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OILFIELD SERVICES

mbr

Rosscliffe Road · Ellesmere Port · Cheshire · England · Tel: (051) 355 4931 Telex 627250

STATOIL

PVT STUDY ON

A BOTTOM HOLE SAMPLE

FROM

WELL 34/10-4 DST 1A

STATOIL

PVT STUDY ON

A BOTTOM HOLE SAMPLE

FROM

WELL 34/10-4 DST 1A

SAMPLE CONTAINER NO. 73 FA 230-26

OILFIELD SERVICES

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Reservoir Fluids Division

FILE NO. OA/526-79

STATOIL,
Stavanger, Norway.

Gentlemen,

WELL 34/10-4 DST 1A

Analysis of the Bottom Hole Sample consigned to us has been carried out as per your telex of 20th November, 1979 and the results are contained in the following report.

After determination of the Ambient Bubble Point of the sample it was re-pressurized to single phase and part transferred to a PVT cell for the determination of pressure-volume relations at Reservoir Temperature.

This portion of the sample was then used for the differential liberation experiment. The viscosities of the equilibrium gases at each pressure stage are calculated figures using the method of Carr, Kobayashi, and Burrows in Trans AIME (1954) 201 264-272.

Further portions were used for the determination of liquid viscosity in a rolling ball viscometer at reservoir temperature, and for the single stage separation followed by distillation and compositional analysis.

We have determined the composition of the reservoir fluid and the distribution of hydrocarbon types in the distillate, but were unable to detail the composition of the distillation residue.

The distillation residue is being sent to you and the remainder of the sample will be held here at our Ellesmere Port Laboratory until we receive further instructions from you.

If you have any queries, or we can be of any further assistance, please do not hesitate to contact us.

Yours faithfully,

P. L. Thomas

JOB NO. OA/526-79
WELL NO. 34/10-4 DST 1A

SUMMARY

Saturation Pressure at Ambient Temperature	Bar Gauge	212.6
Saturation Pressure at 72.2°C	Bar Gauge	235.5

Thermal expansion of reservoir oil at 344.7 bar gauge :

From 15.5°C to 72.2°C % per °C	0.926
Vol. at 72.2°C/Vol.at 15.5°C	1.0525

Compressibility of Reservoir Oil at 72.2°C :

From Bar Gauge	To Bar Gauge	Vol./Vol./Bar x 10^6
344.7	327.5	114
327.5	310.3	119
310.3	293.0	125
293.0	275.8	133
275.8	258.6	142
258.6	246.8	152
246.8	235.5	163

Saturated oil at 235.5 bar gauge and 72.2°C :

Density kg/m^3	756.0
Viscosity Ns/m^2	0.0011784
Formation Volume Factor of Oil	1.2816

Gas liberated by single stage separation:

Vol. gas at 1.013 bar 15°C/Vol. residual oil	106.7

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WELL. 34/10-4 DST 1A

TABULAR DATA

Pressure Bar Gauge	Pressure-Volume Relations @ 72.2°C V/V Sat	Viscosity of Oil @ 72.2°C Ns/m^2	Differential Liberation at 72.2°C		
			Liberated Gas Vol. / Vol. Residual Oil	Solution Gas Volume / Vol. Residual Oil	Vol. Reservoir Oil / Vol. Residual Oil = Formation Volume Factor
344.7	0.9856	0.00171			1.2631
327.5	0.9875	0.00163			1.2656
310.3	0.9895	0.00154			1.2682
293.0	0.9917	0.00146			1.2710
275.8	0.9939	0.00137			1.2738
258.6	0.9964	0.00129			1.2770
241.3	0.9981	0.00121			1.2792
* 235.5	1.0000	0.00118	0	100.29	1.2816
234.4	1.0009	0.00118	-	-	-
227.7	1.0067	-	-	-	-
220.6	1.0134	-	-	-	-
206.8	1.0284	0.00124	13.74	86.55	1.2471
186.2	1.0573	0.00128	21.74	78.55	1.2297
165.5	1.0964	0.00134	29.85	70.44	1.2122
144.8	1.1510	0.00141	37.47	62.82	1.1962
124.1	1.2296	0.00149	45.72	54.57	1.1779
103.4	1.3476	0.00159	53.96	46.33	1.1617
82.7	1.5370	0.00170	62.17	38.12	1.1452
62.1	-	0.00188	70.47	29.82	1.1303
41.4	-	0.00212	78.87	21.42	1.1132
20.7	-	0.00262	-	-	-
6.8	-	-	94.50	5.79	1.0730
0	-	0.00354	100.29	0	1.0437

* Saturation Pressure

Density of Residual Oil at 15°C 881.4 kg/m^3

V Sat = Volume of Reservoir Oil at 235.5 Bar Gauge and 72.2°C.

V = Volume at any other pressure.

Gas and Residual Oil Volumes are at 1.013 Bar and 15°C.

INDEPENDENT ANALYSIS

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Job No. OA 526-79

Well 34/10-4 DST

TABULAR DATA II

P.V. "Y" FUNCTION :-		DIFFERENTIAL LIBERATION GAS :-		
PRESSURE BAR GAUGE	"Y" = $\frac{(P_{SAT} - P)}{(P)(V/V_{SAT} - 1.000)}$	COMPRESSIBILITY FACTOR "Z" = $\frac{PV}{NRT}$	Bg	SPECIFIC GRAVITY LIBERATED GAS (AIR = 1.000)
235.5	Saturation Pressure			
206.8	4.841	0.8690	193.9	0.7025
186.2	4.600	0.8680	174.4	0.6932
165.5	4.358	0.8676	155.3	0.6848
144.8	4.118	0.8677	135.3	0.6777
124.1	3.876	0.8686	116.1	0.6732
103.4	3.636	0.8706	96.3	0.6717
82.7	3.395	0.8738	77.1	0.6725
62.1	-	0.8796	58.0	0.6775
41.4	-	0.8903	38.5	0.6898
6.8	-	-	-	0.7642
0	-	-	-	0.9603

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TABULAR DATA III

CALCULATED VISCOSITY OF GASES AT 72.2°C FROM DIFFERENTIAL LIBERATION

PRESSURE Bar Gauge	VISCOSITY $Ns/m^3 \times 10^{-5}$
206.8	2.09
186.2	1.93
165.5	1.80
144.8	1.67
121.1	1.55
103.4	1.47
82.7	1.38
62.1	1.32
41.4	1.28
6.8	1.16
0	1.08

INDEPENDENT ANALYSIS

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Job No. OA 526-79

Well 34/10-4 DST 1A

DENSITY OF OIL AT 72.2°C AS A FUNCTION OF PRESSURE

PRESSURE BAR GAUGE	DENSITY kg/m^3
344.7	767.1
327.5	765.5
310.3	764.0
293.0	762.3
275.8	760.6
258.6	758.7
241.3	757.4
* 235.5	756.0
206.8	767.4
186.2	772.8
165.5	778.3
144.8	783.4
124.1	789.8
103.4	795.0
82.7	800.5
62.1	805.0
41.4	811.0
20.7	827.8
0	844.5

* Saturation Pressure

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WELL No. 34/10 -4 DST 1A

SEPARATOR TESTS

Separator Pressure Bar Gauge	Gas/Oil Ratios See Footnote (A)		Stock Tank Gravity °API at 60°F	Shrinkage Factor Vsto/Vsat See Footnote (B)	Vsat/Vsto See Footnote (B)	Specific Gravity of Flashed Gas See Footnote (C)	Separator Temp °C
	1st Stage	Total					
0	-	106.67	28.59	0.7735	1.293	0.658	15

NOTES :

(A) Gas/Oil ratio in volumes of gas at 1.013 bar and 15°C relative to volume of Stock Tank Oil at atmospheric pressure and 15°C.

(B) Vsto is the volume of Stock Tank Oil at 15°C and atmospheric pressure produced by one volume of reservoir oil, Vsat, at saturation pressure and reservoir temperature.

(C) Specific gravity of gas relative to air 15°C/15°C

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COMPOSITIONAL ANALYSIS OF RESERVOIR FLUID

COMPONENT			% MOLE	
Nitrogen			1.54	
Carbon Dioxide			0.58	
Hydrogen Sulphide			0.00	
Methane			50.28	
Ethane			3.64	
Propane			1.35	
Iso-Butane			0.59	
N-Butane			0.77	
Iso-Pentane			0.61	
N-Pentane			0.30	
Hexanes			0.87	
Heptanes	0.688	100.198	3.55	39.47
Octanes	0.707	114.224	3.40	
Nonanes	0.722	128.250	3.60	
Decanes	0.734	142.276	3.30	
Undecanes Plus	0.903	372	25.62	

Density of undecanes plus = 903.0 kg/m^3 at 15°C

Average molecular weight of undecanes plus = 372

Asphaltenes = 0.13% by weight

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WELL NO. 34/10-4 DST 1A

COMPOSITIONAL ANALYSIS OF DISTILLATE

CARBON NUMBER	HYDROCARBON TYPE % WEIGHT		
	AROMATICS	NAPHTHENES	PARAFFINS
C3	-	-	0.04
C4	-	-	0.36
C5	-	0.31	1.60
C6	0.32	4.35	3.02
C7	2.99	8.20	4.09
C8	5.37	9.48	4.79
C9	13.61	9.64	5.37
C10	12.12	9.02	5.32
	34.41	41.00	24.59

WELL NO. 34/10-4 DST 1A

FILE NO. OA/526-79

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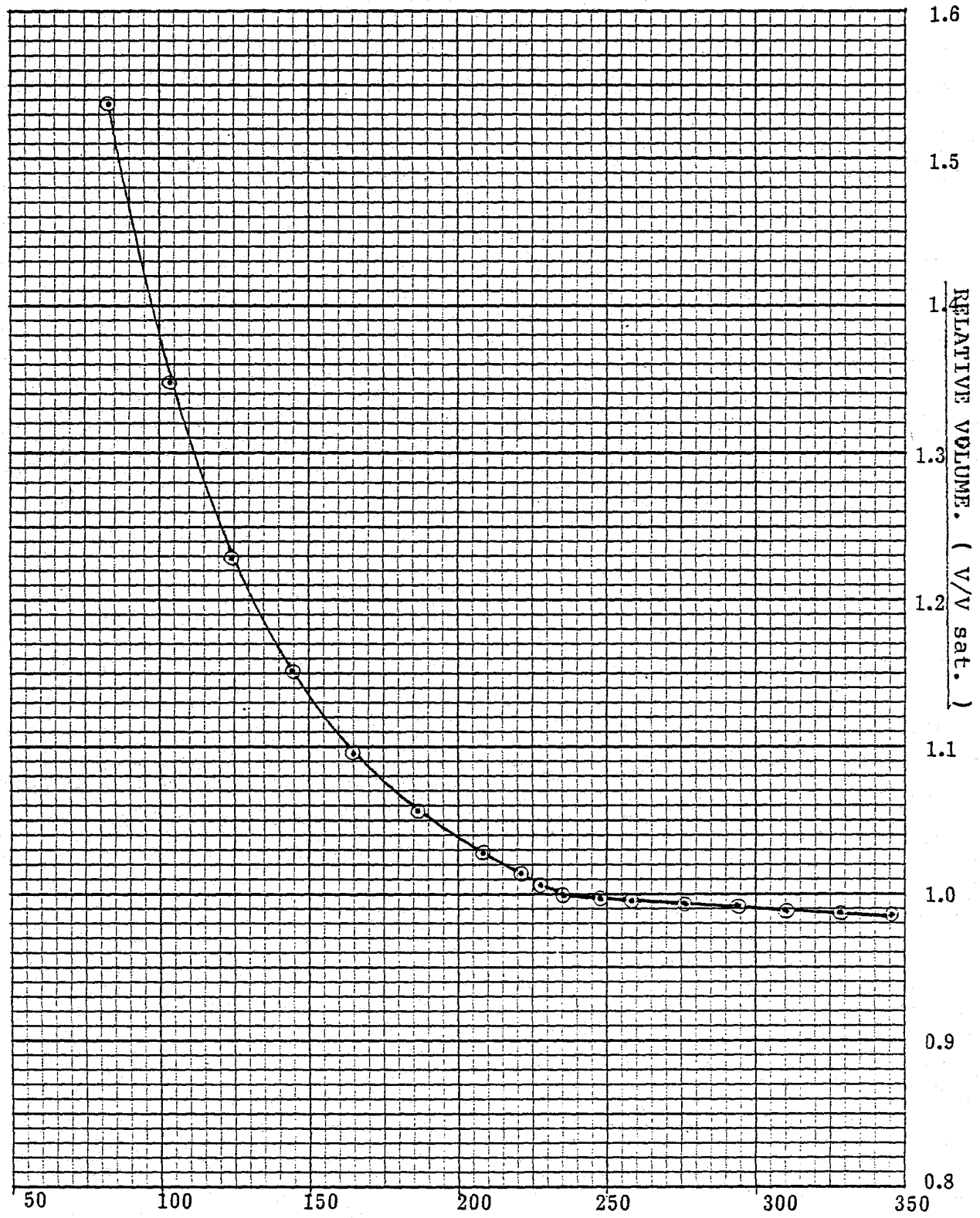
RELATIVE VOLUMES DURING PRESSURE VOLUME RELATIONS AT 72.2°C



WELL NO. 34/10-4 DST 1A

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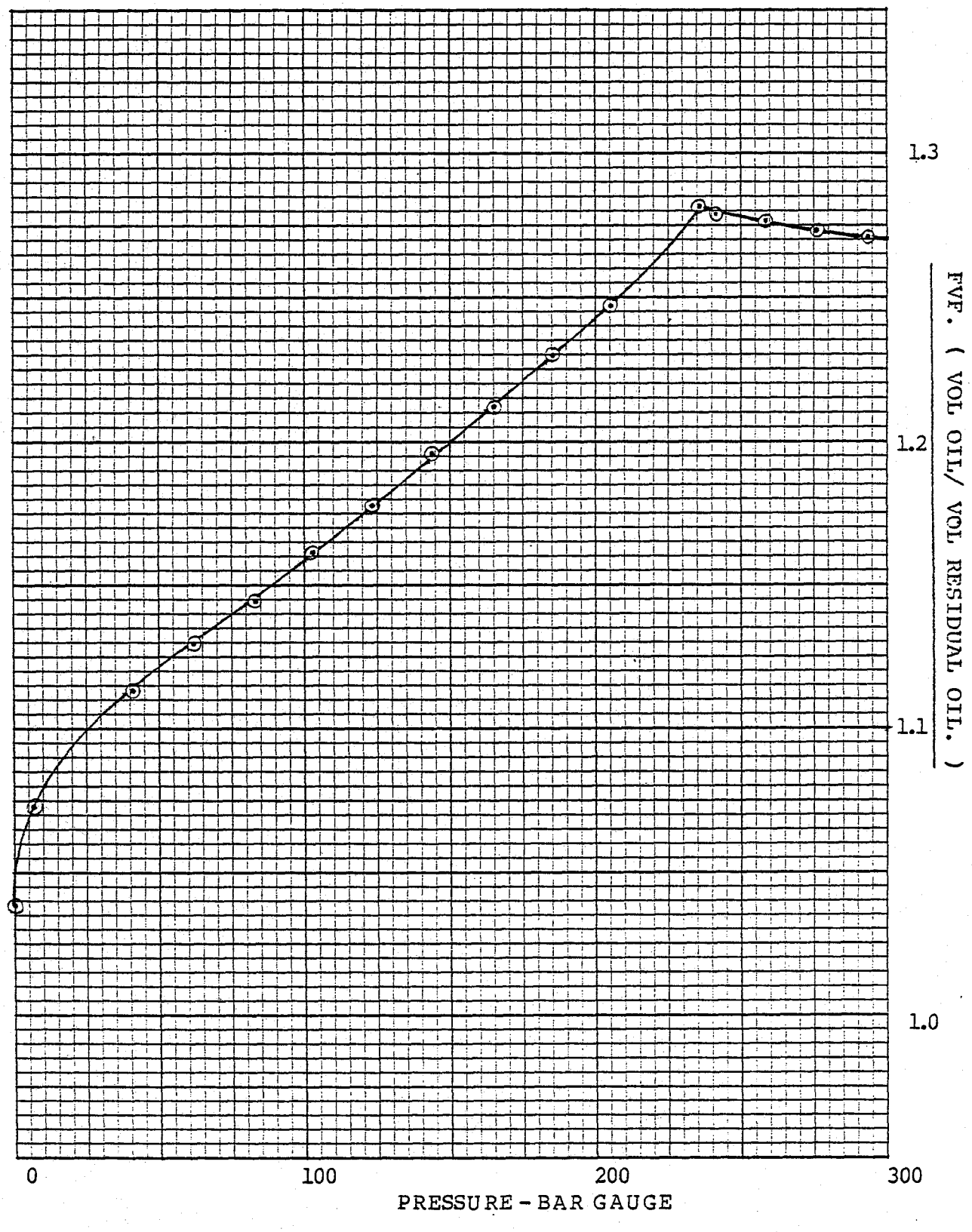
Reservoir Fluids Division

FORMATION VOLUME FACTOR DURING DIFFERENTIAL LIBERATION AT 72.2°C



WELL NO. 34/10-4 DST 1A

FILE NO. OA/526-79

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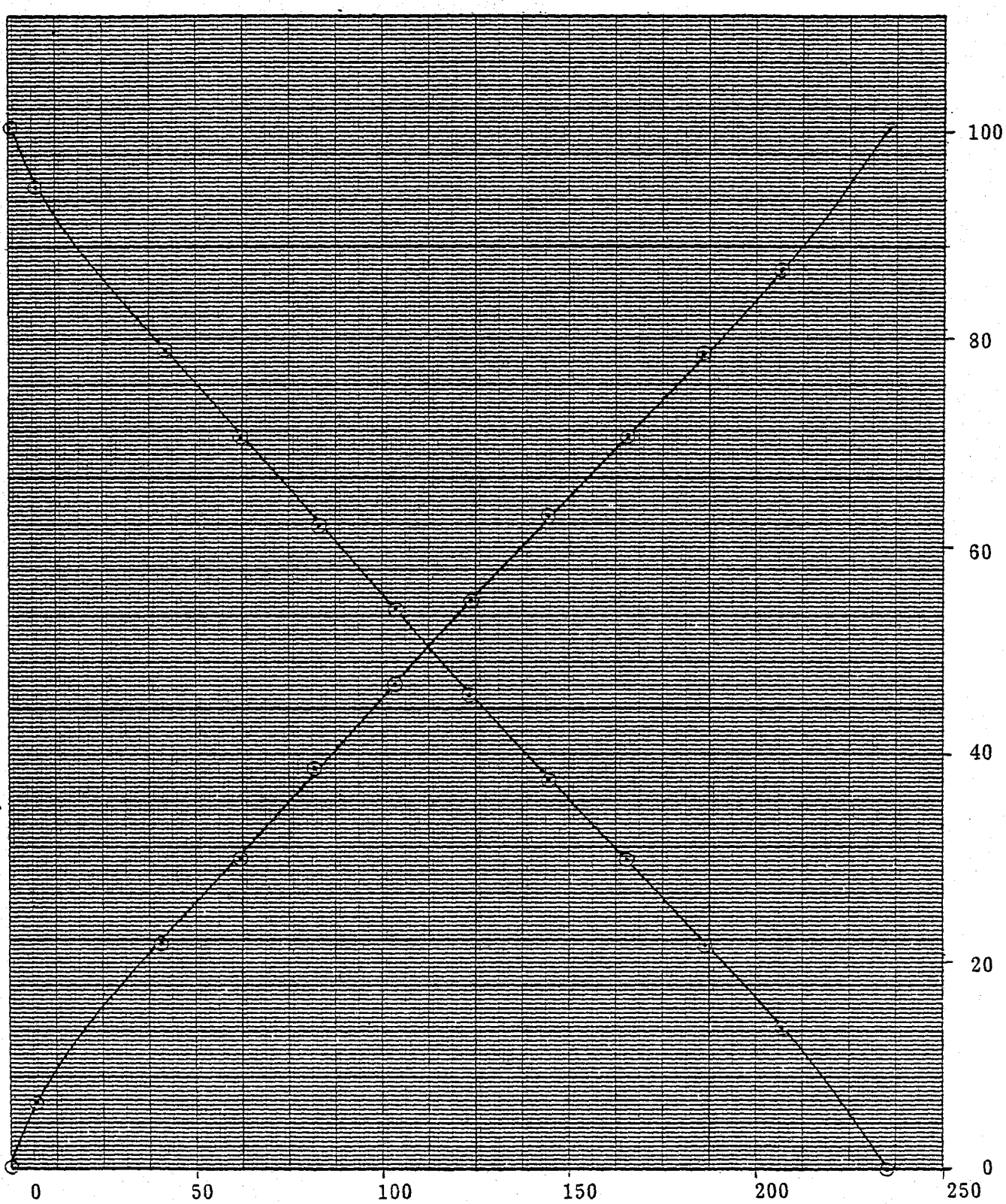
Reservoir Fluids Division

LIBERATED GAS & SOLUTION GAS DURING DIFFERENTIAL LIBERATION @ 72.2°C



WELL NO. 34/10-4 DST 1A

FILE NO. OA/526-79

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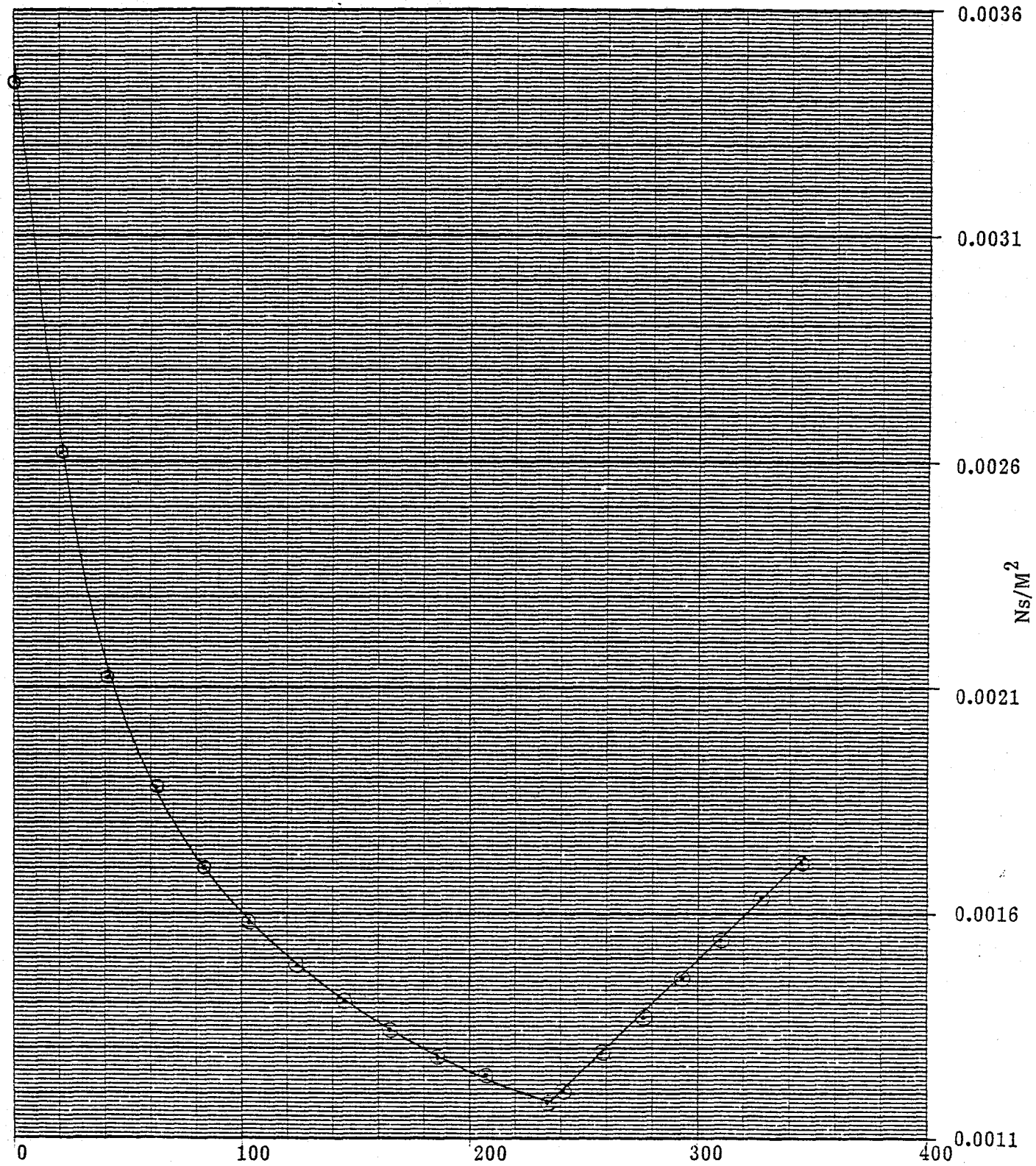
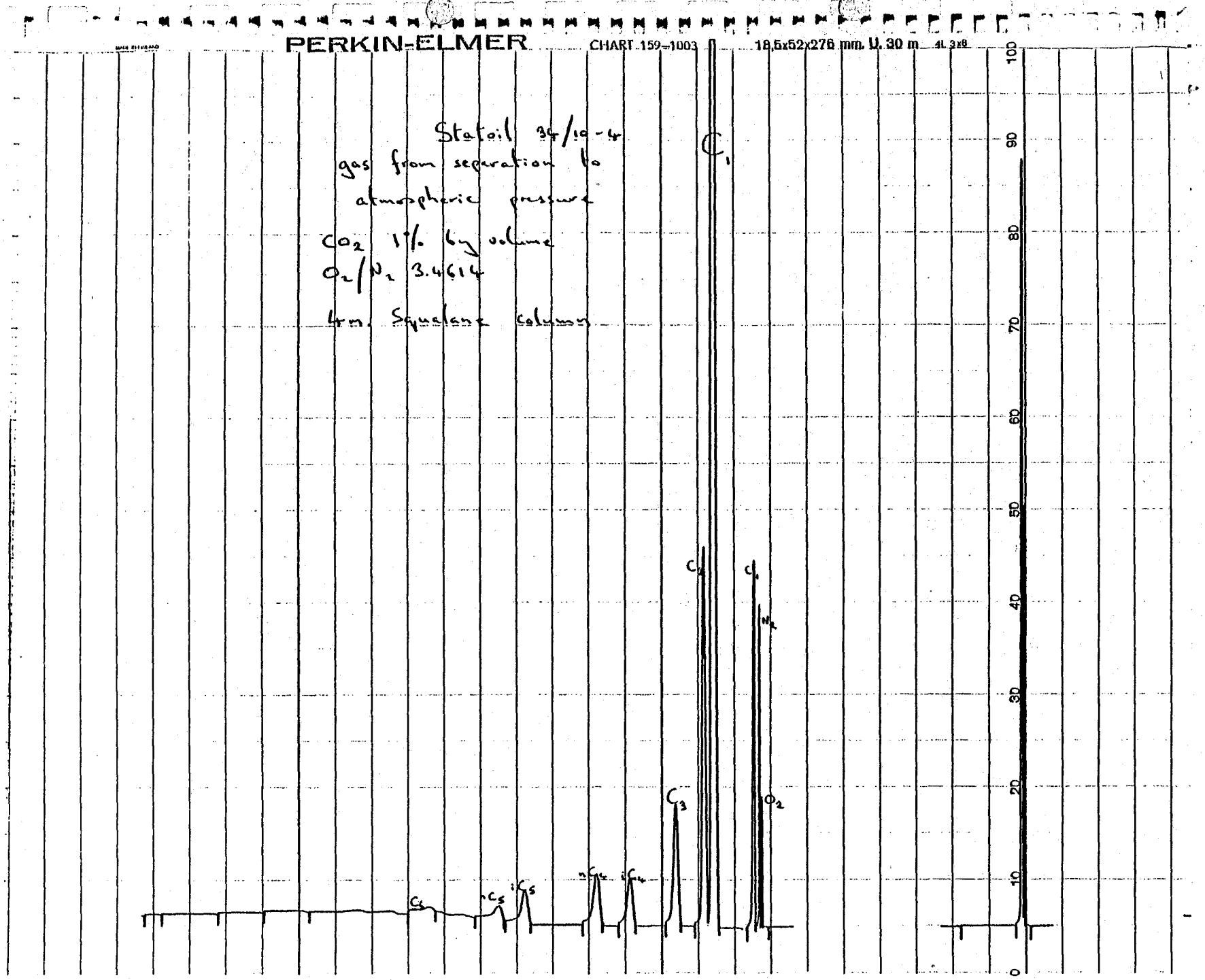
VISCOSITY OF OIL DURING DIFFERENTIAL LIBERATION @ 72.2°C




PERKIN-ELMER
CHART 159-1003
18,5x52x276 mm. U. 30 m
Statoil 34/10-4
gas from separation to
atmospheric pressure
CO_2 1% by volume
O_2/N_2 3.4614
4m. Squalane column
C_1
C_2
C_3
N_2
O_2
C_4
C_5
100
90
80
70
60
50
40
30
20
10
0

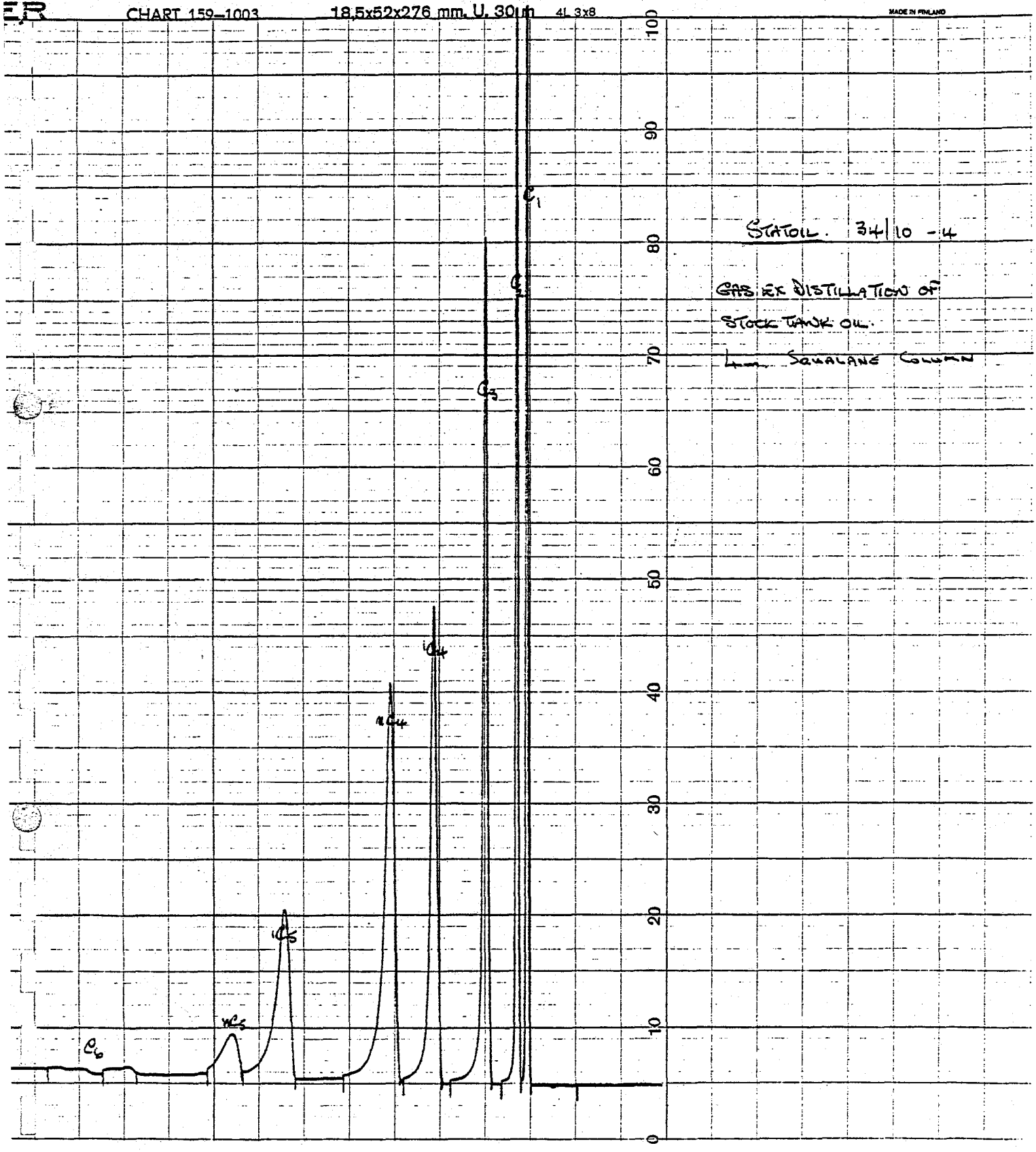
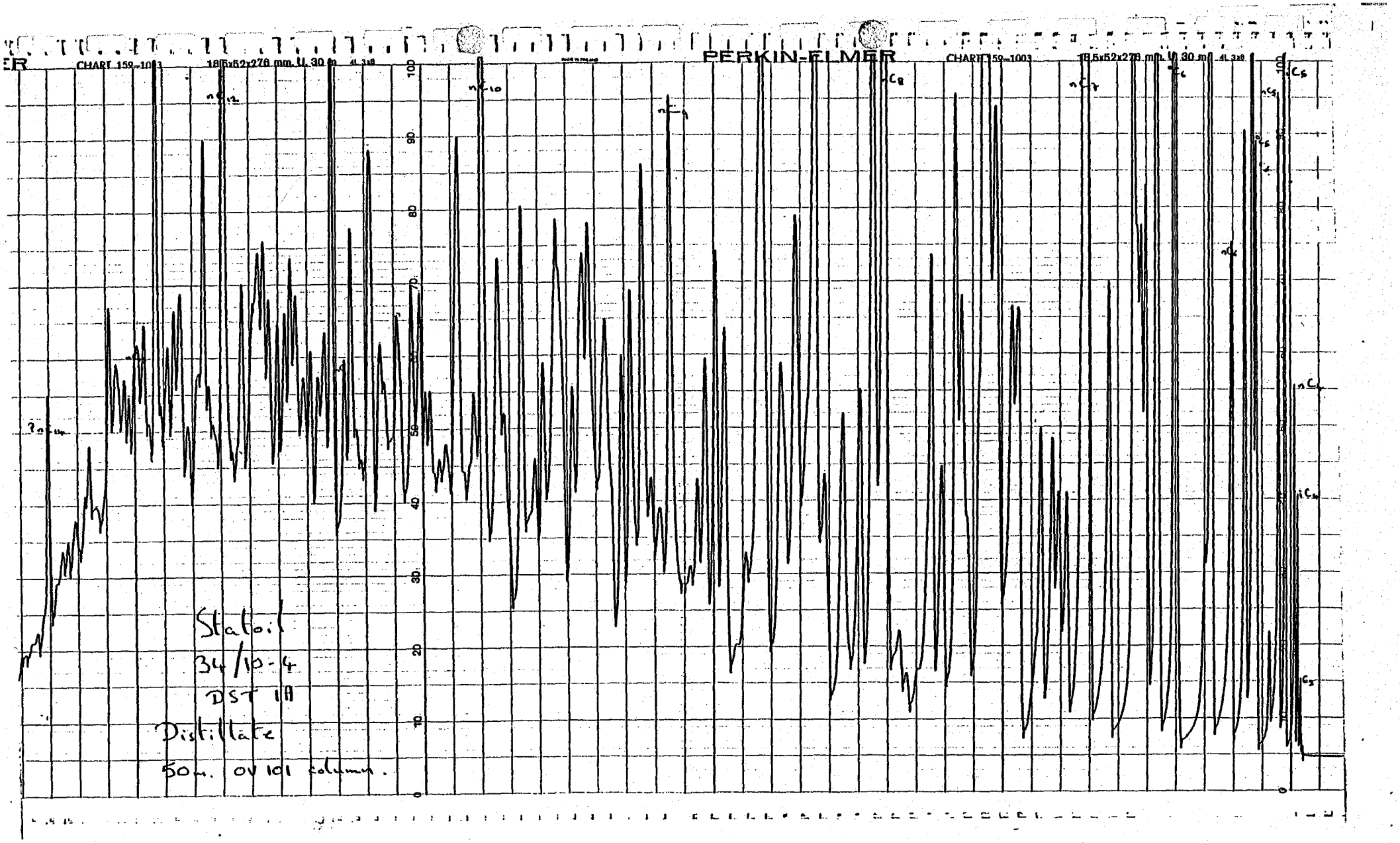


CHART 159-1003
18,5x52x276 mm. U. 30 µm
4L 3x8
MADE IN FINLAND
STATOIL. 34/10 -4
GAS EX DISTILLATION OF
STOCK TANK OIL.
SQUALANE COLUMN
C1
C2
C3
iC4
nC4
iC5
nC5
C6
100
90
80
70
60
50
40
30
20
10
0


PERKIN-ELMER
CHART 159-1003
18.5x52x278 mm U 30 m 4L 3x8
Statoil
34/10-4
DST 1A
Distillate
50m. ov 101 column.