UNIT 61: ENGINEERING THERMODYNAMICS

Unit code: D/601/1410QCF level: 5 Credit value: 15

ASSIGNMENT 3.1 AIR COMPRESSORS.

Assignment front sheet to be attached to assignment when submitted for assessment

NAME:

You are allowed a maximum of 4 weeks from the date of issue to complete this assignment.

Date Issued Date submitted

I agree to the assessment as contained in this assignment. I confirm that the work submitted is my own work.
Signed

Learning outcomes On successful completion of this unit a learner will:	Assessment criteria for pass The learner can:	Achieved
L03 Be able to evaluate the performance of reciprocating air compressors	3.1 evaluate property diagrams for compressor cycles	
	3.2 determine the performance characteristics of compressors	
	3.3 apply the first law of thermodynamics to compressors	
	3.4 identify compressor faults and hazards	
MERIT	• use a range of methods and techniques to collect, analyse and process information/data. • Apply and analyse detailed knowledge and skills, using relevant theories and techniques. • Coherently present and communicate work using technical language correctly.	
DISTINCTION	• Check validity when collecting, analysing and processing complex information/data. • Evaluate and synthesise relevant theories and techniques to generate and justify valid conclusions. • Show an individual approach in representing and communication work coherently, using technical language fluently.	

Feedback Comments

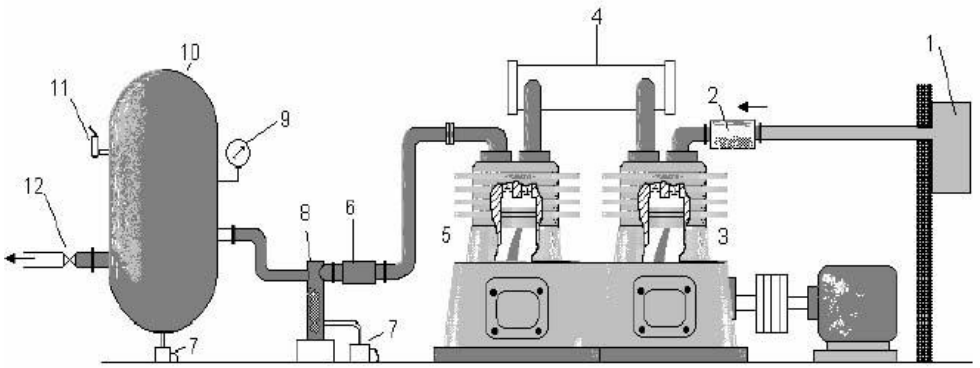
Brief I,V. by Date IV

Grade Awarded Tutor Signature Date

You should complete this assignment within 6 weeks of the date of issue.

PART 1 OPERATING PRINCIPLES

- ***Identify all the parts of the air compressor installation shown on the diagram***
- ***Explain the principles of a reciprocating air compressor and draw the cycle on a pressure – volume diagram.***
- ***Explain the effect produced by the clearance volume on the cycle.***
- ***Explain the meaning of "VOLUMETRIC EFFICIENCY"***
- ***Explain the meaning of "ISOTHERMAL EFFICIENCY"***
- ***Explain the importance of cooling during compression.***
- ***Explain the importance of an intercooler.***



2 STAGE RECIPROCATING COMPRESSOR

PART 2 SAFETY and FAULTS

Imagine that you have been commissioned to produce two leaflets. One is to be entitled "The Safe Operation of Reciprocating Air Compressors" and the other "The Principle Causes of Faults in Reciprocating of Air Compressors".

- ***Find out as much as you can about the safety risks associated with reciprocating air compressors and produce a draft leaflet.***
- ***Find out as much as you can about the main causes of faults associated with reciprocating air compressors and produce a draft leaflet.***

It is up to you to decide the style and format but you should make sure to cover the principle points.

PART 3 ENERGY BALANCE

An air compressor as shown in the diagram is tested in order to produce an energy balance on it. The Power supplied at the shaft is 20 kW. The mass air flow is 0.4 kg/s. The atmospheric pressure is 1 bar and the receiver pressure is 12 bar gauge. The atmospheric temperature is 15^{o}C and the temperature of the air entering the receiver is 40^{o}C. You may assume C_p = 1.005 kJ/kg K at inlet and outlet.

- ***Apply the 1st Law of Thermodynamics to the entire system and calculate the heat removed by the cooling water.***
- ***If perfect cooling was achieved between the inlet and outlet, what would be the heat removed then?***

PART 4 PROBLEM SOLVING

A two stage reciprocating air compressor draws in air at atmospheric conditions and delivers it at p bar.
Atmospheric conditions are 1.013 bar and 20°C.
The intercooler returns the temperature to 20°C.
The low pressure cylinder has a bore D mm and stroke L mm.
The high pressure cylinder has the same stroke.
The index of compression is n throughout.
The clearance ratio is c.
Using the data set allocated to you from the table, calculate the following.

a. The intermediate pressure and compression ratio for each stage that produces minimum indicated power.

b. The volumetric efficiency of each stage.

c. The isothermal efficiency of each stage.

d. The induced volume per stroke.

e. The free air delivery in m^3/min.

f. The indicated power per stage.

g. The bore of the high pressure cylinder.

STUDENT	D mm	L mm	p bar	n	N rev/min.	c
1	60	50	24	1.2	400	0.05
2	70	50	20	1.25	360	0.04
3	60	60	18	1.28	450	0.06
4	50	50	15	1.3	500	0.04
5	80	60	12	1.18	600	0.05
6	100	100	22	1.22	420	0.03
7	120	100	7	1.27	460	0.06
8	100	80	32	1.25	720	0.04
9	110	100	25	1.2	660	0.05
10	90	20	20	1.15	600	0.04
11	100	50	18	1.1	360	0.03