PL 044

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RESERVOAR-ARKIV

RESERVOIR FLUID STUDY

FOR

STATOIL

WELL 1/9 - 3

DST NO. 4

RECOMBINED SAMPLE

Den norske stats oljeselskap a.s

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PT/EAA

5.4.79

RESERVOIR STUDY 1/9-3

Gentlemen

This report presents the results of a reservoir fluid studie on recombined sample from 1/9-3 production test no. 4.

Several problem arose with the samples choosen for analysis. Two oil bottles from flow 4 was found leaking and could not be used. (See appendix one). The separator oil bottle finally used for recombination was marked 14068-64 sampled on 19/09/78. This was recombined with gas marked A3358 sampled 21/09/78. Compositional analysis of gas produced on these two date did not differ significantly.

The separator oil was flashed to stock tank conditions and chromatographic analysis were run on the products. This together with analysis of the separator gas was used to calculate the reservoir fluid composition (well stream) table 1,2.

Physical recombination to a produced GOR of 6790 SCF/BBL sep. oil at sep. cond. was then made in our gas condensate cell and a dew pt. of 355 BAR (5149 psig) at 121.11°C (250°F) observed.

In view of the uncertainty of measuring GOR's on the rig it was decided to reduce GOR to 6000 SCF/BBL sep. oil with the hopes of increasing the dew point. The dew point was determined at 344 BAR (4990 psig). It was on the basis ot these results agreed with Phillips to go back to the first GOR and preform a full analysis on this sample. Looking at the draw-down on the formation in this flow period it is indicative that the sample we had was representative of the well bore fluid.

The gas and separator liquid was yet again recombined to a GOR of 6790 SCF/Sep. bbl and dew point observed at 355 BAR (5149 psig).

Liquid dropout was measured during the constant mass P-V study, reported in table 4.

Further, liquid dropout was measured during constant volume depletion and chromatographic analysis of produced gas in same experiment. These are reported in table 5 and 6.

Fig. 1 shows a graphical presentation of the two liquid drop out curves and fig. 2 shows a graphical presentation of the gas composition in the constant volume depletion.

Statoil production laboratory
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Per R Thomassen

Group leader PVT/chemistry

Table 1. Reservoir and Sample Data

Well and formation Data

Producing zone	Danian, Ekofisk
PERF interval	3094 - 3112 m
Initial static pressure	7000 psig
Reservoir temperature	250°F, 121,11°C
Last static pressure	
Date	21/9-78
Well head pressure and temp.	1558 psi, 156°F
Flowing bottom hole pressure	5300 psig
Tubing size	3½"

Sample Data

Date sampled	21/9-78
Type of sample(s)	Separator
Separator pressure	540 psig
Separator temperature	117°F
Average flow rates during sampling	
First stage separator gas	22,86 MMcf/D
Other separator gases	-
Separator oil	3366 B/D
Water	-

Remarks

Samples used for the recombination were marked

Gas: A-3358

Oil: 14068-64

Table 2. Hydrocarbon Analysis of Separator Products and calculated Wellstream Composition (Test Separator).

Component	Separator liquid mole %	Separator gas Mole %	Wellstream Mole %
Carbondioxide	0.82	3.10	2.86
Nitrogen	0.05	0.17	0.15
Methane	12.38	80.28	73.04
Ethane	6.07	10.03	9.61
Propane	6.15	3.94	4.18
iso-Butane	1.96	0.68	0.82
n-Butane	5.23	1.09	1.53
iso-Pentane	2.86	0.25	0.53
n-Pentane	4.13	0.27	0.68
Hexanes	10.52	0.19	1.23
Heptanes plus	49.83	trace	5.37
	100.00	100.00	100.00

Properties of Heptane plus

Density at 15°C : 0.7914 g/cc
Molecular weight: 175

Calculated separator gas gravity (air = 1.0000): 0.7136
Primary separator conditions: 555 psia, 117°F

Recombination ratio:

Primary separator gas/primary separator liquid: 6790 SCF/BBL at 117°F

Table 3: Hydrocarbon Analysis of Separator Products from flash of Separator Oil

Component	Separator liquid Wt %	Separator liquid mole %	Separator gas mole %	Recombined Separator fluid mole %
Carbondioxide	-	-	2.73	0.82
Nitrogen	-	-	0.17	0.05
Methane	-	-	41.26	12.38
Ethane	0.02	0.11	19.96	6.07
Propane	0.46	1.53	16.92	6.15
iso-Butane	0.41	1.03	4.14	1.96
n-Butane	1.55	3.89	8.35	5.23
iso-Pentane	1.56	3.16	2.15	2.86
n-Pentane	2.42	4.91	2.32	4.13
Hexanes	8.27	14.26	1.79	10.52
Heptanes plus	85.31	71.10	0.21	49.83
	100.00	100.00	100.00	100.00

Properties of Heptane plus.

Density at 15°C : 0.7914 /cc
Molecular weight: 175

Properties of Stock Tank Liquid and result from Single Flash:

Density at 15°C : 0.7671 g/cc
mean mol. weight : 146
GOR of sep. oil : 53.3 m^3/m^3 (standard m^3 at 15°C/m^3) (299 SCF/BBL)
Shrinkage of sep. oil: 1.232 m^3/m^3*

* m^3 of oil at separator conditions/m^3 of oil at stock tank conditions.

Table 4. Constant Composition Expansion at 121.11°C.

Pressure (Bar)	Relative vol (v/v sat)	Liquid dropout (% of Dp. vol)	Z Factor
490.7	0.8634		1.249
461.0	0.8806		1.198
448.0	0.8963		1.184
430.0	0.9119		1.158
411.0	0.9317		1.131
389.0	0.0547		1.097
367.0	0.9833		1.066
355.0 Dew pt.	1.0000	0	1.049
342.0	1.0171	0.68	
325.0	1.0517	2.6	
309.0	1.0800	4.1	
293.0	1.1218	6.4	
276.0	1.1753	8.9	
262.0	1.2192	10.4	
226.0	1.3765	14.3	
204.3	1.5987	15.4	
180.4	1.7795	15.7	
144.6	2.1881	16.1	
117.2	2.7102	16.0	
89.8	3.5702	15.5	

Gas Formation volume factor at dew pt. pressure: 244.4 m^3/m^3 (1.372 MSCF/BBl reservoir fluid)

Table 5. Retrograde liquid drop out during constant volume depletion at 121.11°C

Pressure (Bar)		Liquid volume % Hydrocarbon pore space
355.0	Dew point	0
324.0		2.34
294.0		6.46
285.4	first depletion level	8.73
211.2		13.4
173.3		14.1
130.0		13.8
74.0		12.7
26.5		10.7

Table 6: Constant Volume Depletion Study at 121.1°C.

Hydrocarbon Analysis of Produced Well Stream-Mol Percent.

	Reservoir Pressure Bar							
Component	482*	355**	285.4	211	173	130	74	26.5
Carbon Dioxide	2.86	2.86	2.91	3.05	2.86	3.02	***	2.86
Nitrogen	0.15	0.15	0.29	0.23	0.29	0.24		0.20
Methane	73.04	73.04	74.05	75.55	76.99	77.05		73.86
Ethane	9.61	9.61	9.56	9.86	9.18	9.76		9.50
Propane	4.18	4.18	3.97	3.43	3.54	3.73		4.32
iso-Butane	0.82	0.82	0.71	0.63	0.63	0.67		0.96
n-Butane	1.53	1.53	1.35	1.28	1.29	1.32		1.79
iso-Pentane	0.53	0.53	0.51	0.41	0.40	0.41		0.65
n-Pentane	0.68	0.68	0.63	0.54	0.57	0.55		0.86
Hexanes	1.23	1.23	1.20	1.10	1.00	0.93		1.45
Heptanes plus	5.37	5.37	4.81	3.92	3.25	2.32		3.55
	100.00	100.00	100.00	100.00	100.00	100.00		100.00
Molecular weight of heptanes plus	175	175	147	129	121	120		114
Specific gravity of heptanes plus	0.7914	0.7914	0.7286	0.7060	0.6956	0.6941		0.6884
Deviation Factor - Z								
Equilibrium gas	1.049	1.049	0.980	0.960	***	***		***
Two-phase	-	-	0.876	***				
Well Stream produced -	0	0	13.4	18.3	13.2	12.0	16.2	15.7
Cumulative percent of initial	0	0	13.4	31.7	44.9	56.9	73.1	88.8

* Reservoir pressure. ** Dew point pressure. *** No experimental values available.

STATOIL PRODUCTION LABORATORY

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Reservoir fluid analysis
Statoil well 1/9-3 DST no. 4
Recombined sample

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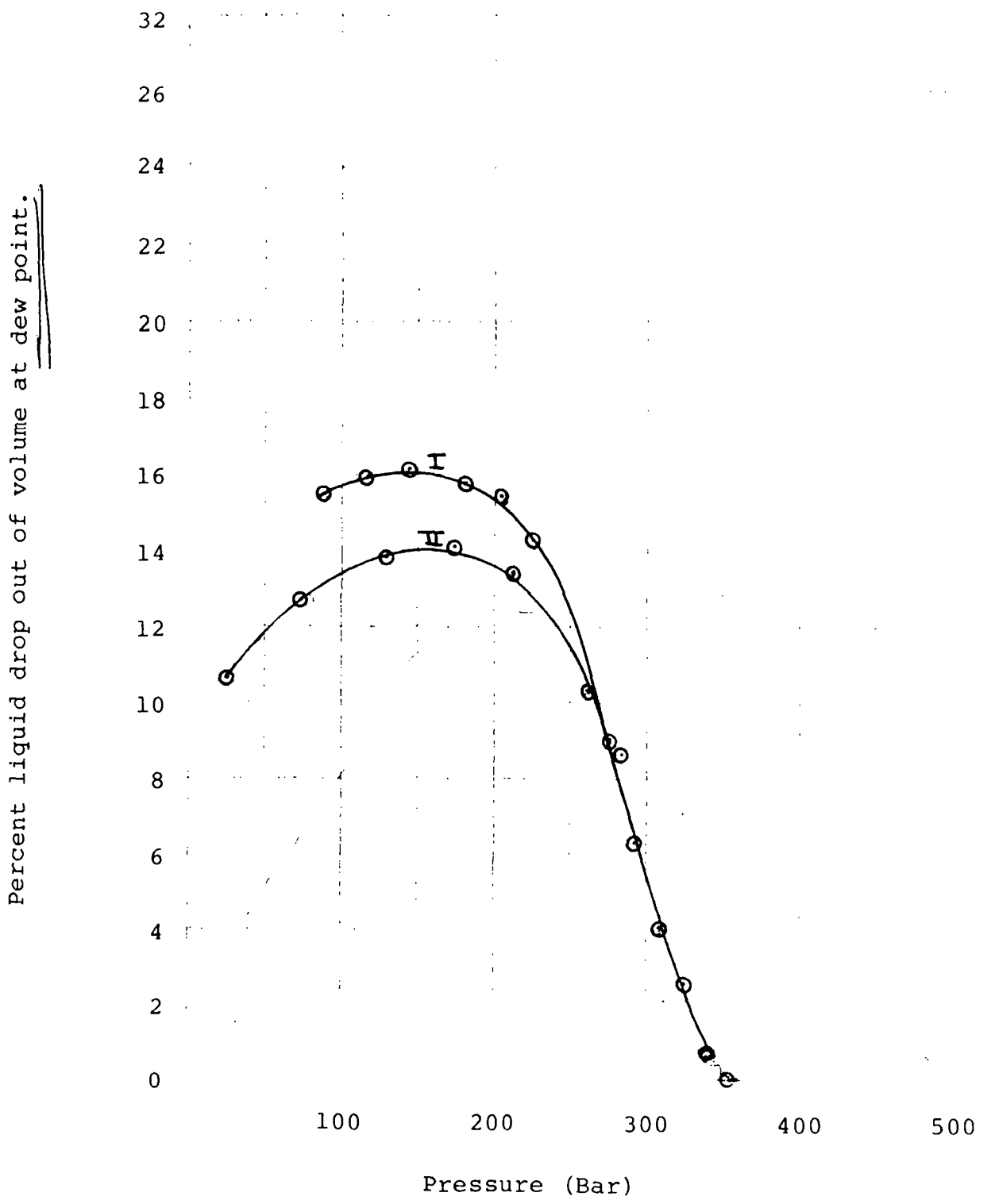
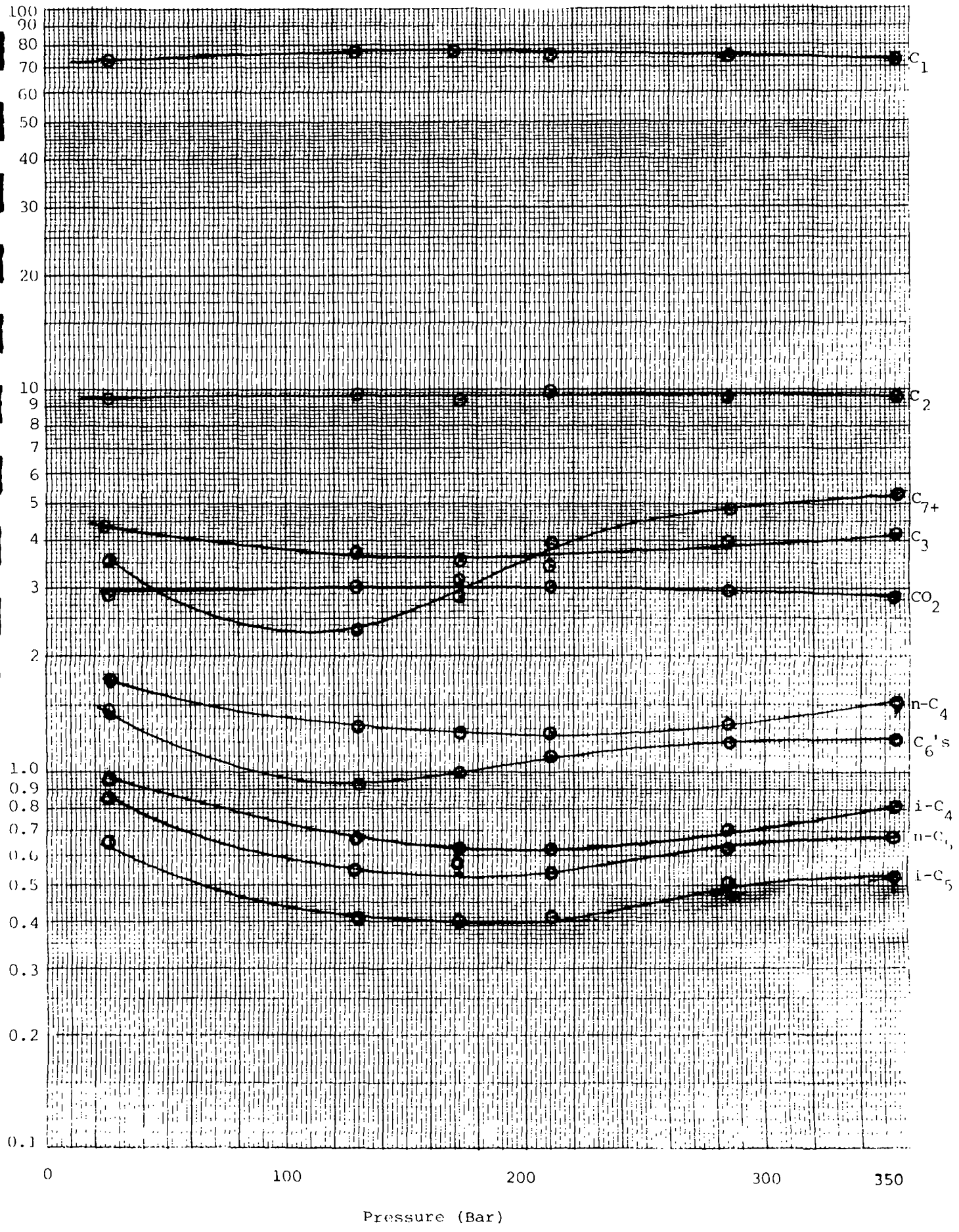
Fig. 1: Liquid drop out during const. comp. expansion I and constant volume depletion II at 121.11°C.



Reservoir fluid analysis, well 1/9-3 DST no. 4.

Fig. 2: Composition of produced well stream vs. pressure.



APPENDIX 1

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N O T A T

TIL: TL
KNe

FRA: PVT Lab/PT

SAK: PVT ANALYSER 1/9-3, SEPARATOR OLJE FLASKER

Under evalueringen av separatorolje-prøvenes verdi, ble det avdekket to forhold med flaskenes tilstand som bør påpekes overfor Flopetrol.

Flaske Nr. 13266/128 ble hentet fra basen for å brukes til rekombinering med gass fra A-3358. Da beskyttelses-hetten på flasken ble skrudd av var det tydelig olje-lekkasje. Det viste seg å stamme fra en kran som ikke var tilstrekkelig tilskrudd.

Flaske Nr. 20438.36 ble da hentet for samme formål. Denne ble tilkoblet systemet og åpningstrykket målt til 22 BAR. For å kunne gå videre med analysen var det nødvendig å få separatorolje-systemet over i enfase. Ved trykk på ca. 250 BAR begynte koblingen mellom ventilene og flaska å lekke. Dette er en 1/8" NPT kobling (se vedlegg). Denne ble forsøkt tilstrammet, men prøven var ikke til å redde.

Disse to tilfellene kan tilskrives unøyaktighet av Flopetrol. I siste tilfellet er det mye som tyder på at flasken ikke var skikkelig vedlikeholdt.

Det er ønskelig at man for framtiden får skikkelig informasjon om flaskens tilstand før den blir leiet fra Flopetrol (trykktest osv.).

Per Thomassen