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August 31, 1945.

R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1928.

The Use of Different 3-GP-4, Class 4B Lubricating
Oils in Testing Corrosion-Preventive Compounds
for Aircraft Engines (Spec. C-27-587).

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Background:

Since February, 1945, the corrosion properties of a number of corrosion-preventive compounds for aircraft engines (Spec. C-27-587) have been investigated in these Laboratories. Although the procedures outlined in the specification were strictly adhered to, it has been difficult to obtain completely uncorroded test panels in the Hydrobromic Acid Neutralization Test. Furthermore, compounds which did not pass the Hydrobromic Acid Neutralization Test in these Laboratories have since been accepted by the Naval Air Experimental Station, U.S. Navy Yard, Philadelphia, Pa. (see letter of July 17, 1945, from Commander J. J. Tomamichel, accompanying letter of July 31, 1935, from W/C Macoun for A/C A.L. Johnson, Director of Aeronautical Inspection, for Chief of Air Staff, Department of National Defence for Air, Ottawa, Canada).

The present investigation was undertaken in an effort to discover the reason for these discrepancies.

Materials Used:

A series of Hydrobromic Acid Neutralization Tests were performed, using the following materials:

- (1) Corrosion-preventive compound labelled "From Imperial Oil Ltd., C.D.T.F. 216, Serial No. 2-R-2689, 34A/94". Test requested in letter dated July 12, 1945, from S/L Spence for A/C A.L. Johnson.
- (2) Corrosion-preventive compound labelled "Oil Anti-Corrosive, Shell Oil Co. Ltd., Contract Air Req. #125, Ser. 6-743342". Test requested in letter dated July 12, 1945, from S/L Spence for A/C A.L. Johnson.
- (3) Corrosion-preventive compound labelled "Anti-Corrosive Concentrate, Spec. C-27-587, Ref. No. 13711, McColl-Frontenac Oil Co. Ltd."
- (4) Lubricating oil to Spec. 3-GP-4, Class 4B, received from the R.C.A.F. at Rockcliffe on May 30, 1945. Labelled "Oil Lubricating 4B/120". The manufacturer of this oil is unknown.
- (5) Lubricating oil received about July 6, 1945, in a McColl-Frontenac Oil Co. Ltd. container and labelled "Diluent Oil (3-GP-4 Class 4B-120). In connection with anti-corrosive concentrate tests, Spec. C-27-587." This presumably was produced by the McColl-Frontenac Oil Co. Ltd.
- (6) Stanolax, Heavy, labelled "Imperial Oil, April 9, 1943". This material was colourless and transparent and had a Saybolt Universal Viscosity at 210° F. of 51.3 seconds.

Experimental Work:

Panels were treated as outlined in the Hydrobromic Acid Neutralization Test specification, using two panels for

(Experimental Work, cont'd) -

each of the following combinations of materials:

Combina- tion No.	Type of Lub. Oil: In Hydrobromic Acid Emulsion	Type of Neutralizing Mixture Used	
		Corrosion- Preventive Compound	Diluent
I	:Oil from R.C.A.F.	:Imperial Oil Co.	:Oil from R.C.A.F.
II	: "	:Shell Oil Co.	: "
III	: "	:McCull-Fontenac Co.	:McCull-Fontenac Co.
IV	: "	:Imperial Oil Co.	:Stanolax.
V	: "	:	:None used.
VI	:McCull-Fontenac Co. oil	:Imperial Oil Co.	:Oil from R.C.A.F.
VII	: " "	:Shell Oil Co.	: "
VIII	: " "	:McCull-Fontenac Co.	:McCull-Fontenac Co.
IX	: " "	:McCull-Fontenac Co.	:Stanolax.
X	: " "	:	:None used.

RESULTS:

1. Corrosion was noted at the end of the test in the case of:

Combination I	-	see Figure 1.
" II	-	" " 2.
" III	-	" " 3.
" IV	-	" " 4.
" V	-	" " 5.
" VII	-	" " 6.
" VIII	-	" " 7.
" IX	-	" " 8.
" X	-	" " 9.

2. No corrosion was observed in the case of Combination VI (see Figure 10).

3. When the lubricating oil from the R.C.A.F. was used in the emulsion, the various combinations of materials could be arranged in the following order:

(Results, cont'd) -

Combination V - Most corrosion on panels.
" I
" II
" IV
" III - Least corrosion on panels.

4. When the McColl-Frontenac lubricating oil was used in the emulsion, the various combinations of materials could be arranged in the following order:

Combination X - Most corrosion on panels.
" VIII
" IX
" VII
" VI - Least corrosion on panels.

5. In general, the combinations in which the lubricating oil from the R.C.A.F. was used for the emulsion produced more corrosion than the ones in which the McColl-Frontenac Co. lubricating oil was used.

Conclusions:

The following conclusions have been drawn from the above experimental data:

1. A neutralizing mixture of Imperial Oil preventive compound and lubricating oil from the R.C.A.F. permits more corrosion than a mixture of Imperial Oil preventive compound and Stanolax (compare results from Combinations I and IV). It is believed that the Stanolax is inert chemically and thus would not tend to either increase or reduce the amount of corrosion by reacting with the preventive compound. Accordingly, it would appear that the lubricating oil from the R.C.A.F. tends to increase the amount of corrosion.

2. A neutralizing mixture of McColl-Frontenac preventive compound and lubricating oil permits little more

(Conclusions, cont'd) -

corrosion than a mixture of McColl-Frontenac preventive compound and Stanolax (compare results from Combinations VIII and IX). Accordingly, assuming that Stanolax is inert, it would appear that the McColl-Frontenac lubricating oil tends to increase the amount of corrosion only slightly.

3. The order of merit of a number of preventive compounds is different when different lubricating oils are used in the hydrobromic acid emulsion.

4. The McColl-Frontenac lubricating oil gives much better results than the lubricating oil from the R.C.A.F., in the hydrobromic acid emulsion. It gives a better emulsion and, in general, the panels are less corroded.

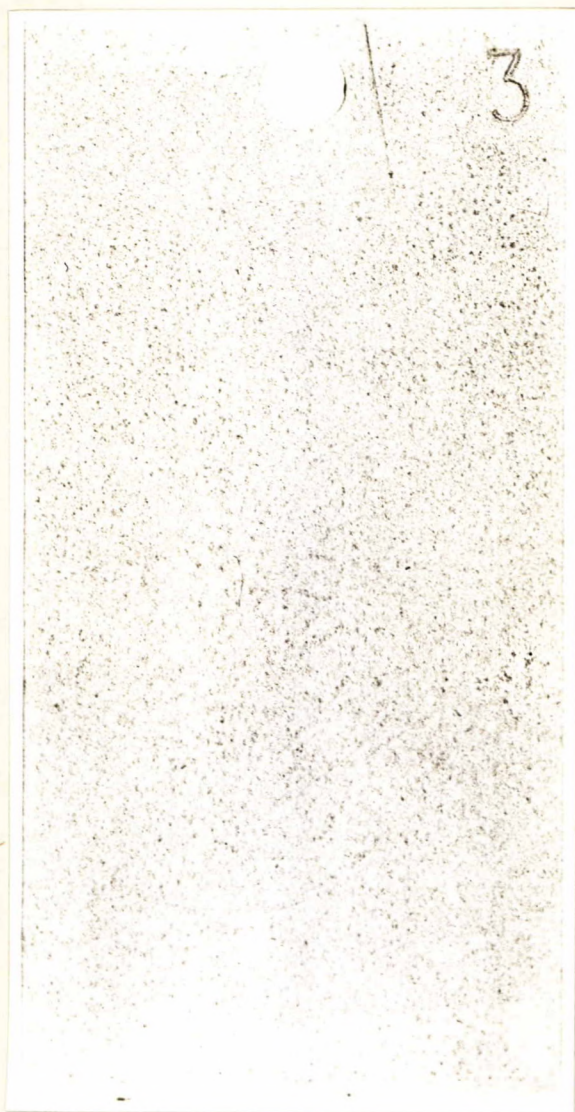
It is believed that this information will be useful in overcoming the discrepancy between results from these and other laboratories.

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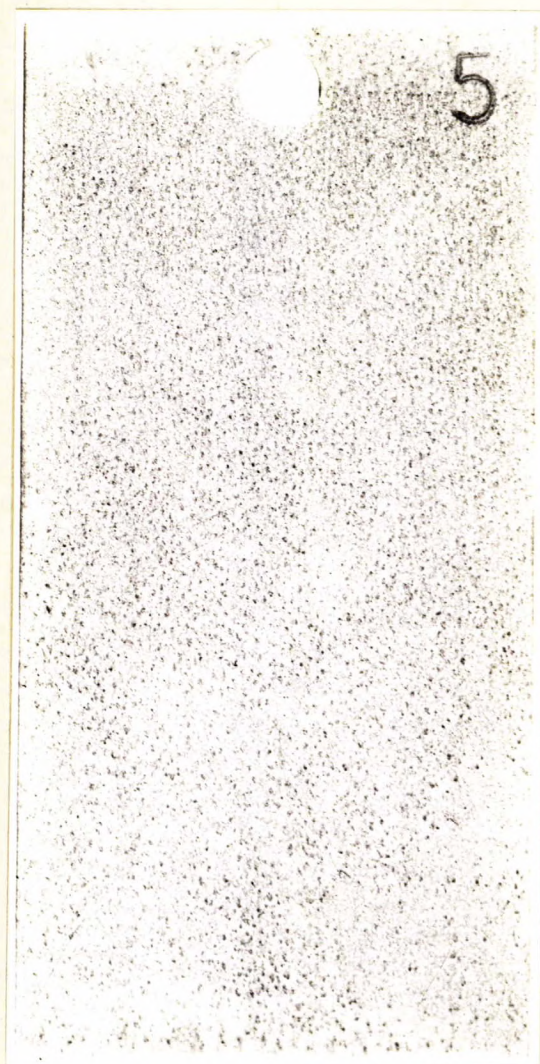
(Pages 6 to 15 contain)
(Figures 1 to 10.)

Figure 1.



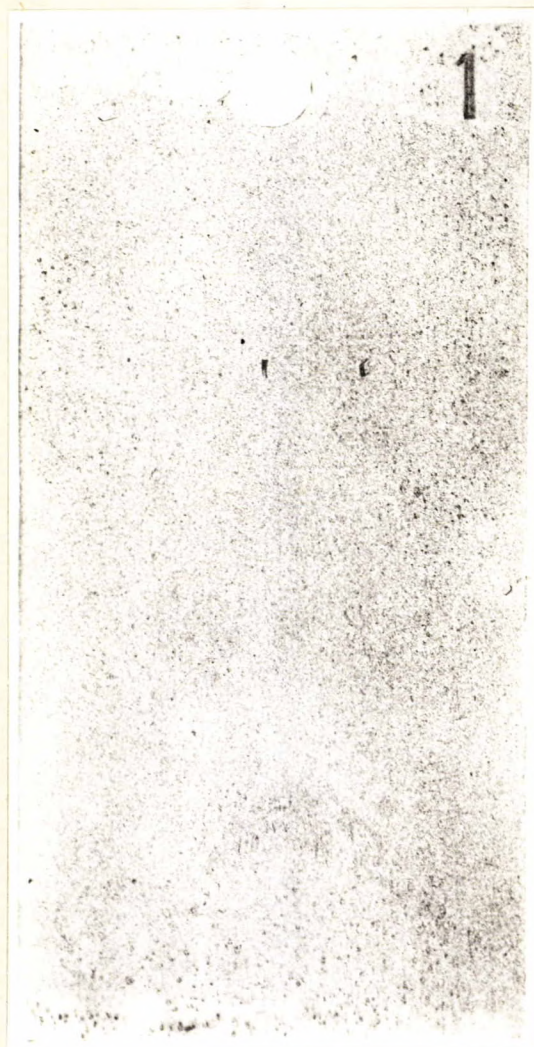
STEEL PANEL AFTER HYDROBROMIC ACID NEUTRALIZA-
TION TEST IN WHICH THE EMULSION CONTAINED THE LUB.
OIL FROM THE R.C.A.F. AND THE NEUTRALIZING MIXTURE
CONTAINED IMPERIAL OIL PREVENTIVE COMPOUND WITH OIL
FROM THE R.C.A.F. AS DILUENT.

Figure 2.



STEEL PANEL AFTER HYDROBROMIC ACID NEUTRALIZA-
TION TEST IN WHICH THE EMULSION CONTAINED THE LUB.
OIL FROM THE R.C.A.F. AND THE NEUTRALIZING MIXTURE
CONTAINED SHELL PREVENTIVE COMPOUND WITH OIL FROM
THE R.C.A.F. AS DILUENT.

Figure 3.



STEEL PANEL AFTER HYDROBROMIC ACID NEUTRALIZATION TEST IN WHICH THE EMULSION CONTAINED THE LUB. OIL FROM THE R.C.A.F. AND THE NEUTRALIZING MIXTURE CONTAINED McCOLL-FRONTENAC PREVENTIVE COMPOUND AND DILUENT.

Figure 4.



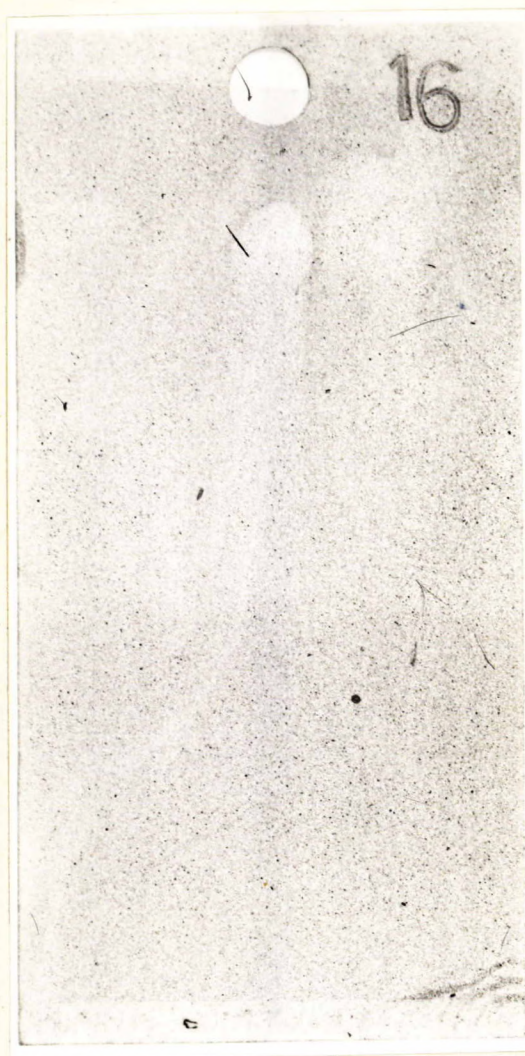
STEEL PANEL AFTER HYDROBROMIC ACID NEUTRALIZATION TEST IN WHICH THE EMULSION CONTAINED THE LUB. OIL FROM THE R.C.A.F. AND THE NEUTRALIZING MIXTURE CONTAINED IMPERIAL OIL PREVENTIVE COMPOUND WITH STANOLAX AS DILUENT.

Figure 5.



STEEL PANEL AFTER HYDROBROMIC ACID NEUTRALIZATION TEST IN WHICH THE EMULSION CONTAINED THE LUB. OIL FROM THE R.C.A.F. AND NO NEUTRALIZING MIXTURE WAS USED.

Figure 6.



STEEL PANEL AFTER HYDROBROMIC ACID NEUTRALIZA-
TION TEST IN WHICH THE EMULSION CONTAINED McCOLL-
FRONTENAC LUB. OIL AND THE NEUTRALIZING MIXTURE
CONTAINED SHELL PREVENTIVE COMPOUND WITH OIL FROM
THE R.C.A.F. AS DILUENT.

Figure 7.



STEEL PANEL AFTER HYDROBROMIC ACID NEUTRALIZA-
TION TEST IN WHICH THE EMULSION CONTAINED McCOLL-
FRONTENAC LUB. OIL AND THE NEUTRALIZING MIXTURE
CONTAINED McCOLL-FRONTENAC PREVENTIVE COMPOUND AND
LUB. OIL.

Figure 8.



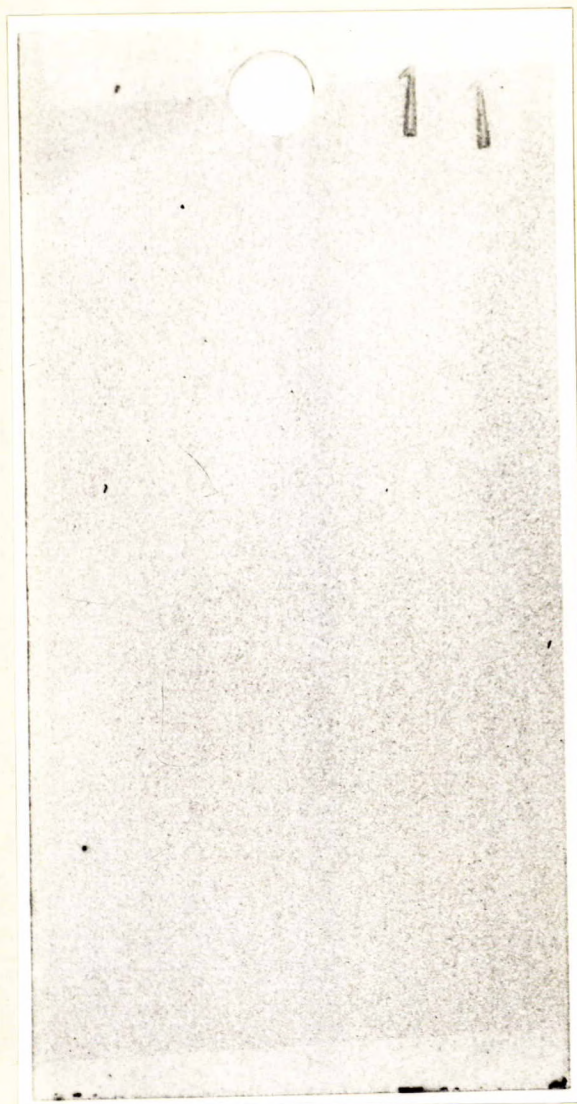
STEEL PANEL AFTER HYDROBROMIC ACID NEUTRALIZA-
TION TEST IN WHICH THE EMULSION CONTAINED McCOLL-
FRONTENAC LUB. OIL AND THE NEUTRALIZING MIXTURE
CONTAINED McCOLL-FRONTENAC PREVENTIVE COMPOUND WITH
STANOLAX AS DILUENT.

Figure 9.



STEEL PANEL AFTER HYDROBROMIC ACID NEUTRALIZA-
TION TEST IN WHICH THE EMULSION CONTAINED McCOLL-
FRONTENAC LUB. OIL AND NO NEUTRALIZING MIXTURE WAS
USED.

Figure 10.



STEEL PANEL AFTER HYDROBROMIC ACID NEUTRALIZA-
TION TEST IN WHICH THE EMULSION CONTAINED McCOLL-
FRONTENAC LUB. OIL AND THE NEUTRALIZING MIXTURE
CONTAINED IMPERIAL OIL PREVENTIVE COMPOUND WITH OIL
FROM THE R.C.A.F. AS DILUENT.

This panel was entirely free from corrosion.

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