N A T I O N A L   R E S E A R C H   C O U N C I L   O F

C A N A D A   A T   O T T A W A

DIVISION OF MECHANICAL ENGINEERING

FUELS AND LUBRICANTS LABORATORY PHOTOGRAPHS

(1944 - 1976)

Sent to the National Photography Collection, Public Archives of Canada, Ottawa

Compiled in 1985 by:

D. Willis
R.B. Whyte
M.J. Friend

FUELS AND LUBRICANTS LABORATORY

The negatives in this collection show work done by the Fuels and Lubricants Laboratory of the National Research Council of Canada for the period covering the middle 1940's to the middle 1970's. Photographs taken after this period are retained by the NRC as part of their active records. The following is a brief summary of the activities of the Laboratory, during this period.

In 1937, the Mechanical Engineering Division of the NRC established a "Gas and Oil" Laboratory to be responsible for all tests on petroleum products against the applicable official specifications. Its main function was to serve as a quality control laboratory for petroleum products for the R.C.A.F. This was the forerunner of the present Fuels and Lubricants Laboratory.

During the Second World War the Laboratory made analyses of some 5000 samples of petroleum products for the Department of National Defence, and also carried out investigations and development work on hydraulic fluids, low temperature greases, recoil oils for guns, substitutes for reapeseed oil, aircraft controls lubricants, aircraft fuels, and other petroleum products used in defence equipment.

The Laboratory was renamed the Liquid Fuels and Lubricants Laboratory in 1949, and the Fuels and Lubricants Laboratory in 1950.

After the War ended many of the investigations carried out by the Laboratory were directed to the use of fuels and lubricants at low temperatures. Research was also done into fuels for jet engines and gas turbines, as well as the continuing program of testing of various petroleum products.

The quality control aspect of operations was gradually transferred to a National Defence laboratory and the emphasis shifted from routine quality control operations towards consumer products testing and a research program designed to help users of liquid fuels and all types of lubricants to obtain maximum performance.

By 1970 the Laboratory was divided into five main areas of responsibility One section covered tribology, the study of the science and practice of friction, lubrication and wear. This Section has carried out a variety of fundamental studies. One investigation undertaken was the wear and deformation occurring in shotgun barrels when using "softened" iron shot instead of conventional lead shot.

Analytical functions were performed by the Physical and Chemical Laboratory Section. It conducted a research program into field methods for the quality control of petroleum products and for exhaust gas analysis. Another was the evaluation of used oils from various engines by a variety of standard and novel methods in relation to engine condition, oil, and filter change periods. One study was done in cooperation with the Ottawa Transportation Commission.

The evaluation of engine and gear oils was conducted in the Performance Laboratory Section. Here a variety of engines and rigs simulated as closely as possible the most severe aspects of field operation. The performance of gasoline, diesel, and aircraft piston engine oils as well as all types of greases, automoti gear oils, steam turbine oils,and aircraft engine synthetic oils was tested.

The Fuels Section dealt mostly with the handling of liquid fuels and other fluids, particularly those used in aviation. They have looked at filtration and cleanliness together with use, estimation and effectiveness of various fuel additives.

Combustion research was done along two main lines: the production of fundamental design data for a small hydrogen/oxygen engine; and a study concerning the evaporation of liquid droplets in a spray.

In recent years the Laboratory has conducted tests on various "gas-saving" devices (retrofit) for the Department of Consumer Affairs and others to determine if the manfacturers claims are justified.

For more detailed information concerning the early history of the Fuels and Lubricants Laboratory please consult: "Mechanical Engineering at the National Research Council of Canada, 1929-1951", by W.E.K. Middleton, published by the Wilfred Laurier Press in 1984. Information on the later years meay be found in the annual "National Research Council Review" (published until 1968), which is available in the Public Archives Library, and in issues of the "Quarterly Bulletin of the Division of Mechanical Engineering and the National Aeronautical Establishment", published until December 1979 as well as annual "Research and Development Reports" of the Division of Mechanical Engineering. The technical reports listed in the description of the photograph collection can be consulted at the Aeronautical Library, NRC, Montreal Rd., Ottawa.

NATIONAL RESEARCH COUNCIL OF CANADA DIVISION OF MECHANICAL ENGINEERING

FUELS AND LUBRICANTS LABORATORY

PHOTO COLLECTION 1944 - 1976

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VIEWS OF BUILDINGS

VIEWS OF BUILDINGS

GO 683-6	Views of exterior of M9	1960
GO 985	Combustion research annex	1961
GO 1281,1282	Building 41 A	1963

TEST APPARATUS

TEST APPARATUS

GO 11	Glycol antifreeze mixture in centrifuge.	1944
GO 25-30	Shear breakdown apparatus for Gas and Oil lab.	1945
GO 35-36	Grease viscometer	1946
GO 37-39	Pressure viscometer	1946
GO 65	Pour point apparatus	1950
GO 66	Viscosity bath	1950
GO 74-76	Special dilution apparatus	1951
GO 104	Carbon formation apparatus	1952
GO 106-107	Stroking test apparatus	1953
GO 116	Vapour pressure apparatus	1954
GO 425	Friction machine	1958
GO 430-431	Evaluation of hydrogenated rapeseed greases	1959
GO 634	High temperature performance of greases (B.Dufault in photo).	1960
GO 636,637	Gas chromptograph and Infra Red Absorption Spectrometer with L. Gardner and R. Brisebois.	1960
GO 638	Measuring sulfur content in fuels.(R. Brisebois in photo)	1960
GO 642,670	Fuel distillation process (Joan Kelleher in photo).	1960
GO 644	Refrigerator oil stability tests.(J. Lowe in photo).	1960
GO 645	IAE gear test machine- used to evaluate turbine oils (D. Davidson in photo).	1960
GO 653,654	Gear wear tester (B. Dufault in photo)	1960
GO 650	GN 3-71 engine, used for crank-case lubricant testing (D. James in photo)	1960
GO 655	Apparent viscosity of greases testing apparatus.	1960
GO 657	Low temperature torque of grease lubricated bearings testing apparatus.	1960
GO 658	High temperature performance of greases testing apparatus.	1960

GO 646	Thermal Oxidation Stability Test rig. For the evaluation of automotive hypoid gear lubricants. (D.Davidson in photo).	1960
GO 639	Knock engine room. (Norm Moss in photo)	1960
GO 640,641	Knock rating engine, used for the determination of fuel octane number. (N. Moss in photo)	1960
GO 659	Hydraulic brake flüid testing. Adjusting wheel assemblies in hot room. (B. Dufault in photo)	1960
GO 660	Hydraulic brake fluid testing - cold room.	1960
GO 661	Stable Pour Point apparatus. Low temperature lubricant test. (T. Suprunchuk in photo).	1960
GO 662,663	Aviation turbine fuel, microscopic examination for sediment. (J. Bordeleau in photo)	1960
GO 664	Radioactive measurement of gear wear. (J. Lowe in photo).	1960
GO 677-679, 680-681	Evaporation of sprays rig. (Dr. Sandri in photo)	1960
GO 682	Fuel ignition testing apparatus.	1960
GO 687-689	Sliding friction research machine.(N.Allen in photo)	1960
GO 692-695	Moisture Corrosion Test rig. For the evaluation of automotive Hypoid gear lubricants.	1960
GO 667	Aniline point test. (P. Bryne in photo)	1960
GO 669	Gum test of fuel.(P. Byrne in photo)	1960
GO 883	Shell 4 ball wear machine, bearing assembly, ball cup and chuck.	1960
GO 884	Shell 4 ball wear machine and Sanborn Recorder.	1960
GO 1133	Bearing wear test apparatus.	1962
GO 424	Rolling contact machine MKI crossed roller rig	1958
GO 427-428	Crossed roller rig	1958
GO 673,675, 676,727	Crossed roller rig, or Rolling contact machine MKII. (N. Allen in one photo)	1960
GO 714	Rolling contact specimens mounted on stand.	1960

GO 763-764	Rolling contact assembly	1960
GO 1014-15	Rolling contact machine	1961
GO 984	Mirror support - combustion research annex	1961
GO 990	Equipment for measurement of oil film	1961
GO 991	Ice friction machine	1961
GO 1052	First filter element test-rig which was built to evaluate elements for filter/water separators used in aviation turbine fuel ground handling systems to ensure that the fuel was clean and dry when pumped into aircraft	1962
GO 1070	Heavy duty rolling friction machine	1962
GO 1129	Wear and friction - pin on disk machine	1962
GO 1261	Talysurf machine	1963
GO 1262	Leitz micro hardness test	1963
GO 1263	Bausch and Lomb camera	1963
GO 1224,25	Rail lubricator test rig	1962
GO 1284	Modified water emulsion test apparatus	1963
	Study of hydrogen-oxygen rocket fuels for engines	
GO 1673	Compressor for hydrogen liquefaction	
GO 1675	Cryostat for final hydrogen liquefaction.	1965
GO 1358	Heavy oil test stand (colour)	1963
GO 1672	Apparatus for determination of knock-rating of aviation gasoline.	1965
GO 1866	Timken test machine	1966
GO 1904-6	High temperature performance test units	1966
GO 1982-3	Anti-icing fluid test stand	1967
GO 2019-20	Torque and vibration test stand set-up	1967
GO 2082	Steel tubes showing deposits from boiler after thermal stability tests (colour)	1967
GO 2319,2325	Low temperature hydraulic oil test installation.	1968

GO 2323,2324	View of console controlling low temperature hydraulic oil test installation	1968
GO 2327	CLR single cylinder oil test engine showing crankcase blow-by control. (A.Duncan in photo)	1968
GO 2423,2424	Adhesion apparatus - experimental set-up.	1969
GO 2425-27	Fluidity and pumpability apparatus.	1969
GO 2482(1-5)	Combustion chamber in M-41 (colour)	1969
GO 2770-3, 2775-8	Water-cooled combustion chamber at M41	1972
GO 2428	Water separometer	1969
GO 2702(b)	Water separometer - standard ASTM test procedure for aviation fuel. (35mm)	1971
GO 2806-8	Water separator	1972
GO 2452,2453	Servomotor bearing endurance test stand.	1969
GO 2488	Carburetor testing rig (35mm) (4) General view of rig (5) Side view of rig (6) Elevated view of rig (7) Close-up of plexiglas tube (8) Top view of plexiglas, close-up	1970
GO 2558	Anti-freeze test kit	1970
GO 111	Filter freezing rig	1953
GO 139,142,143	Filter papers - sediment remaining from aviation oil tests.	1954
GO 2154-5	Filter test rig.	1968
GO 2487,2677	Filter test rig plus filters that have undergone tests (35mm)	1969,1970
GO 2701	Filter test rig (35mm)	1971
GO 2702(a)	Filter test rig A. Aqua glo detector B.Sampling bomb C. Filter element D. A.E.L. Detector (35mm)	1971
GO 2953-55	Oil filter test rig	1974
GO 2748-50	Brookfield viscosity test - low temperature bath and table - with bricks and with test tubes	1971

GO 2946	Hydrocarbon analyzer - for measuring hydrocarbons in exhaust emissions.	1974
GO 2948	Laboratory's first exhaust emission analysis equipment.	1974
GO 2992-4	Apparatus for oil bath.	1975

Automotive hypoid gear oil qualification test rig

i.e.: CRC-L42 Shock load test
CRC-L37 High speed low torque, low speed high torque test

GO 1774	L42 throttle control	1966
GO 1775	L42 strain gauge arrangement - showing slip ring assembly and webbed coupling.	1966
GO 1776	Axle/dynamometer coupling showing L42 strain gauge assembly.	1966
GO 1777	L42 axle clamping arrangement	1966
GO 1778	Gear-box support mount L42-L37 test rig.	1966
GO 1779	Rear right-hand engine mount L42-L37 test rig.	1966
GO 1780	Front right-hand engine mount L42-L37 test rig.	1966
GO 1781	Control panel - Gear oil qualification test rig L42-L37.	1966
GO 1782	General arrangement - Gear oil qualification test rig L42.	1966
GO 1783	L42 axle mount pedestal - right hand.	1966

Field Testing

GO 2505	"Half Scale" field test kit for detecting glycol-base antifreeze in used lubricating oils (ASTM Designation D2982)	1970

Diesel Bus Engine Oil Change Period Study

Samples of used oils from Ottawa Transportation Commission bus engines were examined by standard laboratory and quick field tests to determine their condition under oil change periods ranging from 6,000 to 15,000 miles to determine the optimum oil change period. Examinations were also undertaken of engine components.

GO 2543	OC Transpo bus at the Montreal Road campus of NRC.	1970
GO 2489-97,2500	Various components of bus diesel engine for examination of deposits.	1970

ENGINE OIL QUALIFICATION TESTS

ENGINE OIL QUALIFICATION TESTS

The Fuel and Lubricant Laboratory performed tests on various lubricants to determine if they conformed to certain specified performance qualifications. The tests were run in specially designed laboratory engines under carefully controlled conditions. Both the engines and test methods have been developed over the years and conform to international standards.

Following are photos of various types of test apparatus:

GO 632,633	Engine Room Building M9 - shows the various test engines used by the Laboratory in their research and testing programme.	1960

The Laboratory has a Caterpillar single cylinder test engine used to test engine oil. It is run 480 hours and then is stripped and the deposits on the piston are evaluated against a known standard.

GO 614-616	Shows deposits on the piston and the oil filter element after a run using "NRL 17353/C3 Havoline" oil.	1959
GO 649	Caterpillar L-1 - lubricant test engine.(A. Duncan in photo).	1960
GO 651,652	CLR-LABECO - single cylinder lubricant test engine. Used for CRC-L38 Thermal oxidation stability test procedure.	1960
GO 666	Martin Friend and Robert Whyte discussing tested engine parts.	1960
GO 981-983	Super-charged, single cylinder Caterpillar test engine installation.	1961
GO 1670	CLR test engine being used to test aircraft piston engine oils.	1965
GO 1669	Control panel for CLR test engine.	1965
GO 2170-2172	Shows valve stem deposits on the Laboratory's Caterpillar oil test engine.	1968
GO 2947	Super-charged, single cylinder Caterpillar test engine control panel.	1974

The following are typical examples of standard oil qualification tests conducted in the Fuel and Lubricant Laboratory using various test engines and rigs. The engines were run for a prescribed number of hours depending on the particular test and were then dismantled. The various components were then examined for oil related deposits to determine the performance rating of the oil.

CLR test engine - oil oxidation test (automotive oil) 1965
Testing NRL 24262/AL oil

GO 1632 Piston - front

GO 1633	Piston - rear
GO 1634	Crankcase side cover plate
GO 1635	Push-rod cover plate
GO 1636	Rocker-cover
GO 1637	Oil screen
GO 1638	Oil pan
GO 1639	Sludge trap
GO 1640	Gear case cover

GM 3/7 test engine - navy oil test 1970
Testing NRL 29582/B1 oil

GO 2565	Bearings
GO 2566	Valves
GO 2567	Pistons - thrust
GO 2568	Pistons - antithrust
GO 2569	Cylinder liner thrust
GO 2570	Cylinder liner anti-thrust
GO 2571	Cover plates
GO 2572	Fuel filter
GO 2573	Oil screen
GO 2574	Fuel filter
GO 2575	Oil pan
GO 2576	Rocker cover
GO 2577	Injectors

Caterpillar test engine - diesel oil test 1970
Testing NRL 29239/C1 oil

GO 2532	Piston thrust
GO 2533	Piston anti-thrust
GO 2534	Bearings

GO 2535	Valves
GO 2536	Oil filter

Snow-mobile test engine - 2 cycle oil
Testing NRL 30344/S1/1 oil 1972

GO 2748	Pistons inlet
GO 2749	Pistons exhaust
GO 2750	Cylinder heads
GO 2751	Cylinders viewed through exhaust ports

CLR test engine - high temperature aircraft piston engine oil test
Testing NRL 24262/M4 1972

GO 2817	Sludge trap
GO 2818	
GO 2819	Oil screen
GO 2820-22	Cover
GO 2823	Pan with indented corner
GO 2824	Piston - front
GO 2825	Piston - rear
GP 2826	Gear case cover

AUTOMOTIVE HYPOID LUBRICANT TESTS

Automotive Hypoid Lubricant Tests Using a Full Scale Axle Assembly

The following series shows the results obtained during the development of a suitable test method for the evaluation of 75 grade gear oils. These oils are associated with low-temperature operating conditions.

L 37 - low speed, high torque tests

Photo No.	Temperature	Oil Type	Manufacturer	Result
75 grade at 90 grade conditions		1960		
GO 743,755	295°/275°	NRL18089/F1Ⓓ	B/A	Fail
GO 736,748	295°/275°	NRL18937/F1Ⓒ	Texaco	Fail
GO 739,752	295°/275°	NRL18936/F1Ⓑ	Esso	Fail
GO740,753	295°/275°	NRL 18936/F2Ⓑ	Esso	Fail
75 grade break-in only 275°F		1960,1961		
GO 771,808	275°	NRL18937/F6Ⓒ	Texaco	Pass
75 grade break-in only 220°f	1961			
GO 809	220°	NRL19089/F2Ⓓ	B/A	Fail
75 grade run at 220/200°F		1960,1961		
GO 769,745	220°/200°	NRL18937/F4Ⓒ	Texaco	Pass
GO 770,796	220°/200°	NRL18937/F5Ⓒ		Pass
GO 766,811	220,/200°	NRL18935/F2Ⓐ	Can oil	Fail
Low Temperature 75 grade Modified method- finished oils			1960,1961	
GO 767,810	275°/200°	NRL18935/F3Ⓐ	Can oil	Pass
GO 886,885	275°/200°	NRL18936/F4Ⓑ	Esso	Fail
GO 888,887	275°/200°	NRL18937/F7Ⓒ	Texaco	Pass
GO 915,914	275°/200°	NRL19089/F3Ⓓ	B/A	Pass
GO889,890	275°/200°	NRL19145/F2Ⓔ	Shell	Pass

CRC L42 Shock Load Tests - using specially selected reference oils containing different levels of additive concentrations.

Photo No.	Oil Type	Additive
GO 1529-32	NRL21869/G7	R60 10-63
GO 1533-36	NRL21869/G8	R60 10-63
GO 1537-40	NRL20611/G7	R60 15-62
GO 1541-44	NRL21585/G1	R60 12-90
GO 1545-46	NRL20562/G3	R60 8-90

Miscellaneous tes method development work for the evaluation of automotive hypoid gear lubricants.

GO 635,648	Rear axle hypoid gear test rig(Doug Davidson in photo)	1960
GO 1391-3	Refrigerated box for low temperature tests.	1963
GO 1473,72	Lubricant in hypoid axle undergoing low temperature teats in an insulated box.	1964

Multipurpose Gear Oils

Test methods used in the hypoid axle rig have been checked to ensure that rig temperatures are realistic by temperature measurements in the differential of a Dodge 3/4 ton truck driven under varying conditions of speed, load and ambient temperature.

GO 1582	Photo of Dodge truck used in tests (35mm)	1965
GO 2059	Hypoid lubricant test rig modified so flexibility can be changed in order to adjust severity of tests.	
(12),(19)	Hypoid rig	
(3),(4),(8), (14),(15)	Flexible gear rig	1967
GO 3020	Gear testing rig	
(6),(8)	Gear box test method developement for evaluation of hypoid gear lubricants.	
(9)-(12)	Strain gauge apparatus for measuring torque from gear box. (35mm)	1976

C O R R O S I O N   T E S T S

CORROSION TESTS

GO 1,7	Corrosion test strips	1946
GO 156	Lead-copper corrosion test strip.	1955
GO 403,404, 409,410	Condition of cast iron and of aluminum test strips after stability tests of samples.	1957
GO 432-3	Specimens from galvanic corrosion test-rapeseed grease	1959

Long-term storage of aviation fuels was investigated - stability of fuels and the durability of drums.

GO 59, 61,62, 64	Various non-standard RCAF fuel containers.	1950

Hydrocarbon Fuel Storage in Coated Drums

In cooperation with the Division of Building Research the effectiveness of coatings for steel drums and fuel deterioration was studied over a 10 year storage program involving the storage of three hydrocarbon fuels in coated steel drums. Periodic examination of coatings and fuels has revealed that some coatings were promising and fuel deterioration after seven storage years was slight. The project started in the winter of 1949-50 and the ten year storage study was completed in 1967.

GO 792,793, 800,827, 833	Examples of corrosive effects and deposits on storage drums used in the above project.	1961

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GO 1016-18	Dynamic corrosive tester	1962

Copper Strip Corrosion of Diesel Fuels (colour) 1969

GO 2429	Corrosion of diesel fuel containing sulphur dioxide	
GO 2430	Corrosion of diesel fuel containing hydrogen sulphide	
GO 2431	Corrosion of diesel fuel containing free sulphur	
GO 2432	Corrosion of diesel furl containing isobutyl mercaptan	
GO 2433	A.S.T.M. copper strip corrosion standards	

GO 2541	Vapour space corrosion inhibitor (modified) 3 photos	1970

Another test involved corrosion studies of Hypoid Gear oils

Moisture Corrosion Test of Hypoid Gear Oil 1968

The components were coated with oil then stored for seven days under conditions of high humidity to test the protectiveness of the oil.

GO 2304	NRL 1992A/H2 cover plate
GO 2305	NRL 1992A/H2 - showing corrosion on ring gear.

MPT 417

NATIONAL RESEARCH LABORATORIES

Ottawa, Canada

REPORT

Division of Mechanical Engineering

Fuels and Lubricants Laboratory

Pages - 4
Figures - 1

~~LIMITED~~
Report: MPT-417
Date: 24 March 1955
Lab. Order: 10181A
File: M2-12-2

For: Internal, Fuels and Lubricants Laboratory

Reference: Memorandum dated January 7, 1955 from Dr. J.W. Broughton to Mr. J.H. Parkin.

Subject: EXAMINATION OF FUEL FROM ADMIRAL PEARY CACHE AT WARD-HUNT ISLAND 83.5 NORTH LATITUDE 74.30 WEST LONGITUDE LAID DOWN IN 1909.

Submitted by: J.W. Broughton
Laboratory Head

Authors: J.W. Broughton
B.I. Patterson

Approved by: J.H. Parkin
Director

INTRODUCTION

During the summer of 1954 the Arctic Section of Defence Research Board obtained a sample of fuel from a cache at Ward-Hunt Island 83.5 North Latitude, 74.30 West Longitude. This fuel was laid down in 1909 by Admiral MacMillan as part of a cache for a party headed by Admiral Peary.

The sample was submitted to the laboratory for examination to establish the condition of the fuel after 45 years of storage under Arctic conditions.

NEGATIVES RELATED TO THIS REPORT

GO 147 Fuel container after 45 years in northern cache.

MP 14

NATIONAL RESEARCH LABORATORIES

Ottawa, Canada

REPORT

Division of Mechanical Engineering

Fuels and Lubricants Laboratory

Pages - Preface - 2		Report: MP-14
Text - 8		Date: 6 May, 1959
App. - 6		Lab. Order: 11785A
Tables - 5		File: M2-17-13.S-6
Figures - 1		

For: Internal.

Reference: Meeting of the Group on Drum Storage of Fuel, 12 September, 1957.

Subject: LONG TERM STORAGE OF HYDROCARBON FUELS IN COATED DRUMS:

PART I: SETTING UP OF PROJECT

Submitted by: J.W. Broughton
Head
Fuels and Lubricants Laboratory

Authors: P.L. Strigner, R.B. Whyte

Approved by: D.C. MacPhail
Director

NEGATIVES RELATED TO THIS REPORT

GO 413 General view of drum storage site

MP29

NATIONAL RESEARCH LABORATORIES

Ottawa, Canada

REPORT

Division of Mechanical Engineering

Fuels and Lubricants Laboratory

~~LIMITED~~

Pages -	Preface	- 2	Report: MP-29
	Text	- 5	Date: July 1963
	App.	- 8	Lab. Order: 14744A
Tables		- 2	File: M2-17-14.N-8
Figures		- 2	

For: Department of National Defence, Royal Canadian Navy

Reference: DND-RCN letter NS6551-250 (DG Ships) of 6 September, 1962

Subject: CORROSION TESTS WITH VAPOUR SPACE INHIBITORS IN STEAM TURBINE OIL

Submitted by: J.W. Broughton
Head
Fuels and Lubricants
Laboratory

Author: R.B. Whyte

Approved by: D.C. MacPhail
Director

SUMMARY

Two laboratory methods, the CRC L-33 Axle Moisture Corrosion Test and the Cyclic Rust Test, have been used to evaluate steam turbine oils containing two different vapour space corrosion inhibitors.

The differences in results are discussed in relation to the differences in evaluation methods. It is concluded that n-decanoic acid is the most promising vapour space inhibitor of the two and is worthy of further investigation.

NEGATIVES RELATED TO THIS REPORT

Cover plates from moisture corrosion tests.

GO 865	NRL 19222
GO 1151	NRL 21229
GO 1172	NRL 21328
GO 1152	Steel specimens from cyclic rust tests.

MP 31

NATIONAL RESEARCH LABORATORIES

Ottawa, Canada

REPORT

Division of Mechanical Engineering

Fuels and Lubricants Laboratory

Pages - Preface - 3
Text - 10
Figures - 5

Report: MP-31
Date: November 1964
Lab. Order: 15397A
File: M2-17-14.N-8

For: Department of National Defence, R.C.N., Ottawa, Ontario.

Reference: DND-RCN letter dated 2 October, 1963, file NS 6551-250 (DG SHIPS).

Subject: n-DECANOIC ACID AS A VAPOUR SPACE INHIBITOR FOR STEAM TURBINE OILS

Submitted by: R.B. Whyte
Acting Head

Authors: J. Lowe
L.D. New
P.L. Strigner

Approved by: D.C. MacPhail
Director

SUMMARY

Previous work has shown that n-decanoic acid is a potentially good vapour phase corrosion inhibitor. The effects of the addition of 0.05 and 0.10 percent of the acid on the other properties of steam turbine oils have been further studied. It is concluded that Total Acid Numbers are increased, foaming characteristics are changed and the load-carrying capacity of EP oils is reduced. A significant deterioration of the oxidation stability of one oil is also indicated. The remaining oil properties are substantially unchanged.

The Hot Plate Reflux and Cyclic Rust tests were also evaluated. A modified HPR test seems most suitable as a specification tool.

NEGATIVES RELATED TO THIS REPORT

GO 1506	Test panels from cyclic rust tests "A" oil
GO 1505	Test panels from cyclic rust tests "B" oil
GO 1504	Blanks from cyclic rust test

24.

MP 54

1967

MP 54

VAPOUR SPACE INHIBITOR STUDIES

PART I: THE EFFECT OF N-DECANOIC ACID ON THE OXIDATION CHARACTERISTICS OF STEAM TURBINE OILS

PART II: DEVELOPMENT OF A LABORATORY METHOD FOR MEASURING THE PRESENCE AND EFFECTIVENESS OF VAPOUR SPACE INHIBITORS IN OILS

by

L. NEW AND J. LOWE

SUMMARY

PART I - Previous work indicated the potentialities of low molecular weight organic acids as vapour space inhibitors for oils but a possible incompatibility with oxidation inhibitors was indicated. These confirmatory tests indicate very much shorter lives for blends containing either 4 methyl 2, 6 ditert-butyl phenol or phenyl-α-naphthylamine in the presence of 0.05 percent weight n-Decanoic acid as measured by the Oxidation Characteristics Test (ASTM D943).

PART II - The development of a potential laboratory glassware corrosion test method for measuring the presence and effectiveness of vapour space corrosion inhibitors is described.

NEGATIVES RELATED TO THIS REPORT

GO 1986,2017	Vapour space corrosion inhibitor test apparatus - assembled.
GO 1984	Above apparatus - exploded view
GO 1611	Vapour corrosion inhibitor apparatus - assembled (another type different from "GO" 1986)
GO 1612	Exploded view of GO 1611
	Corrosion vs percent vapour space inhibitor as shown on steel specimens undergoing tests
GO 2057	Various percentages of N-decanoic acid
GO 1884,2056	Various percentages of amine salt.
	Corrosion on steel specimens after evaporation test
GO 1885,2055	0.1% N-decanoic acid after various time periods.
GO 1883,2054	0.1% amine salt after various time periods.

RAILWAY STUDIES

RAILWAY STUDIES

GO 841,842	CPR lubricating bags	1961
GO 879,880	Shows railway axle and temperature indicating system, using magnets.	1961
GO 946-949	Witness marker with Zeiss & Wild microscope set-up.	1961
GO 992-995	Witness marker.	1961
	Railway Axle Boxes and Misscellaneous Parts (wear tests)	1962
GO 1096-98	National freight car bearing	
GO 1099,1100	Clevite bearing	
GO 1094,95, 1102	KAR-GO bearing	
GO 1104,1105	Strain gauge	
GO 1103	Witness mark cutter Mk II	
GO 1101	Ice friction machine head	

GO 1375	Railway bearing lubricating pad - Brereton lubricator	1963
GO 1376	Railway bearing lubricating pad - wicking assembly	1963

MP 22

NATIONAL RESEARCH LABORATORIES

Ottawa, Canada

REPORT

Division of Mechanical Engineering

Fuels and Lubricants Laboratory

~~LIMITED~~ ~~NOT SUITABLE~~

Pages - Preface	- 5		Report: MP-22
Text	- 20		Date: September 1961
Tables	- 4		Lab. Order: 13110A
Figures	- 52		File: M4-R7-S1

For: Associate Committee on Railway Problems

Reference: Letter of 26 September 1960 from Dr. D.C. MacPhail to Mr. J.C. Williams, C.P.R. (file M2-17-13R-10); discussions between Mr. J.C. Williams and Dr. F.W. Smith

Subject: WEAR ANALYSIS OF RAILWAY COMPONENTS IN SERVICE, JUNE TO SEPTEMBER, 1961

Submitted by: J.W. Broughton
Head
Fuels and Lubricants Laboratory

Author: P.B. Hertz[1]

Approved by: D.C. MacPhail
Director

SUMMARY

Experimental tooling has been constructed in order to use a "witness mark" wear measurement technique on railway components in service.

The general applicability of the technique has been determined for journal bearings, brake shoes, and wheels. The results indicate that it is satisfactory for bearing wear analysis, but the high wear rates of brake shoes and plastic deformation of wheels render other methods more practicable for these components.

Satisfactory methods of evaluating maximum bearing temperatures by means of fusible pellets have also been employed. Other factors related to bearing wear have been considered, including the dirt content of the oil and the "battering" of the bearing lugs.

A witness mark system of measuring piston and piston ring wear in G.M. diesel engines, in which the mark can be examined without dismantling the engine, has been developed.

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(1) University of Saskatchewan; N.R.C. Summer Student 1961.

NEGATIVES RELATED TO THIS REPORT

GO 882	Witness mark cutter type II
GO 921,922	Witness marker with railway brass
GO 957	Turbo-grinder type IV
GO 963	Witness mark cutter type V
GO 944, 945	Stereemicroscope and type II cutter
GO 955	Turbo-grinder marking railway wheel specimen.
GO 872	Typical result of "hot-box" failure
GO 933,931,927	Test railway car with recorders being attached
GO 929,930	Journal bearing after the test
GO 966	Gauging of grooves
GO 965	End-play gauging equipment
GO 967	Lug batter as directed by paint coating
GO 964	Axle temperature straps
GO 956	Oil from box L-4 with contaminants
GO 968	Lubricating pad - Rolin type
GO 974	Cast iron brake shoes - various degrees of wear.
GO 958	Crack texture of cast steel wheel specimen with witness marks (28x)
GO 953	Cutter type II used on diesel engine piston rings
GO 970	Wear measuring equipment mounted on diesel engine
GO 973	Tools used to index assembled engine components.
GO 972	Ring tongs in position
GO 971	Piston-rotating rod inserted

YC
NRC
DME
LM
F&L
17

30.

F&L-17

L.O.	~~NATIONAL AERONAUTICAL ESTABLISHMENT~~ OTTAWA, CANADA	NO. F&L-17
FILE	LABORATORY MEMORANDUM	PAGE 1 OF 21
PREPARED BY RJK		COPY NO. 5
CHECKED BY JWB	SECTION Fuels and Lubricants Laboratory	DATE 30 August/62

SECURITY CLASSIFICATION

SUBJECT Experiments Relating to Some Railway Wear Problems, May to August, 1962

PREPARED BY R.J. Kind
(Loyola College, National Research Council Summer Student, 1962)

SUMMARY

A preliminary investigation has been carried out to determine the feasibility of incorporating lubricant in the flanges of railway wheels by filling grooves in these flanges with a porous metal matrix by a flame spraying process, and then vacuum impregnating this porous matrix with a lubricating material. It is found that the flame sprayed metal can be lubricant impregnated. A dovetail section was found to be necessary in order to make the deposit adhere to the specimens. Indications as to whether this device could lead to significant reductions in wear rates in practice are not clear.

On the basis of other experiments it is suggested that the seasonal fluctuation in the wear rates of composition railway brake shoes in all probability is not due to the presence of increased quantities of water on the tracks during winter

NEGATIVES RELATED TO THIS REPORT

GO 1069 Apparatus used for railway wheel wear tests.

MP 34

NATIONAL RESEARCH COUNCIL

Ottawa, Canada

REPORT

Division of Mechanical Engineering

Fuels and Lubricants Laboratory

Pages - Preface - 4
Text - 55
Figures - 21

Report: MP-34
Date: March 1965
Lab. Order: 14501A
File: M2-17-14.Q-2

For: Internal

Reference: Correspondence between Dr. J.W. Broughton, NRC, and Mr. K.R. Kilburn, Quebec North Shore and Labrador Railway Company, file M2-17-14.Q-2

Subject: RAIL CURVE LUBRICANTS - COLD CHAMBER TESTS

Submitted by: R.B. Whyte
Section Head

Authors: R.J.A. Dufault
F.W. Smith

Approved by: D.C. MacPhail
Director

SUMMARY

The report describes tests in which a trackside rail lubricator system was set up in a cold chamber, in order to study the delivery of grease from the system at low temperatures when mechanically actuated in a way that simulated the action of a passing train. Eight proprietary curve greases were studied and the results give the weight of these products delivered under various temperature conditions. Measurements were also made of pressure and mechanical displacement in the system. The data given permit classifying the products into "freely-flowing", "intermediate" and "slowly-flowing" types. A subsequent report will give the correlation of these results with bench-scale apparent viscosity measurements.

NEGATIVES RELATED TO THIS REPORT

GO 1502 - 1503 Photograph of test rig in cold chamber

MPT 6539

NATIONAL RESEARCH COUNCIL

OTTAWA, CANADA

REPORT

~~LIMITED~~

PAGES 7
FIGS.
BOOK SERIAL NO.
BOOK PAGE

REPORT NO. MPT-6539
DATE 26 November, 1968
LAB. ORDER NO. 17848A
FILE NO. M4-R7-S2

DIVISION OF Mechanical Engineering

SECTION Fuels and Lubricants Laboratory.

FOR Internal, Associate Committee on Railway Problems.

REFERENCE Conversations with Dr. H. Wisniowski.

SUBJECT Examination of samples of R.R. Diesel Lubricating Oils in connection with Rocker Arm Lead-Bronze Bushing Galling Problem.

SUBMITTED BY R.B. Whyte
SECTION HEAD

AUTHOR P.L. Strigner

APPROVED D.C. MacPhail
DIRECTOR

1. Introduction

While rapid wear tests were being carried out with Sunoco RR305 oil in the GM567C diesel engine at the Engine Laboratory, it was noted the new and reconditioned rocker-arm shafts were picking up bronze from the lead-bronze rocker-arm bushings (galling) (References 1 and 2). At one time this was tentatively attributed to this particular oil, however subsequent investigations revealed that all semi-ashless railroad oils were to various degrees galling these bushings; the Sunoco RR305, nevertheless, did show the most pronounced tendency to gall. The old, mildly detergent (not semi-ashless) Galena RD76 did not show the galling effect. Corresponding galling conditions were observed in the field with Galena RD40, a semi-ashless oil.

In summary three degrees of galling were apparent:

(a) With Galena RD76 no galling.
(b) With Sunoco RR305 galling of new, reconditioned and run-in rocker-arm bushings.
(c) With other semi-ashless oils no galling of run-in bearings and less galling of new and reconditioned bearings than with Sunoco RR305.

NEGATIVES RELATED TO THIS REPORT

GO 2292 Corrosivisty of railroad diesel engine oils towards copper.

FORM N. R. C. 125

COPY NO. 3 = BLUE

MP 65

~~LIMITED~~

National Research Council Canada
Mechanical Engineering Report MP-65

LOW TEMPERATURE FILTERABILITY OF ATHABASCA TAR SANDS FUELS AND STANDARD DIESEL FUELS

FILTRABILITE A BASSE TEMPERATURE DES CARBURANTS TIRES DES SABLES BITUMINEUX D'ATHABASCA ET DES CARBURANTS DIESEL STANDARD

Prepared for: Associate Committee on Railway Problems

by/par

P.L. STRIGNER, H.U. WISNIOWSKI* AND/ET N.N. KALLIO

SUMMARY

Laboratory bench and cold room rig tests were performed with Athabasca Tar Sands fuels to determine their filterability in locomotive fuel systems at low temperatures. The rig comprised original fuel system parts from a GM, EMD Model 645 locomotive diesel engine. The cold operation qualities of the fuels investigated were compared with those of standard diesel fuel. Only gas oil sidestream and its 50/50 mixture with standard winter diesel fuel were found suitable for winter operation in locomotive diesel engines.

Ottawa January 1974

NEGATIVES RELATED TO THIS REPORT

GO 2809	Rust particles and ice globules on primary filter.
GO 2812	Primary filter showing thin, pinkish, greasy-like layer.
GO 2813	Primary filter showing white foamy deposits on top and waxy deposits generally.
GO 2816	Deposits on secondary filter.

VARIOUS STUDIES

VARIOUS STUDIES

Time test studies to determine the effect on a certain brand of stryfoam used in life-buoys when in contact with various petroleum products.

GO 1806,1811	Shows samples of styrofoam immersed in beakers containing various petroleum products.	1966
GO 2165-7	First automobile "gas-saving" device tested by the laboratory Submitted by Dr. Ott. The tests showed no savings on fuel used.	1968
GO 2962-2969	Various "gas-saving" devices (retrofit) tested by the Lab for the Department of Consumer Affairs to justify claims.	1974
GO 3022-23	Apparatus for tests conducted for the Canadian Liquid Air Co. The laboratory looked at the safety of a replacement mixture for aceteylene for cutting metal. The advantage of the new mixture they devised was its greater compressibility combined with stability. (35mm)	1976

MP 2

NATIONAL RESEARCH LABORATORIES

Ottawa, Canada

REPORT

Division of Mechanical Engineering

Fuels and Lubricants Laboratory

~~LIMITED~~
Report: MP-2
Date: 15 August, 1951
Lab. Order: 6063A
File: M2-17-14.P-1

Pages - Preface - 2
Text - 8
Figures - 1

For: Department of National Defence, Army, Ottawa

Reference: Letter dated 16 February, 1951, from Col. R. L. Franklin, Army file HQ.114-31-1 (DVD)

Subject: CARBON DEPOSITION IN DIESEL EQUIPMENT AT THE WHITEHORSE POWER PLANT

Submitted by: J. W. Broughton
Laboratory Head

Author: J. W. Black

Approved by: J. H. Parkin
Director

NEGATIVES RELATED TO THIS REPORT

GO 82 Piston pin removed from Fairbanks-Morse diesel engine

(LR17)

NATIONAL AERONAUTICAL ESTABLISHMENT

CANADA

NOTE 10

1952

DECLASSIFIED

EFFECT OF ALIPHATIC HALOGEN COMPOUNDS ON CARBON DEPOSITION FROM AIRCRAFT GAS TURBINE FUELS*

W. Sacks and M. T. I. Ziebell

SUMMARY

The results of experiments on the effect of aliphatic halogen compounds on the tendency of aircraft gas turbine fuels to deposit carbon are presented. The deposition on an air-swirler plate, surrounding a miniature pressure atomizer, was measured after combustion in a quartz-tube chamber. The experiments were carried out at air/fuel ratios (wt.) of 6 to 15. Iodides, bromides and chlorides representing a number of different types of molecular structure were investigated. Two turbine fuels were used; a wide boiling range fuel (b.p. 90 - 522°F.) and a kerosine (b.p. 328 - 512°F.).

Low concentrations (1 percent) had no marked effect on the maximum deposition rate (occurring at an air/fuel ratio of about 8) but in general gave increased deposition at air/fuel ratios of about 10 to 15. With a 10-percent concentration of carbon tetrachloride, a large increase in the deposition rate was obtained over the entire air/fuel ratio range. n-butyl iodide (10 percent) gave a similar increase but to a lesser degree.

* The information contained in this report was published in January 1952 as a Laboratory Report LR-17.

NEGATIVES RELATED TO THIS REPORT

GO 94 Apparatus for carbon deposition experiments.

LR 125

NATIONAL AERONAUTICAL ESTABLISHMENT

Canada

LABORATORY REPORT

Fuels and Lubricants Laboratory

Pages - Preface	-	4
Text	-	19
Table	-	1
Figures	-	18

~~LIMITED~~
Laboratory Report: LR-125
Date: 7 February 1955
Lab. Order: 6967A
File: M2-12-2

For: Internal

Reference: Laboratory Order No. 6967A

Subject: COMPARISON OF ALCOHOLS AS AERO GAS TURBINE ANTI-ICING FLUIDS

Submitted by: J.W. Broughton
Laboratory Head

Joint Authors: G.W. Benson
F.G. Kitson

Approved by: J.H. Parkin
Director

SUMMARY

A comparison of the anti-icing properties of methanol, ethanol, isopropanol and ethylene glycol, based on available freezing point, vapour pressure and other data, has been undertaken. These calculations together with considerations of de-icing ability, toxicity, and corrosiveness show that for general purposes ethanol is the most suitable fluid. Under certain circumstances, however, a mixture of glycol and ethanol would prove to be considerably more effective.

NEGATIVES RELATED TO THIS REPORT

GO 120	The corrosiveness of methanol
GO 119	The corrosiveness of ethanol
GO 121	The corrosiveness of isopropanol

LR 131

NATIONAL AERONAUTICAL ESTABLISHMENT

Canada

LABORATORY REPORT

Fuels and Lubricants Laboratory

~~LIMITED~~

Pages - Preface	-	3
Text	-	6
Table	-	1
Figures	-	15

Laboratory Report: LR-131
Date: 18 April 1955
Lab. Order: 9278A
File: M2-17-14.A-12

For: Department of National Defence, R.C.A.F., HQ, DD"A", Ottawa, Ontario.

Reference: (1) Letter dated 3 February, 1953 from S/L D.C. Wilson, R.C.A.F. HQ.
(2) Letter dated 10 March, 1953, from Shell Oil Company of Canada covering three samples of anti-icing fluids.

Subject: AN EVALUATION OF ALCOHOL MIXTURES AS AERO GAS TURBINE ANTI-ICING FLUIDS

Submitted by: J.W. Broughton
Laboratory Head

Author: F.G. Kitson

Approved by: J.H. Parkin
Director

SUMMARY

Five alcohol mixtures were evaluated as aero gas turbine anti-icing fluids based on the relative amounts required to prevent icing under given conditions, corrosiveness, and toxicity. The alcohol mixtures, 90 volumes ethanol (95% V/V) plus 10 volumes isopropanol (99%) and 90 volumes ethanol (95% V/V) plus 10 volumes methanol, were considered superior to the other mixtures for this purpose.

NEGATIVES RELATED TO THIS REPORT

GO 117	Apparatus used for vapour pressure determinations.
GO 124	The corrosiveness of 90 volumes ethanol (95% V/V) plus 10 volumes isopropanol (99%).
GO 122	The corrosiveness of 90 volumes ethanol (95% V/V) plus 10 volumes of absolute methanol.
GO 129	The corrosiveness of 70% ethanol (95% V/V) plus 30% isopropanol (99%).
GO 126	The corrosiveness of 65% isopropanol (99%) plus 35% methanol.
GO 128	The corrosiveness of 65% isopropanol (99%) plus 35% methanol plus 1% anti-corrosive additive.

MPT 706

NATIONAL RESEARCH LABORATORIES

Ottawa, Canada

REPORT

Division of Mechanical Engineering

Fuels and Lubricants Laboratory

Pages -	Preface -	3
	Text -	5
	App. -	13
Tables	-	4
Figures	-	8

~~LIMITED~~
Report: MPT-706
Date: 29 November 1956
Lab. Order: 11368A
File: CM2-12-4

For: Internal, Fuels and Lubricants Laboratory (RCN Oils and Fuels Committee)

Reference: Fuels and Lubricants Laboratory Orders No. 10377A and 11367A. Item 3 of the 5th meeting of the RCN Oils and Fuels Committee. Letter dated 17 October 1956 from Naval Secretary (Navy file NSC 1279-9 (E-in-C)).

Subject: EVALUATION OF THE THERMAL STABILITY AND COMPATIBILITY CHARACTERISTICS OF THE VARIOUS NAVAL BOILER FUELS USING THE TIDE WATER SMALL SCALE APPARATUS, IN SHORT AND SPLIT TERM TESTS

Submitted by: J.W. Broughton
Section Head

Authors: L.D. New
B.I. Patterson

Approved by: J.H. Parkin
Director

NEGATIVES RELATED TO THIS REPORT

GO 199,200	Assembled small scale (Tide Water) apparatus.
GO 201	Fuels and lubricants laboratory thermal stability and compatibility test section.

Appearance of thimbles after small scale thermal stability tests

	Sample NRL 14222
GO 246	7 hour run
GO 245	2 x 7 hour run
	Sample NRL 14223
GO 255	7 hour run
GO 256	2 x 7 hour run
GO 211	20 hour run
	Sample NRL 14224
GO 267	7 hour run
GO 268	2 x 7 hour run
GO 202	20 hour run
	Sample NRL 14410
GO 213	7 hour run
GO 214	2 x 7 hour run
GO 203	20 hour run
	Sample NRL 14824
GO 388	7 hour run
GO 389	2 x 7 hour run
GO 216	20 hour run
	Sample NRL 14823
GO 387	7 hour run
GO 386	2 x 7 hour run
GO 215	20 hour run
	Sample NRL 14825
GO 390	7 hour run
GO 391	2 x 7 hour run
GO 217	20 hour run
	Sample NRL 14965
GO 395	7 hour run
GO 218	20 hour run
	Sample NRL 14966
GO 396	7 hour run
GO 247	20 hour run
	Sample NRL 14967
GO 398	7 hour run
GO 248	20 hour run

Report MPT 706 continued

	Sample NRL 14968
GO 397	7 hour run
GO 250	20 hour run
	Sample NRL 14969
GO 399	7 hour run
GO 249	20 hour run
	Sample NRL 14970
GO 400	7 hour run
GO 252	20 hour run

TR 2181

THE NATIONAL AERONAUTICAL ESTABLISHMENT

CANADA

LIMITED

PAGES 30
FIG. 17

REPORT

REPORT TR-2181
DATE 17 August, 1956
LAB. ORDER 9053A
FILE M2-17-14.A-12

SECTION Fuels and Lubricants Laboratory.

FOR Department of National Defence, (R.C.A.F.), Ottawa, Ontario.

REFERENCE Letter dated 21 October, 1952 from G/C G.G. Truscott, file S301-103-15 (C Dev) 1006B-6-AMC Experimental Project 76/52 (AMTS Directive 39-52)

SUBJECT Evaluation of Clock and Watch Lubricating Oils.

SUBMITTED BY J.W. Broughton
SECTION HEAD

AUTHOR L.D. New, B.I. Patterson

APPROVED J.H. Parkin
DIRECTOR

Summary

An examination of fifteen watch, clock and instrument oils has been made with particular reference to their use in aircraft navigation watches. An oil to U.S. Bureau of Aeronautics Specification 14L16 (Aer), now covered by MIL-L-3198, rated highest with regard to viscosity temperature, evaporation and spreading characteristics. All the other oils were considered unacceptable for the purpose with respect to one or more of these characteristics.

NEGATIVES RELATED TO THIS REPORT

GO 373 Spreading Test - NRL oil smaple NRL 13112 - 24 hrs. after preparation

GO 238 Spreading Test - NRL oil sample NRL 13112 - 4 weeks after preparation

GO 381 Spreading Test - NRL oil sample NRL 13129 - 15 min. after preparation

GO 242 Spreading Test - NRL oil sample NRL 13129 - 1 week after preparation

GO 243, 244 Spreading Test - NRL oil sample NRL 11237 (after oxidation)
243 - 15 minutes after preparation
244 - 4 weeks after preparation

MP 17

NATIONAL RESEARCH LABORATORIES

Ottawa, Canada

REPORT

Division of Mechanical Engineering

Fuels and Lubricants Laboratory

Pages -	Preface - 3		Report: MP-17
	Text - 13		Date: August 1960
Figures	- 17		Lab. Order: 11782A
			File: M2-12-2

For: Internal

Reference: Memorandum dated 17 Sept. 1957 from Dr. F.W. Smith.

Subject: LUBRICANT BEHAVIOUR IN CONCENTRATED CONTACT. THE EFFECT OF TEMPERATURE.

Submitted by: J.W. Broughton
Head
Fuels and Lubricants Laboratory

Author: F.W. Smith

Approved by: D.C. MacPhail
Director

SUMMARY

Experiments are described on the frictional behaviour of a petroleum oil in the contact zone between a steel roller and an aluminum one at 23° C and between steel rollers and between tungsten carbide rollers at 23° C, 100° C and 190° C. The coefficient of sliding friction decreases with increasing temperature. Qualitatively, this is taken to indicate that the frictional force represents the shearing of a thick plastic film of lubricant; quantitative agreement between experiments with steel and with carbide rollers is poor. To explain disaccord with other experiments in which the coefficient of friction increases with increasing temperature, it is proposed that mechanical instability of the lubricant film may be a factor in extreme pressure lubrication. On general physico-chemical grounds, it is suggested that an intermolecular sliding process occurs at a shear plane in typical concentrated contact lubricant films at low temperature and high stresses. The relationship between such shear-plane processes and the Ree-Eyring theory of non-Newtonian viscosity is discussed.

NEGATIVES RELATED TO THIS REPORT

GO 728	Schematic photograph of roller arrangement.
GO 674	Rolling contact machine.

L.O.	47. NATIONAL AERONAUTICAL ESTABLISHMENT OTTAWA, CANADA	NO. F&L-16
FILE M2-12-2	LABORATORY MEMORANDUM	PAGE 1 OF 40
PREPARED BY RJK		COPY NO. 5
CHECKED BY JWB	SECTION Fuels and Lubricants Laboratory	DATE 27 August, 1962

SECURITY CLASSIFICATION

SUBJECT An Investigation of the Rolling Motion of an Elastic Sphere on a Plane

PREPARED BY R.J. Kind
(Loyola College; National Research Council Summer Student, 1962)

Summary

Experiments to measure the tangential contact forces accompanying spin and transverse creep velocities of a sphere rolling on a plane are described. A peculiar vibration which may be due to some occurrence in the contact zone is observed. A theoretical relation is derived to predict the transverse tangential contact force acting on a sphere rolling on a plane without transverse creep, but with a spin velocity; this theory is found to give good results if slip in the contact area due to spin is small. As well, this theory predicts that the limiting value of the moment about the axis of spin will be zero for this system.

NEGATIVES RELATED TO THIS REPORT

GO 1071 Apparatus for investigation

MP 27

NATIONAL RESEARCH LABORATORIES

Ottawa, Canada

REPORT

Division of Mechanical Engineering

Fuels and Lubricants Laboratory

Pages - Preface	- 2		Report: MP-27
Text	- 11		Date: May 1963
Tables	- 2		Lab. Order: 13908A
Figures	- 16		File: M2-12-18

For: Internal

Subject: EXPERIMENTS ON IGNITION OF BIPROPELLANTS UNDER VACUUM CONDITIONS.
I. ON PYROTECHNIC IGNITION OF ETHYL ALCOHOL AND LIQUID OXYGEN.

Submitted by: J.W. Broughton, Section Head

Authors: R. Sandri, R. Billingham

Approved by: D.C. MacPhail, Director

SUMMARY

A series of experiments has been carried out with three different types of pyrotechnic igniters. These igniters were installed in a small uncooled combustion chamber which was mounted on top of a 580 cu. ft. tank which could be evacuated. First, the igniters were fired without propellants both in vacuum and at atmospheric pressure. The pressure produced by the igniter powder gases inside the combustion chamber was measured as a function of time. After that, the igniters were used for the ignition of alcohol and liquid oxygen. These propellants were injected into the combustion chamber under varying conditions which were controlled by an automatic timing device. In this case, propellant rates of flow, injection pressures, combustion chamber pressure and pressure build-up in the vacuum tank during firing were recorded and measured. It was possible to obtain detailed information on the conditions required for satisfactory ignition and on the transient phenomena preceding and following it, as well as on the behaviour of the components of the liquid propellant injection system.

NEGATIVES RELATED TO THIS REPORT

GO 1279(25)	Vacuum tank and injection system.
GO 1789	Vacuum tank and oxidizer tank.
GO 1790	Vacuum tank and interior components of oxidizer tank.
GO 1784, 1276(12)	Injection system and thrust chamber
GO 1277(15),1839	Thrust chamber
GO 1285	Control panel
GO 1785	Technician in safety suit working at ignition test chamber
GO 1787	Technician attaching hose from liquid gas tank

MP 36

NATIONAL RESEARCH COUNCIL

Ottawa, Canada

REPORT

Division of Mechanical Engineering

Fuels and Lubricants Laboratory

Pages - Preface	- 2	Report:	MP-36
Text	- 13	Date:	August 1965
Tables	- 1	Lab. Order:	11607A
Figures	- 6	File:	M2-12-2

For: Internal

Subject: ON THE EVAPORATION OF FUEL SPRAYS AT HIGH TEMPERATURES AND PRESSURES.

Submitted by: R. B. Whyte
Section Head

Authors: R. Sandri
J.K.S. Wong

Approved by: D.C. MacPhail
Director

SUMMARY

A new method for the direct measurement of the average lifetime of droplets (evaporation lag) in a fuel spray in a high temperature and pressure environment is described. Experiments were carried out using alcohol and pentane, which were sprayed into a closed chamber filled with nitrogen at pressures of 400 or 500 p.s.i.g. and temperatures of 500 and 650°C. For each temperature and pressure, an upper and lower limit could be found for the evaporation lag.

NEGATIVES RELATED TO THIS REPORT

GO 1620 Complete equipment for tests.

GO 1618 Optical burette connected to injection system.

51·

MP 42

NATIONAL RESEARCH COUNCIL

Ottawa, Canada

REPORT

Division of Mechanical Engineering

Fuels and Lubricants Laboratory

LIMITED
Report: MP-42
Date: July 1966
Lab. Order: 16227A
File: M2-17-14.P-15

Pages - Preface - 3
Text - 12
App. - 1
Tables - 2 (13 pp.)
Figures - 9

For: Internal

Subject: PROGRESS REPORT ON DEVELOPMENT OF TEST PROCEDURE FOR CHAIN SAW LUBRICATION AND WEAR

Submitted by: R.B. Whyte, Section Head

Authors: T. Maloney, F.W. Smith

Approved by: D.C. MacPhail, Director

SUMMARY

The Report describes progress to May, 1966, on the development of test procedures to evaluate lubricants for the cutting attachments of chain saws, and summarizes results from laboratory chain and bar rig tests and from bench-scale tests. The results indicate that both "heel wear" and "rivet wear" depend on oil viscosity, and suggest that "heel wear" can be reduced by certain extreme-pressure additives.

NEGATIVES RELATED TO THIS REPORT

GO 1804	General view of testing apparatus
GO 1677, 1802	Close-up view of testing bar.
GO 1803	View of drive system

MP 51

National Research Council Mechanical Engineering Report MP-51

EFFECT OF VARIOUS PARAMETERS ON ENGINE SPARK EMISSION FROM POWER SAW EXHAUST SYSTEMS

by

J.K.S. WONG AND D.D. JAMES

SUMMARY

The effect of various parameters on engine spark emission was investigated experimentally. The investigation was divided into three phases. The initial phase involved determining a method that would produce carbon particles in quantity within a reasonably short time. The governing parameters were chosen to be the fuel-to-oil mixture ratio, type of oil, additives, engine speed and load. It was found that by adding 1% volume of a commercial colloidal graphite additive to the oil in a 16 : 1 fuel-to-oil mixture, and using variable speed, the rate of carbon particle formation can be accelerated. The second phase involved field tests using this fuel mixture and different exhaust system arrangements. The last phase involved the examination of a large number of used power saws.

From the results of this investigation, a performance standard for power saw exhaust systems was derived. Specification tests were suggested to control the fire hazard problem of power saws. For a system to pass these specification tests, it must prevent the emission of carbon particles greater than 0.023 in. in size; it must not allow a carbon particle concentration of 0.02 gm/sq in/sec or greater; its surface temperature and exhaust gas temperature must be below 500°F.

January 1969

NEGATIVES RELATED TO THIS REPORT

GO 2174	Cylindrical shaped 30-mesh wire screen connected to a 90° elbow which is connected to a straight pipe.
GO 2177	Muffler of a power saw.
GO 2180	Defective exhaust system.
GO 2185	Broken baffle plate from exhaust system of power saw.
GO 2175	Housing of exhaust system.
GO 2179	Exhaust system of power saw. Note: Lower bridge was bent. Baffle plate is visible through openings was broken.
GO 2183	Exhaust system of power saw. Note: Exhaust system has neither baffle plate nor wire screen.
GO 2176	Another power saw exhaust system. Note: Oil line consists of transparent tubing section and is located next to exhaust system.

MP 33

NATIONAL RESEARCH LABORATORIES

Ottawa, Canada

REPORT

Division of Mechanical Engineering

Fuels and Lubricants Laboratory

Pages - Preface	- 3	Report: MP-33
Text	- 17 (incl. 9 tabs.)	Date: January 1965
Figures	- 13	Lab. Order: 15146A
		File: M4-R7-S3

For: Internal, Fuels and Lubricants Laboratory, N.R.C. (Associate Committee on Railway Problems).

Reference: Letter dated 6 February 1963 from T.J. Delaney to Dr. D.C. MacPhail, Director.

Subject: THE PERFORMANCE OF PROPRIETARY AND AAR SPECIFICATION BRAKE CYLINDER LUBRICANTS AT 150°F. AND -50°F.

Submitted by: R.B. Whyte, Acting Section Head

Authors: L.D. New, B.I. Patterson

Approved by: D.C. MacPhail, Director

SUMMARY

The performance of AAR Specification 914-42 and 914-62 and proprietary lubricants, in 10-in. air brake cylinders, was compared at 150°F. and at -50°F. A proprietary non-soap thickened polyglycol grease, containing MoS_2, was best in endurance tests at 150°F. and in piston release time comparisons at -50°F. AAR 914-42 Specification material provided reasonably good lubrication at 150°F., but release times were high at -50°F. Experimental low temperature formulations prepared to meet AAR Specification 914-62 were, in general, less effective at 150°F. The addition of MoS_2 in various amounts did not significantly improve the effectiveness of poor performers at 150°F.

NEGATIVES RELATED TO THIS REPORT

GO 1477 Air brake cylinders assembled in hot room.

GO 1475 Air control arrangement.

Appearance of cylinder and packing cup of brake system after tests using various lubricants all at 85,000 cycles at 150°F.

GO 1479,1488	NRL lubricant 22051+ 10% MoS2
GO 1484,1490	NRL lubricant 22052
GO 1481,1485	NRL lubricant 22914
GO 1482,1489	NRL lubricant 22914 + 2% MoS2
GO 1480,1487	NRL lubricant 22914 + 10% MoS2
GO 1483,1486	NRL lubricant 22915

Appearance of cylinder after tests using various lubricants - 60,000 cycles at 150° after low temperature tests.

GO 1556	NR1 lubricant 22051
GO 1555	NRL lubricant 22052
GO 1553	NRL lubricant 23368
GO 1554	NRL lubricant 23898

MP 43

NATIONAL RESEARCH COUNCIL

Ottawa, Canada

REPORT

Division of Mechanical Engineering

Fuels and Lubricants Laboratory

Pages - Preface - 3
Text - 4
Tables - 5
Figures - 3

Report: MP-43
Date: August 1966
Lab. Order: 15164A
File: M4-R7-S3

For: Internal

Subject: COMPARATIVE LABORATORY PERFORMANCE OF AIR BRAKE CYLINDER LUBRICANTS

Submitted by: R.B. Whyte
Section Head

Authors: L.D. New
B.I. Patterson

Approved by: D.C. MacPhail
Director

SUMMARY

A test method for measuring the low temperature release time and the high temperature cup wear preventive properties of air brake cylinder lubricants is described.

The results of comparative trials of reference and various proprietary lubricants are given. Again, a non-soap thickened polyglycol grease containing MoS_2 was best at 150°F., besides exhibiting good release time at -50°F. Two other proprietary products gave acceptable performance at both temperature levels.

General observations are offered on the relationship between composition and performance of the air brake cylinder lubricants tested.

NEGATIVES RELATED TO THIS REPORT

GO 1764 Single cylinder mounting.

GO 1763 Multiple cylinder arrangement in controlled temperature room.

57.

MP 53

National Research Council of Canada
Mechanical Engineering Report
MP - 53

DIMENSIONAL CHANGES IN SHOT GUN BARRELS CAUSED BY THE FIRING OF HARD METAL PELLETS

by

C. DAYSON AND T. MALONEY

SUMMARY

This report describes progress to date on the development of a means of assessing the wear and deformation of shot gun barrels caused by the firing of non-toxic but relatively hard metal pellets. The results of an initial series of tests on hard metal pellets, some of which were coated with non-metallic anti-wear coatings, are also presented. These indicate that the enlargement of the bore of the barrel at the muzzle constriction (choke) was, in this case, primarily due to the "hammering out" action of the hard pellets, with the wear of the bore being a secondary effect. The pellet coatings tested proved to be ineffective as a means of preventing either form of damage.

Ottawa July 1969

NEGATIVES RELATED TO THIS REPORT

GO 2197 (5)	Barrel bore at muzzle of unused gun.
GO 2235 (11)	Barrel bore at muzzle of gun from which twenty-five rounds of carbonyl nickel was fired.
GO 2233	Magnified view of muzzle of gun barrel.
GO 2234	Magnified view of breach of gun barrel.

MP 57

National Research Council Canada
Mechanical Engineering Report
MP - 57

THE WEAR AND DAMAGE OF SHOTGUN BARRELS WITH IRON AND NICKEL PELLETS OF VARIOUS HARDNESS

by

C. DAYSON AND T. MALONEY

SUMMARY

A second series of tests is described in which the wear and damage to the barrels of shotguns, from which iron, nickel and lead pellets were fired, was measured. As expected both the wear of the bore and the deformation of the barrel at the choke were less when soft nickel and soft iron pellets were fired than had been the case with harder pellets. Nevertheless both types of damage were still of an appreciable magnitude, indicating that these materials are not suitable for the manufacture of non-toxic pellets to replace lead. The results suggest that there is a definite relationship between the two types of damage and the relative hardnesses of the pellets and the barrel. A greater quantity of more precise data on softer shot materials will be needed to enable estimates to be made of barrel life that can be obtained with such materials.

Ottawa March 1972

NEGATIVES RELATED TO THIS REPORT

GO 2454, 2673	Two views of shotgun test firing mount.
GO 2676	Shows person preparing shotgun on test firing mount.

MPT 7373

NATIONAL RESEARCH COUNCIL
OTTAWA, CANADA

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FIGS. ....
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REPORT

REPORT NO. MPT-7373
DATE 23 October 1973
LAB. ORDER NO. 19081A
FILE NO. 2-17-14-6

DIVISION OF Mechanical Engineering

SECTION Fuels & Lubricants Laboratory

FOR : Internal, Fuels and Lubricants Laboratory

REFERENCE : Letter dated May 7, 1973 from Mr. Miles Papp, M.P. Heating and Gas Fitting, 85 Sunset Drive, Hillcrest, Whitehorse Y.T. to Mr. P.L. Strigner.

SUBJECT : Several Specification Tests on a Sample of Fuel Oil and Examination of Four Nozzles and One Filter.

SUBMITTED BY Dr. R.B. Whyte
SECTION HEAD

AUTHORS : R. Sabourin & P.L. Strigner.

APPROVED Dr. D.C. MacPhail
DIRECTOR

A. Reasons for Submission of Samples

Users of the fuel oil are apparently having difficulties with it. According to Mr. Papp the fuel oil

(a) plugs up nozzles and filters,

(b) causes fuel pumps to break down,

(c) causes a heavy carbon residue in combustion chambers and boilers,

(d) seems to have a very poor flash point,

(e) consumption is high, and

(f) grade is unknown

Mr. Papp submitted a sample of the fuel oil, four malfunctioning fuel nozzles and a felt filter coated with deposits, and requested that these be examined to determine causes of the difficulties outlined.

NEGATIVES RELATED TO THIS REPORT

GO 2931 Figures 2 to 6 depict in colour shaken and quiescent samples of the fuel (FLO-73126) and for comparison clean No. 1 and No.2 fuel oils. Figure 1 depicts the five beakers in Figures 2 to 6 in order side by side.

62.

LTR-FL-57

DIVISION OF MECHANICAL ENGINEERING

DIVISION DE GÉNIE MÉCANIQUE

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FIG.
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DATE
DATE 30 March 1973

SECTION
Fuels and Lubricants Laboratory

LAB. ORDER
COMM. LAB. 19032A

FILE
DOSSIER 2-17-14-6

FOR : General Electric, Medium Gas Turbine Department,
POUR P.O. Box 952, Schenectady, N.Y. 12345.

REFERENCE : Letter on file to Mr. L. Gardner dated December 11, 1972
RÉFÉRENCE from Mr. W. C. Young, G.E. and General Electric.dated Dec.18/72,
PO-087-ETEL-74391.

LTR-FL-57

DEPOSITION TESTS ON THREE SAMPLES OF TURBINE LUBRICANTS

SUBMITTED BY
PRÉSENTÉ PAR Dr. R.B.Whyte
SECTION HEAD
CHEF DE SECTION

AUTHORS: L. Gardner, G. Moroz.
AUTEUR

APPROVED
APPROUVÉ Dr. D. C. MacPhail
DIRECTOR
DIRECTEUR

FORM NRC 539
FORMULAIRE NRC 539

COPY NO.
COPIE NR. 14

NEGATIVES RELATED TO THIS REPORT

Results of deposition tests

NRC Photo #	Test #	Test Condition, °F
	Shell Turbo 35 - FLO 73015	
GO 2868	1	275/550
GO 2857	2	Repeat
GO 2858	1	225/590
GO 2859	2	Repeat
	Fyroquel 150 R & O - FLO 73016	
GO 2860	1	275/550
GO 2861	2	Repeat
GO 2862	1	225/590
GO 2863	2	Repeat
	Turbinol 1122 - FLO 73017	
GO 2864	1	275/550
GO 2865	2	Repeat
GO 2866	1	225/590
GO 2867	2	Repeat

64.

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DIVISION OF MECHANICAL ENGINEERING

DIVISION DE GÉNIE MÉCANIQUE

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FIG.
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DATE
DATE June 25, 1973

SECTION
Fuels & Lubricants Laboratory

LAB. ORDER
COMM. LAB. 19041A

FILE
DOSSIER C2-12-42

FOR
POUR : Surbond Lubricants Limited, 2277 Nipissing Road, Milton, Ontario.

REFERENCE:
RÉFÉRENCE :Letter dated 12th December 1972 to Dr. R.B.Whyte and signed by Mr. J. H. Wannamaker.

LTR-FL-60

THE WEAR CHARACTERISTICS OF A SAMPLE OF WATER-GLYCOL HYDRAULIC FLUID

SUBMITTED BY
PRÉSENTÉ PAR Dr. R.B.Whyte
SECTION HEAD
CHEF DE SECTION

AUTHOR
AUTEUR T. Maloney

APPROVED
APPROUVÉ Dr. D.C.MacPhail
DIRECTOR
DIRECTEUR

FORM NRC 539
FORMULAIRE NRC 539

COPY NO.
COPIE NR. 15

NEGATIVES RELATED TO THIS REPORT

GO 2881	Section of ring before testing
GO2882	Section of ring after 731 hours testing
GO 2883	Vane before testing
GO 2884	Vane after 731 hours testing
GO 2886	Hydraulic pump test rig

66.

NRC MP 66

MP 66

National Research Council Canada
Division of Mechanical Engineering
Ottawa June 1974

THE ENDURANCE OF INSTRUMENT BALL BEARINGS WITH AN OIL RETAINING CHEMICAL BARRIER COAT

L'ENDURANCE DES ROULEMENTS A BILLES D'APPAREILS DE MESURE, AVEC REVETEMENT D'ARRET CHIMIQUE, RETENANT L'HUILE

by/par

T. MALONEY AND/ET C. DAYSON

SUMMARY

The endurance runs on instrument ball bearings have shown that without barrier coating on the bearings the silicone oil is a more effective lubricant than the diester oil. A dramatic improvement in performance is obtained when the diester lubricated bearings are barrier coated.

The barrier coating did not give rise to a similar improvement in performance for bearings lubricated with the silicone oil, in fact the reverse is the case. The reduction in bearing life with the barrier coating was not expected and can only have been brought about by the retention of the silicone oil and its degradation products within the bearings.

Limited.

NEGATIVES RELATED TO THIS REPORT

GO 2920	Bearing test apparatus, mounted in oven.
GO 2921	Bearing test apparatus
GO 2924	Bearing Number 4..Failed silicone oil lubricated. Non-barrier coated.
GO 2926	Bearing Number 27. Failed silicone oil lubricated. Barrier coated.
GO 2928	Bearing Number 93. Diester oil lubricated. Barrier coated.
GO 2930	Bearing Number 65. Failed Diester oil lubricated. Non-barrier coated.