

FOR INFORMATION



JX NIPPON OIL & GAS EXPLORATION (M) LIMITED
TH HEAVY ENGINEERING BERHAD

PROVISION OF EPCIC AND LEASING FOR
LAYANG FPSO FACILITIES
HP GAS COMPRESSOR

COMPRESSOR PERFORMANCE CURVES
(TEST RESULT)



DELIVERY	ORDER No.	31F3224-00	 KOBE WORKS MACHINERY DIVISION AERO-DYNAMIC MACHINERY DEPARTMENT COMPRESSOR ENGINEERING SECTION
THE	1E		
	NOTES		APPROVED
	1. Issued for Information. 2015/12/16		<i>Y. Kurashiki</i>
流込			CHECKED
管理			<i>f. Sawai</i>
生管			DRAWN
検査	1	REVISION	<i>Y. Saito</i>
生技			KK
外注			
購買			
海調			
品証			
回覧控	1		
ISSUE			
DATE	December 16, 2015	DRAWING No.	F3224-0022-01
		REV.	R0

PERFORMANCE CURVE SUMMARY

Project : PROVISION OF EPCIC AND LEASING FOR LAYANG FPSO FACILITIES

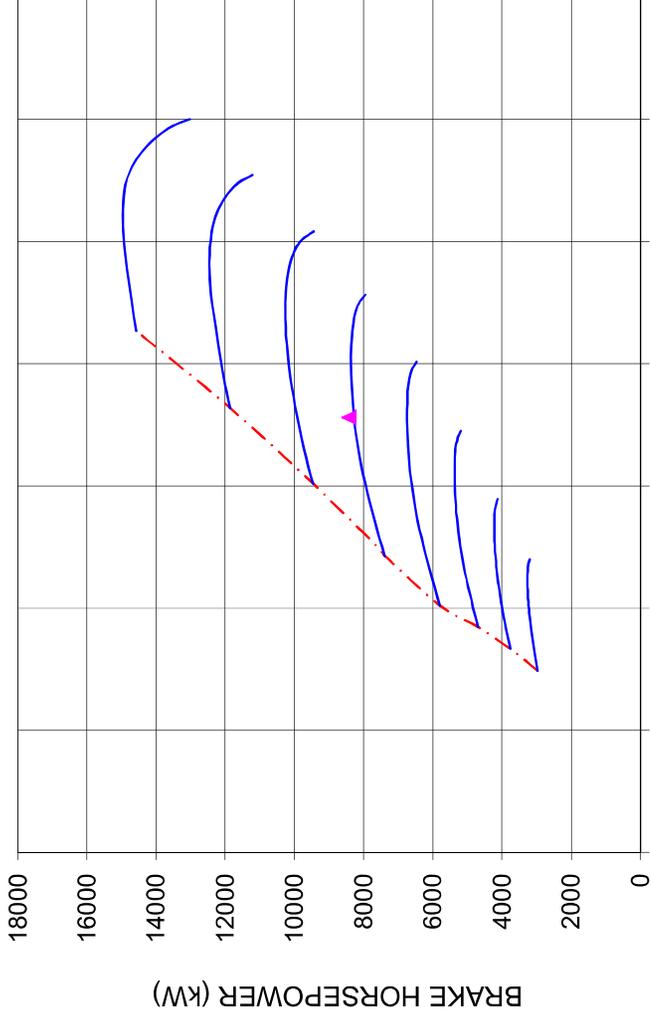
Item No. : K-2430/2440
Compressor : HP Gas Compressor
Model : RB8-7B

Pd : Discharge Pressure kW : Shaft Power
Hp : Polytropic Head η_p : Polytropic Efficiency

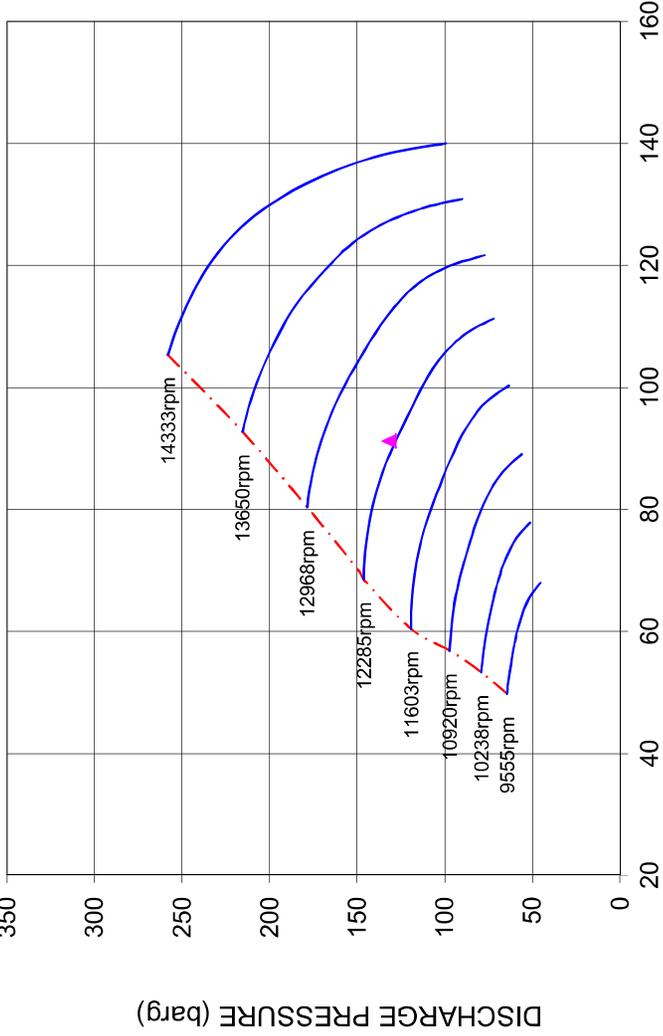
Condition	Curve	Overall	Section-1	Section-2
DESIGN, GROUP 1 (CASE 1) [Guarantee]	Pd / kW Hp / η_p	C1-A -	C1-1-P C1-1-H	C1-2-P C1-2-H
INITIAL LIFE, GROUP 2 (CASE 2)	Pd / kW Hp / η_p	C2-A -	C2-1-P C2-1-H	C2-2-P C2-2-H
INTERIM LIFE, GROUP 2 (CASE 3)	Pd / kW Hp / η_p	C3-A -	C3-1-P C3-1-H	C3-2-P C3-2-H
END OF FIELD LIFE, GROUP 1 (CASE 4)	Pd / kW Hp / η_p	C4-A -	C4-1-P C4-1-H	C4-2-P C4-2-H
REFERENCE CASE (CASE 5)	Pd / kW Hp / η_p	C5-A -	C5-1-P C5-1-H	C5-2-P C5-2-H

COMPRESSOR PERFORMANCE CURVE

Export Gas Compressor / Case1 [Guarantee]



SPEED (rpm)= 14333, 13650, 12968, 12285, 11603, 10920, 10238, 9555



INLET FLOW (MMSCFD)

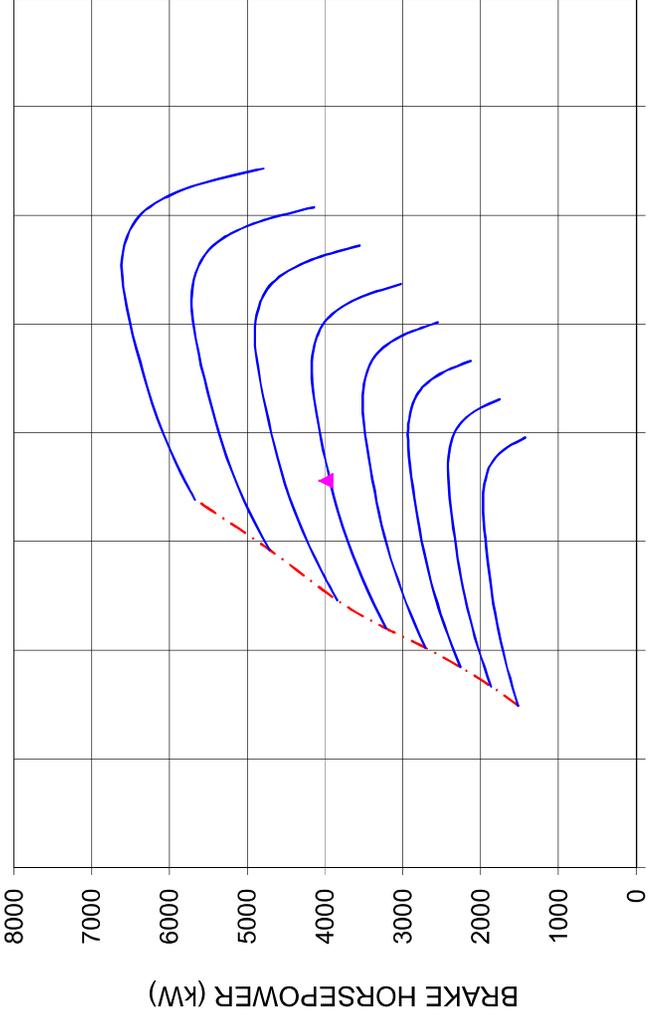
CONDITION: Ps= 18.50 barg, Ts= 39.3 deg.C, MW= 20.69



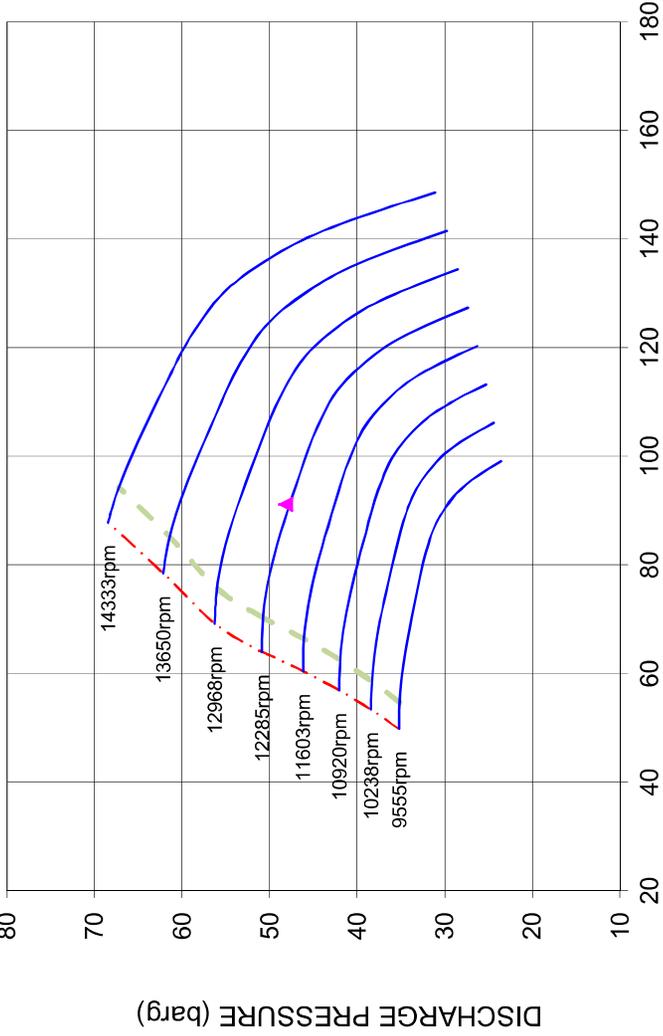
COMPRESSOR ENGINEERING SECTION

COMPRESSOR PERFORMANCE CURVE

Export Gas Compressor / Case1 [Guarantee] (Section1)



SPEED (rpm)= 14333, 13650, 12968, 12285, 11603, 10920, 10238, 9555



INLET FLOW (MMSCFD)

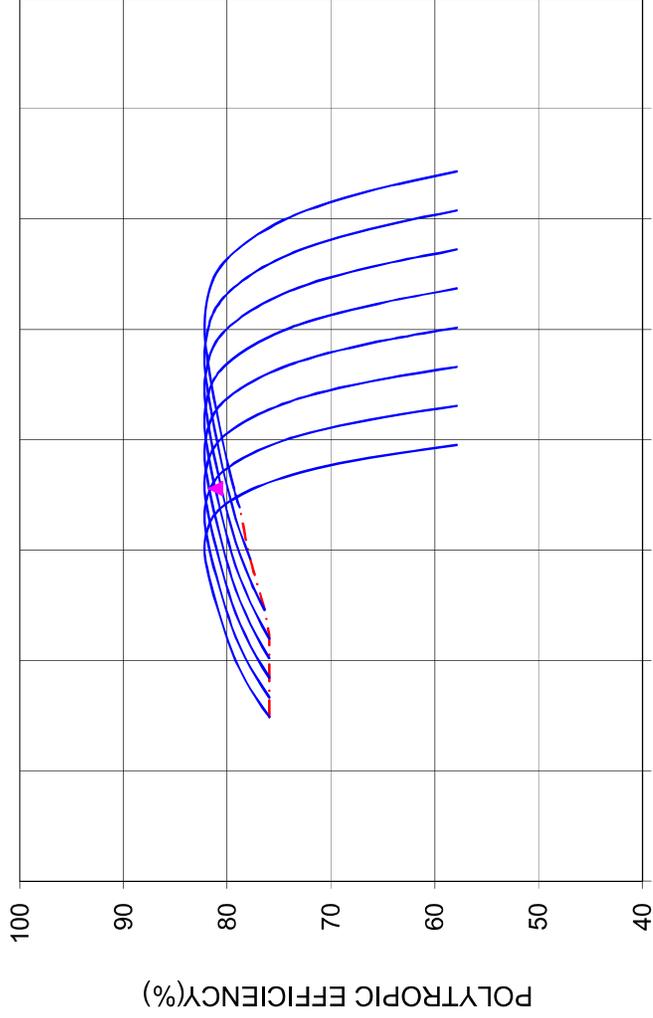
CONDITION: Ps= 18.50 barg, Ts= 39.3 deg.C, MW= 20.69



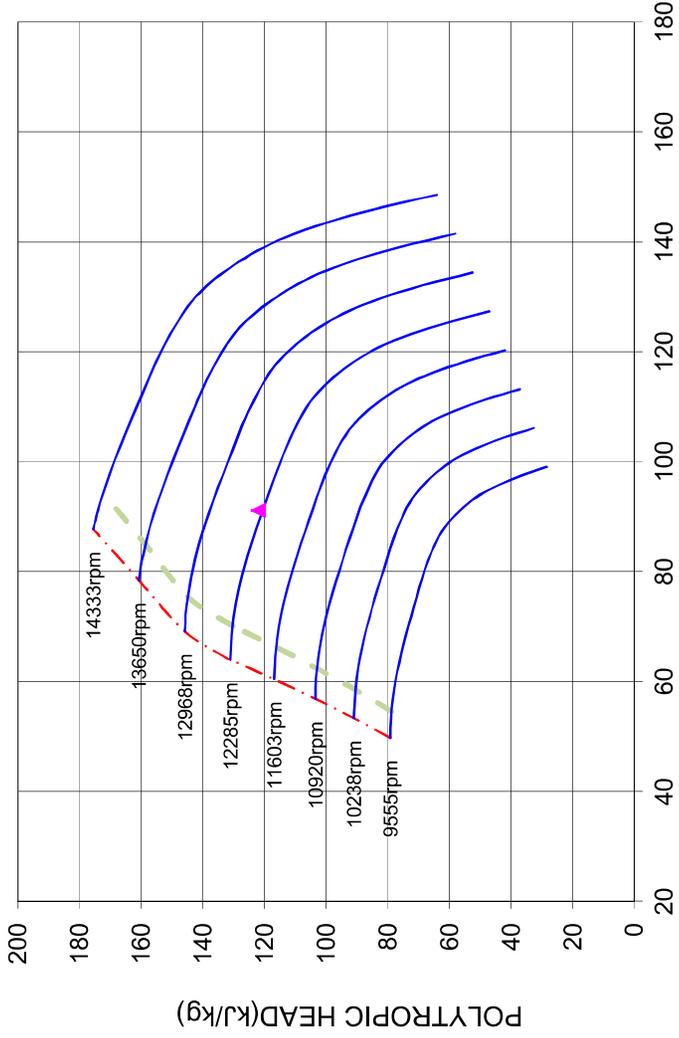
COMPRESSOR ENGINEERING SECTION

COMPRESSOR PERFORMANCE CURVE

Export Gas Compressor / Case1 [Guarantee] (Section1)



SPEED (rpm)= 14333, 13650, 12968, 12285, 11603, 10920, 10238, 9555



INLET FLOW (MMSCFD)

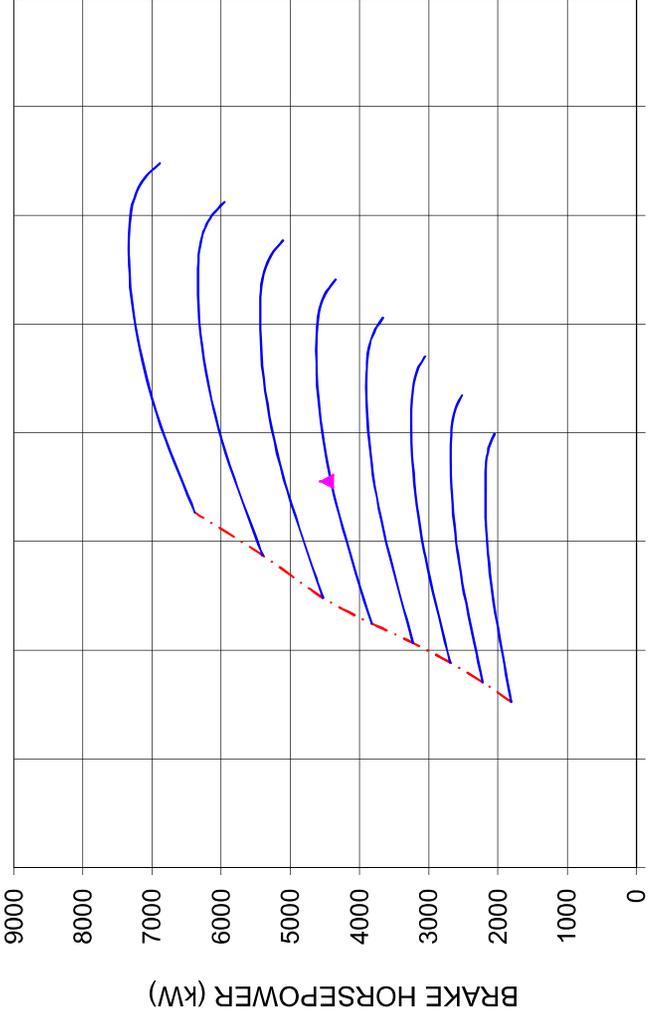
CONDITION: Ps= 18.50 barg, Ts= 39.3 deg.C, MW= 20.69



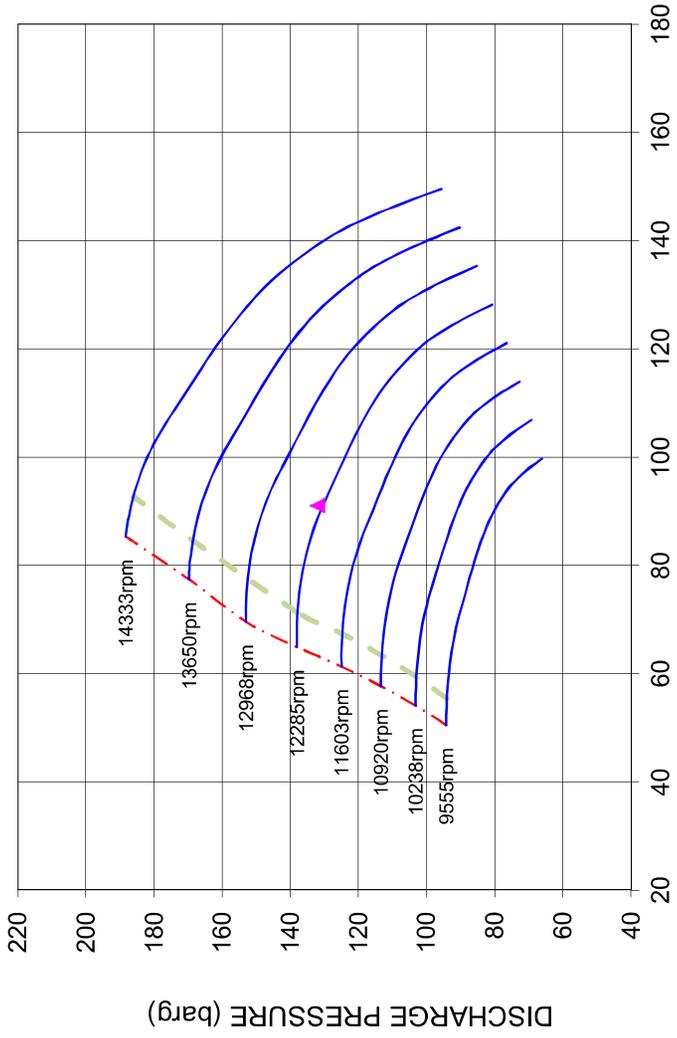
COMPRESSOR ENGINEERING SECTION

COMPRESSOR PERFORMANCE CURVE

Export Gas Compressor / Case1 [Guarantee] (Section2)



SPEED (rpm)= 14333, 13650, 12968, 12285, 11603, 10920, 10238, 9555



INLET FLOW (MMSCFD)

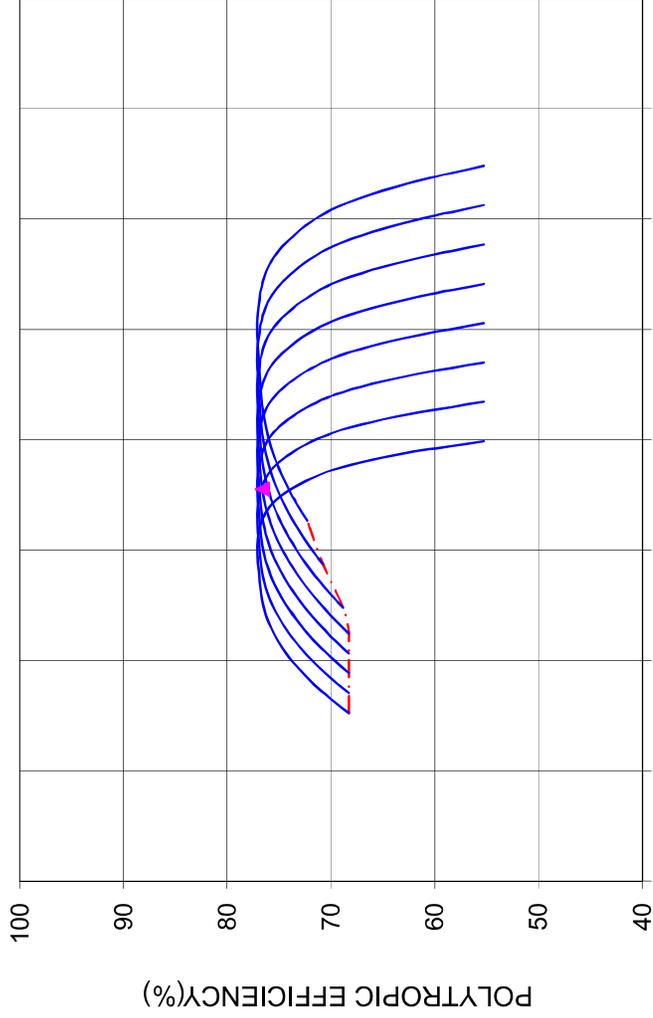
CONDITION: Ps= 47.23 barg, Ts= 44.8 deg.C, MW= 20.65



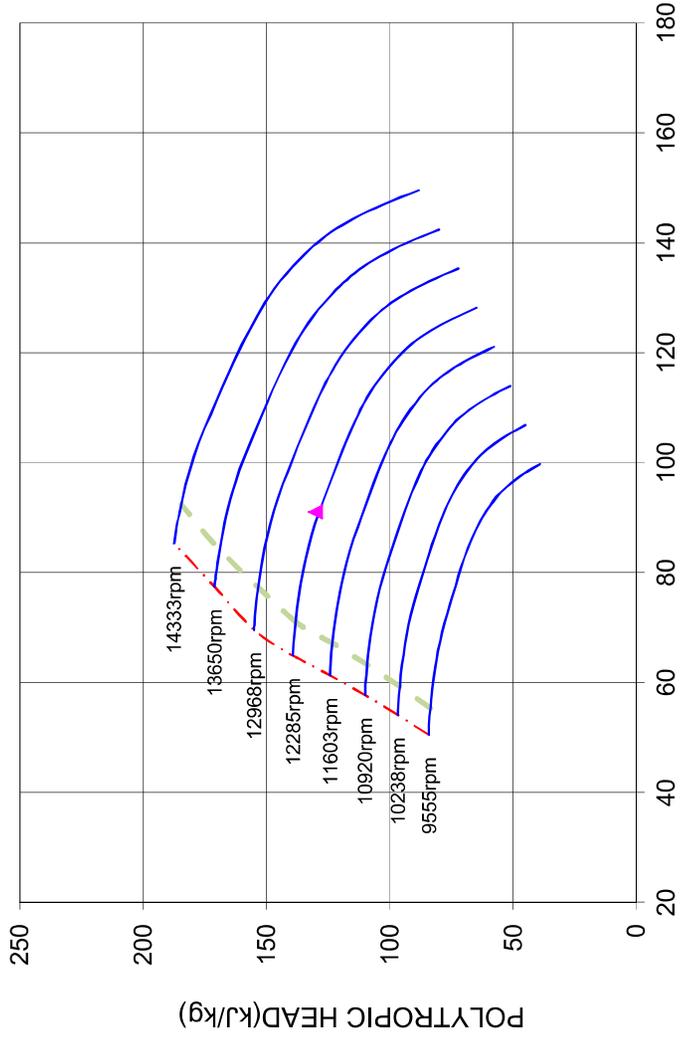
COMPRESSOR ENGINEERING SECTION

COMPRESSOR PERFORMANCE CURVE

Export Gas Compressor / Case1 [Guarantee] (Section2)



SPEED (rpm)= 14333, 13650, 12968, 12285, 11603, 10920, 10238, 9555



INLET FLOW (MMSCFD)

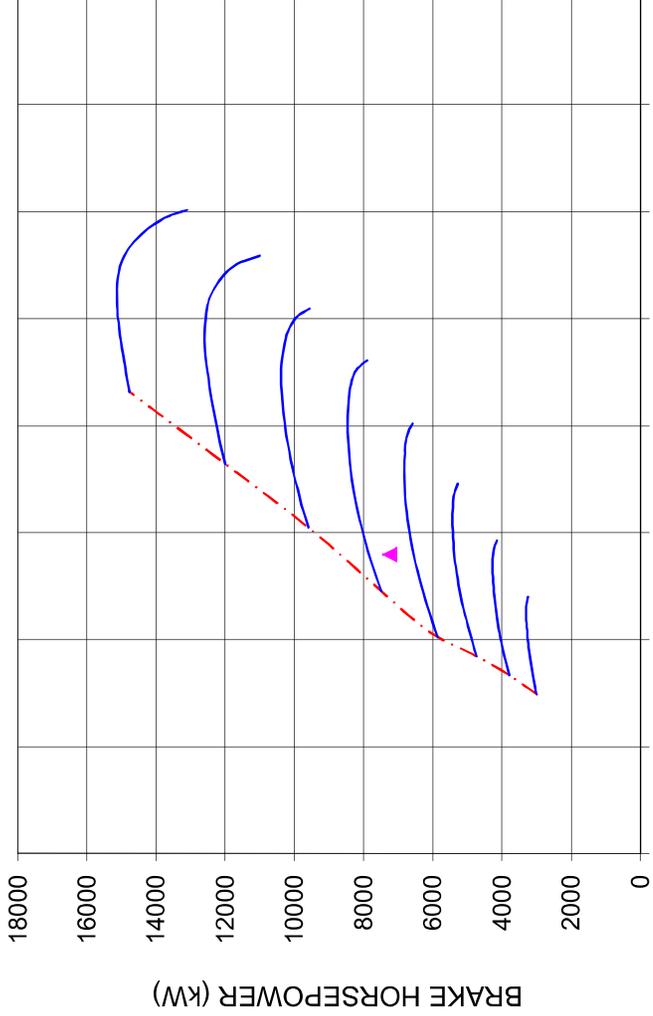
CONDITION: Ps= 47.23 barg, Ts= 44.8 deg.C, MW= 20.65



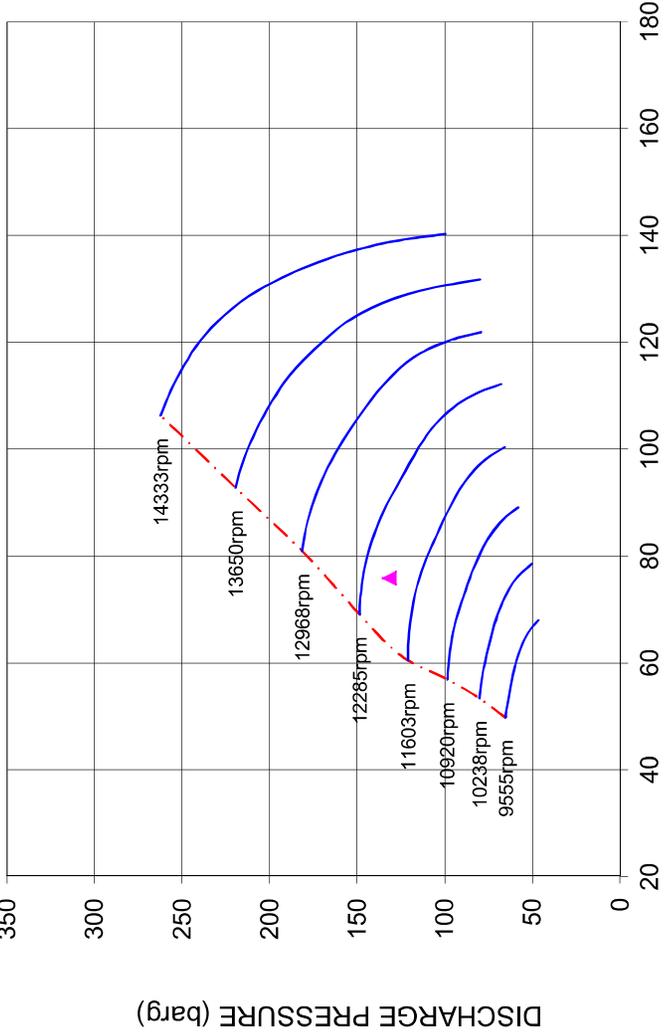
COMPRESSOR ENGINEERING SECTION

COMPRESSOR PERFORMANCE CURVE

Export Gas Compressor / Case2



SPEED (rpm)= 14333, 13650, 12968, 12285, 11603, 10920, 10238, 9555



INLET FLOW (MMSCFD)

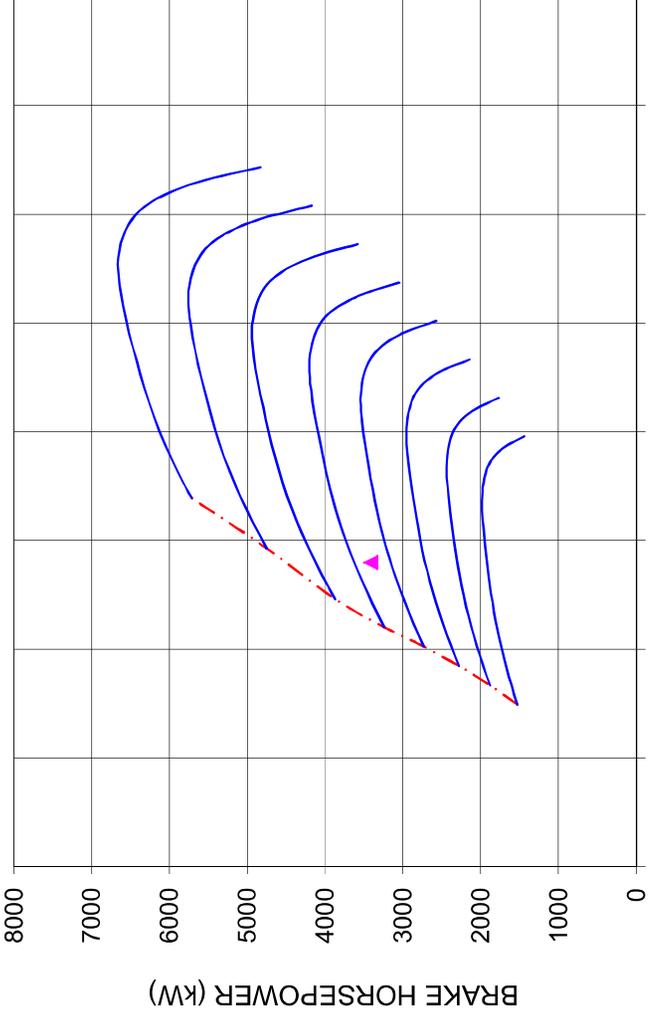
CONDITION: Ps= 18.50 barg, Ts= 39.2 deg.C, MW= 20.82



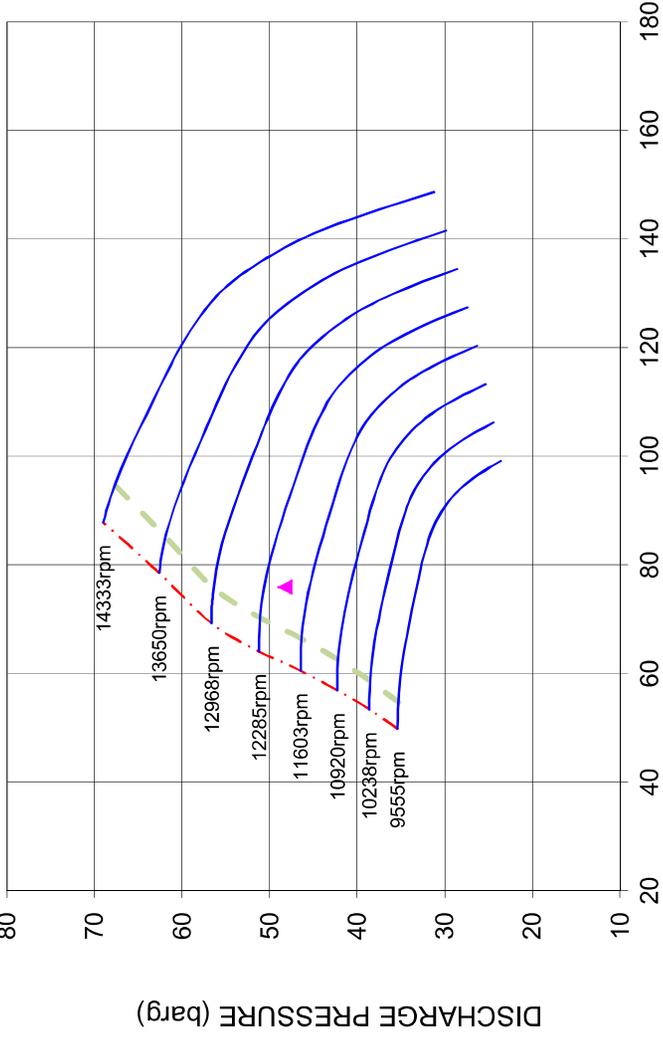
COMPRESSOR ENGINEERING SECTION

COMPRESSOR PERFORMANCE CURVE

Export Gas Compressor / Case2 (Section1)



SPEED (rpm)= 14333, 13650, 12968, 12285, 11603, 10920, 10238, 9555



INLET FLOW (MMSCFD)

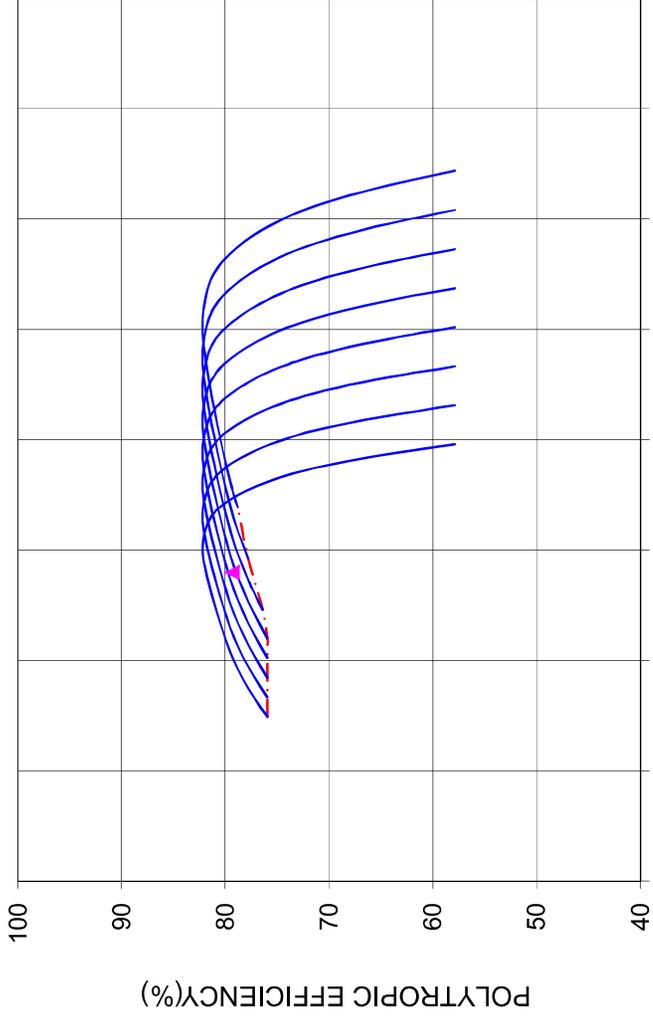
CONDITION: Ps= 18.50 barg, Ts= 39.2 deg.C, MW= 20.82



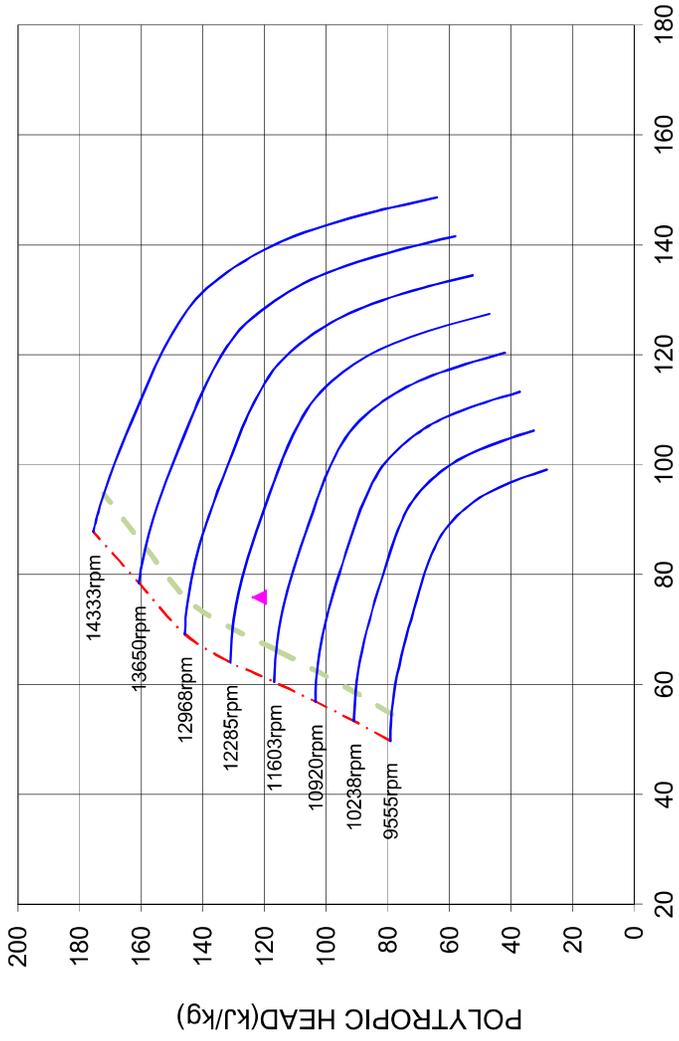
COMPRESSOR ENGINEERING SECTION

COMPRESSOR PERFORMANCE CURVE

Export Gas Compressor / Case2 (Section1)



SPEED (rpm)= 14333, 13650, 12968, 12285, 11603, 10920, 10238, 9555



INLET FLOW (MMSCFD)

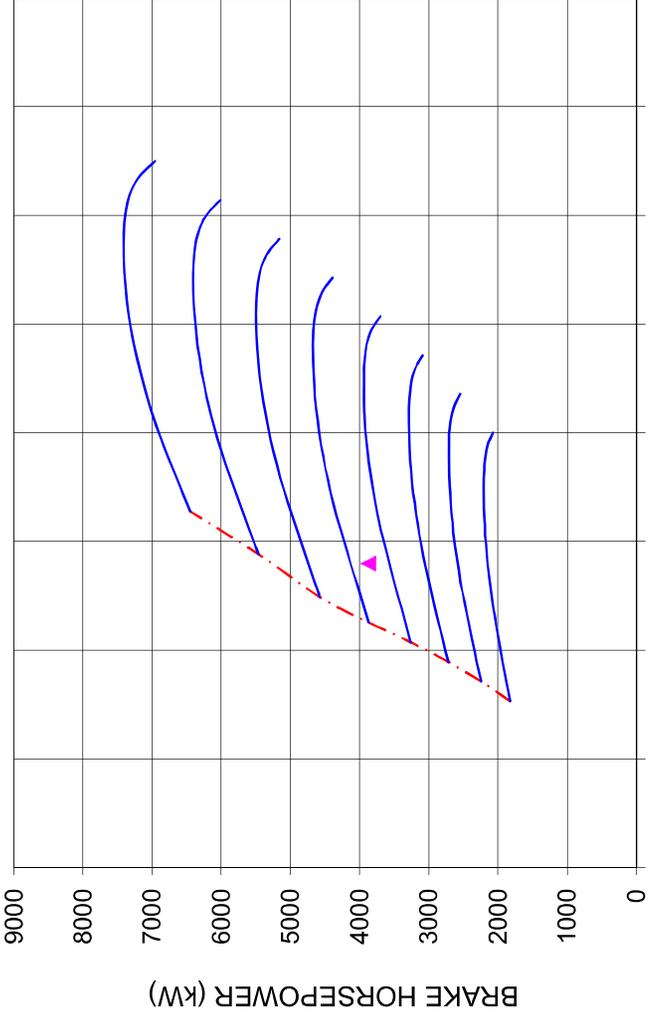
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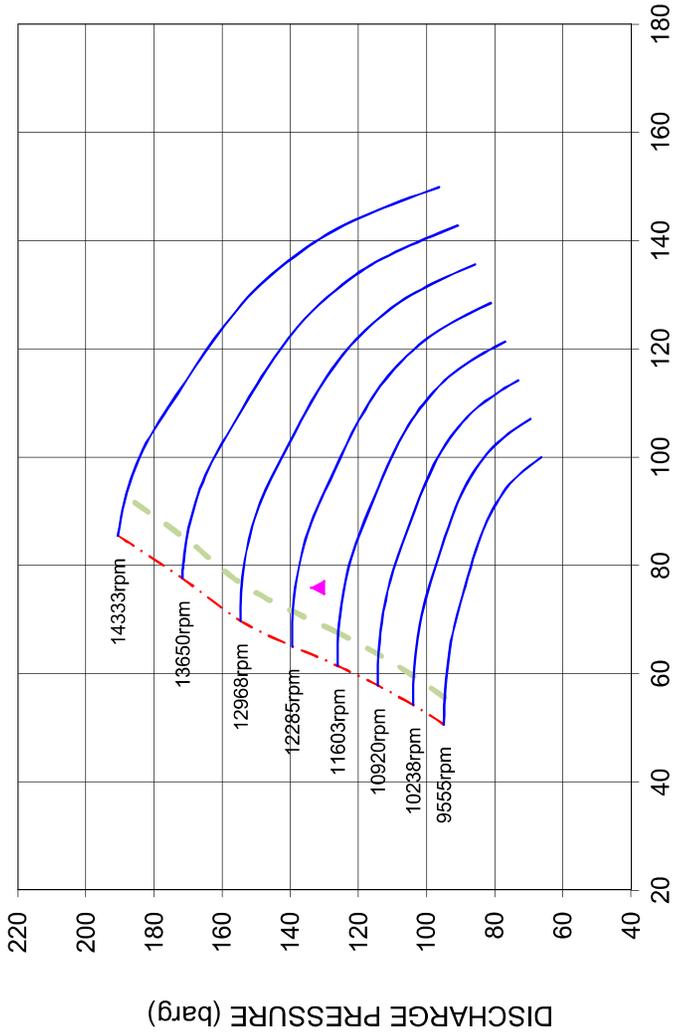
COMPRESSOR ENGINEERING SECTION

COMPRESSOR PERFORMANCE CURVE

Export Gas Compressor / Case2 (Section2)



SPEED (rpm)= 14333, 13650, 12968, 12285, 11603, 10920, 10238, 9555



INLET FLOW (MMSCFD)

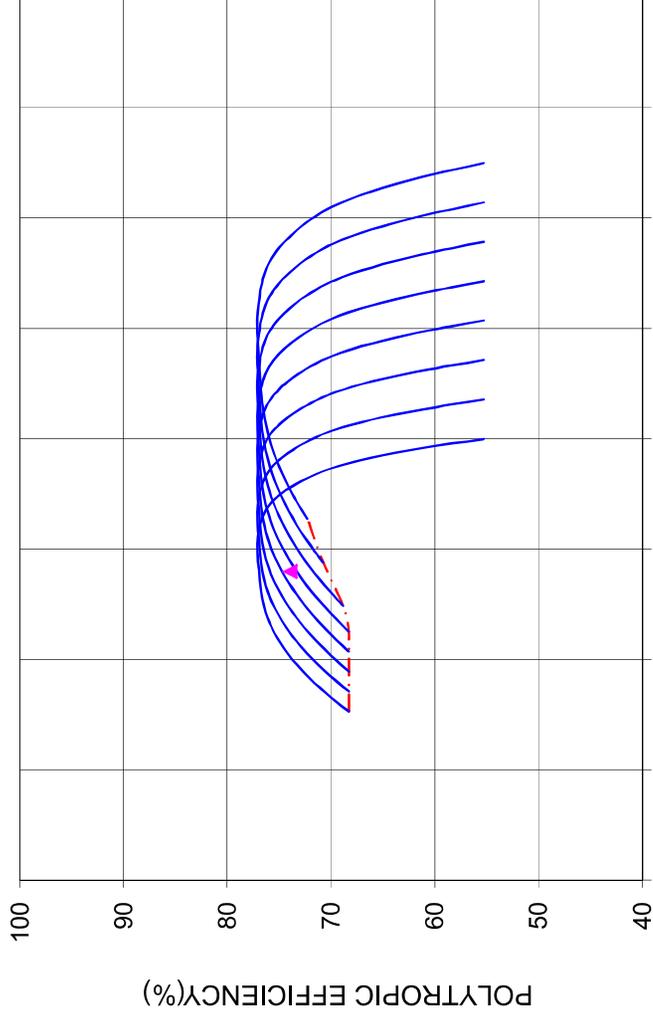
CONDITION: Ps= 47.26 barg, Ts= 44.8 deg.C, MW= 20.82



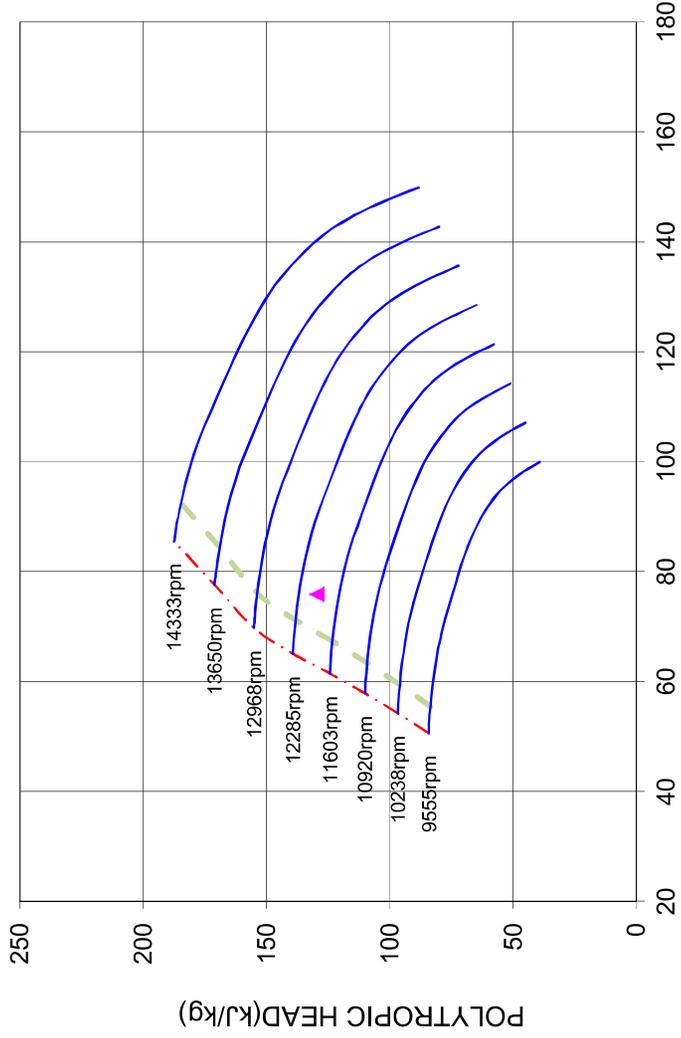
COMPRESSOR ENGINEERING SECTION

COMPRESSOR PERFORMANCE CURVE

Export Gas Compressor / Case2 (Section2)



SPEED (rpm)= 14333, 13650, 12968, 12285, 11603, 10920, 10238, 9555



INLET FLOW (MMSCFD)

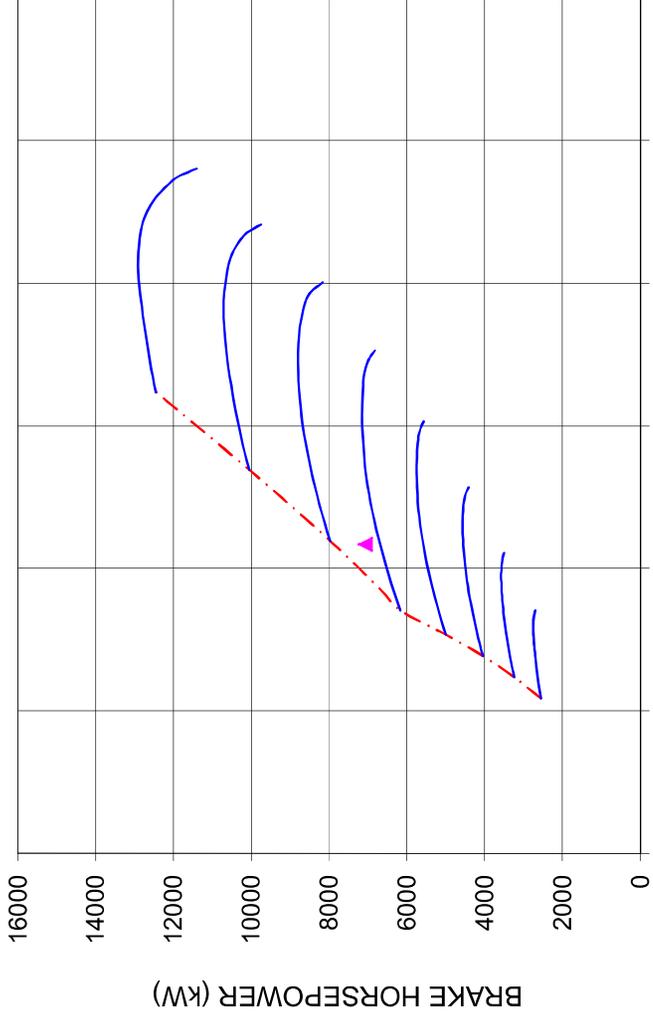
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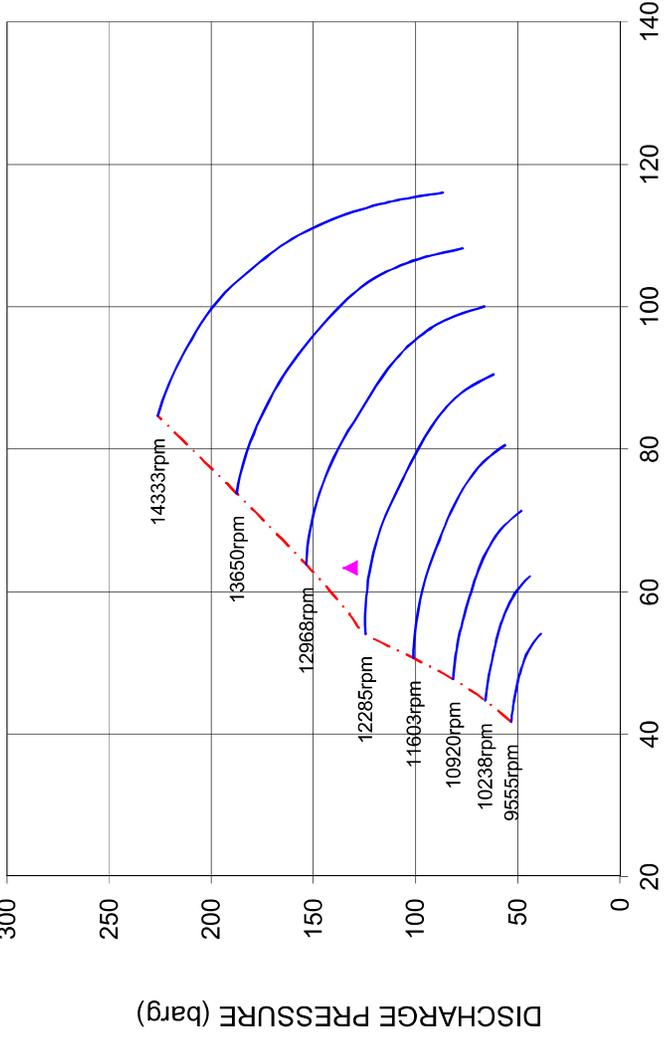
COMPRESSOR ENGINEERING SECTION

COMPRESSOR PERFORMANCE CURVE

Export Gas Compressor / Case3



SPEED (rpm)= 14333, 13650, 12968, 12285, 11603, 10920, 10238, 9555



INLET FLOW (MMSCFD)

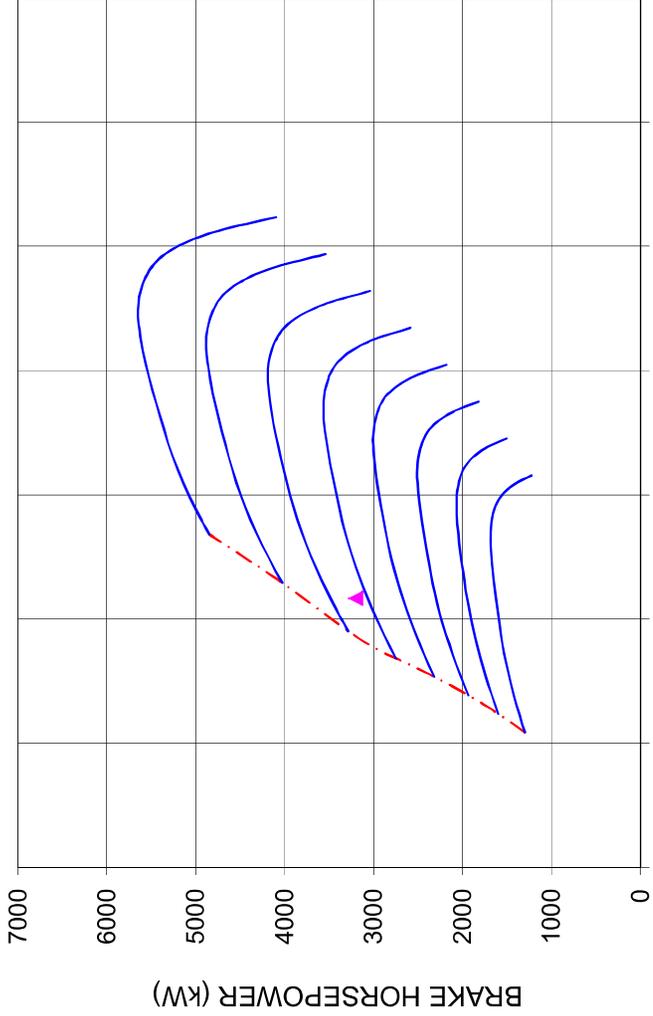
CONDITION: Ps= 15.50 barg, Ts= 39.3 deg.C, MW= 21.00



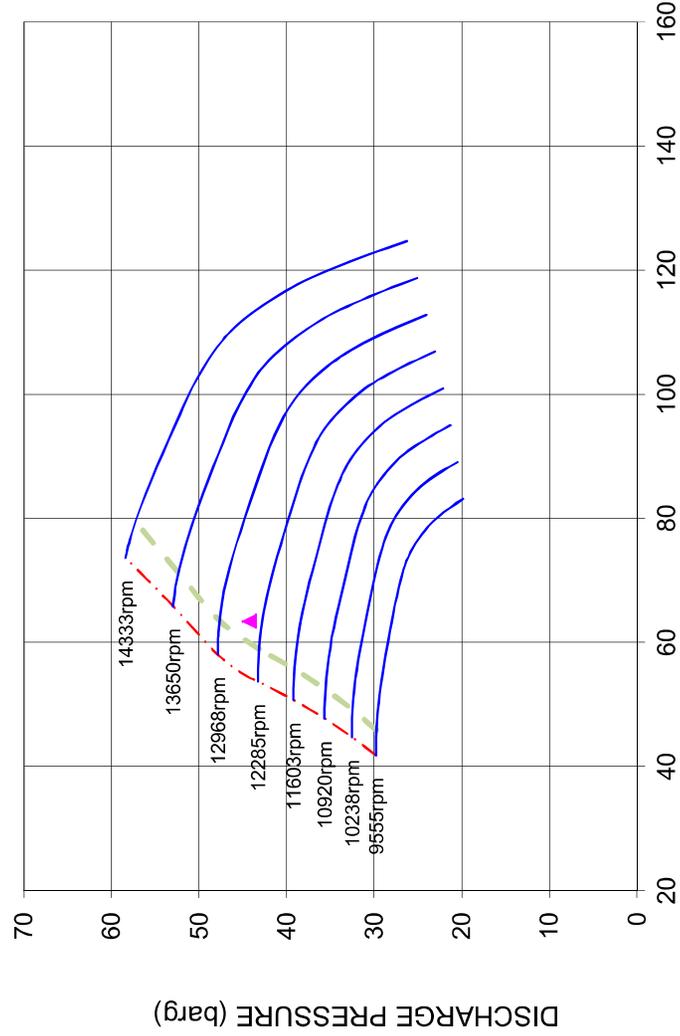
COMPRESSOR ENGINEERING SECTION

COMPRESSOR PERFORMANCE CURVE

Export Gas Compressor / Case3 (Section1)



SPEED (rpm)= 14333, 13650, 12968, 12285, 11603, 10920, 10238, 9555



INLET FLOW (MMSCFD)

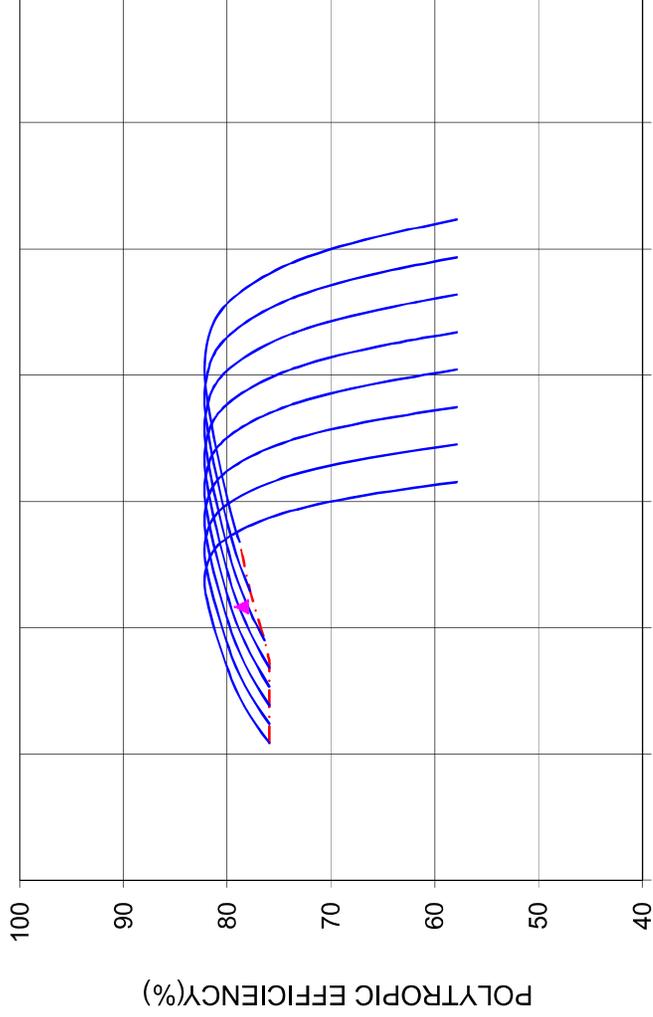
CONDITION: Ps= 15.50 barg, Ts= 39.3 deg.C, MW= 21.00



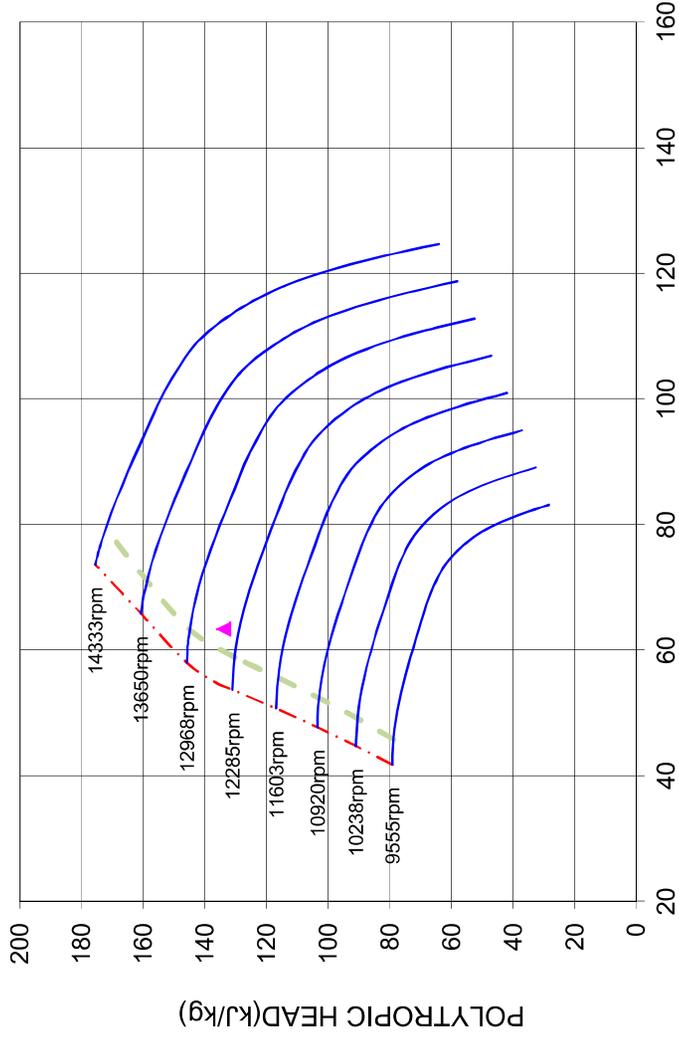
COMPRESSOR ENGINEERING SECTION

COMPRESSOR PERFORMANCE CURVE

Export Gas Compressor / Case3 (Section1)



SPEED (rpm)= 14333, 13650, 13650, 12968, 12285, 11603, 10920, 10238, 9555



INLET FLOW (MMSCFD)

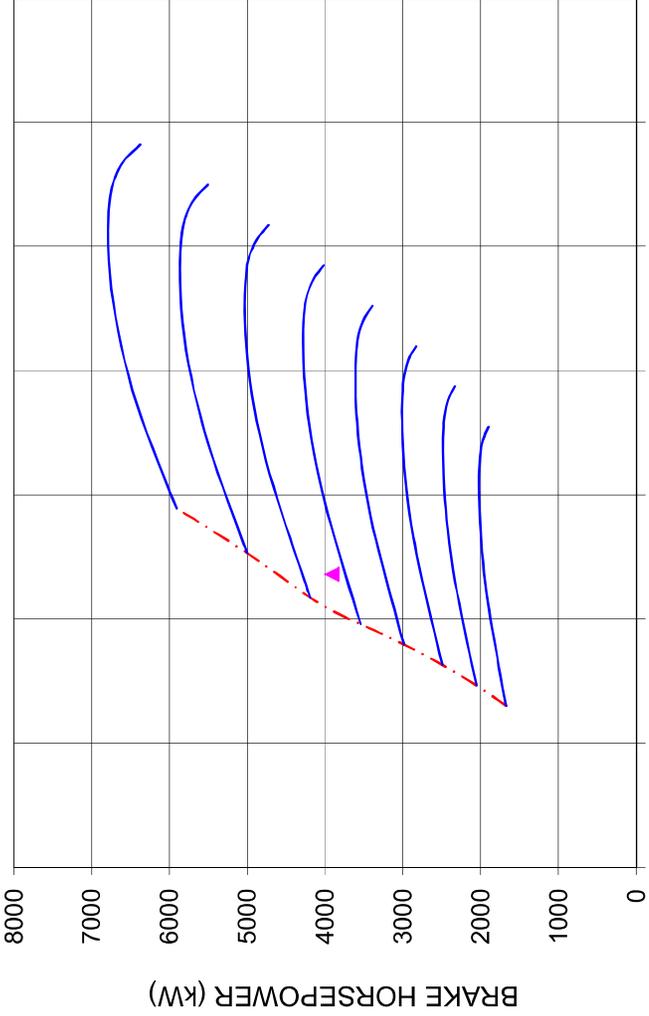
CONDITION: Ps= 15.50 barg, Ts= 39.3 deg.C, MW= 21.00



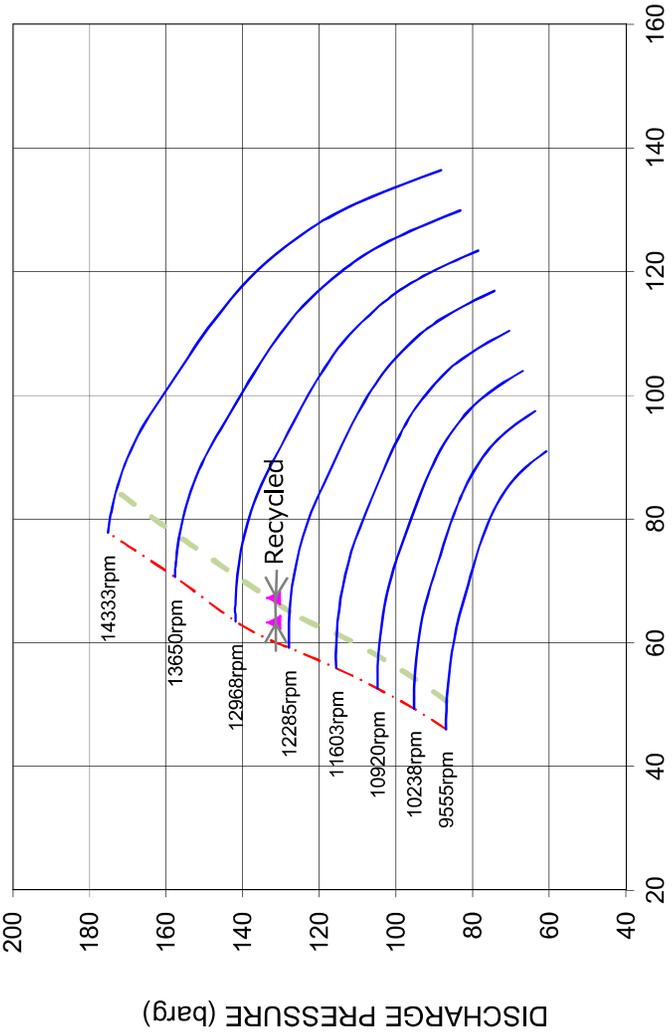
COMPRESSOR ENGINEERING SECTION

COMPRESSOR PERFORMANCE CURVE

Export Gas Compressor / Case3 (Section2)



SPEED (rpm)= 14333, 13650, 12968, 12285, 11603, 10920, 10238, 9555



INLET FLOW (MMSCFD)

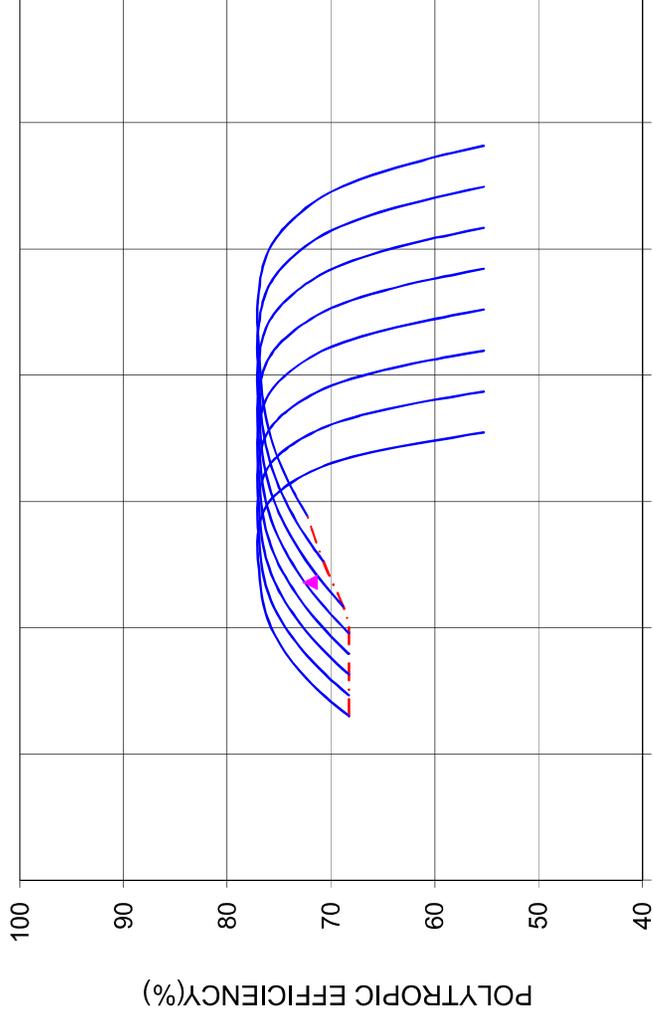
CONDITION: Ps= 43.31 barg, Ts= 44.8 deg.C, MW= 20.94



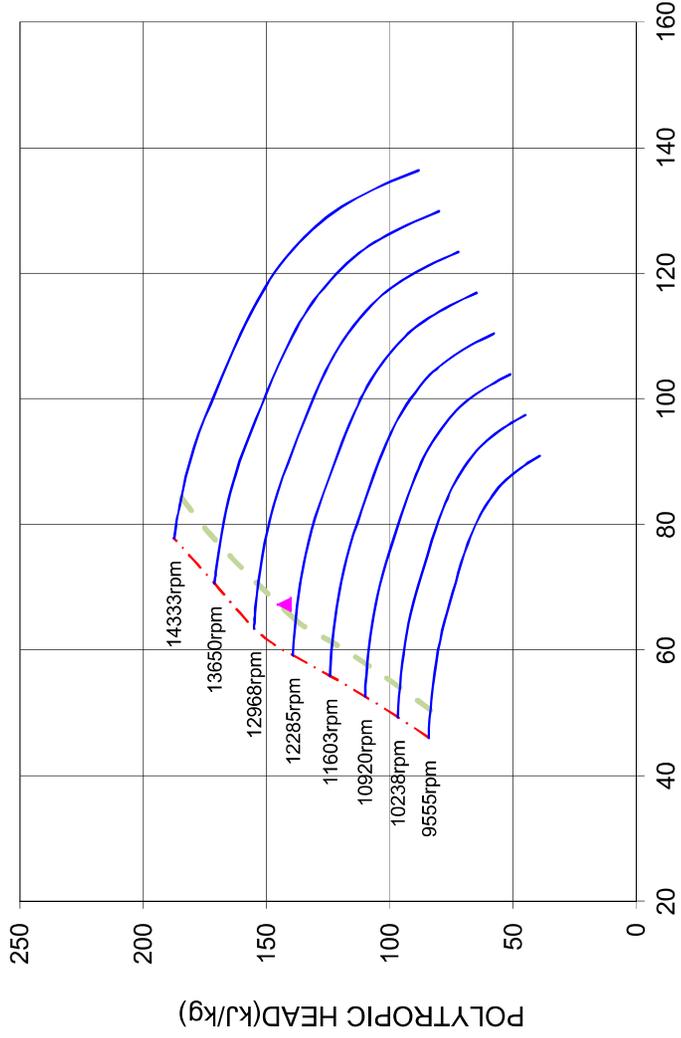
COMPRESSOR ENGINEERING SECTION

COMPRESSOR PERFORMANCE CURVE

Export Gas Compressor / Case3 (Section2)



SPEED (rpm)= 14333, 13650, 12968, 12285, 11603, 10920, 10238, 9555



INLET FLOW (MMSCFD)

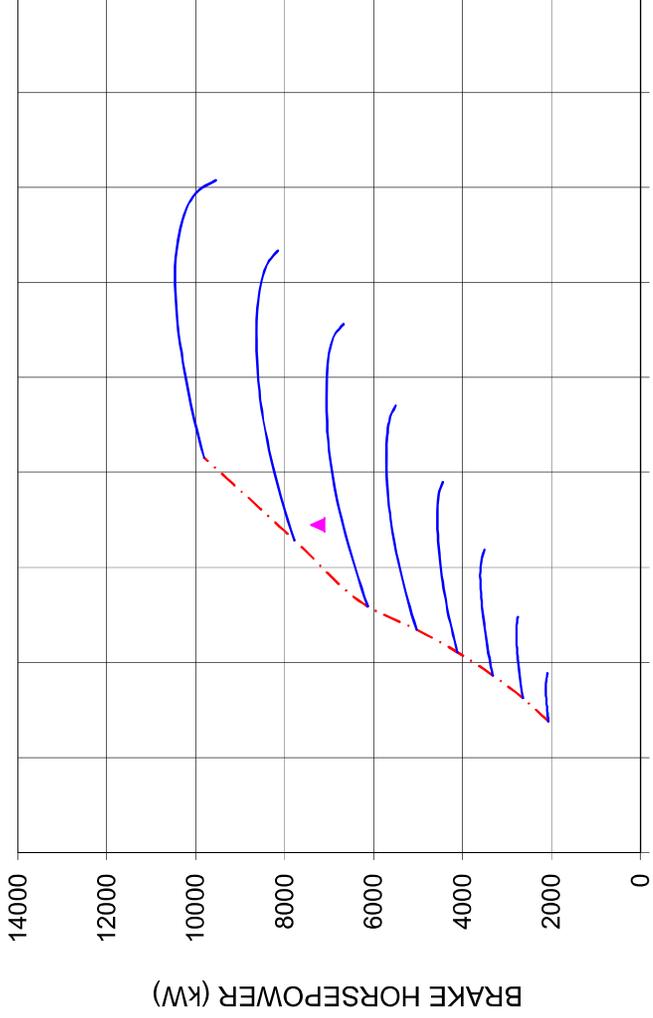
CONDITION: Ps= 43.31 barg, Ts= 44.8 deg.C, MW= 20.94



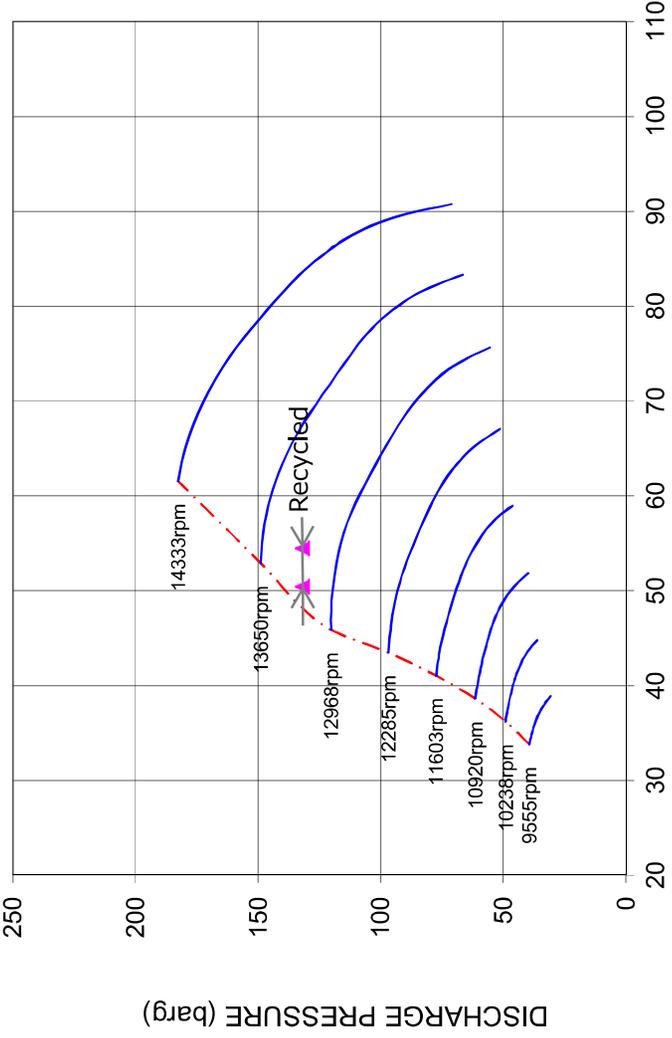
COMPRESSOR ENGINEERING SECTION

COMPRESSOR PERFORMANCE CURVE

Export Gas Compressor / Case4



SPEED (rpm)= 14333, 13650, 12968, 12285, 11603, 10920, 10238, 9555



INLET FLOW (MMSCFD)

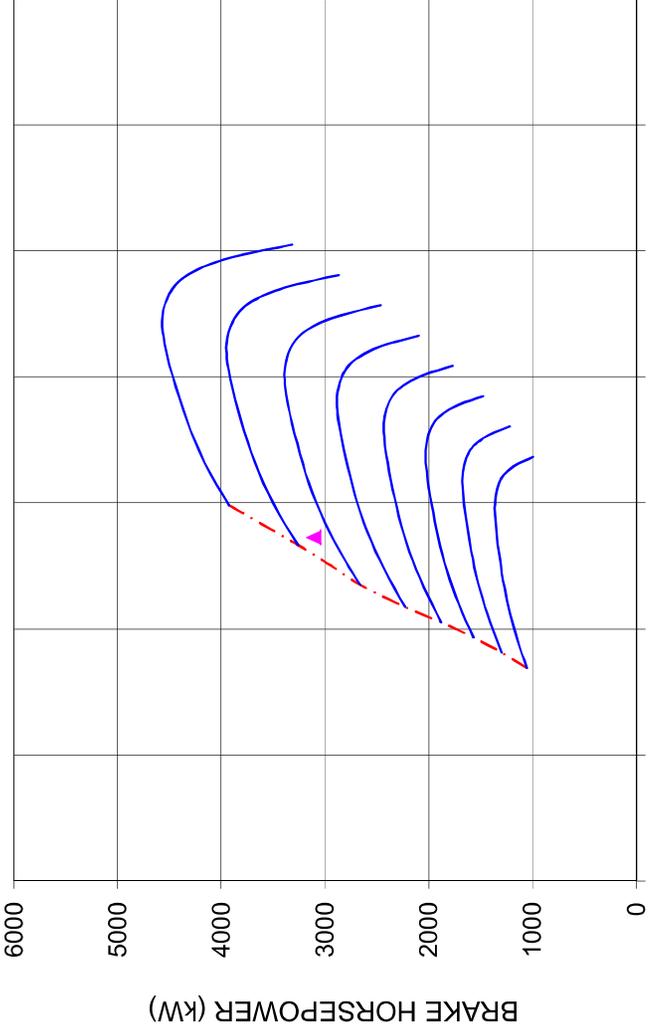
CONDITION: Ps= 12.50 barg, Ts= 39.2 deg.C, MW= 20.91



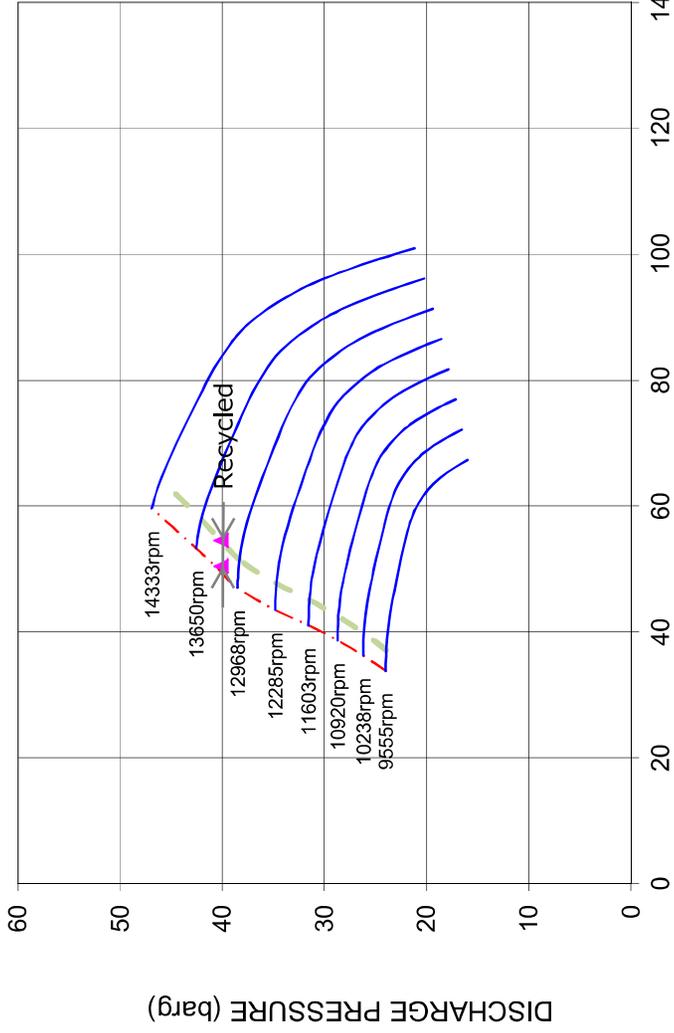
COMPRESSOR ENGINEERING SECTION

COMPRESSOR PERFORMANCE CURVE

Export Gas Compressor / Case4 (Section1)



SPEED (rpm)= 14333, 13650, 12968, 12285, 11603, 10920, 10238, 9555



INLET FLOW (MMSCFD)

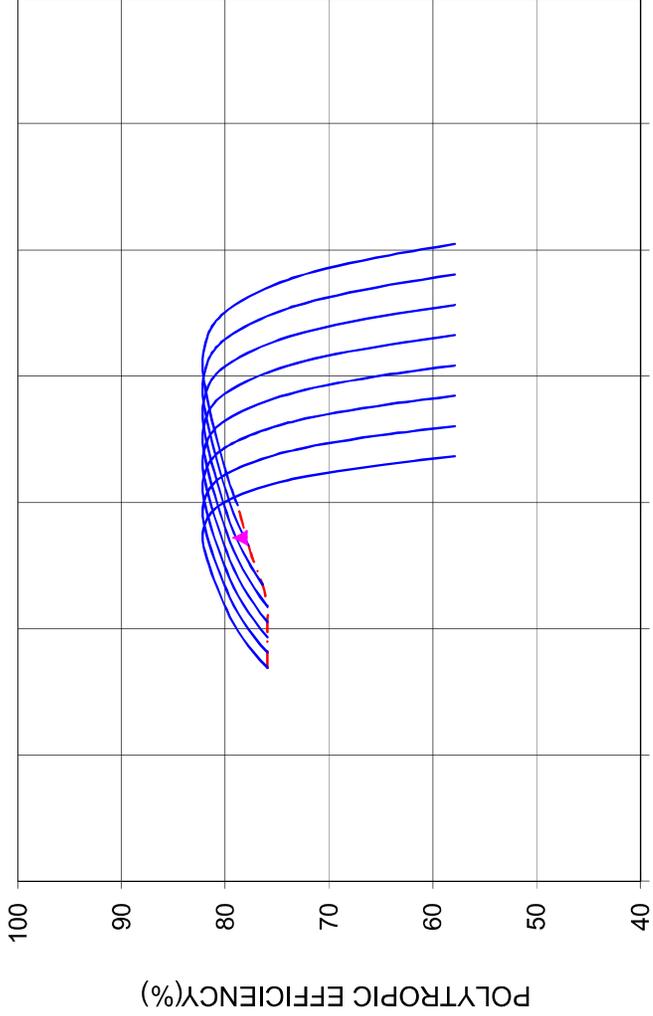
CONDITION: Ps= 12.50 barg, Ts= 39.2 deg.C, MW= 20.91



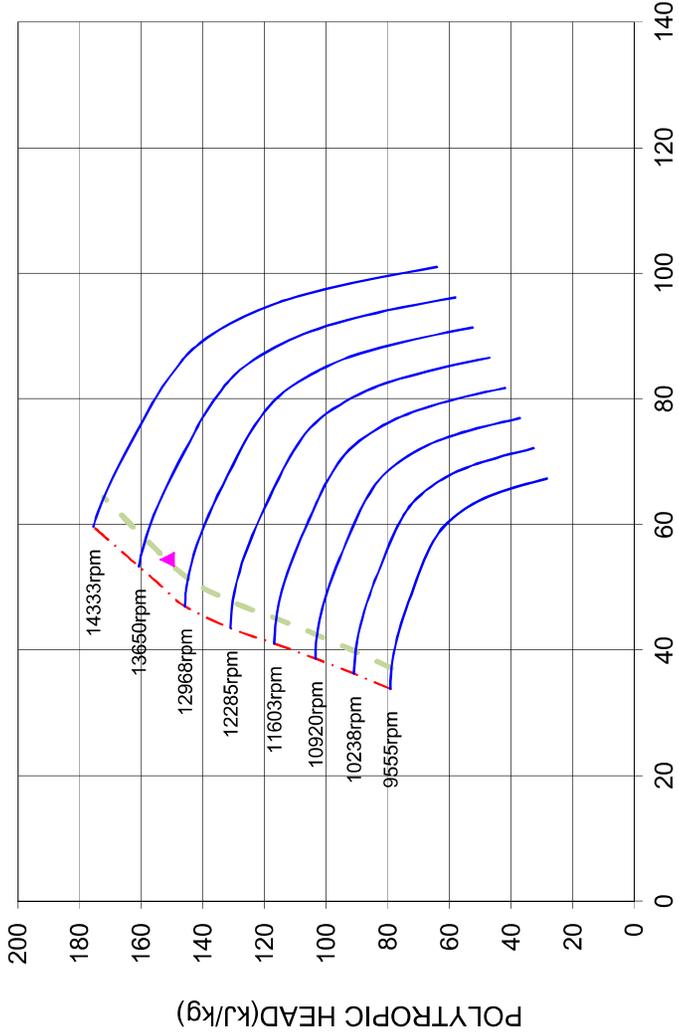
COMPRESSOR ENGINEERING SECTION

COMPRESSOR PERFORMANCE CURVE

Export Gas Compressor / Case4 (Section1)



SPEED (rpm)= 14333, 13650, 12968, 12285, 11603, 10920, 10238, 9555



INLET FLOW (MMSCFD)

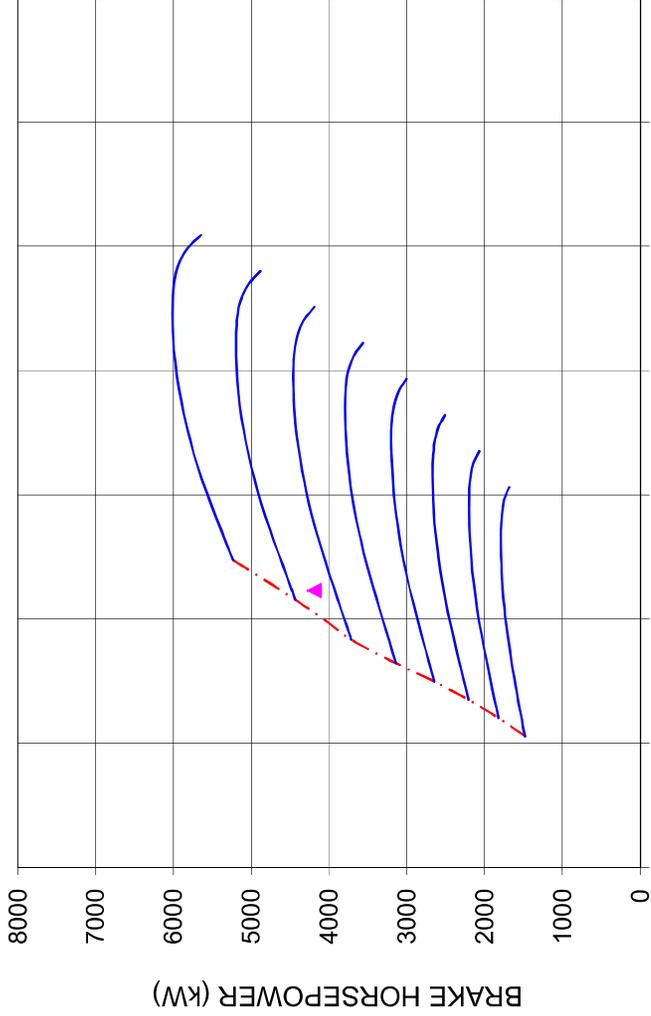
CONDITION: Ps= 12.50 barg, Ts= 39.2 deg.C, MW= 20.91



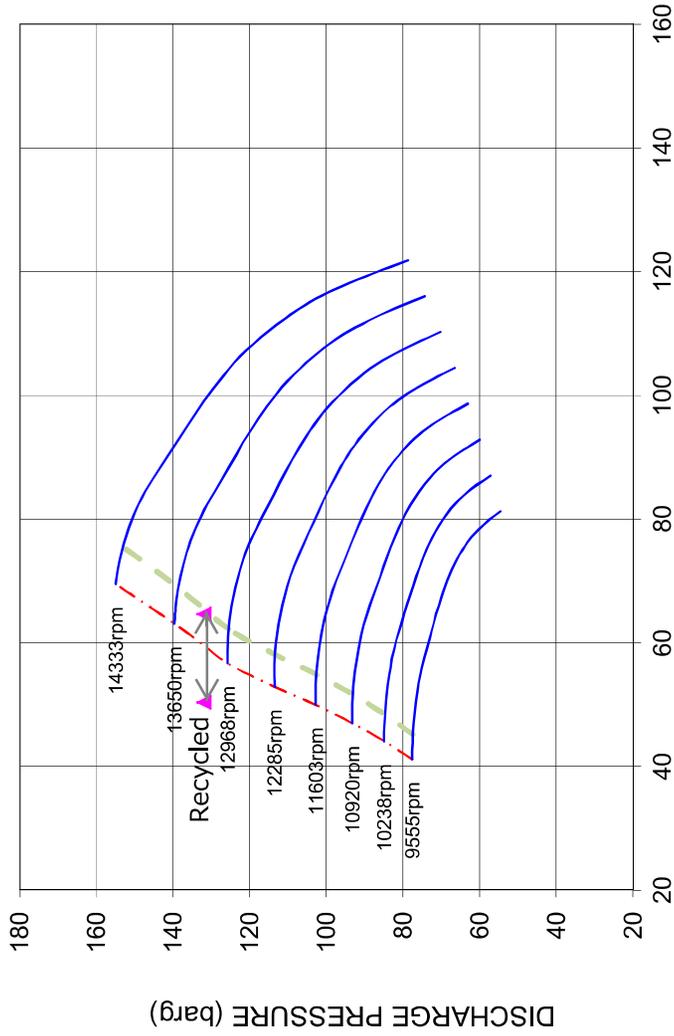
COMPRESSOR ENGINEERING SECTION

COMPRESSOR PERFORMANCE CURVE

Export Gas Compressor / Case4 (Section2)



SPEED (rpm)= 14333, 13650, 12968, 12285, 11603, 10920, 10238, 9555



INLET FLOW (MMSCFD)

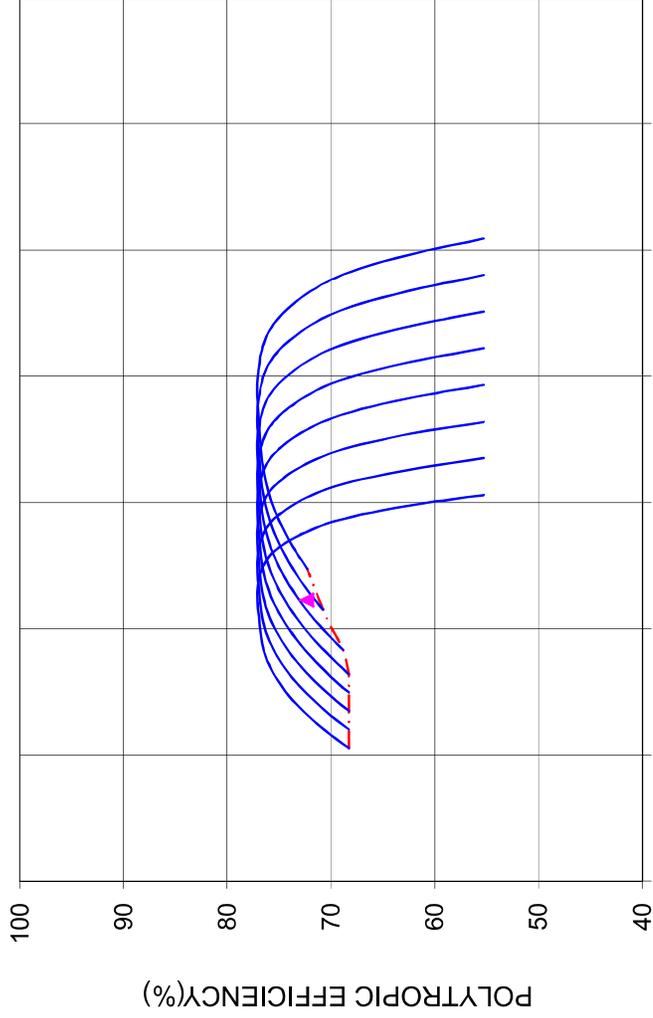
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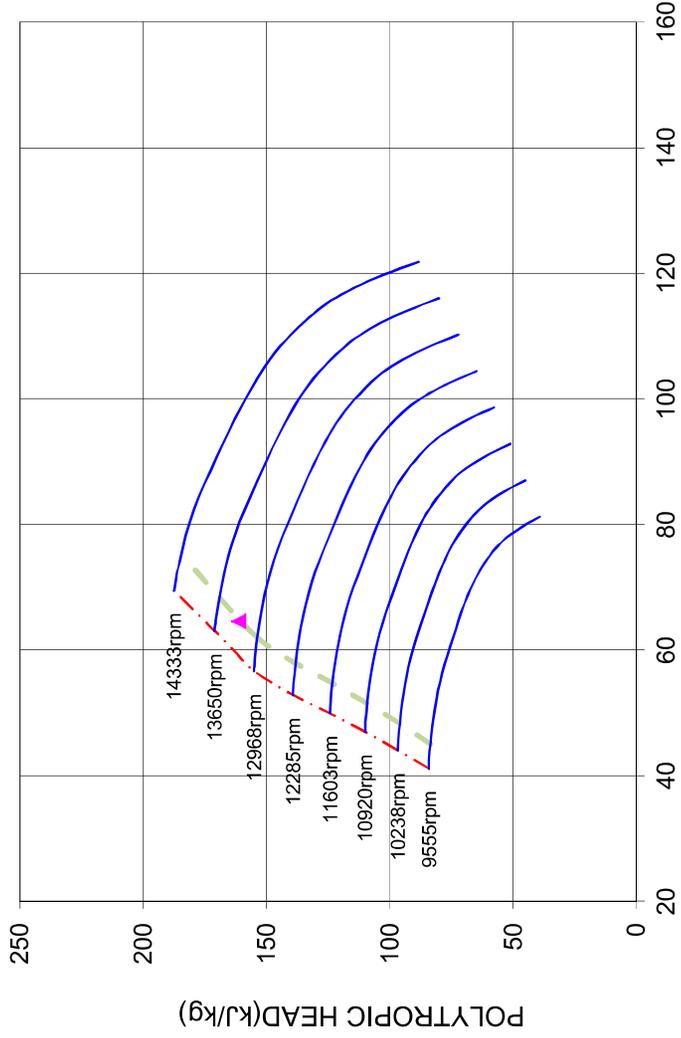
COMPRESSOR ENGINEERING SECTION

COMPRESSOR PERFORMANCE CURVE

Export Gas Compressor / Case4 (Section2)



SPEED (rpm)= 14333, 13650, 12968, 12285, 11603, 10920, 10238, 9555



INLET FLOW (MMSCFD)

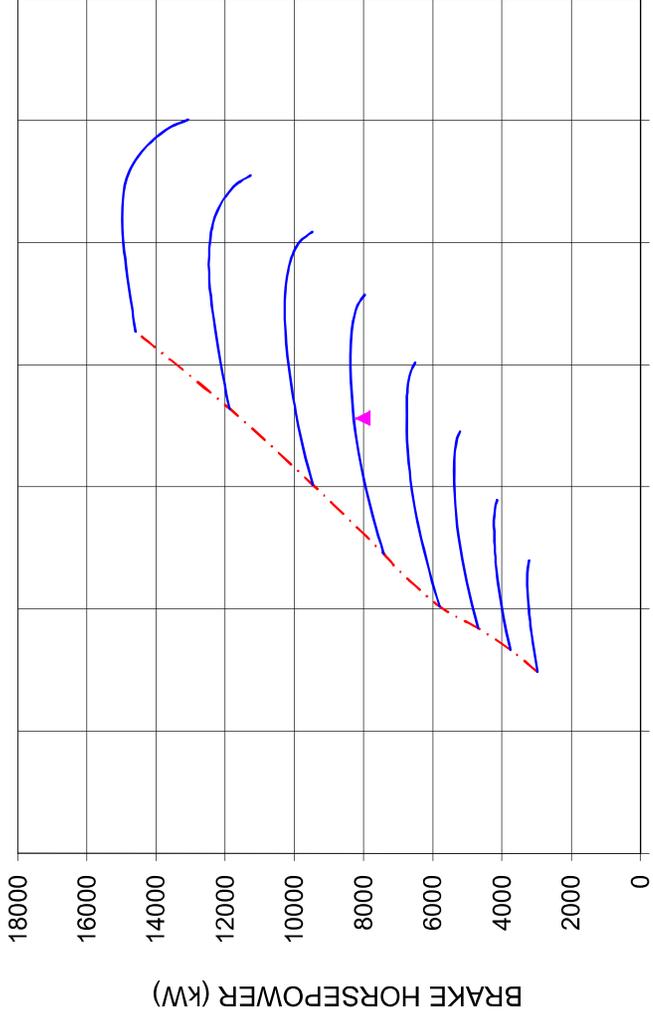
CONDITION: Ps= 39.13 barg, Ts= 44.8 deg.C, MW= 20.74



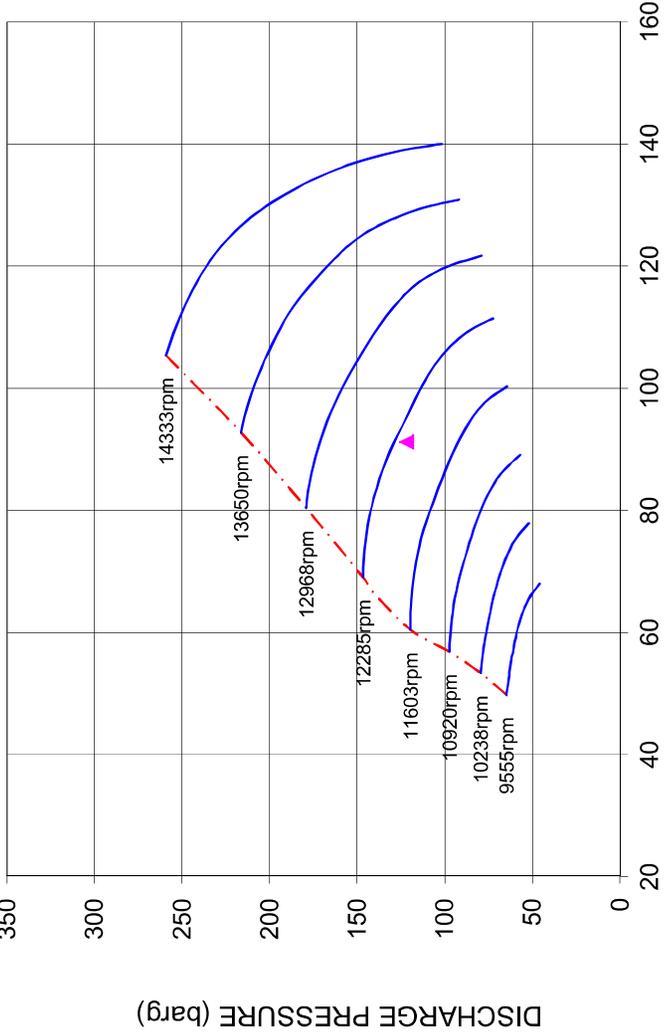
COMPRESSOR ENGINEERING SECTION

COMPRESSOR PERFORMANCE CURVE

Export Gas Compressor / Case5



SPEED (rpm)= 14333, 13650, 12968, 12285, 11603, 10920, 10238, 9555



INLET FLOW (MMSCFD)

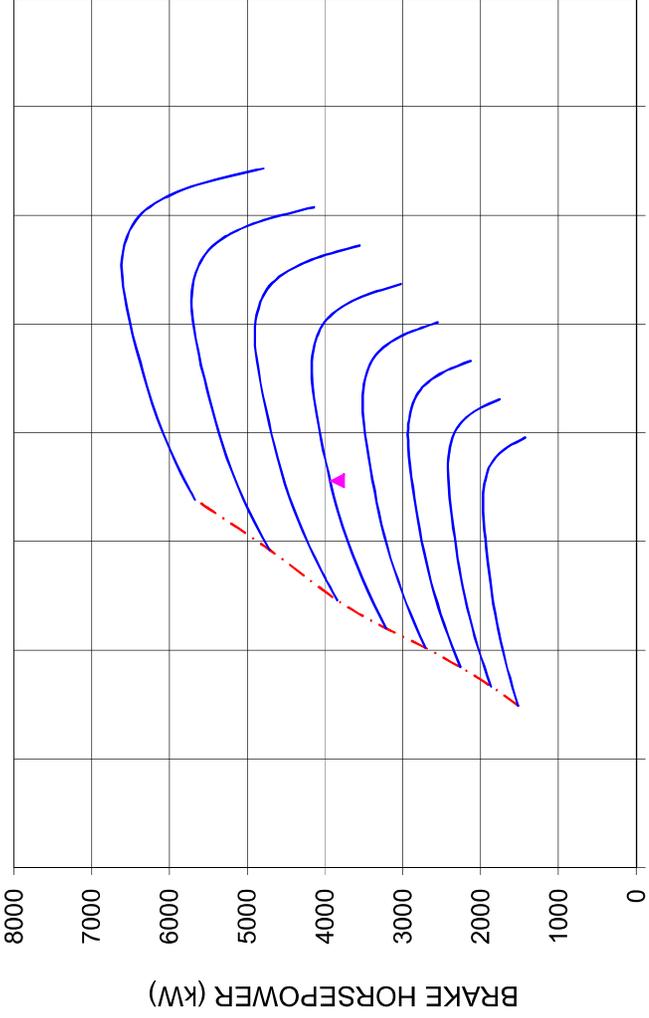
CONDITION: Ps= 18.50 barg, Ts= 39.3 deg.C, MW= 20.69



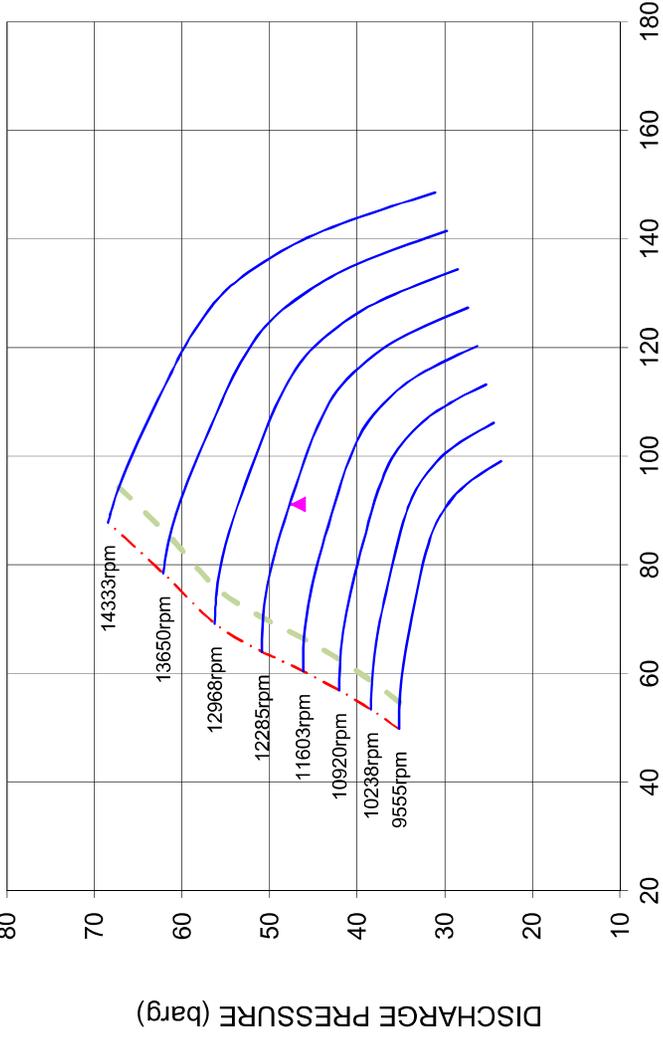
COMPRESSOR ENGINEERING SECTION

COMPRESSOR PERFORMANCE CURVE

Export Gas Compressor / Case5 (Section1)



SPEED (rpm)= 14333, 13650, 12968, 12285, 11603, 10920, 10238, 9555



INLET FLOW (MMSCFD)

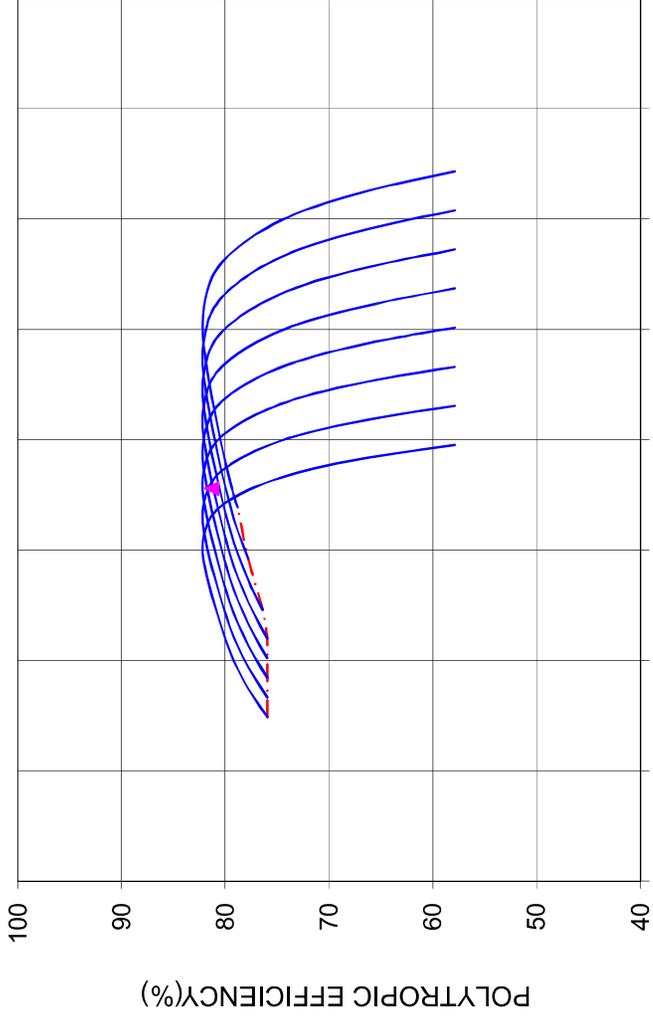
CONDITION: Ps= 18.50 barg, Ts= 39.3 deg.C, MW= 20.69



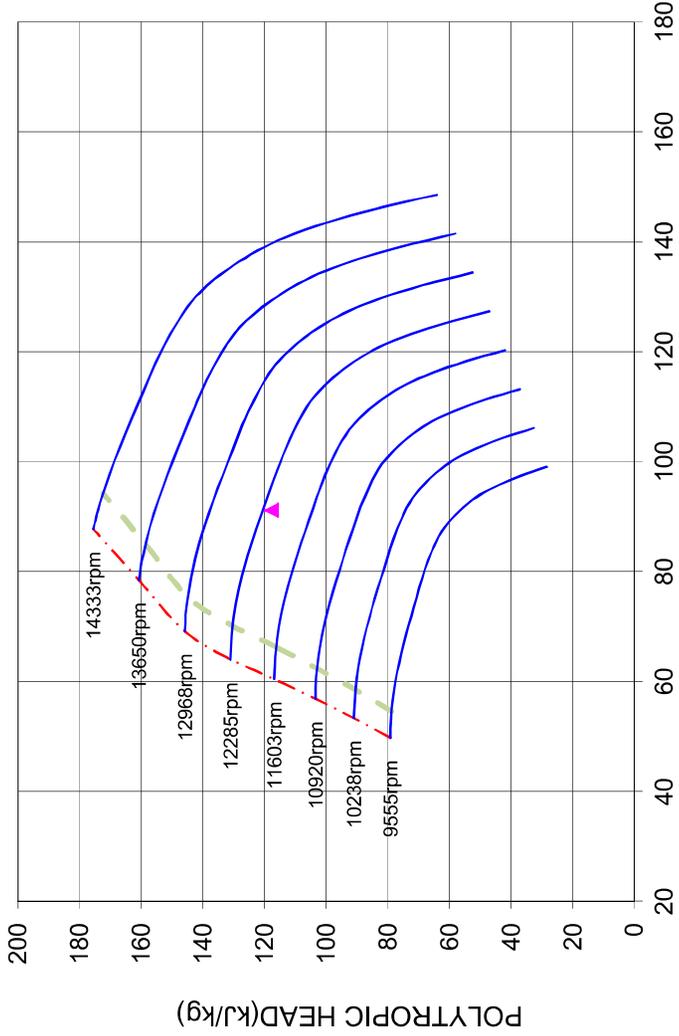
COMPRESSOR ENGINEERING SECTION

COMPRESSOR PERFORMANCE CURVE

Export Gas Compressor / Case5 (Section1)



SPEED (rpm)= 14333, 13650, 12968, 12285, 11603, 10920, 10238, 9555



INLET FLOW (MMSCFD)

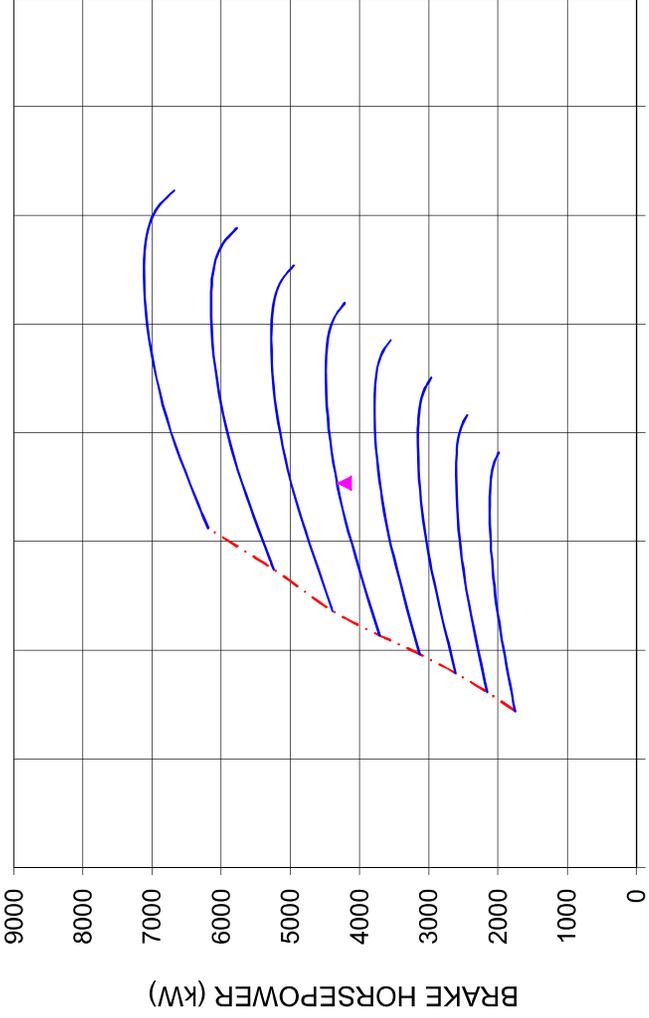
CONDITION: Ps= 18.50 barg, Ts= 39.3 deg.C, MW= 20.69



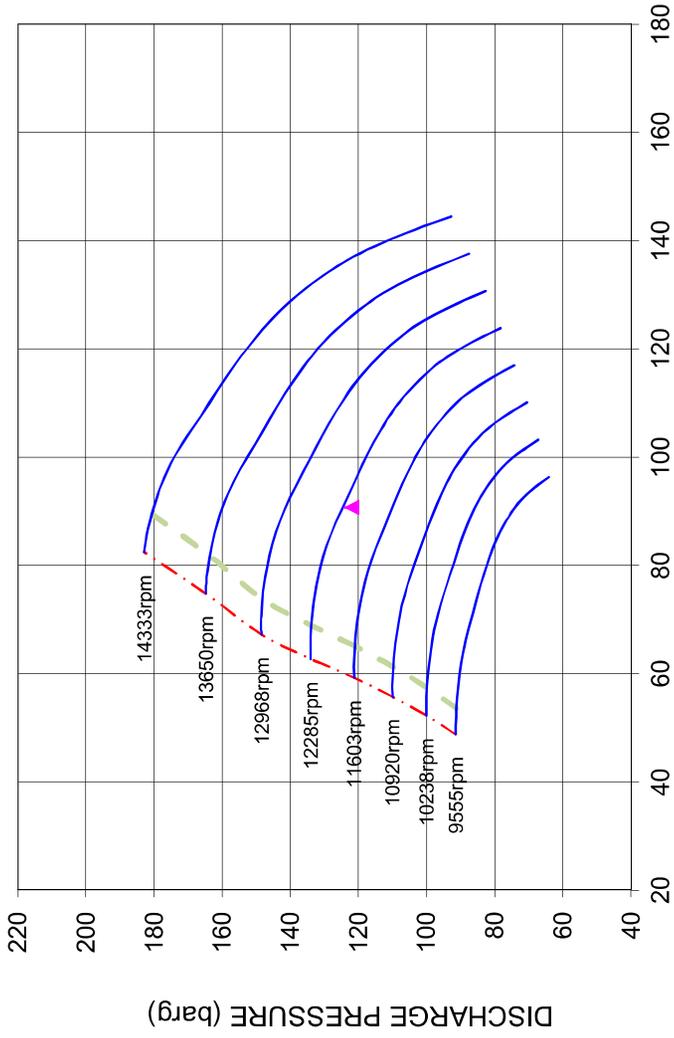
COMPRESSOR ENGINEERING SECTION

COMPRESSOR PERFORMANCE CURVE

Export Gas Compressor / Case5 (Section2)



SPEED (rpm)= 14333, 13650, 12968, 12285, 11603, 10920, 10238, 9555



INLET FLOW (MMSCFD)

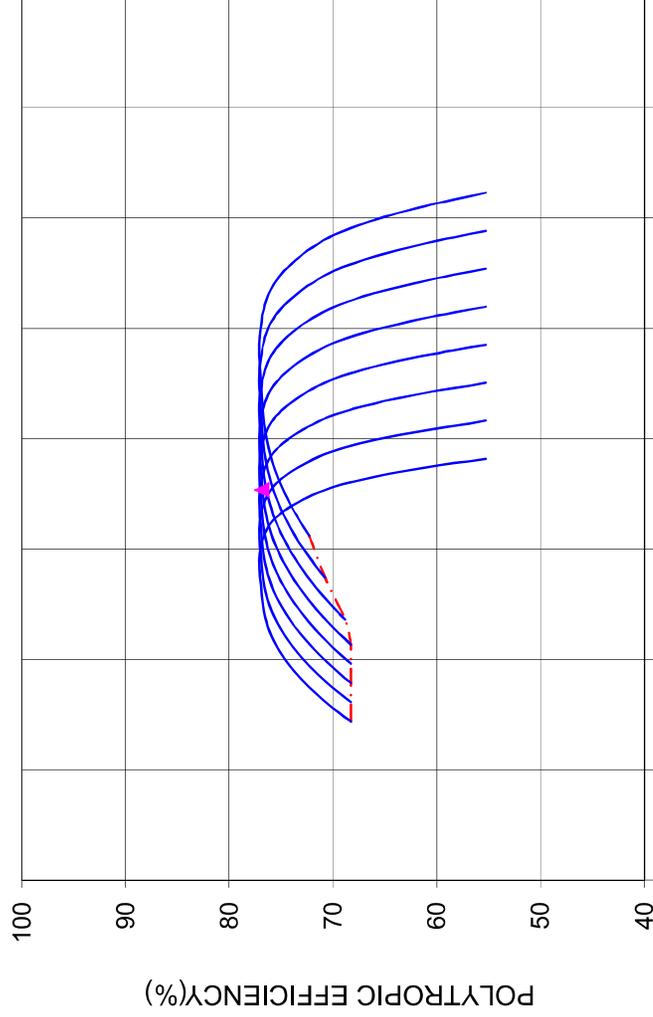
CONDITION: Ps= 45.79 barg, Ts= 44.8 deg.C, MW= 20.69



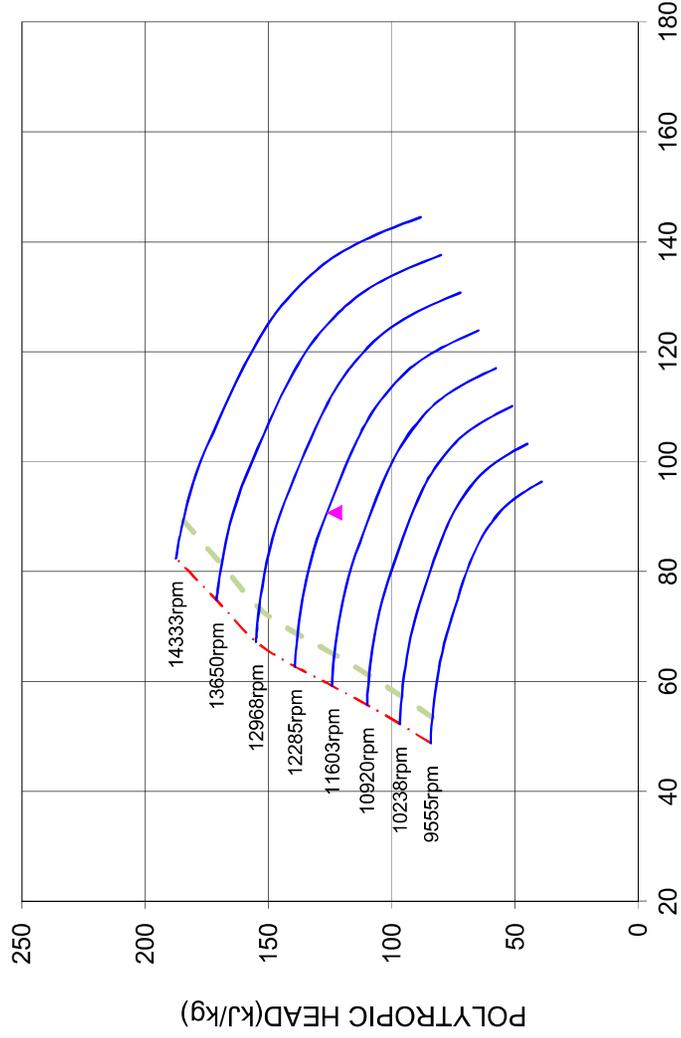
COMPRESSOR ENGINEERING SECTION

COMPRESSOR PERFORMANCE CURVE

Export Gas Compressor / Case5 (Section2)



SPEED (rpm)= 14333, 13650, 12968, 12285, 11603, 10920, 10238, 9555



INLET FLOW (MMSCFD)

CONDITION: Ps= 45.79 barg, Ts= 44.8 deg.C, MW= 20.69



COMPRESSOR ENGINEERING SECTION

Appendix 2 – OEM Datasheet

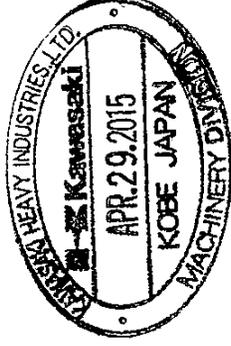
FOR APPROVAL



JX NIPPON OIL & GAS EXPLORATION (M) LIMITED
TH HEAVY ENGINEERING BERHAD

PROVISION OF EPCIC AND LEASING FOR
LAYANG FPSO FACILITIES
HP GAS COMPRESSOR

COMPRESSOR DATA SHEET



DELIVERY	ORDER No.	31F3224-10
THE 1E	NOTES	1. Issued for approval 2014/11/4
流込	REVISION	R1. Revised as per customer's comment and issued for Approval. 2015/4/28 T.I., S.S., X.K.
管理	CHECKED	J. Inai <i>jd.</i>
生管	DRAWN	T. Ito
検査	APPROVED	Y. Kurashiki
生技		
外注		
購買		
海調		
品証		
回覧		
控		
ISSUE	DRAWING No.	F3224-1060
	DATE	Nov. 4, 2014
	REV.	R1

Kawasaki
CENTRIFUGAL COMPRESSOR
DATA SHEET (API 617-7th Chapter 2)
SI UNITS (1-1.6.5)

JOB NO. 31F3224 ITEM NO. K-2430/K-2440 & K-2530/K-2540
PURCHASE ORDER NO. S3000060-1
INQUIRY NO. _____
REVISION NO. 1 DATE 31-Oct-14
PAGE 1-a OF 6 BY T. Ito

1 APPLICABLE TO PROPOSAL PURCHASE AS-BUILT
2 FOR Provision of EPIC and Leasing for Layang FPSO Facilities
3 SITE FPSO Layang
4 SERVICE Hydrocarbon Gas / Export Gas
5 CONTINUOUS INTERMITTENT STAND BY
6 MANUFACTURER Kawasaki Heavy Industries, Ltd. MODEL RB8-7B
7 INFORMATION TO BE COMPLETED: BY PURCHASER BY MANUFACTURER MUTUAL AGREEMENT (PRIOR TO PURCHASE)
8 **OPERATING CONDITIONS**

UNIT - SERIAL NO. 31F3224-A/B
NO. REQUIRED 2 (Two)
DRIVER TYPE (1-3.1.1) Electric Motor with VFD
DRIVER ITEM NO. -

(ALL DATA ON PER UNIT BASIS)

SECTION	DESIGN, GROUP 1 (CASE 1)		INITIAL LIFE, GROUP 2 (CASE 2)		INTERIM LIFE, GROUP 2 (CASE 3)	
	1st Section	2nd Section	1st Section	2nd Section	1st Section	2nd Section
● GAS HANDLED (ALSO SEE PAGE 2)	HC	HC	HC	HC	HC	HC
△ GAS PROPERTIES (1-2.1.1-1.4)						
● STANDARD VOLUME FLOW (MMSCFD) (1.013 BarA & 15.6 °C DRY)	91.2	91.1	75.9	75.9	63.4	67.2 *2
● WEIGHT FLOW (kg/h) (WET)	94,323	93,704	79,034	78,699	66,595	70,110
INLET CONDITIONS :						
● PRESSURE (BarG)*3	18.5	47.9	18.5	48.1	15.5	44.2
● TEMPERATURE (°C)	39.27	44.78	39.24	44.77	39.25	44.77
○ RELATIVE HUMIDITY (%)						
● MOLECULAR WEIGHT (WET)	20.69	20.65	20.82	20.82	21.00	20.94
■ Cp/Cv (K ₁)	1.304	1.420	1.304	1.422	1.291	1.404
■ COMPRESSIBILITY (Z ₁)	0.941	0.870	0.941	0.868	0.949	0.876
■ ACTUAL INLET VOLUME (m ³ /h) (WET)	5,714	2,133	4,754	1,765	4,732	1,715
DISCHARGE CONDITIONS :						
● PRESSURE (BarG)	48.9	132.0	49.1	132.0	45.2	132.0
■ TEMPERATURE (°C)	116.2	137.0	116.7	137.3	123.9	146.6
■ Cp/Cv (K ₂)	1.296	1.382	1.296	1.382	1.280	1.364
■ COMPRESSIBILITY (Z ₂)	0.938	0.913	0.938	0.912	0.945	0.920
■ GAS POWER REQUIRED (kW)	3,953	4,511	3,315	3,787	3,099	3,766
■ TRAIN BRAKE POWER REQUIRED (kW)	8,516 *1		7,152		6,918	
■ BRAKE POWER REQUIRED AT DRIVER INCL. EXT. LOSSES (kW)						
■ SPEED (RPM)	12,707		12,342		12,654	
■ ESTIMATED SURGE (MMSCFD) (AT ABOVE SPEED)	62.9	64.2	60.2	61.6	54.0	60.8
■ POLYTROPIC HEAD (kJ/kg)	124	129	124	127	136	140
■ POLYTROPIC EFFICIENCY (%)	82.2	74.3	82.0	73.3	81.3	72.3
● CERTIFIED POINT	YES					
■ PERFORMANCE CURVE NUMBER						

PROCESS CONTROL (1-3.4.2.1) ;
METHOD : SUCTION THROTTLING VARIABLE INLET SPEED VARIATION DISCHARGE COOLED BYPASS
FROM _____ BarA GUIDE VANE BLOWOFF FROM _____ TO _____
TO _____ BarA (2-2.4.1) TO _____ TO _____
(100% = 13,650 rpm)

SIGNAL: ● SOURCE (1-3.4.2.1)
TYPE ● ELECTRONIC ○ PNEUMATIC ○ OTHER
RANGE **4 - 20** mA BarA

ANTI-SURGE SYSTEM (1-3.4.2.2) ○ MANUAL ● AUTOMATIC ○ NONE

REMARKS

*1. KHI will guarantee this power with +4% API tolerance.
*2. Recycled @ surge flow+10%. Customer specified flow is 63.3 MMSCFD. (3.9 MMSCFD Recycled.)
*3. 1.0 bar pressure drop is considered between 1st & 2nd section.

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JOB NO. 31F3224 ITEM NO. K-2430/K-2440 & K-2530/K-2540
 PURCHASE ORDER NO. S3000060-1
 INQUIRY NO. -
 REVISION NO. 1 DATE 31-Oct-14
 PAGE 1-b OF 6 BY T. Ito

1 APPLICABLE TO PROPOSAL PURCHASE AS-BUILT
 2 FOR Provision of EPIC and Leasing for Layang FPSO Facilities
 3 SITE FPSO Layang
 4 SERVICE Hydrocarbon Gas / Export Gas
 5 CONTINUOUS INTERMITTENT STAND BY
 6 MANUFACTURER Kawasaki Heavy Industries, Ltd. MODEL RB8-7B
 7 INFORMATION TO BE COMPLETED: BY PURCHASER BY MANUFACTURER MUTUAL AGREEMENT (PRIOR TO PURCHASE)
 8 **OPERATING CONDITIONS**

(ALL DATA ON PER UNIT BASIS)

SECTION	END OF FIELD LIFE, GROUP 1 (CASE 4)		REFERENCE CASE (CASE 5)	
	1st Section	2nd Section	1st Section	2nd Section
HC	HC	HC	HC	HC
52.9 *1	67.4 *2	91.2	91.1	
55,413	69,682	94,323	93,703	
12.5	40.2	18.5	46.4	
39.20	44.77	39.3	44.8	
20.91	20.74	20.69	20.65	
1.280	1.385	1.304	1.413	
0.958	0.888	0.941	0.874	
4,880	1,914	5,714	2,210	
41.2	132.0	47.4	122.0	
134.0	156.2	113.6	132.4	
1.264	1.346	1.296	1.380	
0.954	0.931	0.938	0.910	
2,960	4,192	3,815	4,283	
	7,211		8,148	
	13,650		12,540	
47.9	61.0	61.8	60.4	
155	157	120	122	
80.5	72.5	82.1	74.3	

9 **INLET CONDITIONS :**
 10 PRESSURE (BarG)^{*3}
 11 TEMPERATURE (°C)
 12 RELATIVE HUMIDITY (%)
 13 MOLECULAR WEIGHT (WET)
 14 Cp/Cv (K₁)
 15 COMPRESSIBILITY (Z₁)
 16 ACTUAL INLET VOLUME (m³/h) (WET)
 17 **DISCHARGE CONDITIONS :**
 18 PRESSURE (BarG)
 19 TEMPERATURE (°C)
 20 Cp/Cv (K₂)
 21 COMPRESSIBILITY (Z₂)
 22 GAS POWER REQUIRED (kW)
 23 TRAIN BRAKE POWER REQUIRED (kW)
 24 BRAKE POWER REQUIRED AT DRIVER INCL. EXT. LOSSES (kW)
 25 SPEED (RPM)
 26 ESTIMATED SURGE (MMSCFD) (AT ABOVE SPEED)
 27 POLYTROPIC HEAD (kJ/kg)
 28 POLYTROPIC EFFICIENCY (%)
 29 CERTIFIED POINT
 30 PERFORMANCE CURVE NUMBER
 31 **PROCESS CONTROL (1-3.4.2.1) ;**
 32 METHOD : SUCTION THROTTLING VARIABLE INLET SPEED VARIATION DISCHARGE COOLED BYPASS
 33 FROM BarA TO BarA FROM 70 % BLOWOFF TO 105 %
 34 (2-2.4.1) (100% = 13,650 rpm)
 35 SIGNAL: SOURCE (1-3.4.2.1) OTHER
 36 TYPE ELECTRONIC PNEUMATIC NONE
 37 RANGE 4 - 20 mA BarA
 38 ANTI-SURGE SYSTEM (1-3.4.2.2) MANUAL AUTOMATIC NONE

50 **REMARKS**

51 *1. Recycled @ surge flow+10%. Customer specified flow is 50.4 MMSCFD. (3.4 MMSCFD Recycled.)
 52 *2. Recycled @ surge flow+10%. Customer specified flow is 50.2 MMSCFD. (17.2 MMSCFD Recycled.)
 53 *3. 1.0 bar pressure drop is considered between 1st & 2nd section.
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Kawasaki
CENTRIFUGAL COMPRESSOR
DATA SHEET (API 617-7th Chapter 2)
SI UNITS (1-1.6.5)

JOB NO. 31F3224 ITEM NO. K-2430/K-2440 & K-2530/K-2540
PURCHASE ORDER NO. S3000060-1
INQUIRY NO. -
REVISION NO. 1 DATE 31-Oct-14
PAGE 2-a OF 6 BY T. Ito

OPERATING CONDITIONS (Continued) (1-2.1.1.1) (1-3.1.2) (1-3.1.3)

GAS ANALYSIS :	DESIGN, GROUP 1 (CASE 1)		INTERIM LIFE, GROUP 2 (CASE 2)		INTERIM LIFE, GROUP 2 (CASE 3)		REMARKS :
	1st Section	2nd Section	1st Section	2nd Section	1st Section	2nd Section	
● MOL % ○ WEIGHT %	HC	HC	HC	HC	HC	HC	
AIR							
OXYGEN							
NITROGEN	0.0037	0.0037	0.0037	0.0038	0.0038	0.0038	
WATER VAPOR	0.0039	0.0003	0.0039	0.0045	0.0003	0.0003	
CARBON MONOXIDE							
CARBON DIOXIDE	0.0146	0.0146	0.0182	0.0178	0.0178	0.0179	(1-2.2.1.6)
HYDROGEN SULFIDE							(1-2.2.1.9)
HYDROGEN							
METHANE	0.8340	0.8377	0.8267	0.8300	0.8222	0.8268	
ETHYLENE							
ETHANE	0.0528	0.0530	0.0550	0.0553	0.0561	0.0563	
PROPYLENE							
PROPANE	0.0528	0.0530	0.0553	0.0555	0.0560	0.0562	
IBUTANE	0.0103	0.0103	0.0102	0.0102	0.0104	0.0104	
n.BUTANE	0.0738	0.0738	0.0735	0.0735	0.0739	0.0739	
i.PENTANE	0.0045	0.0044	0.0040	0.0040	0.0043	0.0043	
n.PENTANE	0.0035	0.0034	0.0031	0.0031	0.0034	0.0033	
HEXANE PLUS	0.0061	0.0058	0.0064	0.0062	0.0076	0.0068	
TOTAL	1.00	1.00	1.00	1.00	1.00	1.00	
AVG. MOLECULAR WEIGHT	20.69	20.65	20.82	20.82	21.00	20.94	

LOCATION (1-2.1.8) :
 INDOOR ● OUTDOOR ○ GRADE
 HEATED ● UNDER ROOF ○ MEZANINE
 UNHEATED ● PARTIAL SIDES ○
 ● ELECTRICAL AREA CLASSIFICATION (1-2.1.14) _____
 ZONE 2 GROUP IIA TEMP. CLASS T3
 WINTERIZATION REQD ○ TROPICALIZATION REQD

SITE DATA (1-2.1.8) :
 ● ELEVATION 20 m BAROMETER _____ BarA
 ● RANGE OF AMBIENT TEMPERATURES _____
 DRY BULB _____ WET BULB _____
 NORMAL °C _____
 MAXIMUM °C 35
 MINIMUM °C 17
 DESIGN °C 40 / 17

UNUSUAL CONDITIONS : ○ DUST ○ FUMES
 ● OTHER (1-2.1.8) Saliferous, Offshore Marine, Ship Motion
 ● COPPER AND COPPER ALLOYS PROHIBITED (1-2.2.1.14) _____

COATING (1-2.2.1.16) :
 ROTATING COMPONENTS N/A
 STATIONARY COMPONENTS N/A

APPLICABLE SPECIFICATIONS :
 API617, 7TH CHAPTERS 1 & 2
 ● VENDOR HAVING UNIT RESPONSIBILITY (1-1.5.52)(1-1.8) (1-2.1.5)
Compressor Vendor / Kawasaki Heavy Industries
 GOVERNING SPECIFICATION (IF DIFFERENT) _____

PAINTING :
 ● MANUFACTURER'S STANDARD
 OTHER _____

SHIPMENT (1-4.4) :
 DOMESTIC ● EXPORT ○ EXPORT BOXING REQUIRED
 ● OUTDOOR STORAGE MORE THAN 6 MONTHS (1-4.4.1) 6 MONTHS
 SPARE ROTOR ASSEMBLY PACKAGED (1-4.4.3.10)
 HORIZONTAL STORAGE ● VERTICAL STORAGE

NOISE SPECIFICATIONS (1-2.1.9) :
 APPLICABLE TO MACHINE : _____
 SEE SPECIFICATION _____
 APPLICABLE TO NEIGHBORHOOD : _____
 SEE SPECIFICATION _____

ACOUSTIC HOUSING : ○ YES ● NO
 *1 SOUND LEVEL 85 dB(A) @ 1 m

REMARKS

*1. Expected sound level of each equipment.

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Kawasaki
CENTRIFUGAL COMPRESSOR
DATA SHEET (API 617-7th Chapter 2)
SI UNITS (1-1.6.5)

JOB NO. 31F3224 ITEM NO. K-2430/K-2440 & K-2530/K-2540
PURCHASE ORDER NO. S3000060-1
INQUIRY NO. -
REVISION NO. 1 DATE 31-Oct-14
PAGE 2-b OF 6 BY T. Ito

OPERATING CONDITIONS (Continued) (1-2.1.1.1) (1-3.1.2) (1-3.1.3)

	GAS ANALYSIS :		END OF FIELD LIFE GROUP 1 (CASE A)		REMARKS :
	● MOL %	○ WEIGHT %	1st Section	2nd Section	
5	AIR		MW	HC	HC
6	OXYGEN	28.966			
7	NITROGEN	32.000			
8	WATER VAPOR	28.016	0.0035	0.0037	0.0037
9	CARBON MONOXIDE	18.016	0.0055	0.0003	0.0003
10	CARBON DIOXIDE	28.010			
11	HYDROGEN SULFIDE	44.010	0.0149	0.0150	0.0146
12	HYDROGEN	34.076			(1-2.2.1.6)
13	METHANE	2.016			(1-2.2.1.9)
14	ETHYLENE	16.042	0.8293	0.8362	0.8340
15	ETHANE	28.052	0.0518	0.0521	0.0528
16	PROPYLENE	30.068			
17	PROPANE	42.078	0.0537	0.0537	0.0528
18	IBUTANE	44.094	0.0107	0.0107	0.0103
19	n.BUTANE	58.120	0.0145	0.0143	0.0138
20	i.PENTANE	58.120	0.0048	0.0046	0.0044
21	n.PENTANE	72.146	0.0037	0.0036	0.0034
22	HEXANE PLUS	72.146	0.0076	0.0060	0.0058
23					
24					
25	TOTAL		1.00	1.00	1.00
26	AVG. MOLECULAR WEIGHT		20.91	20.74	20.69
27	NOISE SPECIFICATIONS (1-2.1.9):				20.65

LOCATION (1-2.1.8):
 INDOOR OUTDOOR GRADE
 HEATED UNDER ROOF MEZANINE
 UNHEATED PARTIAL SIDES
 ELECTRICAL AREA CLASSIFICATION (1-2.1.14)
 ZONE 2 GROUP IIA TEMP. CLASS T3
 WINTERIZATION REQD TROPICALIZATION REQD

SITE DATA (1-2.1.8):
 ELEVATION 20 m BAROMETER _____ BarA
 RANGE OF AMBIENT TEMPERATURES
 DRY BULB _____ WET BULB _____
 NORMAL _____ °C
 MAXIMUM _____ °C 35
 MINIMUM _____ °C 17
DESIGN _____ °C 40 / 17

UNUSUAL CONDITIONS : DUST FUMES
 OTHER (1-2.1.8) Saliferous, Offshore Marine, Ship Motion
 COPPER AND COPPER ALLOYS PROHIBITED (1-2.2.1.14)

COATING (1-2.2.1.16):
 ROTATING COMPONENTS N/A
 STATIONARY COMPONENTS N/A

ACOUSTIC HOUSING : YES NO
 *1 SOUND LEVEL 85 dB(A) @ 1 m

APPLICABLE SPECIFICATIONS :
 API617, 7TH CHAPTERS 1 & 2
 VENDOR HAVING UNIT RESPONSIBILITY (1-1.5.52) (1-1.8) (1-2.1.5)
Compressor Vendor / Kawasaki Heavy Industries
 GOVERNING SPECIFICATION (IF DIFFERENT)

PAINTING :
 MANUFACTURER'S STANDARD
 OTHER _____

SHIPMENT (1-4.4):
 DOMESTIC EXPORT EXPORT BOXING REQUIRED
 OUTDOOR STORAGE MORE THAN 6 MONTHS (1-4.4.1) 6 MONTHS
 SPARE ROTOR ASSEMBLY PACKAGED (1-4.4.3.10)
 HORIZONTAL STORAGE VERTICAL STORAGE

REMARKS

*1. Expected sound level of each equipment.



CENTRIFUGAL COMPRESSOR
DATA SHEET (API 617-7th Chapter 2)
SI UNITS (1-1.6.5)

Kawasaki Heavy Industries, Ltd.

JOB NO. 31F3224 ITEM NO. K-2430/K-2440 & K-2530/K-2540
 PURCHASE ORDER NO. S3000060-1
 INQUIRY NO. -
 REVISION NO. 1 DATE 31-Oct-14
 PAGE 3-a OF 6 BY T. Ito

CONSTRUCTION FEATURES

HP Gas Compressor RB8-7B

- 1 **SPEEDS:**
- 2 MAX CONTINUOUS 14333 rpm TRIP 14476 rpm
- 3 MAX TIP SPEED 313 m/s @ 100% SPEED
- 4 329 m/s @ MAX CONTINUOUS SPEED
- 5 **LATERAL CRITICAL SPEEDS (DAMPED):**
- 6 FIRST CRITICAL 5600 rpm 1st Bending MODE
- 7 SECOND CRITICAL 21200 rpm 2nd Bending MODE
- 8 THIRD CRITICAL N/A rpm - MODE
- 9 FOURTH CRITICAL N/A rpm - MODE
- 10 **TORSIONAL CRITICAL SPEEDS:**
- 11 FIRST CRITICAL 779 rpm
- 12 SECOND CRITICAL 3670 rpm
- 13 THIRD CRITICAL 21347 rpm
- 14 FOURTH CRITICAL 34681 rpm
- 15 LATERAL ANALYSIS ADDITIONAL REQUIREMENTS (1-2.6.2.14)
- 16 TRAIN LATERAL ANALYSIS REQUIRED (1-2.6.2.6)
- 17 TRAIN TORSIONAL ANALYSIS REQUIRED (1-2.6.7.1)
- 18 LIST OF UNDESIRABLE SPEEDS (1-2.6.1.4)
- 19 STABILITY ANALYSIS (1-2.6.6.5)
- 20 **VIBRATION:**
- 21 ALLOWABLE TEST LEVEL (PEAK TO PEAK) 23.2 μ m

NAMEPLATE (2-2.11.2): Metric

- 22 **ROTATION, VIEWED FROM DRIVEN END:** CW CCW
- 23 **MATERIALS INSPECTION REQUIREMENTS (1-4.2.2.1):**
- 24 RADIOGRAPHY REQUIRED FOR _____
- 25 ULTRASONIC REQUIRED FOR _____
- 26 MAGNETIC PARTICLE REQUIRED FOR _____
- 27 LIQUID PENETRANT REQUIRED FOR _____

CASING:

- 28 MODEL RB8-7B CASING SPLIT Vertical (Radial)
- 29 MATERIAL Forged Steel (A266 Gr.2 or eq.)
- 30 THICKNESS 183 mm CORROSION ALLOWANCE 3 mm
- 31 MAX ALLOWABLE PRESSURE 147.0 BarG
- 32 TEST PRESSURE: HELIUM _____ BarG
- 33 HYDRO 220.5 BarG
- 34 ALLOWABLE TEMPERATURE: MAX 180 °C MIN -29 °C²
- 35 OPERATING TEMPERATURE: MAX _____ °C MIN -11 °C³
- 36 MAX CASING CAPACITY 7500 m³/h
- 37 CASING SPLIT SEALING O-Ring (Viton) (1st/
- 38 SYSTEM RELIEF VALVE SET PRESSURE (2-2.3.1.1) 75 / 147 BarG (2nd)
- 39 QUALITY CONTROL OF INACCESSIBLE WELDS (1-2.3.1.1.2)

DIAPHRAGMS & VOLUTE:

- 40 MATERIAL Carbon Steel
- 41 **IMPELLERS:**
- 42 NO. 7 ⁴ DIAMETERS 438, 419, 381, 349 mm
- 43 NO. OF VANES 17 x 3, 15 x 4 for each impeller
- 44 TYPE Enclosed, Welded
- 45 MATERIAL 3 x SS630 (17-4PH) eq. / for 1st Section
- 46 2 x SS630 (17-4PH) eq. +
- 47 2 x USS Carilloy T-1 (A517 Gr.F) eq. / for 2nd Section

- 48 YIELD STRENGTH _____ ⁵ Bar
- 49 BRINELL HARDNESS: MAX 6 MIN 6
- 50 SMALLEST TIP INTERNAL WIDTH 5.7 mm
- 51 MAX MACH NO. @ IMPELLER EYE 0.50 / 0.39
- 52 MAX IMPELLER HEAD @ 100% SPEED 134200 / 126500 N-m/kg
- 53 (Total head of each sections @ surge)

- 54 **SHAFT:**
- 55 MATERIAL AISI 4140 or eq.
- 56 DIAMETERS: 153 mm @ IMPELLERS 102 mm @ COUPLING
- 57 SHAFT END: TAPERED CYLINDRICAL
- 58 SPLINED INTEGRAL FLANGE
- 59 YIELD STRENGTH min 6550 Bar
- 60 BRINELL HARDNESS: MAX 302 MIN 235
- 61 MAX TORQUE CAPABILITY 14200 N-m
- 62 **BALANCE PISTON:**
- 63 MATERIAL AISI 4140 or eq. AREA 3400 mm²
- 64 FIXATION METHOD Shrink Fit
- 65 **SHAFT SLEEVES:**
- 66 @ INTERSTAGE CLOSE CLEARANCE POINTS MATERIAL SS403 eq.
- 67 @ SHAFT SEALS MATERIAL _____
- 68 ACCESSIBLE (2-2.8.3)

LABYRINTHS:

- 69 INTERSTAGE: _____
- 70 TYPE Knife Edge, Damper Seal MATERIAL Aluminium Alloy
- 71 BALANCE PISTON: _____
- 72 TYPE Knife Edge MATERIAL Aluminium Alloy

SHAFT SEALS:

- 73 SEAL TYPE (1-2.8.1.3) Tandem Dry Gas Seal
- 74 SETTLING OUT PRESSURE (1-2.8.1.1) 52.5 / 112.5 / 67 BarG (1st / 2nd / Overall)
- 75 SPECIAL OPERATION (1-2.8.1.1) _____
- 76 SUPPLEMENTAL DEVICE REQUIRED FOR CONTACT SEALS (1-2.8.3.4)

- 77 BUFFER GAS SYSTEM REQUIRED (1-2.8.1.5)
- 78 BUFFER GAS TYPE (1-2.8.1.5) Process Gas with IA Separation *7 *8
- 79 BUFFER GAS CONTROL SYSTEM SCHEMATIC BY VENDOR _____
- 80 PRESSURISING GAS FOR SUBATMOSPHERIC SEALS (1-2.8.2.4)
- 81 EDUCER INJECTION (1-2.8.2.3)
- 82 SEAL MANUFACTURER John Crane

- 83 INNER OIL LEAKAGE (PER SEAL) _____ m³/DAY
- 84 BUFFER GAS REQUIRED FOR _____
- 85 AIR RUN-IN OTHER _____
- 86 BUFFER GAS FLOW (PER SEAL): _____

Refer to Utility list "Doc. No. F3224-0025"

BEARING HOUSING CONSTRUCTION:

- 87 TYPE Separate SPLIT Horizontal
- 88 MATERIAL Cast Steel / Carbon Steel

REMARKS

- 89 *1. **NDE** will be carried out in accordance with KHI standard. Refer to "Inspection & Test Plan" for details.
- 90 *2. **-29 degC** is only allowable for non-operating conditions (blowdown etc.). External back-up buffer gas shall be supplied for the conditions above.
- 91 *3. **-11 degC** is minimum allowable suction temperature of compressor during full recycle operation.
- 92 *4. Three (3) / 1st + Four (4) / 2nd with back-to-back arrangement
- 93 *5. Min. 7250 bar / SS630 (17-4PH) eq.
- 94 Min. 6270 bar / USS Carilloy T-1 eq. (A517 Gr.F eq.)
- 95 *6. Min. 277 / SS630 (17-4PH) eq.
- 96 Min. 241 - Max. 293 / USS Carilloy T-1 eq. (A517 Gr.F eq.)
- 97 *7. Compressor discharge gas will be utilized as buffer gas during compressor normal operation.
- 98 *8. Back-up buffer gas shall be prepared by others for start-up and any other pressurized conditions.



JOB NO. 31F3224 ITEM NO. K-2430/K-2440 & K-2530/K-2540
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HP Gas Compressor RB8-7B CONSTRUCTION FEATURES (Continued)

ALLOWABLE PIPING FORCES AND MOMENTS (Refer to KHI Doc. F3224-0112)

NO.	SIZE	TYPE	INLET FORCE (N)	INLET MOMENT (N-m)	DISCHARGE FORCE (N)	DISCHARGE MOMENT (N-m)	MOMENT (N-m)
3	3/4", 1"	Flanged					
3	1-1/2", 2"	Flanged					
2	1"	Flanged					
4	1"	Flanged					
5	3/4"	Flanged					
2	2"	Flanged					

AXIAL
 VERTICAL
 HORIZ. 90°

AXIAL
 VERTICAL
 HORIZ. 90°

LUBRICATION AND SEALING SYSTEMS (1-2.10)(1-3.5.1,2)

- SEE ATTACHED APH614 DATA SHEET
- SEPARATE COMBINED (2-2.10.1)
- INTEGRAL OIL RESERVOIR (1-3.3.2.11)
- OIL TYPE (2-2.10.2) **ISO VG32**

ACCESSORIES

COUPLINGS AND GUARDS (1-3.2) Gear - Compressor

- NOTE : SEE ROTATING ELEMENTS - SHAFT ENDS
- SEE ATTACHED APH671 DATA SHEET
 - KEYLESS HYDRAULIC KEYPED FLANGED OTHER _____
 - COUPLING FURNISHED BY **Kawasaki Heavy Industries** (GEAR SIDE)
 - MANUFACTURER **Eagle Industry or eq.** TYPE **Diaphragm** MODEL **100F310**
 - COUPLING GUARD FURNISHED BY **Kawasaki Heavy Industries** TYPE FULLY ENCLOSED SEMI-OPEN OTHER **Non Sparking**

COUPLINGS DETAILS

VENDOR MOUNT HALF COUPLING
 PLUG AND RING GAUGES (1-3.2.5)
 LUBRICATION REQUIREMENTS :
 NON-LUBE CONT. OIL LUBE OTHER _____ L/min
 QUANTITY PER HUB _____

MOUNTING PLATES (1-3.3)

- BASEPLATES FURNISHED BY **Kawasaki Heavy Industries**
- COMPRESSOR ONLY DRIVER GEAR
- OTHER **Dry Gas Seal Console** _____ mm
- NON-SKID DECKING (1-3.3.2.4) SLOPED DECK (1-3.3.2.4.1)
- LEVELING PADS OR TARGETS (1-3.3.2.6)
- COLUMN MOUNTING (1-3.3.2.5)
- SUB-SOLE PLATES REQUIRED (1-3.3.2.10)
- STAINLESS STEEL SHIM THICKNESS _____ mm
- MACHINED MOUNTING PADS REQUIRED (1-3.3.2.9)

REMARKS

*1. Common baseplate for compressor, gear unit, driver and lube oil console.



Kawasaki Heavy Industries, Ltd.

CENTRIFUGAL COMPRESSOR DATA SHEET (API 617-7th Chapter 2) SI UNITS (1-1.6.5)

JOB NO. 31F3224 ITEM NO. K-2430/K-2440 & K-2530/K-2540 PURCHASE ORDER NO. S3000060-1 INQUIRY NO. REVISION NO. 1 DATE 31-Oct-14 PAGE 6 OF 6 BY T. Ito

UTILITIES

UTILITY CONDITIONS: STEAM INLET EXHA ELEC VOLT HERT PHAS REDL NUIME INSTL MAX PRESS. BarG MIN PRESS. BarG WIT / HOLD

- MANUALS: DRAFT MANUAL FOR REVIEW (1-5.3.5.1.2), TECHNICAL DATA MANUAL (1-5.3.5.4)

- MISCELLANEOUS: RECOMMENDED STRAIGHT RUN OF PIPE DIAMETERS BEFORE SUCTION, Minimum 3.5 x D, COMPRESSOR TO BE SUITABLE FOR FIELD RUN-IN ON AIR (1-2.1.16), INJECTION MANIFOLD (2-3.5.1.2), VENDOR'S REVIEW & COMMENTS ON PURCHASER'S CONTROL SYSTEMS (1-3.4.1.1), SHOP FITUP OF VENDOR PROCESS PIPING (1-4.4.3.11), WELDING HARDNESS TESTING (1-4.2.1.5), INSPECT CLEANLINESS (1-4.2.1.4), DESIGN AUDIT (1-5.1.4), BALANCE PISTON ΔP (1-5.3.2.1.5), PROVIDE TAIL END SCHEDULES (1-5.3.3.2)

- VENDOR'S REPRESENTATIVE SHALL (1-2.1.13), OBSERVE FLANGE PARTING, CHECK ALIGNMENT AT TEMPERATURE, BE PRESENT AT INITIAL ALIGNMENT

WEIGHTS: ROTORS, COMPRESSOR 13000 kg, GEAR 9900 kg, DRIVER 20700 kg, BASE 22600 kg, COMPRESSOR UPPER CASE N/A kg, LO CONSOLE 6000 kg (DRY), DGS CONSOLE 650 kg, OVERHEAD RUNDOWN TANK N/A kg, *1 MAX. FOR MAINTENANCE (IDENTIFY) 20700 kg (Main Motor), TOTAL SHIPPING WEIGHT 82000 kg

SPACE REQUIREMENTS: COMPLETE UNIT, *2 DRIVER, *3 LO CONSOLE, *4 DGS CONSOLE, OVERHEAD RUNDOWN TANK

SHOP INSPECTION AND TESTS (1-4.1.4): RECID WIT / HOLD

REMARKS

*1. Max. Maintenance Weight except Main Motor : 4300 kg / Gear LSS (3000kg / Compressor Bundle)
*2. Included in the space requirements of the complete unit.
*3. Integrated into compressor baseplate.
*4. Installed on compressor baseplate.