

<b>MATERIALS &amp; PROCESSES REPORT</b>	<b>13/4026</b>	ISSUE 1
<b><u>SUBJECT:</u> Piaggio P180 NLG Oil Sample</b>		
<b><u>PART NUMBER:</u> 201033002 MSN 1057 / N401WS CS03</b>		

## HISTORY

In support of an investigation into a Piaggio P180 uncommanded steering incident, an oil sample taken from unit serial No. M-DAG 42/01 was submitted to the Laboratory.

This report summarises the testing results that have been performed on the sample to assist with the ongoing investigation by the N.T.S.B.

## CONCLUSIONS

Test	Method	Results ( <i>Specification</i> )
1 <b>Identification of fluid</b>	Gas Chromatography (Comparison to reference fluids)	Fluid matched MIL-H-5606 mineral oil
2 <b>Viscosity @ 40°C</b>	Cone & Plate MLP3-62 (As specified in PCS-7100)	11.4 cP ( $\geq 8.5$ )
3 <b>Total Acidity</b>	MLP3-65 (As specified in PCS-7100)	0.03 mg KOH/g ( $\leq 0.2$ )
4 <b>Water content</b>	Karl Fischer MLP3-85 (As specified in PCS-7100)	52 ppm ( $\leq 200$ )
5 <b>Solid Contaminants*</b>	SEM/EDX analysis (Visual identification and measurement after filtration through 0.8µm membrane )	No contamination. (Few metallic particles smaller than 20µm)

			Approval on file		
DEPT.		Materials & Processes			
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### INITIAL EXAMINATION

The sample was supplied in glass bottles (Figure 1). No leakage was observed during transport to the MBD laboratory. Approximately 60 ml of fluid was received so it was not possible to use an automatic particle counting technique to determine fluid cleanliness.

Initial examination of the fluid showed that it had a red colour (as mineral oil fluids) and was pretty clean seeing that there were no particles or visible contamination.

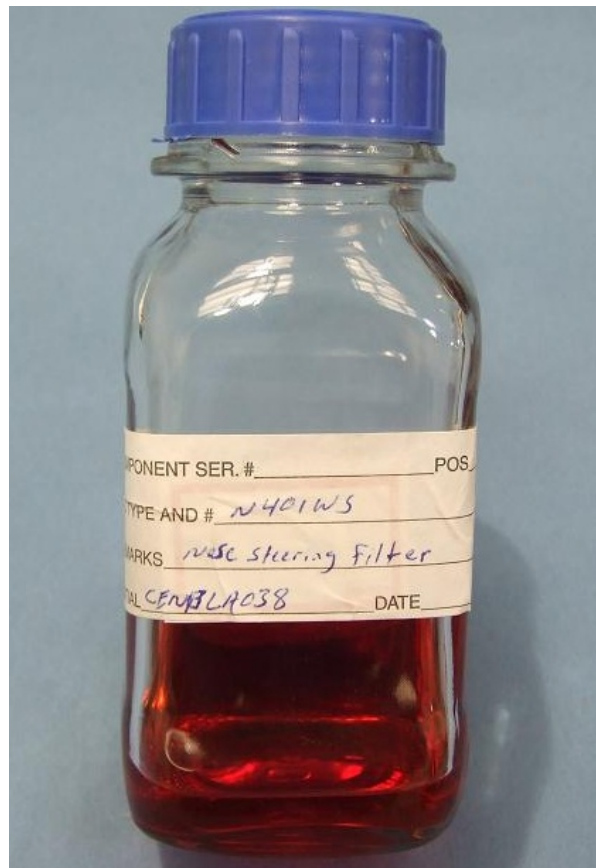


Figure 1: Sample as received

## GAS CHROMATOGRAPHY

The hydraulic fluid type was assessed using Gas Liquid Chromatography. A 0.5  $\mu\text{l}$  sample was injected into a Perkin Elmer Clarus 500 GC, and compared to reference samples of mineral oils. Fluid sample matched the mineral oil MIL-H-5606 reference sample, as shown in Figure 2.

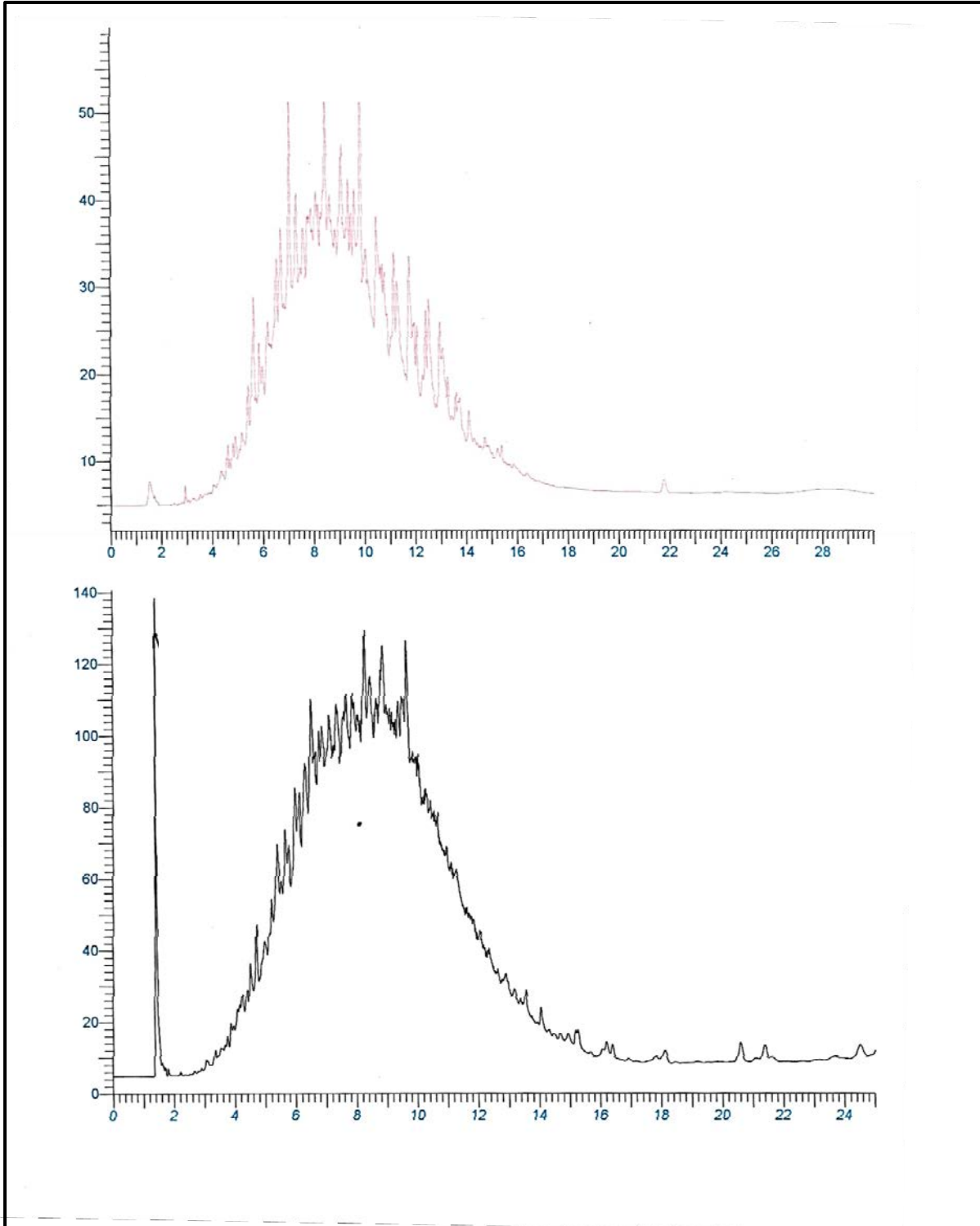


Figure 2: Gas Chromatographs. ( Sample N401WS in red, Reference MIL-H-5606 in dark)

## FLUID TESTS

The properties of the fluid sample was tested and compared to the requirements for new mineral oil fluids, as provided in the specification PCS-7100.

### ❖ Viscosity

The viscosity of the sample was measured using a cone and plate Brookfield viscometer, and the results are provided in Table 1. The viscosity of the fluid sample was acceptable compared to the limit for new fluids.

Sample	Viscosity (cP)	Limit (cP) – PCS7100
N401WS	11.4	≥8.5

Table 1: Viscosity result

### ❖ Water content

The water content of was determined using the columetric Karl Fischer titration method and the result is provided in Table 2. The water content of the sample was acceptable for new fluids.

Sample	Water content (ppm)	Limit (ppm) – PCS 7100
N401WS	52.11	≤200

Table 2: Water content results

### ❖ Acidity

The organic and inorganic acidity of the hydraulic fluid was measured and the result is presented in Table 3. The acidity level was correct.

Sample	Acidity (mg KOH/g)	Limit (mg KOH/g) – PCS 7100
N401WS	0.03	≤0.2

Table 3: Acidity results

## PARTICLE ANALYSIS

A sample of fluid was agitated and then filtered through a 0.8 µm nylon membrane filter (Figure 3). The resulting filter paper was relatively clean, although few small white debris particles were observed on the surface of the paper (Figures 4). In order to determine the nature and composition of these particles SEM and EDX analysis were carried out on the filtered papers.

This revealed the rare presence of metallic contamination (aluminium or silicium). These particles were smaller than 20µm and unimportant . (Figure 5)



Figure 3: Filtered fluid sample

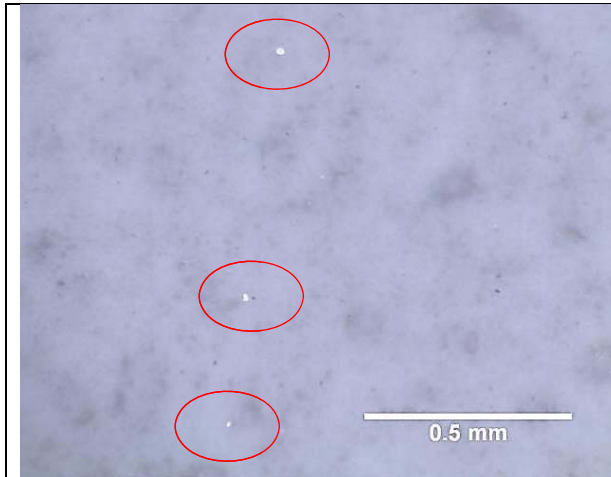


Figure 4: Rare particles on filter paper

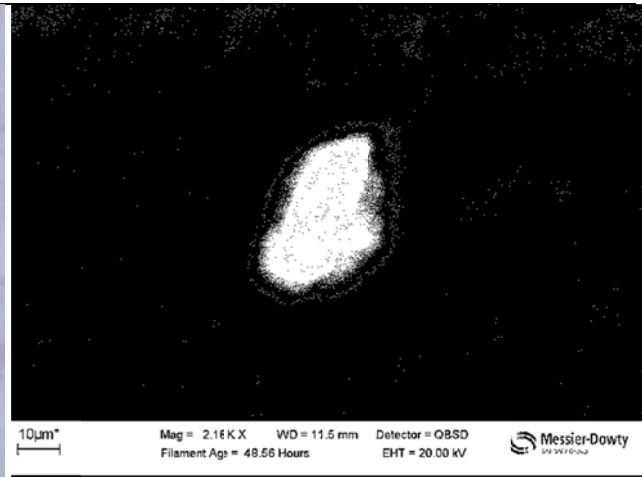


Figure 5: Metallic particle under SEM

## **DISCUSSION**

The sample N401WS was in accordance with all requirements and specifications of a mineral oil.

Moreover, all the tests proved that the fluid had the same characteristics as a new mineral oil fluid. The rare particles found on the nylon membrane could come from the sample preparation before its analysis.

## REVISION SHEET

ISSUE	DATE	REVISED	APPROVED	PAGES AFFECTED	REMARKS
1		-	PT / RA	-	Initial Issue