

5.4 Testing

One drill stem test was performed in the oilbearing section of the Statfjord Formation.

The test interval was

2547 - 2563 m RKB

(The depths refer to the CDL/CNL log of December 25, 1984).

The test objectives were to:

- sample reservoir fluid
- estimate reservoir pressure and temperature
- evaluate reservoir properties
- evaluate reservoir productivity
- confirm that no moveable water is present in the interval
- detect any lateral heterogenities in the sand

The main components in the test string were:

- A Geo Vann tubing conveyed perforating system
- One internal bundle carrier and one F-nipple in which the pressure temperature recorders were installed.
- A standard Halliburton DST-string with a downhole tester valve, circulating valves and a retrievable packer.
- 5" VAM-tubing 24.2 lbs/ft.
- A Flopetrol subsea test tree, lubricator valve and surface test tree.

A standard 1440 psi Flopetrol separator was used to separate gas and liquids.

The test zone was perforated against an open 19 mm adjustable choke at 70 bar underbalance to the formation. During the 10 minutes initial flow period 10.5m³ of cushion were flowed back. The well was shut in for a 3 hours initial pressure build-up period to obtain

the initial pressure. The well was then opened for a 24 hours main flow period during which formation fluid was sampled at the wellhead and the separator, (see chapter 5.5 Fluid Analyses). Finally the well was shut in for a 36 hours main pressure build up period.

The main events of the test are listed in table 5.4. The flowrates and the bottom hole pressures are shown in fig. 5.2, and the pressure data from the last build up are listed in table 5.5.

During the main flow period the well produced clean oil at a rate of 865 Sm³/day through a 9.5 mm fixed choke. The GOR was 34 Sm³/Sm³ at separator conditions of 19.5 bar and 14.4°C.

The maximum temperature recorded was 91°C.

The first hours of the flowperiod the choke plugged up repeatedly from coarse perforating debris, but after this clean-up period no water or sand was produced.

5.5 Fluid Analyses

Two FMT-chambers containing reservoir fluid were collected. These samples proved not to be representative, since the bubble point pressures were too low. Analyses of the fluid from these samples are presented in table 5.6.

Six single phase fluid samples were taken during the main flow period of the DST. This sampling was performed at the wellhead, since the pressure here exceeded the bubble point pressure of the fluid. In addition to this, Jerry cans of stabilized oil were filled from the separator outlet.

The final PVT-analyses report are not received to date, but preliminary data are presented in tables 5.7, 5.8 and 5.9.

The initial Formation Volume Factor was 1.27 m³/Sm³ and the Solution Gas Oil Ratio 73.5 Sm³/Sm³. Both values are measured by single stage flash of reservoir fluid to standard conditions.



FORMATION PRESSURE MEASUREMENTS.

DEPTH (mRKB)	HYDROSTATIC MUD PRESSURE (PSIG)	MEASURED FORMATION PRESSURE (PSIG)	TEMPERATURE CORRECTED FORMATION PRESSURE		EQUIVALENT PRESSURE GRADIENT	
			(PSIA)	(BAR)	(g/cm ³)	(ppg)
RUN 3A	154°F		26.12.84			
2537	6145	5577	5578 S	384.6	1.56	
2548.5	6173	5590	5591	385.5	1.56	
2554	6186	5596	5597	385.9	1.56	
2558	6195	5601	5603	386.3	1.56	
2567	6217	Lost seal				
2579	6245	Lost seal				
2590.5	6271	5640	5642	389.0	1.55	
2610.5	6318	5660	5662	390.4	1.55	
2621	6344	5824*	Loosing seal			
2606.3	6304	Tight				
RUN 3B	168°F					
2626	6360	Tight				
2627	6360	Lost seal				
2625	6355	Tight				
2610	6320	5671	5673	391.1	1.54	
2610	6320	5675	5677	391.4	1.54	
2701	6535	Tight				
2610	6320	5671	5673	391.1	1.54	
2610	6320	5675	5677	391.4	1.54	
2701	6535	Tight				
2705	6543	5810	5813	400.8	1.54	
2711.5	6552	Tight				
2555	6201	5620	5622 S	387.6	1.56	
	KB = 26 m					

* Not stable S = Sample
Dresser FMT Tool
Temp Corr - 10 to - 15 PSI

DATE	21.6.85	AUTH.	SKL
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REF			



FORMATION PRESSURE MEASUREMENTS.

DEPTH (mRKB)	HYDROSTATIC MUD PRESSURE (PSIG)	MEASURED FORMATION PRESSURE (PSIG)	TEMPERATURE CORRECTED FORMATION PRESSURE		EQUIVALENT PRESSURE GRADIENT	
			(PSIA)	(BAR)	(g/cm ³)	(ppg)
Run 4E	1620F		3.1.85			
2783	6099	5947	5951	410.3	1.52	
2806	6146	5980	5984	412.6	1.51	
2811	6160	5989	5993	413.2	1.51	
2860	6266	6063	6068	418.4	1.51	
2897	6349	6117	6122	422.1	1.50	
2902.5	6363	6127	6132	422.8	1.50	
2921	6406	6153	6158	424.6	1.49	
2940	6448	6182	6187	426.6	1.49	
2947	6464	6191	9196	425.3	1.49	
3005	6586	6277	6282	433.1	1.48	
3058	6702	6362	6367	439.0	1.48	
3073	6736	6382	6387	440.4	1.47	
2860	6256	6070	6075	418.9	1.51	
KB = 26 m						

Dresser FMT
 Temp Corr - 10 to - 11 PSI
 1 bar/m = 9.81 g / cm³

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EVENT	DURATION (Hours)	CHOKE SIZE (mm)	FLOW RATE (m ³ /d)	BOTTOM HOLE PRESSURE (bar)	WELL HEAD PRESSURE (bar)	REMARKS
Initial flow	0.2	12.7	1145 (cushion)		102.4	10.5 m ³ cushion recovered
Initial build up	3					
Main flow	24 (3.0)	12.7				The choke plugged up repeatedly
	(3.0)	14.3	1146*	373.7**	82.4	
	(2.5)	7.9	604*	378.7**	163.4	
	(10)	9.5	802	376.3**	130.0	
	(4 min)			382.3**		the well was shut in accidentally
	(6.5)	9.5	865	376.3**	129.7	
Main build up	36				195.2	the well was shut in at the choke manifold

The GOR was 34 Sm³/m³ at separator conditions of 19.5 bar and 14.4.°C

* estimated

** refers to SDP/CRG # 83832 at 2527 mRKB

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TABLE 5.5: BOTTOM HOLE PRESSURES,
RECORDED DURING MAIN
BUILD-UP PERIOD

WELL: 34/7-4

TIME (HRS)	PRESSURE (PSIA)
11.252	5456.580
11.253	5467.360
11.256	5491.880
11.258	5514.840
11.261	5526.490
11.264	5529.690
11.269	5532.630
11.281	5535.670
11.303	5538.980
11.347	5542.580
11.436	5546.260
11.614	5549.880
11.969	5553.320
12.681	5556.730
13.036	5557.860
14.464	5560.950
15.175	5561.910
15.353	5562.050
15.419	5562.570
16.842	5563.370
17.908	5564.000
18.103	5564.570
19.525	5564.730
20.947	5565.330
22.369	5565.920
23.792	5566.370
1.214	5566.800
2.636	5567.140
4.058	5567.250
5.481	5567.350
6.903	5567.440
8.325	5567.680
11.169	5568.160
14.014	5568.540
16.858	5568.680
21.125	5568.730
22.547	5568.920

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TABLE 5.6: DATA ON FLUID FROM
FMT-CHAMBERS

WELL: 34/7-4

DEPTH (M RKB)	BUBBLE POINT PRESSURE (BAR)	GOR (SM ³ /SM ³)	DENSITY OF RESIDUAL OIL AT 15° C (KG/M ³)
2537	57.7 AT 15.5°C	60.8	843
2555	37.0 AT 15.5°C	45.5	836

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TABLE 5.7:

PRELIMINARY COMPOSITIONAL
ANALYSIS OF RESERVOIR FLUID

WELL:

34/7-4

COMPONENT	MOL %	WEIGHT %
N ₂	0.24	0.09
CO ₂	0.40	0.09
C ₁	22.87	2.84
C ₂	6.35	1.53
C ₃	8.88	3.15
I-C ₄	1.33	0.62
N-C ₄	4.67	2.17
I-C ₅	1.94	1.12
N-C ₅	3.26	1.89
C ₆	3.89	2.68
C ₇	4.21	3.14
C ₈	4.44	3.64
C ₉	4.57	4.15
C ₁₀₊	32.95	72.79

MOLECULAR WEIGHT

C₇₊ FRACTION: 226

DENSITY C₇₊
FRACTION AT 15.5°
(KG/M³): 862

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REF			

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TABLE 5.8: PRELIMINARY COMPOSITIONAL
ANALYSIS OF STOCK TANK OIL
WELL: 34/7-4

COMPONENT	MOL %	WEIGHT %
N ₂	NIL	NIL
CO ₂	NIL	NIL
C ₁	0.05	TRACE
C ₂	0.28	0.03
C ₃	2.63	0.61
I-C ₄	1.04	0.32
N-C ₄	4.61	1.40
I-C ₅	2.42	0.91
N-C ₅	3.48	1.31
C ₆	4.23	1.90
C ₇	10.30	4.97
C ₈	8.74	4.68
C ₉	7.46	4.43
C ₁₀	6.51	4.31
C ₁₁	4.93	3.68
C ₁₂	4.14	3.37
C ₁₃	4.10	3.61
C ₁₄	3.62	3.50
C ₁₅	3.19	3.31
C ₁₆	2.45	2.71
C ₁₇	2.17	2.53
C ₁₈	1.99	2.47
C ₁₉	2.08	2.73
C ₂₀₊	19.68	47.22

MOLECULAR WEIGHT
STOCK TANK OIL: 211

DENSITY STOCK
TANK OIL (KG/M³): 843

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TABLE 5.9: PRELIMINARY
PVT-DATA DST NO. 1
WELL: 34/7-4

BUBBLE POINT PRESSURE AT 90.5°C: 101 BAR

*GAS OIL RATIO: 73.5 SM³/M³

*OIL FORMATION VOLUME
FACTOR AT RES. PRESSURE: 1.27 M³/SM³

*GAS GRAVITY (AIR = 1): 0.929

*MEASURED FROM SINGLE STAGE FLASH OF RESERVOIR FLUID TO
STANDARD CONDITIONS (1 BAR AND 15°C)

OTHER PROPERTIES ON STOCK TANK OIL:

POUR POINT: 0°C

CLOUD POINT: 21°C

WAX APPEARANCE POINT: 14°C

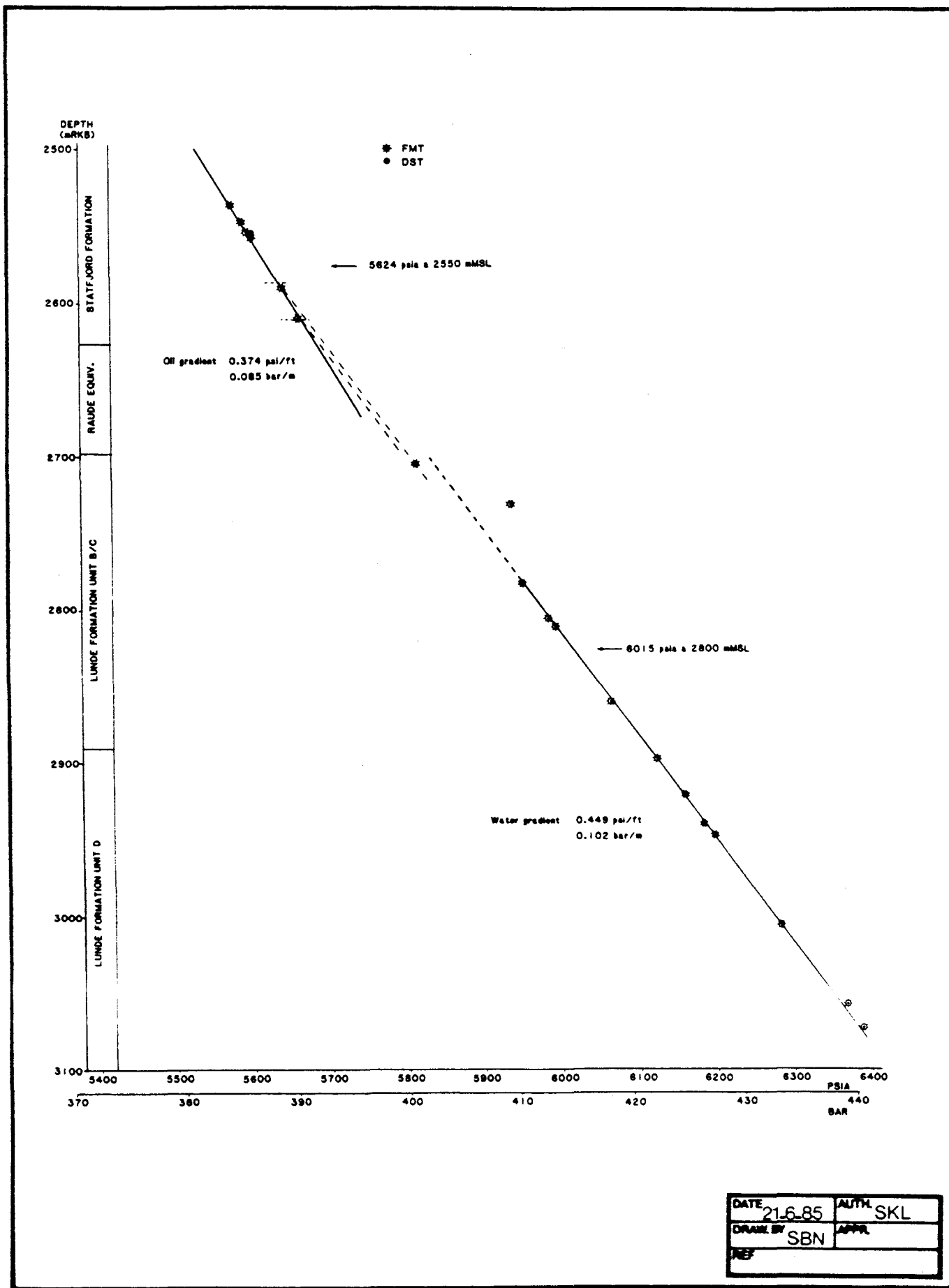
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FIG. 5.1: FORMATION PRESSURE VERSUS DEPTH

WELL: 34/7-4



6.2.1. Mud Properties, Daily Report

Well no: 34/7-4

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DATE	HOLE SIZE INCHES	DEPTH METERS	MUD WEIGHT ppg	P.V.	Y.P.	GEL STRENGTH	n	K	WATER LOSS	pH	ALKALINITY Pf/Mf	Ca+ ppm	CL- ppm	SAND %	SOLIDS %	COMMENTS
19.11.84	36	408														Drilg. 36" hole
20.11.	36	469														Set 30" csg.
21.11.	12 1/4"	704	9.2	12	57	20/38	0.231	16.320	N/L	9.7	.1/.15	180	4800	TR	6	Drilg. 12 1/4" pilot hole
22.11.	12 1/4"	972	9.6	11	49	35/43	.243	13.207	N/L	9.6	.1/.15	180	8000	TR	7	"
23.11.	26"	960	10.2	12	56	28/43	.234	15.772	N/L	9.4	.1/.15	270	9500	TR	8	Reaming/logging
24.11.	"	960	10.2	12	56	27/40	.234	15.772	N/L	9.4	.1/.15	250	9000	TR	8	Reaming
25.11.	"	961	10.2	14	50	28/40	.29	10.4	N/L	9.4	.1/.15	250	10000	TR	9	Log
26.11.	"	963	10.2	12	48	25/96	.26	11.9	N/L	9.3	.1/.15	250	10000	TR	9	Csg.
27.11.		MIXING NEW MUD														
28.11.		"	"													
29.11.		963	8.9	13	17	3/4	.52	1.2	7	9.6	.05/.1	2600	21000	-	-	Test BOP WOW
30.11.		963	8.9	11	17	3/4	.48	1.4	7	9.7	.05/.1	2100	20000	-	-	WOW
1.12.		963	8.9	14	18	3/4	.52	1.3	7	9.5	.05/.1	2100	20000	-	-	WOW
2.12.		963	8.9	15	19	4/5	.53	1.2	7	9.5	.05/.1	2100	20000	-	-	WOW pull BOP
3.12.		963	8.9	13	19	3/4	.49	1.5	7	9.5	.05/.1	2100	20000	-	-	Test BOP, run BOP
4.12.		963	8.9	15	19	3/4	.53	1.2	7	9.5	.05/.1	2100	20000	-	-	WOW pull BOP
5.12.	17 1/2"	953	9.5	18	24	4/5	.51	1.8	7	9.8	.05/.1	2100	20000	-	5	Run BOP, RIH drl.
6.12.	"	1123	9.5	14	20	4/5	.50	4.3	6	9.5	.05/.2	2000	19000	TR	5	Dril. cmt.
7.12.	"	1552	10.0	12	18	3/4	.49	1.4	6	9.5	.05/.2	2400	20000	.25	6.5	Dril.
8.12.	"	1652	11.0	19	18	3/4	.60	.9	6	9.6	.05/.2	2400	20000	.25	11.5	Dril.
9.12.	"	1750	11.0	18	22	4/5	.54	1.4	6	9.5	.1/.3	2400	21000	.25	12.0	Dril.
10.12.	"	1888	11.4	26	22	7/12	.62	1.0	6	9.5	.1/.4	2700	21000	.25	13.5	Dril.
11.12.	"	1930	12.0	26	19	3/10	.66	.7	6	10.0	.1/.45	2300	21000	.25	16.5	Dril., circ., log
12.12.	"	1930	12.0	22	20	4/17	.61	.9	7	9.5	.1/.4	2000	21000	TR	16	Log, run csg.
13.12.	12 1/4"	1930	12.0	22	20	4/15	.60	.95	8	9.5	.1/.4	2000	21000	TR	16	Set csg., cmt.
14.12.	"	2081	12.0	33	17	8/28	.73	.53	11	9.8	.03/.35	2800	18000	TR	16	Dril. 12 1/4" hole
15.12.	"	2288	13.0	22	15	9/22	.67	.56	9	9.6	.03/.4	2520	20000	TR	16	"
16.12.	"	2381	13.3	24	18	7/24	.65	.72	8	9.8	.1/.3	2320	19000	TR	16	"
17.12.	"	2498	1.69	23	16	4/25	.67	.60	6	9.8	.06/.41	2440	18000	1/4	20	"
18.12.	"	2537	1.69	23	16	7/25	.67	.60	6	10.0	.03/.40	2320	19000	TR	22	" , coring
19.12.	"	2560	1.69	23	13	4/25	.67	.60	6.2	9.8	.1/.30	1920	18000	TR	22	Coring

6.2.2. Mud Materials used

Well no: 34/7-4



MATERIAL	UNIT	36" HOLE	26" HOLE	17 1/2" HOLE	12 1/4" HOLE	8 1/2" HOLE	5 7/8" HOLE	TOTAL
Barite	M/T		110	311	815	100	63	1399
Bentonite	M/T	11	25			7		43
Bentonite	50 kg			33				33
Bicarbonate	50 kg			1	11			12
CaCl ₂	50 kg						216	216
Caustic Soda	25 kg	12	19	84	187	19		321
Drispac Reg.	50 lb			92	9		3	104
Drispac S/L	50 lb			27	132	17		176
Gypsum	40 kg			497	375			876
LD-8	5 gal			4	8	5	1	18
Lime	40 kg	2						2
MD	55 gal		1		4	1		6
Mica	25 kg				1			1
Milbio	55 gal			2	1	1		4
Milpolymer 302	25 kg			143	14			157
Permalose	25 kg			200				200
Propol L/V	25 kg				15			15
Pro-thin	25 kg			57	430			487
Unical	25 kg				85	120		205