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**Preliminary Report on Aircraft Wipe Sample Analysis for  
Tricresyl Phosphate Isomers**

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# Preliminary Report on Aircraft Wipe Sample Analysis for Tricresyl Phosphate Isomers

## Source of aircraft wipe samples.

Wipe samples, from interior surfaces of a number of aircraft were provided by Mr. Tim van Beveren with the request that these samples be analyzed for Tricresyl Phosphate isomers that are constituents in many jet engine lubricating oils. The samples were delivered to the University of British Columbia by "FedEx" on January 26, 2009. The results of the analyses were obtained on January 29, 2009 and transmitted to Mr. van Beveren.

## Analytical procedure

After receipt of the samples they were catalogued, removed from their plastic zip lock bags and individually placed in properly identified glass, screw capped, vials. Extraction and analysis was done according to the method described by van Netten 2009, i.e.; Wipe samples and control samples were extracted with 5 ml n-pentane at ambient temperature and sonicated in a water bath, also at ambient temperature, for 30 min. They were reduced to dryness using a nitrogen stream reconstituted to .5 ml in ethyl acetate and transferred to GC vial, 1  $\mu$ l was injected into a 30 m Agilent HP5MS capillary column 250  $\mu$ m diameter 0.10  $\mu$ m film situated on a Agilent 6890GC gas chromatograph operating in the splitless mode with a .5 min splitless time, along with an Agilent technologies GMSD 5973, set for specific TCP ion monitoring (SIM) at 368. Inlet temperature of the column was 250  $^{\circ}$ C changing at a rate of 10 degrees/minute to a final temperature of 325. Carrier gas was helium at a pressure of 2.57 psi and at a flow of 1.3 ml/min. TCP Standards were obtained from Fluka Chemicals.

## Results.

### Condor:

Aircraft: B757-300

Registration: D-ABOA

Airline: Condor

Samples: 4 + 2 controls

1, wipe sample Cab 30 E.

2, wipe sample Cab 47 E

3, wipe sample Galley 5L

4, wipe sample Cab 3E

5, Control ziplock bag wiped inside using control glove and control wipe (Blue pack) Jintr pin Alcohol prep pad, 70% isopropyl alcohol.

6, Control wipe, blue pack

**Nanograms TCP/sample**

**81.9 / cm<sub>2</sub>**

**75.5 / cm<sub>2</sub>**

**253.6 / cm<sub>2</sub>**

**196.0 / cm<sub>2</sub>**

**<1.0**

**<1.0**

Aircraft:	B757-300	
Registration:	D-ABOG	
Airline:	Condor	
Samples:	2, area: 2 cm	<b>Nanograms TCP/sample</b>
	1- wipe sample, above seat 3D	<b>98.9</b>
	2-honey comb type air screen (“filter”), black 4mm holes.	<b>36716.0</b>
Aircraft:	B757-300	
Registration:	D-AB0L	
Airline:	Condor	
Samples:	2, area: 2 cm	
	1, wipe sample, toilet front left,	<b>154950.0</b>
	2, wipe sample	<b>325.0</b>
Aircraft:	B757-300	
Registration:	D-ABOL	
Airline:	Condor	
Samples:	1 (Cockpit)	
	1, D-ABOL- “Unique from cockpit” foam filter for temp sensor in cockpit.	<b>64976.0</b>
<b>Lufthansa:</b>		
Aircraft:	B747-400	
Registration:	D-ABKV	
Airline:	Lufthansa	
Samples:	2 + 1 Control	
	1, moistened small hand wipe, LAV?	<b>45.1</b>
	2, as above, right Lav.	<b>87.4</b>
	3, as above, Reference (Control) No swab	<b>&lt;1.0</b>
Aircraft:	B737-500	
Registration:	D-ABIL	
Airline:	Lufthansa	
Samples:	3	
	1, wipe sample, seat 11 F	<b>34.5</b>
	2, wipe sample, Toilette left	<b>15.0</b>
	3, wipe sample Toilette right	<b>18.2</b>

**Air Berlin:**

Aircraft:	A320	
Registration:	D-ABDN	
Airline:	Air Berlin	
Samples:	3	<b>Nanograms TCP/sample</b>
	1, wipe sample , air inlet 16 A	<b>62.2</b>
	2, wipe sample, toilet rear right	<b>14.5</b>
	3, wipe sample , window.	<b>32.5</b>
	4, Control wipe . “Alcohol Pads B Braun” 70% isopropyl alcohol and water.	<b>&lt;1.0</b>

**SWISS:**

Aircraft:	AVRO RJ 100	
Registration:	HB IXV	
Airline:	Swiss	
Samples:	5	
	1, wipe sample, under windowsill, 21A.	<b>11.7</b>
	2, wipe sample, “carpet underneath window”, 21A	<b>4.9</b>
	3, wipe sample, above air slit (window) 21A	<b>544.8</b>
	4, wipe sample “air vent above seat 21A	<b>219.3</b>
	5, wipe sample, Toilet ceiling	<b>237.4</b>

Aircraft:	AVRO RJ 100	
Registration:	HB IYW	
Airline:	Swiss	
Samples:	5	
	1, wipe sample, seat 10A, underneath window	<b>6.97</b>
	2, wipe sample, carpet side, 10 A	<b>&lt;1.0</b>
	3, wipe sample, air inlet above window 10 A	<b>77.4</b>
	4, wipe sample, air vent over seat 10A	<b>87.9</b>
	5, wipe sample, Toilet rear ceiling air vent	<b>182.4</b>

## **EASY JET**

Aircraft:	A319	
Registration:	unknown	
Airline:	EasyJet	
Samples:	2	<b>Nanograms TCP/sample</b>
	1 wipe sample in same bag + black debris.	<b>409.8</b>
	2, 1 small “fluffy” part “from air filter” same bag as above.	<b>78.9</b>

## **TUIFly (new aircraft)**

Aircraft:	B737-700	
Registration:	D-AHXE	
Airline:	Tuifly	
Samples:	1+ 1 control	
	1, wipe sample (red pack) Lavatory rear right underneath toilet.	<b>&lt;1.0</b>
	2, Control glove wiped used with Control wipe (red pack) to wipe inside of Control plastic zip lock bag	<b>&lt;1.0</b>

## **EUROWINGS**

Aircraft:	BAE 146-300	
Registration:	D-AEWO	
Airline:	Eurowings	
Samples:	4,	
	1, wipe sample, back toilet ceiling.	<b>244.1</b>
	2, wipe sample 17 A, “carpet”	<b>88.5</b>
	3, wipe sample, back toilet	<b>28.5</b>
	4, wipe sample seat 17A, air vent	<b>98.1</b>

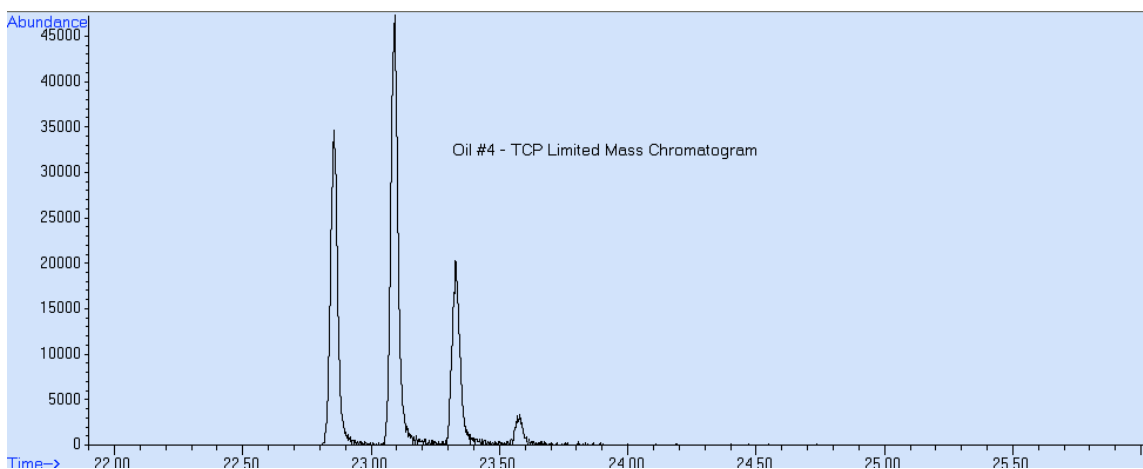
### **Other samples**

1, Control, red wipe package, Kendall, Webcol UK, Skin cleaning alcohol prep.	<b>&lt;1.0</b>
2, Control wipe, control glove and control ziplock bag wiped inside., Glove “Gammex”	<b>&lt;1.0</b>

## Discussion

A typical gas chromatograph trace of a representative jet engine lubricating oil is shown in figure 1.

**Figure 1:** S.I.M. Limited Mass Chromatogram of m/z 368 ion of TCP – in a representative jet engine (reproduced from van Netten 2008)



It can be observed from figure 1 that a typical jet engine oil isomer profile has 4 TCP isomers. These isomers have been identified, using the Fluka standards along with the information provided in a recent publication (De Nola et al. 2008) as, left to right, mmm-TCP, mmp-TCP, mpp-TCP and ppp-TCP. The isomer ooo-TCP will elute prior to mmm-TCP ( due to the severe time constraint placed on this project, standard traces and additional information will be provided at a later date in a final version of this report)

All wipe samples that were positive for TCP, showed the same pattern of isomers that is characteristic of many jet engine lubricating oil, as shown in figure 1. Tri ortho cresyl phosphate was not found in any of the samples above the detection limit of < 1 nanogram/sample.

## References

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- van Netten C. Design of a small personal air monitor and its application in aircraft. *Sci Total Environ* 2009, 15;407(3):1206-1210.
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