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Customer:	Afton Chemical GmbH		
Project:	Turbine Oil Approval Test		
Key:	Oelfreigaben		
Subject:	Evaluation of Turbine Oil Samples with the Product Names ENOC VORTEX GT-2 32 and ENOC VORTEX GT-2 46 to ALSTOM Specification HTGD 90117		
Keywords:	Approval Test, Turbine Oil, ENOC VOLTEX GT-2		
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1 Subject Data

Two turbine oil samples with the product names "ENOC VORTEX GT-2 32" and "ENOC VORTEX GT-2 46", should be tested with respect to their conformity with the ALSTOM specification HTGD 90117 – „Lubricating and Control Oils for Turbines – Specification and Supervision“. The turbine oils contain no EP/AW additives.

2 Designation of the Samples

Sample description: ENOC VORTEX GT-2 32

Lab. No. 12099A

Sample description: ENOC VORTEX GT-2 46

Lab. No. 12099B

3 Tests Performed, Results

See tables and IR-spectra enclosed.

4 Decisions

The FT-IR-spectra and RULER measurements show that the turbine oils "ENOC VORTEX GT-2 32", and "ENOC VORTEX GT-2 46" are based on mineral oil and contain aminic antioxidants. The determined oxidation stabilities according to ASTM D 2272 (RPVOT) and according to ISO 4263-1 (TOST) are good.

All measured test results of the turbine oils "ENOC VORTEX GT-2 32" and "ENOC VORTEX GT-2 46", meet the requirements of the ALSTOM specification HTGD 90117.

Therefore all turbine oils are recommended for inclusion in the table "ALSTOM tested lube and control oils" of the HTGD 90117.

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Power Plant Chemistry

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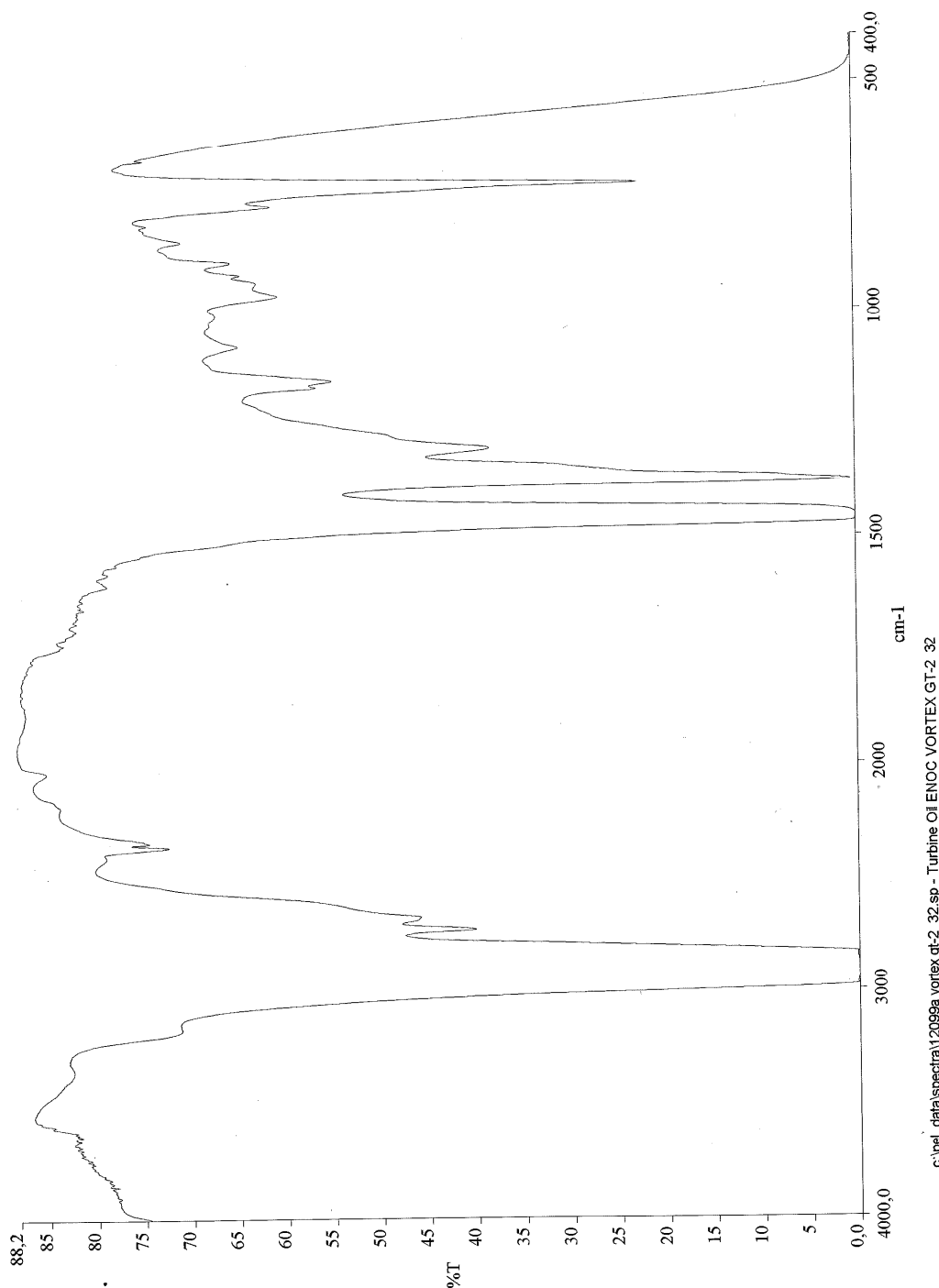


5 Analysis Results

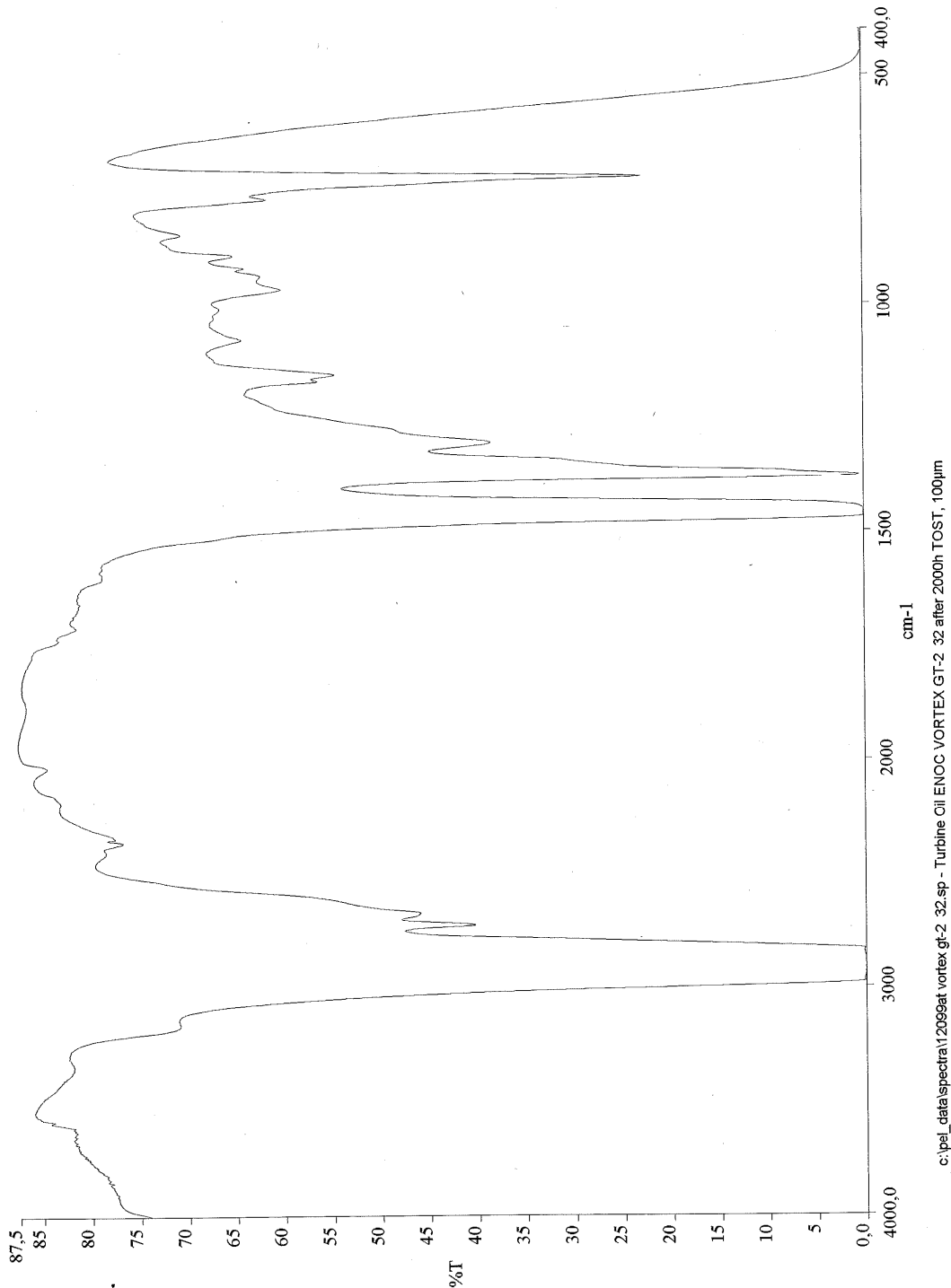
Turbine Oil ENOC VORTEX GT-2 32; Lab.No. 12099A

Property	Test method	Unit	Measured Value	Requirements
Appearance	visual		clear	-
ASTM-Color	ASTM D1500	-	L 0,5	-
Density at 15°C	EN ISO 12185	kg/m ³	854	≤ 880
Flashpoint (Cleveland- open cup)	ISO 2592	°C	216	≥ 200
Pourpoint	ISO 3016	°C	-18	≤ -9
Zinc content	AAS	mg/kg	< 1	< 5
Kin. Viscosity at 40°C	DIN 51562	mm ² /s	31,2	32 ± 10%
Viscosity Index	ISO 2909		117	> 90
Acid number	ISO 6618	mgKOH/g	0,11	≤ 0,2
Air release at 50°C	ISO 9120	Minutes	1,0	≤ 4
Demulsibility after steam treatment	DIN 51589-1	Seconds	87	< 300
Foaming characteristics Seq. I at 24°C	ISO 6247			
- Foam volume/ Foam volume after 5-min		ml/ml	20/0	< 300/0
Seq. II at 93,5°C				
- Foam volume/ Foam volume after 5-min		ml/ml	10/0	< 50/0
Seq. III at 24°C				
- Foam volume/ Foam volume after 5-min		ml/ml	50/0	< 300/0
Copper corrosion (100°C/3h)	DIN ISO 2160	-	1b	Max. 2
Rust preventing characteristics	DIN ISO 7120	-	pass	Pass B
IR-Spectrum	-		Mineral oil	Mineral oil
- Aromatics content	IEC 590	%	2,0	
Oxidation stability (TOST)	ISO 4263-1			
Acid number after 1000 hours		mgKOH/g	0,06	
Acid number after 2000 hours		mgKOH/g	0,04	Increase < 0,5
Additional tests after 2000 hours				
- Sludge		Mass %	0,016	-
- Remaining Inhibitor , aminic	RULER	%	36	-
- IR-aging band at 1710 cm ⁻¹ (d=0,1mm)			none	-
Oxidation stability (RPVOT)	ASTM D 2272	Minutes	1556	> 300
Filterability	ISO 13357-2			
- Stage I		%	94,7	min. 93
- Stage II		%	87,2	min. 85

FT-IR Spectra of ENOC VORTEX GT-2 32 , Lab. No. 12099A, as delivered.



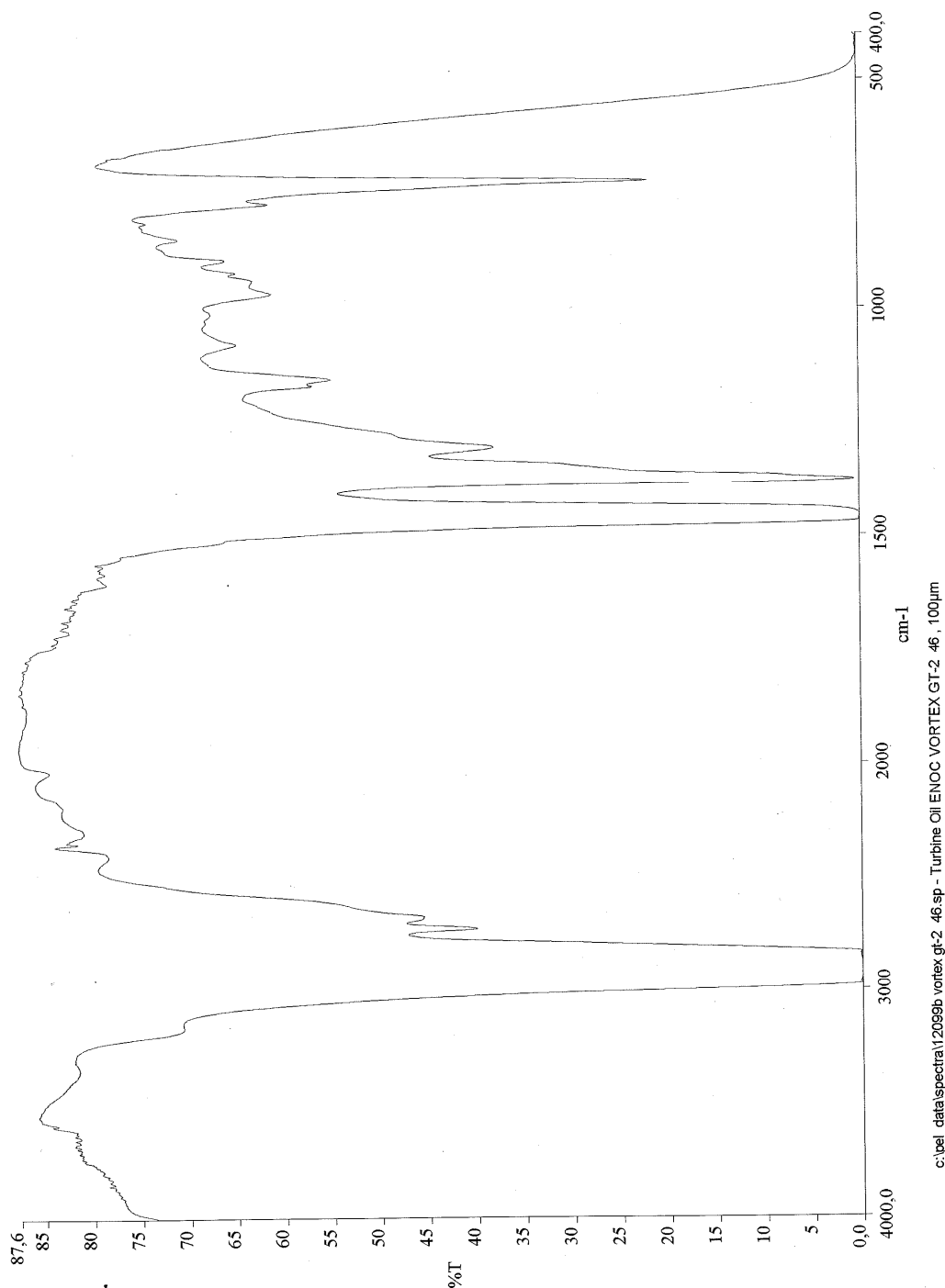
FT-IR Spectra of ENOC VORTEX GT-2 32 , Lab. No. 12099A, after 2000h of TOST.



Turbine Oil ENOC VORTEX GT-2 46; Lab.No. 12099B

Property	Test method	Unit	Measured Value	Requirements
Appearance	visual		clear	-
ASTM-Color	ASTM D1500	-	L 0,5	-
Density at 15°C	EN ISO 12185	kg/m³	857	≤ 880
Flashpoint (Cleveland- open cup)	ISO 2592	°C	237	≥ 200
Pourpoint	ISO 3016	°C	- 20	≤ -9
Zinc content	AAS	mg/kg	< 1	< 5
Kin. Viscosity at 40°C	DIN 51562	mm²/s	48,4	46 ± 10%
Viscosity Index	ISO 2909		116	> 90
Acid number	ISO 6618	mgKOH/g	0,10	≤ 0,2
Air release at 50°C	ISO 9120	Minutes	2,5	≤ 4
Demulsibility after steam treatment	DIN 51589-1	Seconds	89	< 300
Foaming characteristics Seq. I at 24°C - Foam volume/ Foam volume after 5-min	ISO 6247	ml/ml	0/0	< 300/0
Seq. II at 93,5°C - Foam volume/ Foam volume after 5-min		ml/ml	10/0	< 50/0
Seq. III at 24°C - Foam volume/ Foam volume after 5-min		ml/ml	0/0	< 300/0
Copper corrosion (100°C/3h)	DIN ISO 2160	-	1 b	Max. 2
Rust preventing characteristics	DIN ISO 7120	-	pass	Pass B
IR-Spectrum - Aromatics content	- IEC 590	%	Mineral oil 2,2	Mineral oil
Oxidation stability (TOST) Acid number after 1000 hours Acid number after 2000 hours Additional tests after 2000 hours - Sludge - Remaining Inhibitor , aminic - IR-aging band at 1710 cm ⁻¹ (d=0,1mm)	ISO 4263-1 RULER	mgKOH/g mgKOH/g Mass % %	0,06 0,04 0,016 36 none	Increase < 0,5 - - -
Oxidation stability (RPVOT)	ASTM D 2272	Minutes	1133	> 300
Filterability - Stage I - Stage II	ISO 13357-2	% %	96,5 93,3	min. 93 min. 85

FT-IR Spectra of ENOC VORTEX GT-2 46 , Lab. No. 12099B, as delivered.



FT-IR Spectra of ENOC VORTEX GT-2 46 , Lab. No. 12099B, after 2000h of TOST.

