



Client:	Petrobakken	Rev.	A
Project title:	Heward Oil Battery	By:	MHR
NEDG Project No.:	0689NE	Chk'd:	
Date	18-May-10	App'd:	

## GAS COMPRESSOR DESIGN CALCULATION

### Calculation No.

### Title:

Gas Compressor Sizing Calculation

### Objective:

Sizing Heward Oil Battery gas compressor

### Method:

Pressure loss in the gas pipeline from Heward to Creelman And required pressure at the destination.

### References:

PIPEFLO for line pressure loss  
Ariel compressor catalogue for BHP calculation

### Design Input/Assumptions:

Gas analysis sheet  
3" NPS pipeline from Heward to Creelman  
Four cases:  
1- Gas is sent to Creelman compressor suction at 50 psi.  
2- Gas is sent to Creelman compressor discharge (directly to Innes) at 265 psi.  
3- Creelman compressor is killed and Heward gas is sent directly to Innes (no gas from Creelman) at 90 psi.  
4- Creelman compressor is killed and Heward gas is sent directly to Innes (no gas from Creelman) at 120 psi.

### Confirmation Required

Yes

No

### Conclusions:

Please refer to the summary table for more detailed information:  
First case needs single stage compressor with one suction

### Confirmation Required

Yes

No

scrubber and one aftercooler. Driver should be 150 kW.

Second case needs a two stage compressor with two suction scrubbers, one intercooler and one aftercooler. Driver should be 200 kW.

Third case will have a two stage compressor with two suction scrubbers, one intercooler and one aftercooler. Driver should be 200 kW.

Fourth case will have a two stage compressor with two suction scrubbers, one intercooler and one aftercooler. Driver should be 200 kW.

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## Input data:

The following assumptions are made for the compressor sizing:

### Assumptions for Compressor Sizing

Item	Unit	Value
Site elevation	m	610
Heward - Creelman pipeline NPS	NPS	3
Heward - Creelman pipeline length	km	16.1
Heward Compressor suction pressure	bar	3.45
Suction gas temperature	°C	40
Suction scrubber loss	bar	0.48

Based on gas analysis data, the following properties of gas are calculated (outputs from Ariel Compressor Inc. compressor sizing program):

### Operational & process data

Item	Unit	Value
Flowrate	$\text{e}^3\text{m}^3/\text{d}$	40
Safety Factor	-	1.1
SG	-	1.05944
Density	$\text{kg}/\text{m}^3$	5.305
Dynamic Viscosity	cP	0.0132
Compressibility $Z_s$	-	0.9751
Compressibility $Z_d$	-	0.95331

## Operation Cases

Four scenarios have been considered, and the compressor has been sized for each one.

In all cases we are assuming the following line specifications:

Pipeline size: **3"**  
Pipeline length: **10 miles (16.1 km)**  
Pipeline material: **Steel**

Each case is calculated separately as follows:

### Case 1:

In this case, compressed gas should be received at Creelman with 3.45 barg pressure. The pressure at the beginning of the line could be obtained by calculating the Pressure drop from Heward to Creelman. following results are from PIPE-FLO program (see the attachment #1 for the complete PIPE-FLO output):

Discharge pressure: **271 psia 18.66 bara**

From compressor sizing program, the driver rating will be as follows (see attachment #2: Compressor Performance Run):

Number of stages: **1**  
Pressure ratio: **4.85**  
Outlet temperature: **120 °C**  
Condensate Dropout: **0.18 %**  
Compressor power demand: **123 kW**  
Compressor driver size: **150 kW**

### Case 2:

In the second case, compressed gas should be injected to downstream of Creelman compressor, so it should be received at Creelman with 18.27 barg (265 psig) pressure. The pressure at the beginning of the line could be obtained by calculating the Pressure drop from Heward to Creelman. following results are from PIPE-FLO program (see the attachment #3 for the complete PIPE-FLO output):

Discharge pressure: **384 psia 26.49 bara**

From compressor sizing program, the driver rating will be as follows (see attachment #4: Compressor Performance Run):

Number of stages: **2**

	Stage 1	Stage 2
Pressure ratio:	<b>3</b>	<b>2.40</b>
Outlet temperature:	<b>95.5 °C</b>	<b>98.1 °C</b>
Condensate Dropout:	<b>0.18 %</b>	<b>1.85%</b>

Compressor power demand:	<b>154.1 kW</b>
Compressor driver size:	<b>200 kW</b>

### Case 3:

In the third case, compressed gas should be Innes via the existing Creelman-Innes flexipipe line and should be received at Innes with 6.21 barg (90 psig) pressure. The pressure at the beginning of the line could be obtained by calculating the Pressure drop from Heward to Innes. following results are from PIPE-FLO program (see the attachment #5 for the complete PIPE-FLO output):

Discharge pressure: **341 psia      23.53 bara**

From compressor sizing program, the driver rating will be as follows (see attachment #6: Compressor Performance Run):

Number of stages: **2**

	<b>Stage 1</b>	<b>Stage 2</b>
Pressure ratio:	<b>2.8</b>	<b>2.26</b>
Outlet temperature:	<b>92.3 °C</b>	<b>93.4 °C</b>
Condensate Dropout:	<b>0.18 %</b>	<b>1.57%</b>
Compressor power demand:	<b>146 kW</b>	
Compressor driver size:	<b>200 kW</b>	

### Case 4:

In the third case, compressed gas should be Innes via the existing Creelman-Innes flexipipe line and should be received at Innes with 8.27 barg (120 psig) pressure. The pressure at the beginning of the line could be obtained by calculating the Pressure drop from Heward to Innes. following results are from PIPE-FLO program (see the attachment #7 for the complete PIPE-FLO output):

Discharge pressure: **351 psia      24.20 bara**

From compressor sizing program, the driver rating will be as follows (see attachment #8: Compressor Performance Run):

Number of stages: **2**

	<b>Stage 1</b>	<b>Stage 2</b>
Pressure ratio:	<b>2.8</b>	<b>2.30</b>
Outlet temperature:	<b>93 °C</b>	<b>94.3 °C</b>
Condensate Dropout:	<b>0.18 %</b>	<b>1.62%</b>
Compressor power demand:	<b>148.1 kW</b>	
Compressor driver size:	<b>200 kW</b>	

### Heward Compressor Calculation Summary (Metric Units)

Description	Unit	CASE 1		CASE 2		CASE 3		CASE 4	
PIPELINE DATA									
Receiving Point	-	Creelman		Creelman		Innes		Innes	
Heward-Creelman Pipeline Size / Length	mm/km	88.9 / 16.1 km		88.9 / 16.1 km		88.9 / 16.1 km		88.9 / 16.1 km	
Pressure at Receiving Point	Bara	4.45		19.27		7.21		9.27	
Pipeline Pressure Drop	Bar	14.21		7.22		16.32		14.93	
COMPRESSOR DATA		Stage 1	Stage 2	Stage 1	Stage 2	Stage 1	Stage 2	Stage 1	Stage 2
Compressor Inlet Pressure	Bara	4.45		4.45		4.45		4.45	
Compressor Discharge Pressure	Bara	18.66		26.49		23.53		24.2	
Total Pressure Ratio	-	4.85		6.9		6.1		6.3	
Number of satges	-	1		2		2		2	
Per-Stage Pressure Ratio	-	4.85	N/A	3	2.4	2.8	2.26	2.3	2.8
Stage Outlet Temperature	°C	120	N/A	95	98	92	93	93	94
Condensate Dropout	%	0.18	N/A	0.18	1.85	0.18	1.57	0.18	1.62
Compressor Power Demand	kW	123		154		146		148	
Motor Standard Size	kW	150		200		200		200	

### Heward Compressor Calculation Summary (USC Units)

Description	Unit	CASE 1		CASE 2		CASE 3		CASE 4	
PIPELINE DATA									
Receiving Point	-	Creelman		Creelman		Innes		Innes	
Heward-Creelman Pipeline Size / Length	inch/mile	3" / 10 miles		3" / 10 miles		3" / 10 miles		3" / 10 miles	
Pressure at Receiving Point	psia	65		279		105		134	
Pipeline Pressure Drop	psi	206		105		237		216	
COMPRESSOR DATA		Stage 1	Stage 2	Stage 1	Stage 2	Stage 1	Stage 2	Stage 1	Stage 2
Compressor Inlet Pressure	Bara	65		65		65		65	
Compressor Discharge Pressure	psia	271		384		341		351	
Total Pressure Ratio	-	4.85		6.9		6.1		6.3	
Number of stages	-	1		2		2		2	
Per-Stage Pressure Ratio	-	4.85	N/A	3	2.4	2.8	2.26	2.3	2.8
Stage Outlet Temperature	°F	248	N/A	203	208	198	199	199	201
Condensate Dropout	%	0.18	N/A	0.18	1.85	0.18	1.57	0.18	1.62
Compressor Power Demand	HP	165		207		196		198	
Motor Standard Size	HP	200		250		250		250	