



**COT**  
onafhankelijk

**Test procedure for Cargo Tanks**  
**Coating Qualification for Crude Oil**  
**Tankers**

*Development of a suitable test method*  
*(first results after 3 months)*

Ing. M. Walrave, Managing Director  
Wednesday October 7th 2009 JWG3 London

COT bv  
Jan Tademaweg 40  
2031 CV HAARLEM  
T 023 - 531 95 44  
F 023 - 527 72 29  
E info@cot-nl.com  
W www.cot-nl.com




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COT bv  
Jan Tademaweg 40  
2031 CV HAARLEM  
T 023 - 531 95 44  
F 023 - 527 72 29  
E info@cot-nl.com  
W www.cot-nl.com




**Test methods**


**Condensation Vapour Test**

- Modified ISO 3231 at 60°C
- Gastight cabinet flushed weekly with gas mixture (N<sub>2</sub> (83±2%), CO<sub>2</sub> (13±2%), O<sub>2</sub> (4±1%))
- Weekly additions of SO<sub>2</sub> (±300ppm) and H<sub>2</sub>S (200 ppm)
- Water is added/refreshed every 2 weeks
- Total test duration 6 months
- First assessment after 3 months
- Rust (ISO 4628-3) and blistering (ISO 4628-2)

**COT bv**  
Jan Tademaweg 40  
2031 CV HAARLEM  
T 023 - 531 95 44  
F 023 - 527 72 29  
E info@cot-nl.com  
W www.cot-nl.com




**Test methods**



*Condensation Vapour Test*

**COT bv**  
Jan Tademaweg 40  
2031 CV HAARLEM  
T 023 - 531 95 44  
F 023 - 527 72 29  
E info@cot-nl.com  
W www.cot-nl.com




**Test methods**

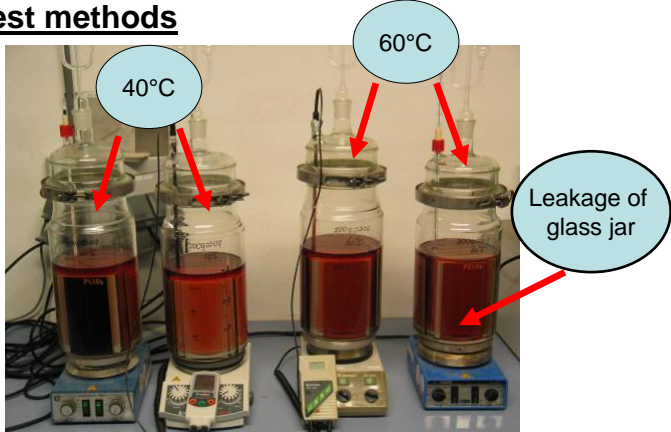
**Immersion test**

- At 40°C and 60°C (panels are fully immersed)
- Immersion liquid based upon DMA (Saybolt Netherlands)
  - density : 0.849 kg/L (0.880 kg/L)
  - Viscosity : 2.98 mm<sup>2</sup>/s (5 CSt)
  - Naphtenic acid (acid number 2.5 mg KOH)
  - Benzene/Toluene (1:1) 8%
  - H<sub>2</sub>S 5 ppm
  - Seawater 5%
- Total test duration 6 months
- First assessment after 3 months
- Rust (ISO 4628-3) and blistering (ISO 4628-2)

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 E info@cot-nl.com  
 W www.cot-nl.com



**Test methods**



Immersion Test

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 2031 CV HAARLEM  
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E info@cot-nl.com  
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Alternative heating device

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**Test methods**

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Jan Tademaweg 40  
2031 CV HAARLEM  
T 023 - 531 95 44  
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E info@cot-nl.com  
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Alternative heating device



**Results 1st evaluation (3 months)**


**Test systems (overall)**

- P-systems (4 systems, 3 tests, 24 test panels)
- K-systems (4 systems, 3 tests, 24 test panels)
- C-systems (4 systems, 3 tests, 24 test panels)
- D-systems (4 systems, 3 tests, 8 test panels)
- N-systems (4 systems, 3 tests, 24 test panels)
- H-systems (4 systems, 3 tests, 24 test panels)
- X-systems (4 systems, 3 tests, 24 test panels)

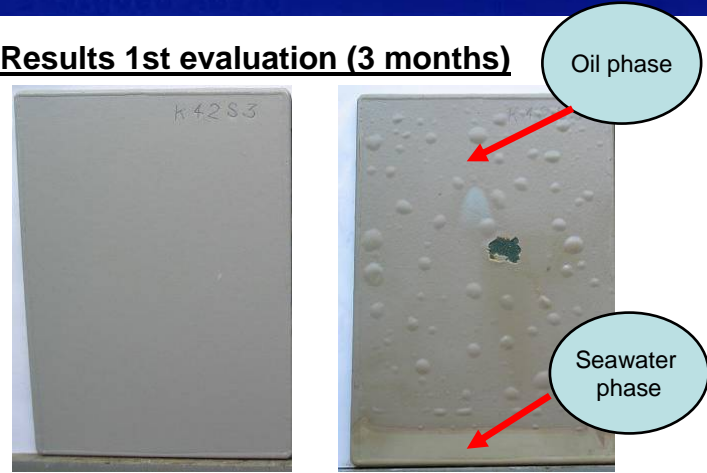
- Code S (Shoppriem) and B (Blasted)
- Code 1 (Epoxy) and 2 (Modified Epoxy)

*(Vinyl and Tar system not taken into account)*

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 2031 CV HAARLEM  
 T 023 - 531 95 44  
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 E info@cot-nl.com  
 W www.cot-nl.com




**Results 1st evaluation (3 months)**

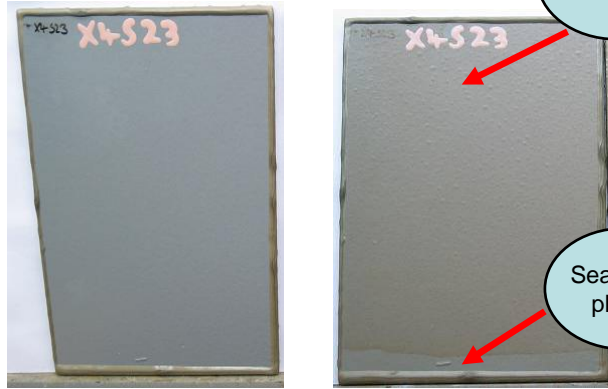


**K42S3 start**      **K42S3 after 3 months 40°C**

**COT bv**  
 Jan Tademaweg 40  
 2031 CV HAARLEM  
 T 023 - 531 95 44  
 F 023 - 527 72 29  
 E info@cot-nl.com  
 W www.cot-nl.com




**Results 1st evaluation (3 months)**




**X4S23 start**      **X4S23 after 3 months 40°C**

**COT bv**  
 Jan Tademaweg 40  
 2031 CV HAARLEM  
 T 023 - 531 95 44  
 F 023 - 527 72 29  
 E info@cot-nl.com  
 W www.cot-nl.com




**Results 1st evaluation (3 months)**

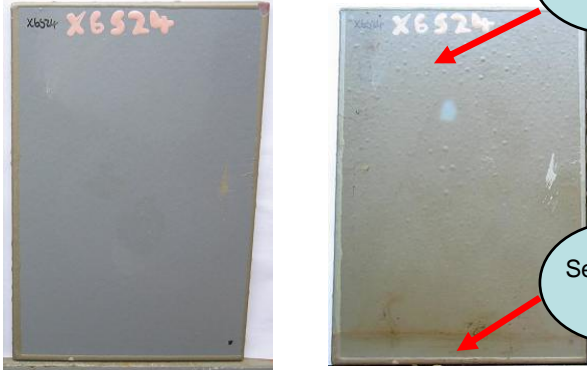


**K62B4 start**      **K62B4 after 3 months 60°C**

**COT bv**  
 Jan Tademaweg 40  
 2031 CV HAARLEM  
 T 023 - 531 95 44  
 F 023 - 527 72 29  
 E info@cot-nl.com  
 W www.cot-nl.com




**Results 1st evaluation (3 months)**




**X6S24 start**      **X6S24 after 3 months 60°C**

**COT bv**  
 Jan Tademaweg 40  
 2031 CV HAARLEM  
 T 023 - 531 95 44  
 F 023 - 527 72 29  
 E info@cot-nl.com  
 W www.cot-nl.com





**Results 1st evaluation (3 months)**



**CV2S4 start**      **CV2S4 after 3 months Vapour**

**COT bv**  
 Jan Tademaweg 40  
 2031 CV HAARLEM  
 T 023 - 531 95 44  
 F 023 - 527 72 29  
 E info@cot-nl.com  
 W www.cot-nl.com






**Results 1st evaluation (3 months)**

*Overall results*

<u>% Passed</u>	Vapour	40°C Immersion	60°C Immersion
<b>P-Systems</b>	100%	100%	100%
<b>K-Systems</b>	100%	50%	75%
<b>C-Systems</b>	100%	100%	50%
<b>D-Systems</b>	100%	100%	50%
<b>N-Systems</b>	100%	100%	0%
<b>H-Systems</b>	100%	100%	50%
<b>X-Systems</b>	100%	50%	67%

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 Jan Tademaweg 40  
 2031 CV HAARLEM  
 T 023 - 531 95 44  
 F 023 - 527 72 29  
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**Preliminary conclusions**

**Immersion test at 40°C**

- 13 of 13 Epoxy systems pass (100%)
- 9 of 13 Modified Epoxy systems pass (69%)
- 10 of 12 Blasted systems pass (83%)
- 12 of 14 shopprimed systems pass (86%)
- Vinyl failed (cracking/soft), Tar passed

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 2031 CV HAARLEM  
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Jan Tademaweg 40  
2031 CV HAARLEM  
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**Preliminary conclusions**

**Immersion test at 60°C**

- 11 of 14 Epoxy systems pass (79%)
- 4 of 13 Modified Epoxy systems pass (31%)
- 6 of 13 Blasted systems pass (46%)
- 9 of 14 shopprimed systems pass (64%)
- Vinyl failed (cracking/soft), Tar passed




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Jan Tademaweg 40  
2031 CV HAARLEM  
T 023 - 531 95 44  
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E info@cot-nl.com  
W www.cot-nl.com

**Preliminary conclusions**

**Vapour test at 60°C**


- All systems pass the test
- Vinyl failed (rust/cracking), Tar passed



**Results 1st evaluation (3 months)**  
*Results with heating coil at 60°C are discarded*


<u>% Passed</u>	Vapour	40°C Immersion	60°C Immersion
<b>P-Systems</b>	100%	100%	100%
<b>K-Systems</b>	100%	50%	75%
<b>C-Systems</b>	100%	100%	<b>100%</b>
<b>D-Systems</b>	100%	100%	-
<b>N-Systems</b>	100%	100%	<b>50%</b>
<b>H-Systems</b>	100%	100%	<b>75%</b>
<b>X-Systems</b>	100%	50%	<b>75%</b>

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 Jan Tademaweg 40  
 2031 CV HAARLEM  
 T 023 - 531 95 44  
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 E info@cot-nl.com  
 W www.cot-nl.com



**Results 1st evaluation (3 months)**  
*Results with bottom heating at 60°C*


Manufacturer	Vapour Test				40°C Immersion				60°C Immersion			
	PE		ME		PE		ME		PE		ME	
	BL	SP	BL	SP	BL	SP	BL	SP	BL	SP	BL	SP
K	OK	OK	OK	OK	OK	OK	B	B	OK	OK	B	OK
N	OK	OK	OK	OK	OK	OK	OK	OK	OK	B	B	OK
C	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK
D	OK	-	OK	-	-	OK	-	OK	-	-	-	-
X	OK	OK	OK	OK	OK	OK	B	B	OK	OK	OK	B
H	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	B	OK
P	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK



### Results 1st evaluation (3 months)

*Results with heating coil at 60°C*

Manufacturer	Vapour Test				40°C Immersion				60°C Immersion			
	PE		ME		PE		ME		PE		ME	
	BL	SP	BL	SP	BL	SP	BL	SP	BL	SP	BL	SP
K	OK	OK	OK	OK	OK	OK	B	B	OK	OK	B	OK
N	OK	OK	OK	OK	OK	OK	OK	OK	B	B	B	B
C	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	B	B
D	OK	-	OK	-	-	OK	-	OK	OK	OK	B	B
X	OK	OK	OK	OK	OK	OK	B	B	OK	OK	OK	B
H	OK	OK	OK	OK	OK	OK	OK	OK	B	OK	B	OK
P	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK



### Preliminary conclusions (3 months)


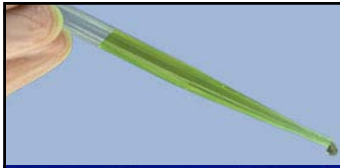
- Immersion at 40°C seems appropriate
- Vapour test at 60°C seems appropriate
- Immersion at 60°C seems too harsh
- Most blisters are observed in oil phase
- No rust visible (except in Vinyl system)
- Method of heating high effect on results

### Recommendations

Disadvantage of test methods:

- Use of H<sub>2</sub>S (Health and Safety issue)
- Flashpoint of DMA Mixture is ± 60-65 °C
- Heating method must be specified

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**Thank you for your attention!**

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2031 CV HAARLEM  
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F 023 - 527 72 29  
E [info@cot-nl.com](mailto:info@cot-nl.com)  
W [www.cot-nl.com](http://www.cot-nl.com)

Ing. M. Walrave, Managing Director  
*Wednesday October 7th 2009 JWG3 London*