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## REPORT

Testing ECOSPEED system  
according to NORSOK M-501, Rev. 5, System 7

Haarlem, August 19<sup>th</sup>, 2010

Civil projects  
Corrosionprotection  
Laboratory

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**Project number** : 20080843

**Reference** : LAB10-0737-REP

**Handled by** : Mr N. Blokker

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ANNEX: FT-IR spectra



## **1 INTRODUCTION**

### **1.1 Order**

By order of Mr. M. Hof of Hydrex NV / Subsea Industries NV in Antwerp, Belgium, the Centrum voor Onderzoek en Technisch advies (COT bv), The Netherlands, has tested Ecospeed according to Norsok M-501, Rev. 5, System 7.

The order has been confirmed by Hydrex NV / Subsea Industries NV in the e-mail of December 4<sup>th</sup> 2008, 10:16.

### **1.2 General information**

Samples : Coated test panels and wet paint

COT sample number : 19-03-09/0218 Ecospeed  
19-03-09/0219 Butanox  
19-03-09/0220 coated panels

Batch number and colour : VF 2870/5, RAL 3003

Test panels, size : 150 x 75 x 5 mm

Start of tests : 06-04-2009  
End of tests : 09-10-2009

## **2 PAINT APPLICATION AND CURING**

The coating system has been applied on Sa 2½ grit blasted steel test panels by Hydrex NV/Subsea Industries. The panels have been supplied by COT.

The dry film thickness of the coating system has been measured with a magnetic thickness gauge (Elcometer 456, COT no. E009), in accordance with ISO 2178 and COT instruction 30.01.12.



### **3 PERFORMANCE TESTS**

#### **3.1 Ageing test**

The fully cured coating system has been scribed horizontal down to the bare metal. The scratch line is 2 mm wide and 50 mm long. The coating system has been exposed to the following cycle according to ISO 20340 Annex A:

72 hours	UV-A 340 nm weatherometer in accordance with ISO 11507 Method A (4 hours UV-light at 60°C / 4 hours condensation at 50°C)
72 hours	Salt Spray Test according to ISO 9227 NSS
24 hours	Exposure to low temperature (-20°C)

The total exposure time has been 4200 hours.

#### **3.2 Seawater immersion**

The fully cured coating system has been scribed horizontal down to the bare metal. The scratch line is 2 mm wide and 50 mm long. The system has been immersed in synthetic seawater (according to ISO 15711) at 40°C during 4200 hours according to ISO 2812-2.

#### **3.3 Cathodic Disbonding**

Cathodic disbonding has been determined according to ISO 20340 (ISO 15711). After 4200 hours exposure time the maximum disbonding has been measured.

#### **3.4 Adhesion test**

The adhesion before and after the ageing test and the seawater immersion has been determined by a pneumatic adhesion tester in accordance with ISO 4624. The coating surface and the dolly have been sanded lightly and the epoxy adhesive has been applied. After curing of the adhesive and prior to testing, the coating and the adhesive have been scratched around the dolly down to the bare metal. Two trials on each panel have been carried out and the average has been reported.

#### **3.5 Overcoatable without mechanical treatment**

After 4200 hours ageing test the coating has to be coated with the same top layer without mechanical treatment. After 7 days the adhesion has to be determined according to ISO 4624.

#### **3.6 Fingerprint**

The fingerprint (binder content, pigment content, infrared spectra, non-volatile matter, density and ash content) has been determined according to ISO 20340 Annex B.

## 4 REQUIREMENTS

### 4.1 Ageing test

After exposure to the specified time, the test panels shall comply with the following requirements:

Method		Requirements
--	Corrosion creep from scribe*	≤ 8.0 millimetres
ISO 4628-2	Blistering	0(S0)
ISO 4628-3	Rusting	Ri 0
ISO 4628-4	Cracking	0(S0)
ISO 4628-5	Flaking	0(S0)
ISO 4624	Adhesion	minimum 5.0 MPa and maximum 50% reduction from original value
ISO 4624	Overcoatable without mechanical treatment	minimum 5.0 MPa

\*) The corrosion creep is calculated from the equation:  $M=(C-W)/2$ , where  
M = corrosion creep (mm)  
C = average of the nine measurements (mm)  
W = the original width of the scribe (mm)

### 4.2 Seawater immersion test

After exposure to the specified time, the test panels shall comply with the following requirements:

Method		Requirements
--	Corrosion creep from scribe*	≤ 8.0 millimetres
ISO 4628-2	Blistering	0(S0)
ISO 4628-3	Rusting	Ri 0
ISO 4628-4	Cracking	0(S0)
ISO 4628-5	Flaking	0(S0)
ISO 4624	Adhesion	min. 5.0 MPa
	Cohesion	max 50% reduction from original value with a minimum of 2 MPa

\*) The corrosion creep is calculated from the equation:  $M=(C-W)/2$ , where  
M = corrosion creep (mm)  
C = average of the nine measurements (mm)  
W = the original width of the scribe (mm)

### 4.3 Cathodic disbonding

After exposure to the specified time, the test panels shall not show disbonding around the holiday with an equivalent diameter < 20 mm.



## 5 RESULTS

### 5.1 Original adhesion value

Panel number : 1  
 Dry film thickness (µm) : 2450 ±175  
 Adhesion (MPa) ISO 4624 : Not possible, because the epoxy adhesive does not adhere to the system.

### 5.2 Ageing test

**Exposure time: 4200 hours**

Method	Panel 4	Panel 5	Panel 6
-- Dry film thickness (µm)	1740 ± 199	2310 ± 24	1490 ± 293
ISO 4628-2 Blistering	0 (S0)	0 (S0)	0 (S0)
ISO 4628-3 Rusting	Ri 0	Ri 0	Ri 0
ISO 4628-4 Cracking	0 (S0)	0 (S0)	0 (S0)
ISO 4628-5 Flaking	0 (S0)	0 (S0)	0 (S0)
-- Corrosion creep from scribe (mm)	6.0	7.7	7.6
ISO 4624 Adhesion (MPa)	Not possible	Not possible	Not possible
ISO 4624 Adhesion of overcoat (MPa) *	--	--	--

\* The overcoatability has not been determined.

### 5.3 Seawater immersion

**Exposure time: 4200 hours**

Method	Panel 10	Panel 11	Panel 12
-- Dry film thickness (µm)	1770 ± 183	2300 ± 148	2460 ± 115
ISO 4628-2 Blistering	0 (S0)	0 (S0)	0 (S0)
ISO 4628-3 Rusting	Ri 0	Ri 0	Ri 0
ISO 4628-4 Cracking	0 (S0)	0 (S0)	0 (S0)
ISO 4628-5 Flaking	0 (S0)	0 (S0)	0 (S0)
-- Corrosion creep from scribe (mm)	± 1.0	± 1.0	± 1.0
ISO 4624 Adhesion (MPa)	Not possible	Not possible	Not possible

### 5.4 Cathodic Disbonding

**Exposure time: 4200 hours**

	Panel 7	Panel 8	Panel 9
Dry film thickness (µm)	2100 ± 86	2440 ± 86	1650 ± 153
Equivalent diameter disbonding (mm)	0	0	0

## 5.5 Fingerprint

Main Parameter*	Ecospeed Red	Butanox
Binder content (by mass)	38±2 %	36±2 %
Pigment content (including extenders) (by mass)	28±2 %	0
Infrared spectra	Polyester	MEKP (peroxide)
Non-volatile by mass	67 %	36.2 %
Density	1.24 g/ml	--**
Ash	29 %	0

\*) The fingerprint analysis has been done according to ISO 20340 (2003), which requires more items than the 2009 version.

\*\*\*) Too less sample.

## 6 CONCLUSION

The Ecospeed system, COT sample number 19-03-09/0220, as delivered by Hydrex NV meets the requirements of Norsok M-501, Rev. 5, System 7.

The adhesion and overcoatability could not be determined.

CENTRUM VOOR ONDERZOEK  
EN TECHNISCH ADVIES (COT bv)



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Laboratory Technician

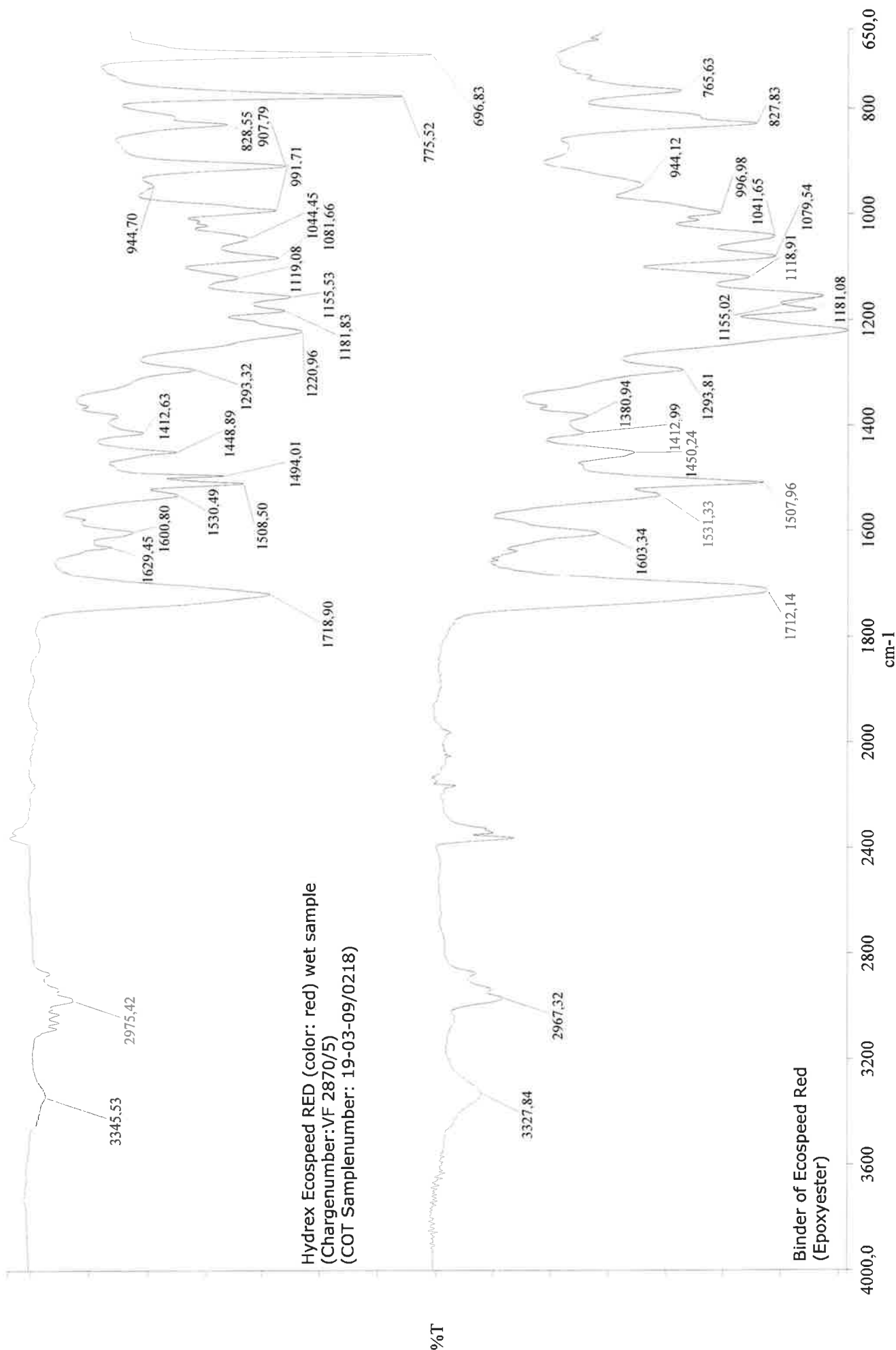


Dr. B.P. Alblas  
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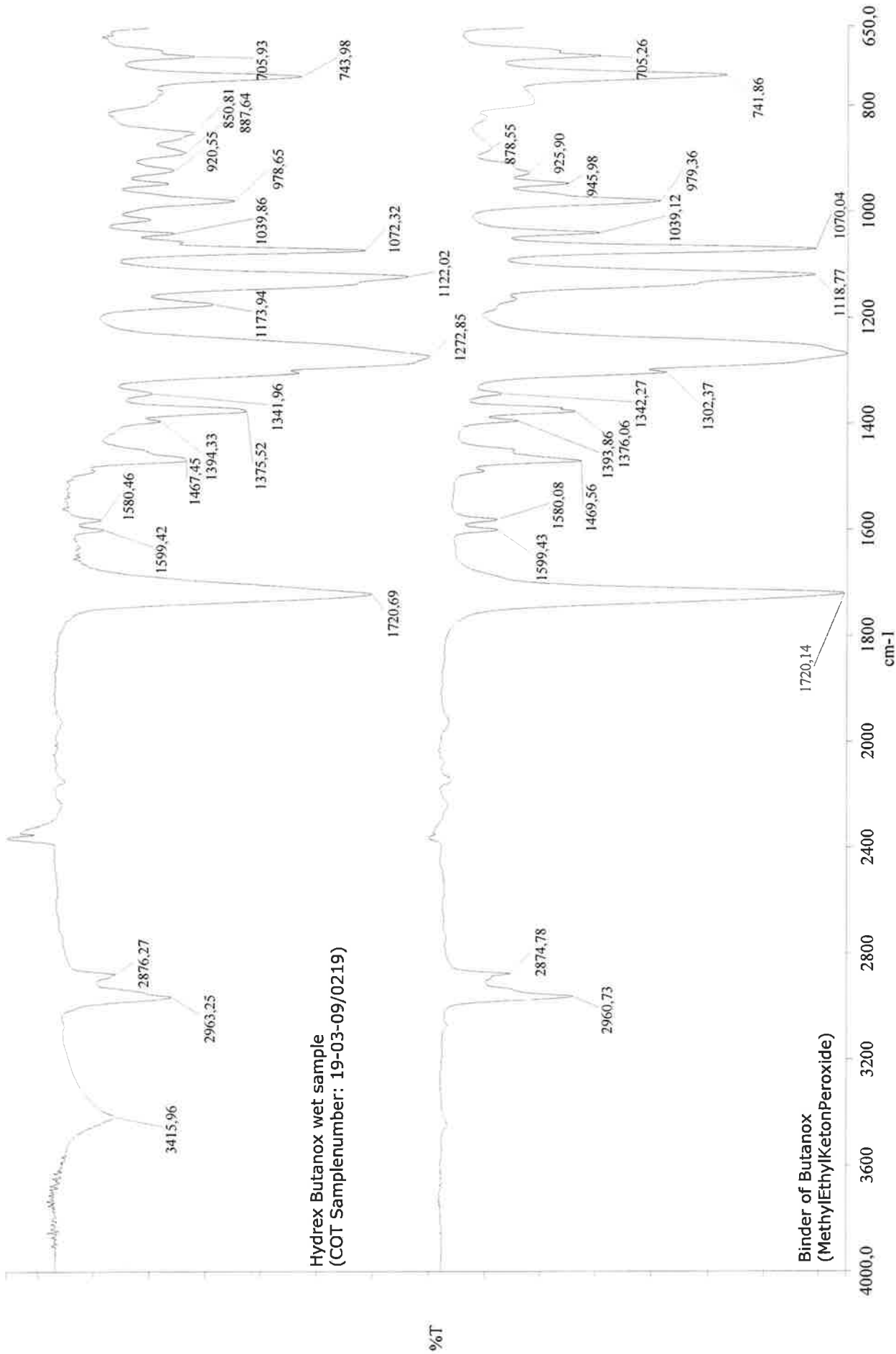
**ANNEX**

**FT-IR Spectra Ecospeed Red and Butanox**



n:\instrumenten\infrar\spectra\2009\09\_0218.sp - Ecospeed Red (color: red) wet sample

n:\instrumenten\infrar\spectra\2009\09\_0218\_1.sp - Binder of Ecospeed Red (color: red)



n:\instrumenten\infrat\spectra\2009\09\_0219.sp - Butanox (Wet sample)

n:\instrumenten\infrat\spectra\2009\09\_0219\_1.sp - Binder of Butanox