EEE-160008

Operation, Maintenance And Trouble-Shooting Of Deutz Tcg 2020 V16 Gas Engine

B.Sc Engineering Thesis

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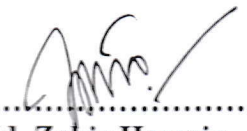
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Candidates' Declaration

It is declared hereby that this thesis paper or any part of it has not been submitted to anywhere else for the award of any degree.



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Certificate

This is to certify that the thesis entitled "Operation,Maintenance And Trouble Shooting Of Deutz Tcg 2020 V16 Gas Engine" by Md. Zakir Hossain(EEE1403003104) Md. Rokibul Hassan (EEE1403003102) Md.Ohidul Islam(EEE1403003093) and Sanjoy Mazumder (EEEE1403003095) have been carried out under my supervision.

Supervisor

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Letter of Transmittal

8th January, 2016

To

The Head

Department of Electrical & Electronics Engineering,

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Sub: Submission of the Practicum Report.

Dear Sir,

We would like to submit our practicum report on "**Operation, Maintenance, and Trouble-shooting of Deutz Gas Engine**". We have prepared this report for partial fulfillment of the degree of Bachelor of Science in Electrical & Electronics Engineering program from SU. All the necessary steps are taken to make this report up to standard.

We have tried our level best to gather all the required information for preparing this report to the required standard. It was certainly a great opportunity to work on this paper to actualize our theoretical knowledge in the practical area.

We express our heart to you to go through this report and make your valuable comments. It would be kind of you, if you please evaluate our performance regarding this report.

Sincerely Yours,

.....

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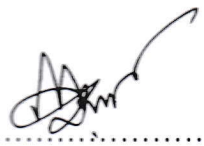
To Whom It May Concern

This is to certify that **Md. Zakir Hossain, Md. Rokibul Hassan, Sanjoy Mazumder, Md. Ohidul Islam** students of Bachelor of Science in Electrical & Electronics Engineering (BSEEE) program of **Sonargaon University(SU)** have successfully completed their practicum on **"Operation, Maintenance and Trouble-shooting of Deutz TCG 2020 V16 Gas Engine"** at SS Steel (Pvt.) Ltd. From 20th September, 2015 to 04th December,2015. They have submitted a copy of their project report to the Managing Director of SS Steel (Pvt.) Ltd. They are permitted to submit this practicum report to SU to fulfill the academic requirement.

I am very much pleased for their satisfactory performance during the period. Their hard working, honesty, dedication to the company and personal initiative is commendable.

I hope that they will be able to introduce their achieved experiences at any organization.

I wish their success.



.....

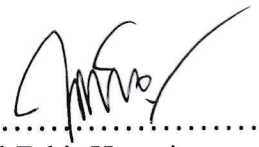
Md. Mahi Uddin
Technical & Production Manager
SS Steel (Pvt.) Ltd

Student Declaration

We **Md. Zakir Hossain,Md. Rokibul Hassan, Sanjoy Mazumder, Md.Ohidul Islam** hereby declare that we have uniquely prepared this report on "**Operation, Maintenance and Trouble-shooting of Deutz TCG 2020 V16 Gas Engine**" after completion of about three months work in SS Steel (Pvt.) Ltd.

We also confirm that the report is only prepared to fulfill the academic requirement and not for any other purpose. It will not be used with the interest of any other competitor.

Faithfully yours,



.....

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Acknowledgement

The report titled as on "**Operation, Maintenance and Trouble-shooting of DEUTZ Gas Engine**" has been prepared to fulfill the requirement of our practicum program. In the process of doing and preparing our practicum report, we would like to pay our gratitude to some persons for their enormous help and vast cooperation.

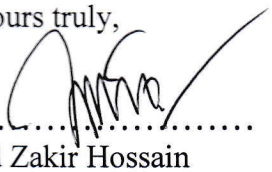
At first, we would like to show our gratitude to the **University authority** to permit us to do our practicum. Then we would like to thank to the management of SS Steel (Pvt.) Ltd. Especially **Md. Mahi Uddin**, Technical Manager , who helped us a lot to prepare this report successfully.

Specially, we would like to thank to our honorable teacher **Engr. Aminul Islam**, Coordinator, Department of Electrical & Electronics Engineering, SU– Sonargaon University, Dhaka, for his valuable and patient advice, sympathetic assistance, co-operation, contribution of new idea.

Finally, we would like to thanks again to the respected **Vice- Chancellor of SU, Professor M.A Razzaque** because he designated such an environment for learning through which we got the opportunity to acquire knowledge under BSEEE program, and that will be very helpful for our prospective career.

We are, indeed, grateful to all those from whom we got sincere cooperation and help for the preparation of this report

Yours truly,



.....

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Executive Summary

SS Steel (Pvt.) Limited is a company which was established in 1986 started the business that was completely dedicated to produce reinforcement-bars. The company now produce 130 tons rod and it has plan to boost its production capacity to 250 tons per day. To meet the required electricity demand the company will also boost the present power generation capacity from 7.5 MW to 15 MW.

The industry is divided into several sections like Power Generation section, Steel section, Re-rolling section, HR section etc. During the practicum period, as trainee engineer, our main concentration was to the Power Generation section where there are five DEUTZ TCG 2020 V16 gas engines are set to produce electricity. This power is used to the furnace to melt raw materials. It is a 7.5 MW power generation plant. At the beginning of the practicum we concentrated to the operating system of the engines. After a few days we followed the situational and schedule maintenance work. During the maintenance work we focused on troubleshooting simultaneously. This practicum report has been arranged with a sequence that starts with the company's profile. After that details discussion has been given about the TCG 2020 V16 gas engine according to its operation procedure, it's several systems with components, it's maintenance work and trouble-shooting. We tried to identify the circumstances of the engines and the plant which may affect on the effective work of the engines.

Now we expect that it is possible by us to find out the problems of the engines and give proper solutions. What we learned during the practicum helps us to understand the technical operation of various mechanical systems practically. We think that this report and knowledge will help us to flourish our future in Mechanical Engineering sectors. Moreover, we are intended to do the best in our future life.

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CHAPTER ONE

INTRODUCTION



1.1 Source of the Report

Every student needs to learn practical knowledge on his subject area. It is also required to know theoretical knowledge about his specialize sector. After completion of theoretical part, students need to earn practical experience and compare with the theoretical knowledge & thereby problems finding are being brought out which leads to a few recommendation on the overall concern projects.

This report carries an integral part of an internship program for Bachelor of Science in Electrical & Electronics Engineering and intended to be submitted to Sonargaon University (SU). SS Steel (Pvt.) Ltd was nominated as the organization for the practicum attachment while our honorable faculty Engr. Aminul Islam, Department of Electrical & Electronics Engineering concentrated to supervise the internship program.

1.2 Objective

The general objective of the report is to show to the department of Electrical & Electronics of SU of what we have learned through the practicum period in the industry. It is a record of the student's acquired practical knowledge. During the practicum period we concentrated to some specific topics where our main objectives were:

- ✓ To know how to operate various engines
- ✓ To know about absolute maintenance of the Electrical & Electronics Engineering appliance including engines.
- ✓ To know about troubleshooting of the engines.
- ✓ To identify different types of problems which are responsible of engine's shutdown.
- ✓ To analyze the appeared problems
- ✓ To suggest of the possible solutions of the identified problem.

1.3 Scope

This report consists of eight chapters; the first chapter is about introductory and background information. The second chapter is about the company overview. The third chapter contains the details information about Deutz TCG 2020V16 engine. The fifth chapter contains information on operating system of the engine. The sixth chapter discusses the maintenance procedure of the engine. The chapter seven contains the troubleshooting information of the report. Finally, the chapter eight is about the recommendation and conclusion.

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1.4 Background

Electrical & Electronics Engineering is the mother of all engineering programs. Internal combustion engine is an important part of Electrical & Electronics Engineering. In order to make the practicum done we have concentrated to the operation, maintenance and troubleshooting of IC engine which is an important part in Electrical & Electronics Engineering job field. During the practicum period we firstly focused on operation and then the problems which arise during running period. According to the problem the maintenance work is done. So we acquired knowledge of troubleshooting simultaneously.

1.5 Methodology

To make this report we have followed a sequence. We started by focusing on company's overview and proceeded to the end through engine's operation, problem identification, necessary solution and some recommendation. During the whole work we collected data from various sources. In particularly from

- ✓ Company's profile
- ✓ Management manual
- ✓ Engine's logbook
- ✓ Maintenance log
- ✓ Personal experience
- ✓ Interview from employed engineers
- ✓ Text book

CHAPTER TWO

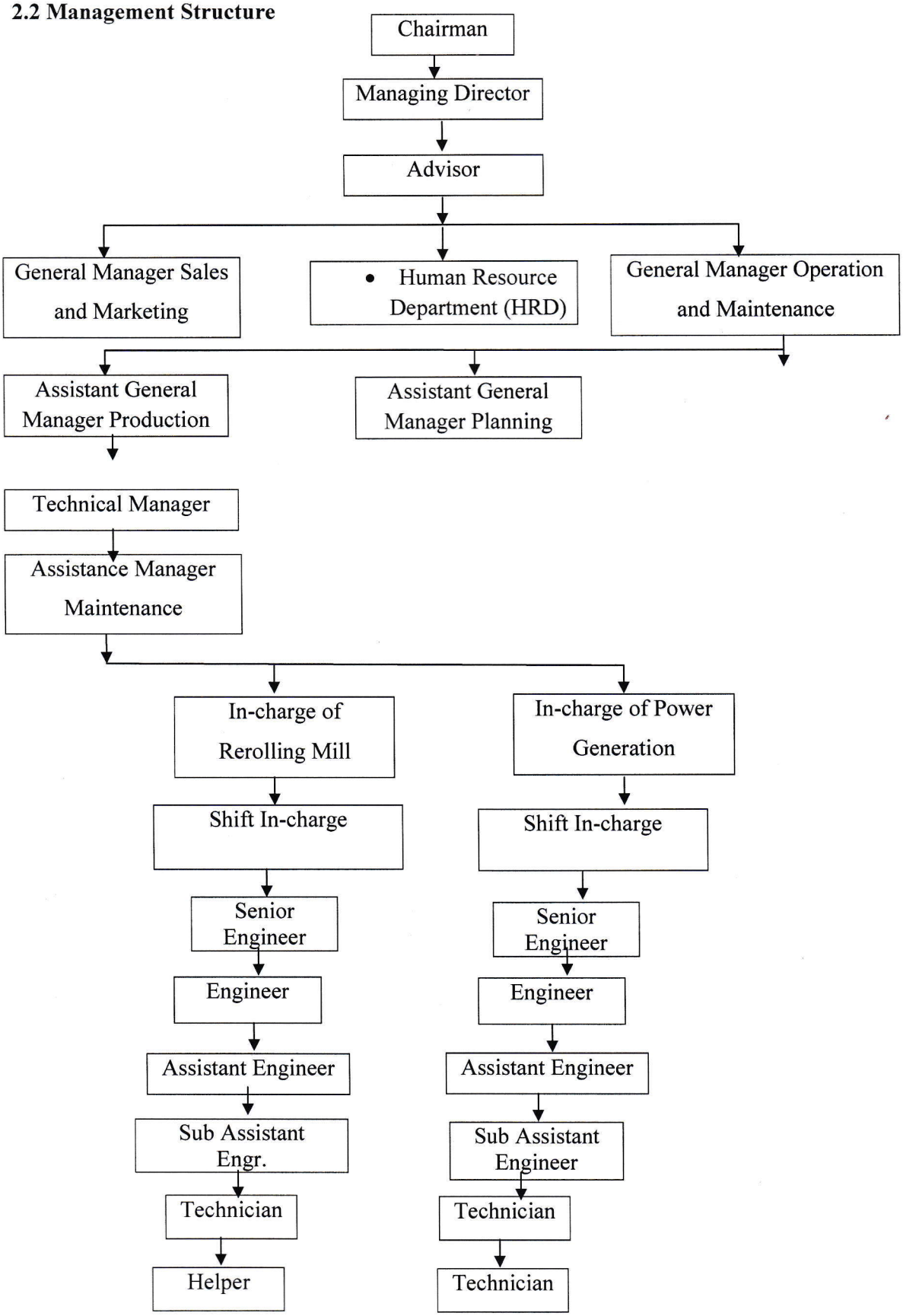
Company's Overview

2.1 At a Glance of SS Steel Mill Limited

SS Steel (Pvt) Ltd., located in the heart of mill-gate road in Tongi, also known to be the oldest industrial region in Dhaka, Bangladesh; re-established the steel manufacturing business by its second generation family.

Nearly 26 years ago Kazi Shafi father of the 2 sons started the business that was dedicated solely to producing reinforcement-bars from small rolling mills. At the time rolling mills were fed with sheered and cut plates derived out of abandoned ships. Rods were produced to meet the needs for affordable steel and iron for the growing territories and basic infrastructure in the newly formed Bangladesh then. Since the inception of the company SS Steel continued to expand its capability in every aspects of the production spectrum. Today the company narrowed their product line to focus and become a Specialty Production Mill seeking to service a much more select group of demanding, quality-conscious customers.

2.2 Management Structure



2.3 Vision

Product quality is ensured throughout the manufacturing processes in both Steelmaking and the Rod/Bar mill through strict adherence to process control requirements. Every SS Steel Mill employee is devoted to quality: quality processes, quality products, and quality service. Each individual is focused on his or her responsibility within the process — from hauling scrap to in-the-field customer service — and understands how the power of synergy and the value of each facet of the process results in an exceptional outcome. Because SS Steel rod and bars and finished products meet the customer's need, individual focus within a team environment creates an exceptional end product. The knowledgeable and experienced personnel of SS Steel are committed to customer service through the development, manufacturing, delivery and installation processes. We know our success is dependent upon your satisfaction.

2.4 Mission

To supply the products with high quality that meets the demands of the customers.

2.5 Slogan

Use Tiger save cost.



Figure 2.1: Slogan

2.6 Factory Setup

S.S. Steel is a composite A to Z solution for construction contractors and builders. The entire process from melting Mild Steel Scrap in induction furnaces to producing the end product, reinforced bars (Re-Bar/ MS Rod) at the rolling mills, is conducted in our own facility. An assortment of testing equipment are available in-house are available for our steel and rolling mills to produce deformed and plain bars using TMT technology to our clients' requirement.

2.7 Sections of the Industry

The whole plant is divided into several sections depending on the types of work. The sections are

i. HRD Section
ii. Sales and Marketing Section
iii. Purchase
iv. Finance Section
v. Operation Section
vi. Power Generation Section
vii. Steel Section (Furnace)
viii. Rolling and Rerolling Section
ix. Workshop Section
x. Store
xi. Lab Section

2.8 An Overview of HRD Section

Human resource management (HRM, or simply HR) is the management of the organization's workforce, or human resources. It is responsible for the attraction, selection, training, assessment, and rewarding of employees, while also overseeing organizational leadership and culture, and ensuring compliance with employment and labor laws. In circumstances where employees desire and are legally authorized to hold a collective bargaining agreement, HR will typically also serve as the company's primary liaison with the employees' representatives.

2.9 An Overview of Sales and Marketing Section

The marketing department is responsible for researching and analyzing the business and the market. Using the information gathered, the marketing plan, budget and key performance

indicators are developed. Action plans are devised and the marketing strategy is implemented. The marketing department measures and reports on the results of the marketing strategy. Staff in the marketing department train staff in other departments so they are aware of current campaigns.

The purpose of their activity is to manage the four Ps of marketing (Place, Price, Product and Promotion). The aim is to stimulate demand for the business goods and services and to generate leads. Leads are customers who are likely to make a purchase. Leads are identified by collecting the details of people who contact the business to ask about products or services, or by gathering details of prospective customers from online surveys, competition entries or newsletter subscriptions. After raising interest and demand for the products and services, the leads that are generated are passed on to the sales department.

Leads are people who may make a purchase. It is up to sales staff to contact people, identify their needs and help them make a purchasing decision. Sales staff deal directly with customers and they must build a good relationship. Sales staffs also deal with people who walk in off the street or contact the business through their website. The role of sales staff is to make sure the business gets a return from its investment in marketing and to turn demand into sales.

2.10 An Overview of Power Generation Section

The Power Generation Section is consisted with five Deutz TCG 2020 V16 gas engine unit which has total 7.5 MW electricity production capacity. Here each unit can produce 1.5 MW electricity. The Section is divided into two parts. One part is with two engines which has capacity of 3 MW and the other part is consisted with three engines which has 4.5 MW electricity production capacity. There are two furnaces connected with the first unit where each furnace consumes 2.2 MW electricity. The furnaces do not run at the same time. There are two furnaces connected with the second unit (4.5 MW electricity production capacity) where each furnace consumes 2.8 MW electricity and the furnaces are come into work one after another.

2.11 An Overview of Steel Section

Steel Section is responsible to melt the raw metal by induction furnace and produce ingot. There are 48 employees working in this section.



Figure 2.2: Raw metals are melting in the Furnace

Raw metals are poured in the furnace and it melts. After that the molted metal is poured into the mould. The mould is taken away for a period of times and it becomes cold slowly. When the mould is cooled then the ingots ate taken out from the mould.

2.12 An Overview of Rolling and Rerolling Section

In the re-rolling section the anchors are reheated by reheating furnace. In this section the rest total rod manufacturing procedure from reheating furnace to twin channel is done. here are 94 employees are employed in this section. The work that are done in this section are reheating, roughing, share cutting, intermediate milling, pre-pinching, TMT, post pinching ,flying sharing ,tail braking and twin channeling.

2.13 Production Capacity

At present the production capacity is 130 tons per day

2.14 Quality Control Facility

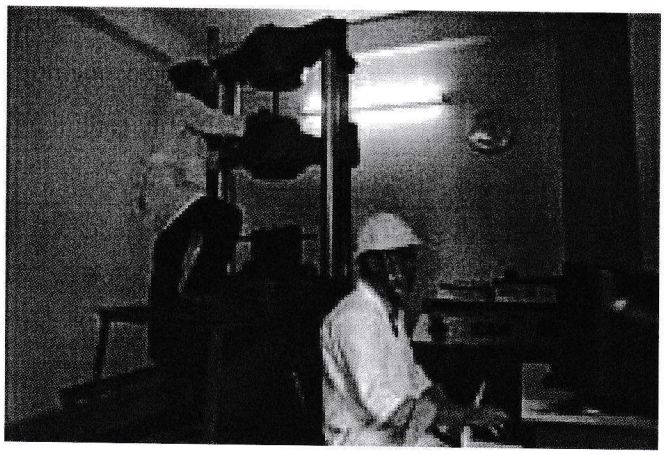


Figure 2.3: Testing Lab

SS Steel Mill has in-house state-of-the-art lab facility run by highly experienced chemists from abroad to maintain superior quality. They regularly test the products in random order to further ensure constant high standard.

2.15 Finished Good

Specializing in 500w TMT and 60 grade Re-bars/ Rods. The company also produces 40 grade Re-Bars/ Rods from time to time to meet their clients' requirement.

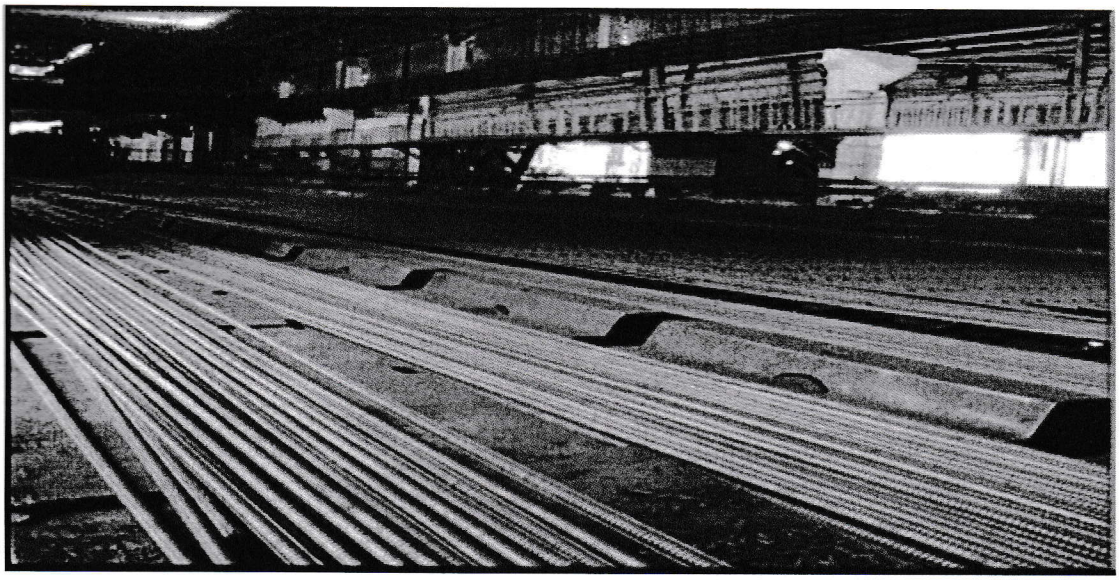


Figure 2.4: Produced Rod

Reinforced bar

Grades	Sizes
300 W / 40	Required Special Order from clients/Projects
400 W / 60	10,12,16,20,22,25,28,32
500 W/ TMT	10,12,16,20,22,25,28,32

2.16 Sales Process

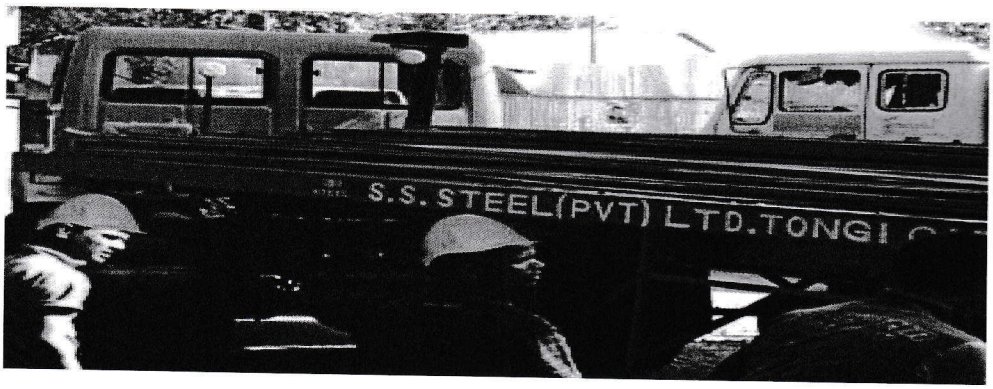


Figure 2.5: Sailing the rods

Our experienced sales crew is trained not only to cater each client's unique requirements with quality products and service, but also to provide relentless after sales service regardless of the sale volume or the name of the client.

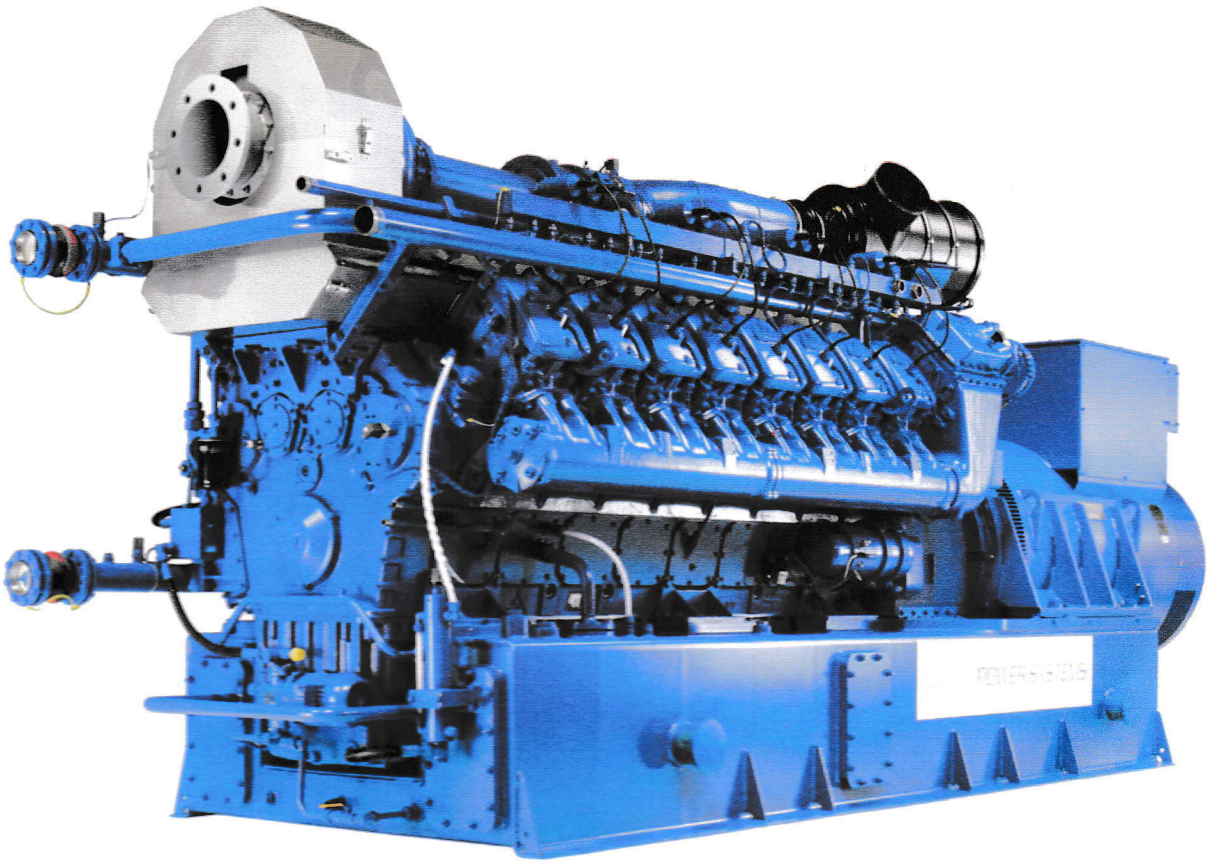
2.17 Clients & Projects

- Abdul Monem Ltd.
- . BUET
- Jamuna Future Park
- National Development
- Engineers Ltd
- Mohakhali Flyover
- GBB Ltd.
- Al - Amin Construction
- Union Development
- Dada Engineering
- Nirman International
- SS Properties
- Kapatakkha Properties
- ABC Real Estate

and many more.....

CHAPTER THREE

The Engine

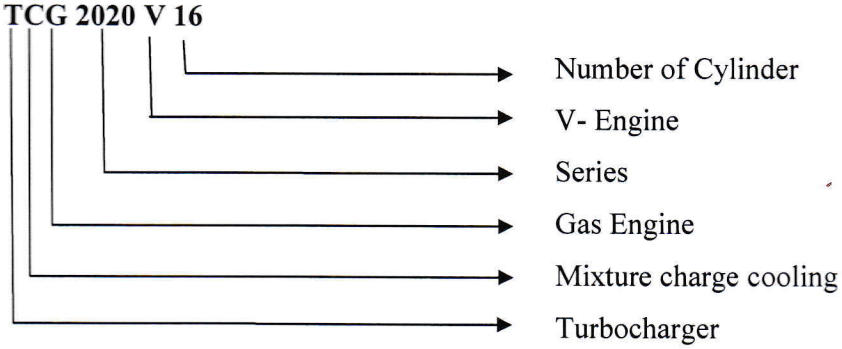


3.1 Engine's Specification

DEUTZ TCG 2020 V16 is a gas engine which is manufactured by DEUTZ Company of Germany. This type of engine is used in the industries with generator to produce electricity. It is a turbo-charging intercooled 16 cylinders engine. The manufacturing company (DEUTZ) of this engine was established in 1864 which is the first industrial engine company in the world. The company not only sales industrial engines but also automotive and Mobile Machinery, Gen Sets, Marine and Agricultural Machinery with relevant services to the customers.

What the Engine Model Means:

TCG 2020 V 16



3.1.1 Overview

⇒ 16 cylinder V-engines.

⇒ Air-fuel turbo-charging and two-stage intercooling.

⇒ Single cylinder heads with four-valve technology.

⇒ Centrally arranged industrial spark plug with intensive plug seat cooling.

⇒ Microprocessor-controlled high-voltage ignition system.

⇒ One ignition coil per cylinder.

⇒ Electronic control and monitoring of genset operation through TEM.

⇒ Exhaust emissions controlled according to combustion chamber temperature

3.1.2 Technical Data

Engine type		**TCG 2020 VK**
Engine power	kW	1500
Speed	min-1	1500
Mean effective pressure	bar	18.1
Exhaust temperature	approx. °C	440
Exhaust mass flow wet	approx. kg /h	8575
Combustion air mass flow	approx. kg /h	8300
Combustion air temperature	minimum/design °C	20/25
Ventilation air flow	approx. kg /h	33375
Bore/stroke	mm	170/195
Displacement	dm3	70.8
Compression	ratio	13.5 : 1
Mean piston speed	m/s	9.8
Lube oil content	dm3	865
Lube oil consumption mineral oil	+ 20% g /kWh	0.3
Generator		
Efficiency	%	97.2
Electrical power	kW	1455
Jacket water heat	± 8% kW	795
Intercooler LT heat	± 8 % kW	145
Exhaust cooled to 120°C	±8% kW	845
Exhaust cooled to 150°C	±8% kW	766
Engine radiation heat	kW	60
Generator radiation heat	kW	45
Fuel consumption	+ 5 % kW	3724
Specific fuel consumption	+ 5 % kWh/kWh	2.33
Electrical efficiency	%	41.8
Thermal efficiency	%	44.0
Total efficiency	%	85.8

System parameters

Engine jacket water flow rate min./max.	m3/h	50/65
Engine KVS-value	m3/h	50
Intercooler coolant flow rate	m3/h	40
Intercooler KVS-value	m3/h	42.9
Engine jacket water volume	dm3	151
Intercooler coolant volume	dm3	28
Engine jacket water temperature max.	°C	80/92
Intercooler coolant temperature	°C	40
Exhaust backpressure min./max.	mbar	30/50
Maximum pressure loss in front of air cleaner	mbar	5
Dry weight engine	kg	5800
Dry weight genset	kg	13500

3.1.3 Benefits:

⇒ Package of favorable investment and low operating costs.

⇒ Low energy consumption thanks to maximum primary energy utilization.

⇒ Long service intervals and ease of service guarantee additional cost savings.

⇒ Efficient energy conversion with outstanding efficiencies.

⇒ Inter cooling permits maximum power even when using gases with low methane numbers.

⇒ Reliable control and monitoring with high safety standards ensure optimum combustion and maximum engine protection.

⇒ All governing, service, control and monitoring functions are easy and comfortable to operate.

3.1.4 Theory of the Engine

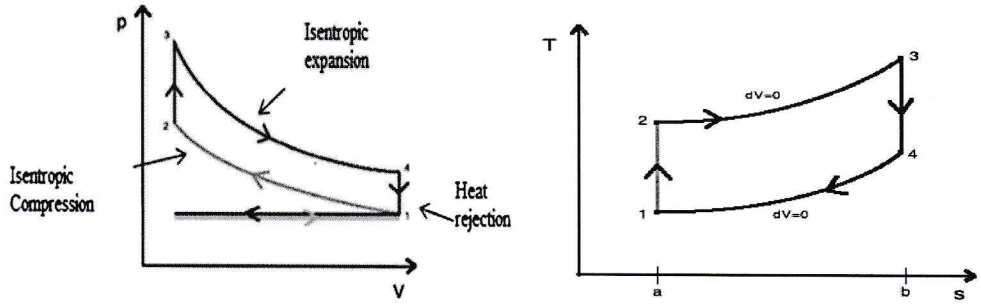


Figure 3.1: P-V and T-S diagram of Otto Cycle

Air enters a cylinder at point 1 when compression starts and it ends at point 2. Isentropic compression is considered with no entropy change. Heat addition starts at point 2 and it ends at point 3. At a constant volume, combustion takes place (fuel is added to the cylinder and the air temperature raises) and/or heat gets added to air. Expansion starts at point 3 and it ends at point 4. Isentropic expansion is considered with no entropy change. Air heat rejection starts at point 4 and it ends at point 1. At a constant volume, air gets cooled and the working fluid temperature goes down. It should be mentioned that air at point 1 enters the compression process again and the cycle is repeated.

As the name suggest the Four Stroke Gas Engine uses a cycle of four strokes and Gas as the fuel. Each cycle includes 2 rotations of the crankshaft and four strokes, namely:

1. Intake Stroke
2. Compression Stroke
3. Power Stroke
4. Exhaust Stroke

The steps involved are as follows:

1. Intake Stroke:

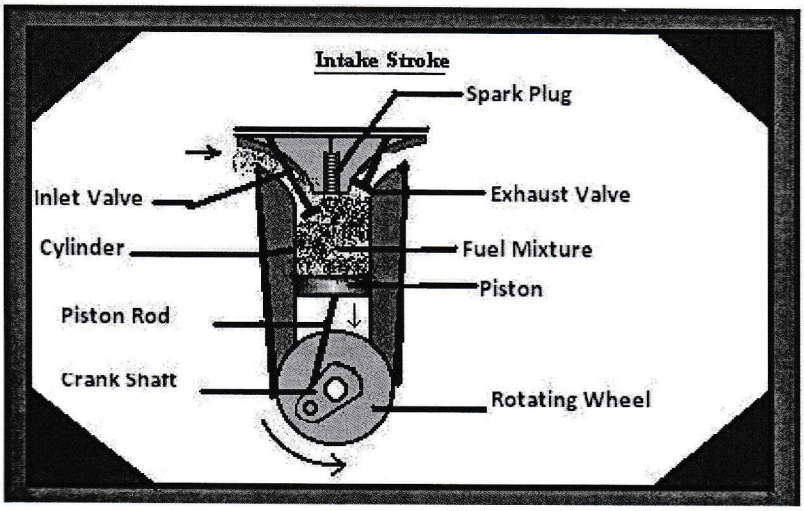


Figure 3.2: Intake stroke

As the name suggests in this stroke the intake of fuel takes place. When the engine starts, the piston descends to the cylinder's bottom from the top. Thus the pressure inside the cylinder reduces. Now the intake valve opens and the fuel and air mixture enters the cylinder. The valve then closes.

2. Compression Stroke:

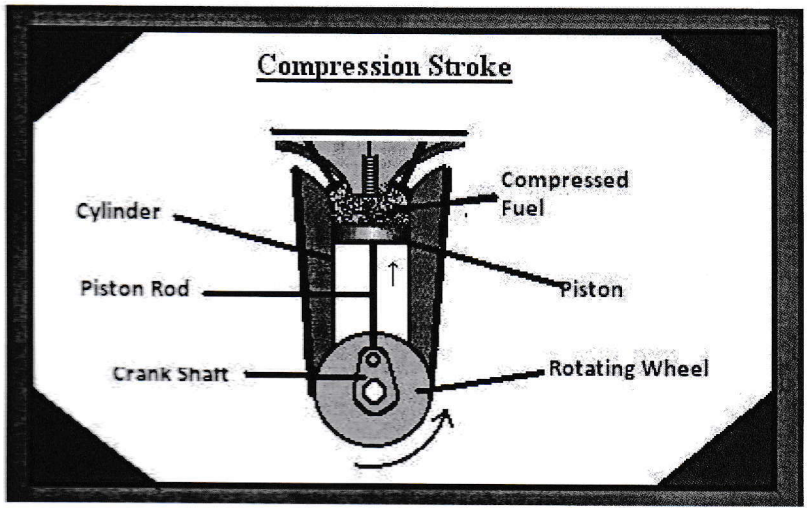


Figure 3.3: Compression stroke

This stroke is known as compression stroke because the compression of the fuel mixture takes place at this stage. When the intake valve closes (exhaust valve is already closed), the piston forced back to the top of the cylinder and the fuel mixture gets compressed. The

compression is around 1/8th of the original volume. An engine is considered more efficient if its compression ratio is higher.

3. Combustion/Power Stroke:

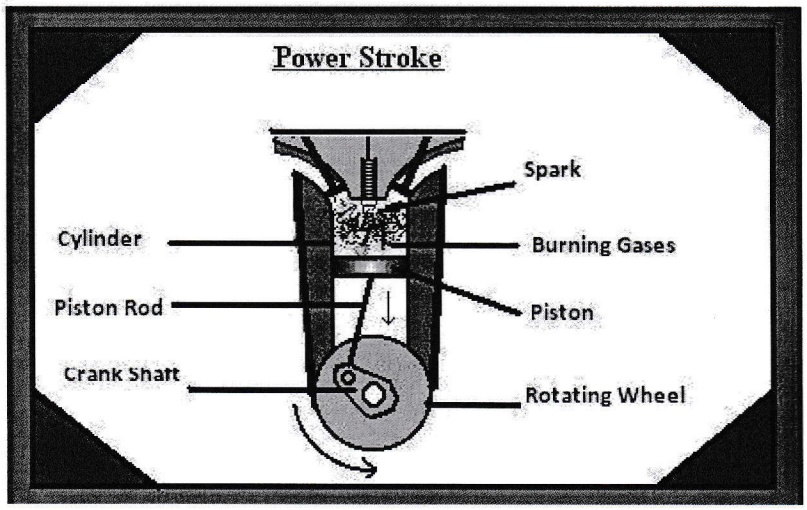


Figure 3.4: Power stroke

Now in case of petrol engine when the fuel mixture compresses to the maximum value the spark plug produces spark which ignites the fuel mixture. The combustion leads to the production of high pressure gases. Due to this tremendous force the piston is driven back to the bottom of the cylinder. As the piston moves downwards, the crankshaft rotates which rotates the wheels of the vehicle.

4. Exhaust Stroke:

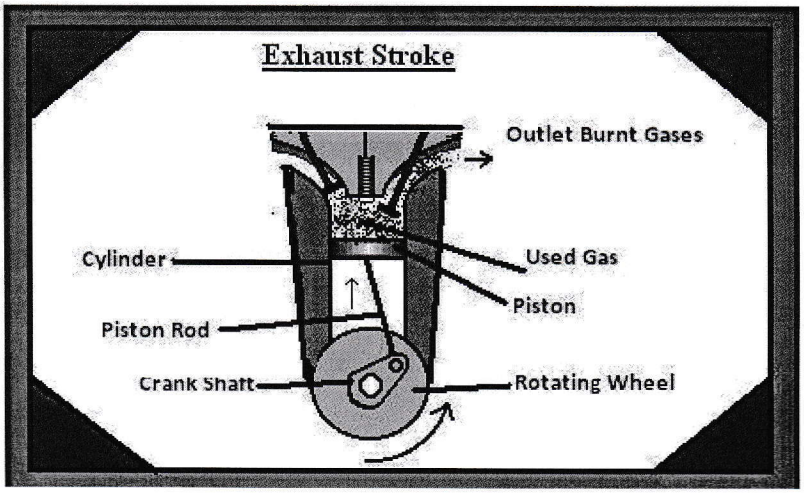


Figure 3.5: Exhaust stroke

As the wheel moves to the bottom the exhaust valve opens up and due to the momentum gained by the wheel the piston is pushed back to the top of the cylinder. The gases due to combustion are hence expelled out of the cylinder into the atmosphere through the exhaust valve.

3.4.1 Definition of Some Parameters

Piston Displacement

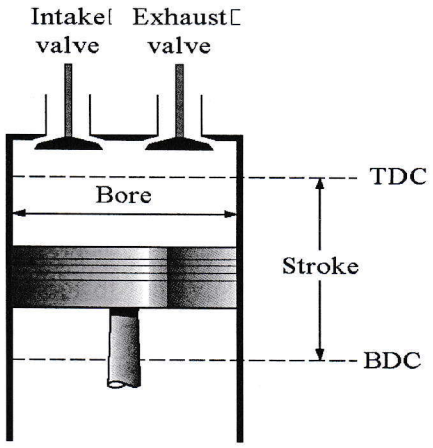


Figure 3.6: Piston displacement

The volume which a piston in a cylinder displaces in a single stroke, equal to the distance the piston travels times the internal cross section of the cylinder. And Manufacturing Tolerance means, during manufacturing the mechanism the manufacturers keep a negative tolerance than the mentioned volume of the cylinder that it can be used in future during boring and honing(if needed).

Clearance Volume:

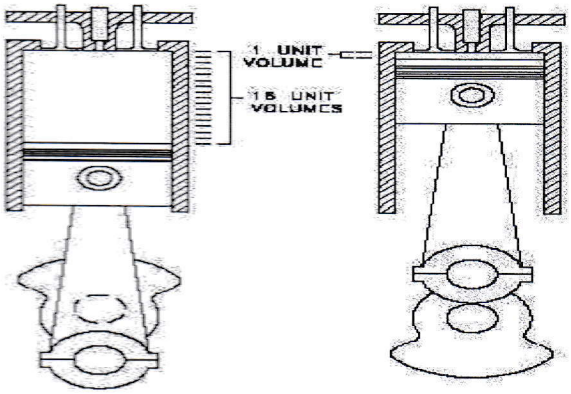


Figure 3.7: Clearance volume

Total Volume: Total Volume includes the Swept volume and Clearance Volume.

Top-Dead-Center (TDC): Position of the piston when it stops at the furthest point away from the crankshaft. Top because this position is at the top of most engines and dead because the piston stops at this point.

Bottom-Dead-Center (BDC): Position of the piston when it stops at the point closest to the crankshaft.

Cylinder Bore: Diameter of the cylinder or diameter of the piston face, which is the same minus a very small clearance. We use 100 mm cylinder bore for EICHER engines.

Stroke: Movement distance of the piston from one extreme position to the other, TDC to BDC or BDC to TDC. We use 105 mm stroke length for EICHER engines.

Fuel Consumption: The weight flow rate of fuel required to produce a unit of power or thrust.

Brake thermal efficiency: Brake thermal efficiency is a measure of the amount of fuel energy converted into useful power during the combustion process in the engine.

Air-Fuel Ratio: Air–fuel ratio is the mass ratio of air to fuel present in an internal combustion engine. If exactly enough air is provided to completely burn all of the fuel.

3.2 Engine Components

There are so many components of an IC engine. Among them here is a list of the main components:

i. The Engine Block
ii. The Cylinder Liner
iii. Main Bearing
iv. Crankshaft
v. Connecting Rods

vi. Pistons
vii. The Piston Ring Set
viii. Cylinder Head
ix. Inlet Valves
x. Exhaust Valves
xi. Seal Ring
xii. Camshafts
xiii. Centrifugal Filter
xiv. Turbocharger
xv. Charge Air Cooler
xvi. Oil Sump
xvii. Automatic Filter
xviii. Oil filter
xix. Air Filter

Engine Block

The cylinder block is the foundation of the engine. All other engine parts are attached to the cylinder block. Blocks are cast from cast iron mixed with other metals such as nickel and chromium. Block has large holes for cylinder bores. It also has water jackets and lubricating oil passages.

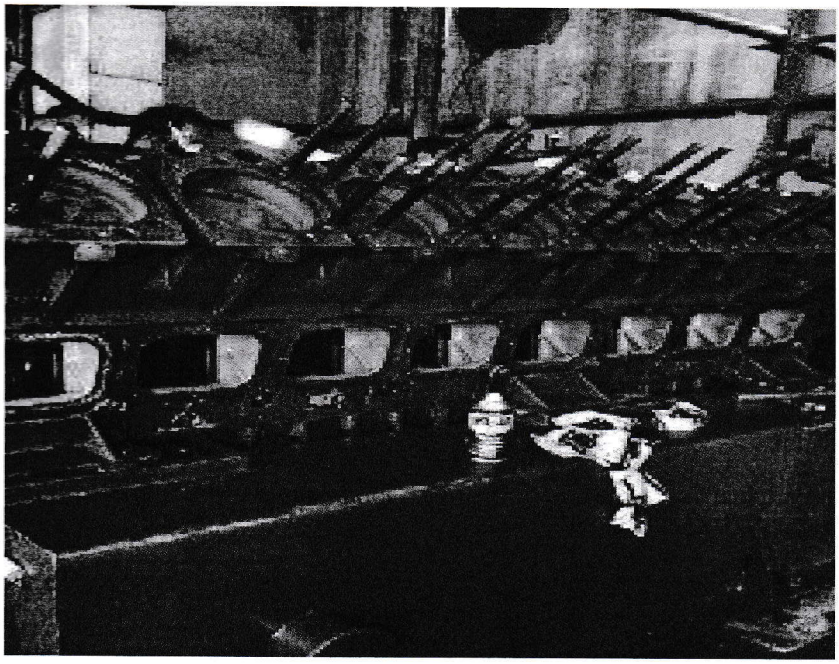


Figure 3.8: Engine block

Cylinder head

The head is usually cast iron or aluminum, and bolts to the engine block. The head contains spark plug and valves. Manufacturing the head is similar to manufacturing the block.

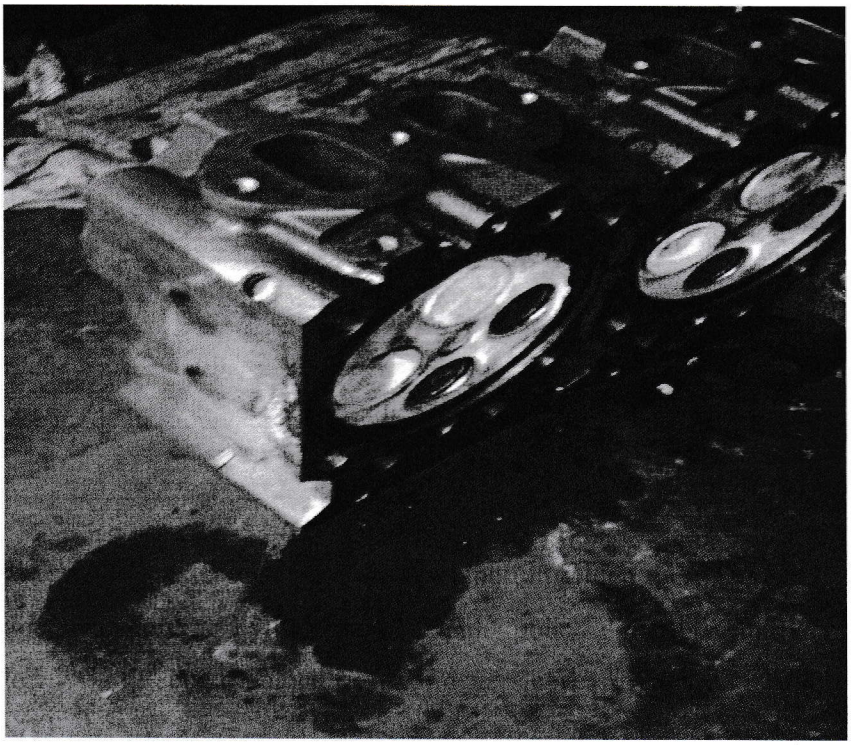


Figure3.9: Cylinder head

Head gasket:

Gasket is served as a sealant between the engine block and the head where they bolt together. The gaskets are made in sandwich construction of metal and composite materials.

Cylinder:

The circular cylinders are served in the engine block in which the pistons reciprocate back and forth. The walls of the cylinder have highly polished hard surfaces. Cylinders are machined directly in the engine block or hard metal sleeve are pressed into the softer metal block.

Cylinder sleeves:

Cylinder sleeves are used in engine blocks to provide a hard-wearing material for pistons and piston rings. The block is made of one kind of iron that's light and easy to cast, while the

sleeve uses another kind that is better able to stand up to wear and tear. There are three main types of sleeves - dry, flanged dry and wet.

Oil pan

Oil reservoir is bolted to the bottom of the engine block, making up part of the crankcase and holds lubricating oil.

Piston

The cylindrically shaped mass that reciprocates back and forth in the cylinder transmitting the pressure forces in the combustion chamber rotating the crankshaft. The top of the piston is called crown and the sides are called skirt. Pistons contain an indented bowl in the crown which makes the clearance volume. Pistons are made of aluminum alloy.

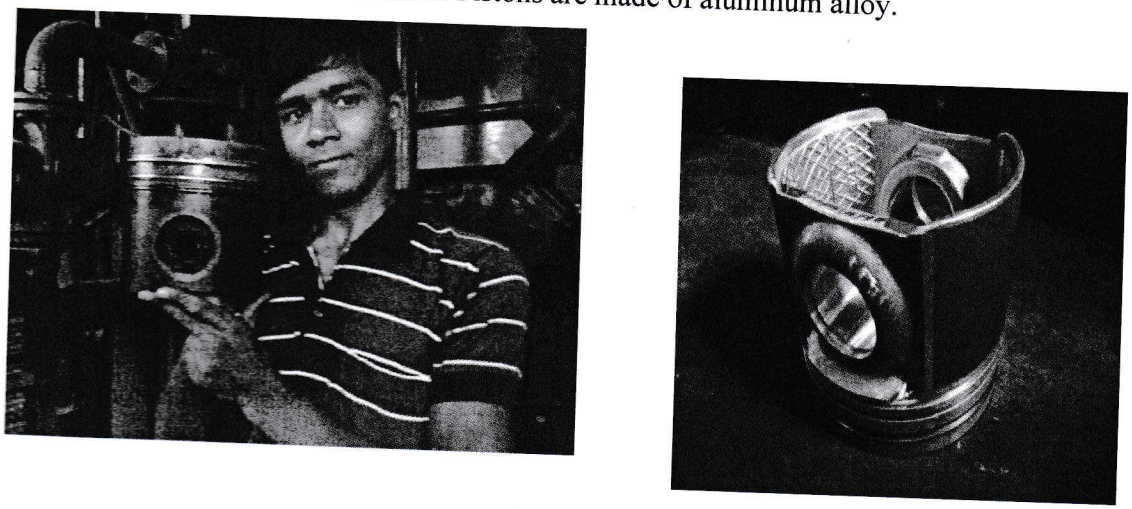


Figure 3.10: Piston

Piston rings

Pistons are fitted with piston rings. The two types of piston rings are compression rings and oil control rings. Compression rings seal compression and combustion pressures in the combustion chambers. Oil control rings scrape oil from the cylinder walls. Two compression rings and an oil control ring are used in a piston.

New rings and cylinders have minor irregularities and when these wear off, the rings will make a better fit. To help this along, the rings can be given a phosphorous coating. It's softer and wears more quickly than the ring material which is usually cast iron. To prevent wear, the face of the piston ring can be coated with a harder material like chromium that operates well

against cast iron without scuffing. They are split so they can be fitted into grooves in the piston, and to expand against the cylinder walls. When they're removed, their diameter's larger than the piston's. So when they're installed they're compressed and the gap is almost closed. Tension in the rings keeps them against the walls.

Connecting rod

A connecting rod is a linkage to connect a piston with rotating crankshaft. The connecting rod connects the piston to the crankshaft. It is fastened to the piston at its little end, by a piston pin, also known as a gudgeon pin or wrist pin. Another method lets the pin float in both the piston and connecting rod, and it is held with circlips.



Figure 3.11: Connecting rod

There is a bearing in the small end of the connecting rod. The big end of the connecting rod has a detachable cap, and carries 2 halves of the big end bearing. The big end is attached to the crankshaft at the crankpin journal. Connecting rods must be very strong and rigid, and as light as possible. They are subject to stretching, compressing and bending, so they are highly stressed. To maintain engine balance, all the connecting rods in an engine are a matched set.

Crankshaft:

Rotating shaft through which engine work output is supplied to external systems. The crankshaft is connected to the engine block with the main bearings. It is rotated by the reciprocating pistons through connecting rods connected to the crankshaft. Crankshafts must be strong enough to do this without bending or twisting.

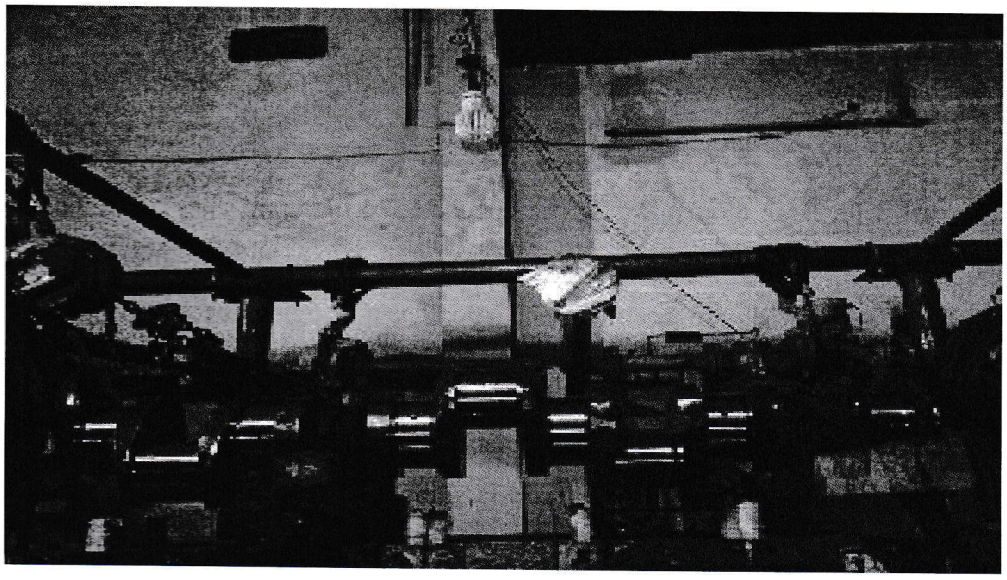


Figure 12: Crankshaft

They are a one piece casting, or forging, of heat-treated alloy steel or cast iron of great mechanical strength. Counterweights are formed to balance the throws, and also the big end of the connecting rod. The crankshaft rotates in the engine on journals which run in bearings called the main bearings. The connecting rod with its big end bearings are attached to the crankshaft crank pins located on the throws. Drilled passages carry lubricant under pressure from the main bearings to the adjacent big end bearings. The rear of the crankshaft is drilled and tapped for flywheel attachment. Near the front of the crankshaft, a timing gear is attached to drive the camshafts. A drive pulley is mounted on front of the crankshaft. It drives many components including the alternator, the fan and water pump, and power steering. A harmonic balancer is attached to the crankshaft. The harmonic balancer is more correctly called the crankshaft torsional vibration damper. It prevents crankshaft vibration. In most cases the harmonic balancer incorporates the drive pulley.

Camshaft:

A rotating shaft is used to open and close intake valves and exhaust valves at the proper time in the engine cycle through mechanical linkage (push rods, rocker arms, and tappets).The camshaft is driven by the crankshaft gear and timing gear. The camshaft rotates at half of the engine speed. The camshaft is made of cast iron and forged steel.

Flywheel:

Rotating mass with large moment of inertia connected to the crankshaft of the engine. The purpose of the flywheel is to store energy and furnish a large angular momentum that keeps the engine rotating between power strokes and smoothes out engine operation.

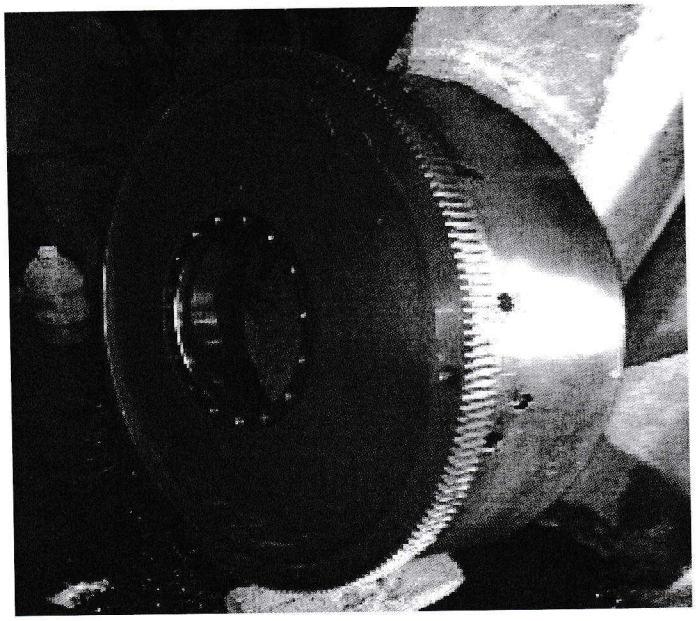


Figure 3.13: Flywheel

Valves:

Engine valves control the intake and exhaust flow to and from the combustion chamber. It is used to allow flow into and out of the cylinder at the proper time in the cycle. A valve must not soften at high temperatures. It needs good hot strength to stand up to being forced against the seat, and to prevent tensile failure in the stem. It needs good fatigue properties to overcome cracking. Various surface treatments are used to help the valve resist wear, burning and corrosion.

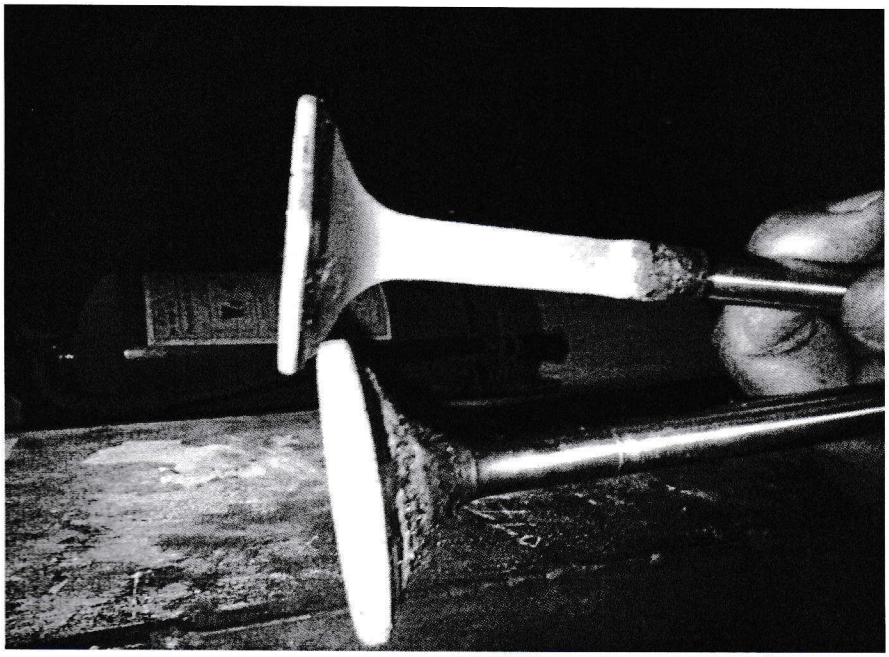


Figure 3.14: Valves

Inlet valves are made of steels mixed with chromium or silicon to make them more resistant to corrosion, and manganese and nickel to improve their strength. Exhaust valves are made of nickel-based alloys. Some high performance applications use especially hard-wearing titanium alloys.

Valve trains:

The valve train includes all of the components that are driven from the camshaft. In an overhead valve or pushrod system the valves are in the cylinder head, but the camshaft is in the block near the crankshaft. A valve lifter or tappet rides on the cam. As the cam lobe reaches the lifter, it rises, transfers the motion to the pushrod. This then moves a rocker which in turn pushes the valve open.

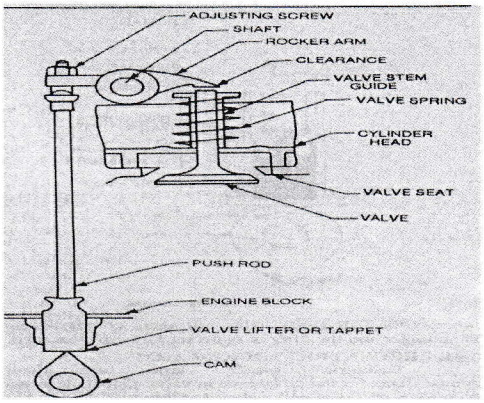


Figure3.15: Valve train

A hollow solid lifter made of cast iron is mounted in a bore in the crankcase. It is free to rotate slowly, which distributes wear from the cam over the face of the lifter. The gap between the valve tip and the valve train is called valve clearance or valve lash. This must be maintained when the cam is not applying pressure to open the valve. It can be adjusted with a screw and locknut built into the rocker arm. These adjustments are needed regularly.

Air Filter

Air Filter is used in the intake system of the engine. The dusts which come with air get stuck in the air filter. When the filter become jammed with dust then it is to clean by forced air(compressed air).After 8000 engine's run hour the filter is to changed.

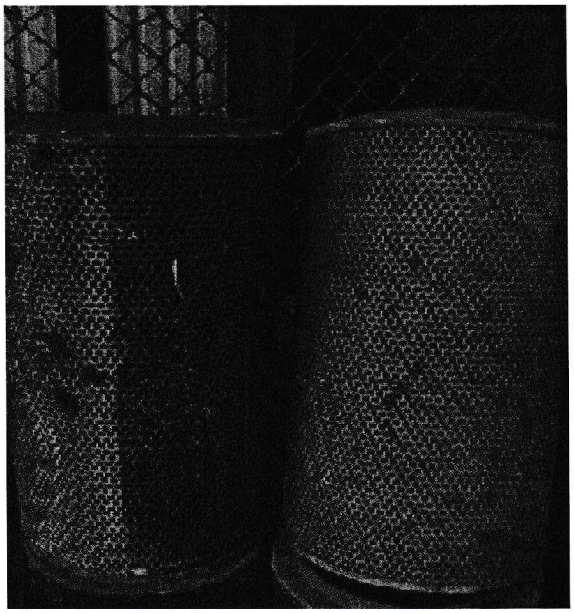


Figure 3.16: Air filter

Checking Parameters of TCG 2020V16 Engine before Starting

i. Battery terminals
ii. All connected cables
iii. Starting motor
iv. Ventilation and exhaust system
v. Lube oil label
vi. Cooling water pressure

vii. Starting air pressure
viii. Turning gear disengaged
ix. Engine is not running
x. Shut down alarm inactive
xi. Tripping alarm inactive
xii. Breaker truck in service
xiii. Pre lubricating performed

3.3 Systems of the engine

There are several kinds of systems are involved with the engine to make the engine's work done. The systems are :

i. Starting System
ii. Gas Control system:
iii. Ignition system display:
iv. Lubricating system:
v. Cooling system:
vi. Intake and Exhaust system:
vii. Turbo Charging System

3.3.1 Starting System

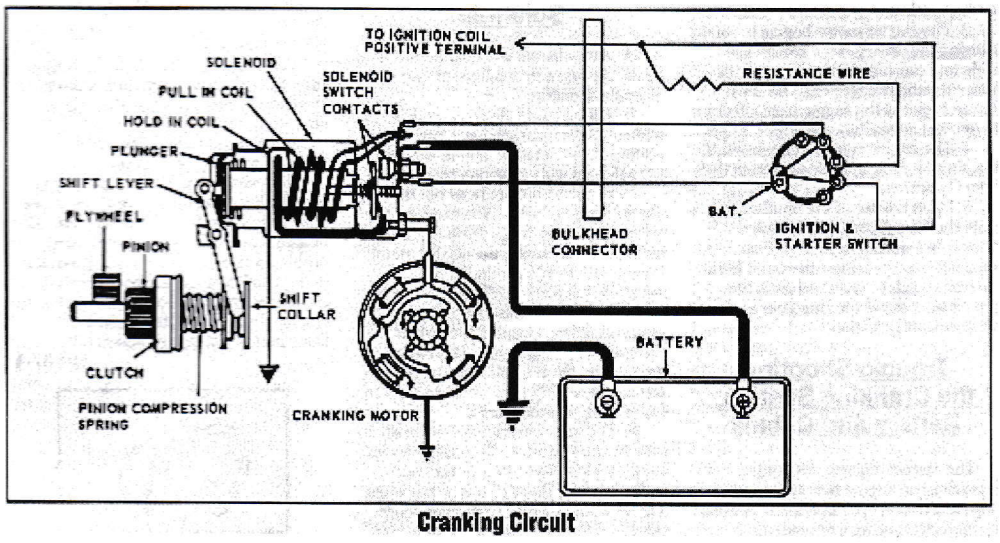


Figure 3.17: Starting system

The battery stores electrical energy in chemical form until it is needed by some part of the automotive electrical system. The energy is measured by starting the voltage and current rating of the battery. A rough analogy to electrical voltage is the pressure in a home water system. Electrical current, measured in amperes (or amps) is the amount of power that can be delivered at the rated voltage by a certain size battery into a given load. Current can be thought of as somewhat similar to the amount of water that can be delivered at a stated pressure and through certain size pipes. Current is determined by a combination of the voltage and the electrical resistance that the current has to pass through. Thus, if the resistance path (wiring, connections, switches, etc.) becomes higher resistance than originally designed, the currents passing through the loads (motors, solenoids, lamps, etc.) and the voltage at the loads, will be lower than needed and the loads will not operate as designed.

The negative battery cable connects the negative post of the battery to the engine. The engine is electrically connected to the frame and body via ground straps. This combination of engine, body, and frame provides a conductive path (called "ground") from all devices on the vehicle that are connected to ground back to the battery negative post. The positive cable is connected from the positive post of the battery to the large + post on the battery to the large + post on the solenoid.

Sequence of Operation

When we turn the ignition switch to "start", the following events occur: (assuming a good battery and proper wiring)

1. Power is switched to the "S" terminal on the solenoid causing the solenoid to operate. It requires 40 to 50 amps to operate the solenoid.
2. The solenoid drives the starter gear out and against the ring gear and closes the high current switch between the battery positive post and the starter motor windings.
3. The starter motor begins to rotate causing the drive gear to rotate and slide into the mesh with the ring gear (if it was not initially engaged). The starter motor requires as much as 550 amps to operate normally.
4. The engine rotates (cranks) until the ignition switch is released from the "start" position.
5. Upon release of the ignition switch from the "start" position, the solenoid reverts to a normally off condition. The solenoid return spring causes the high current switch to open and pulls the starter gear out of the ring gear back to its normal off position.

3.3.2 Gas Control System

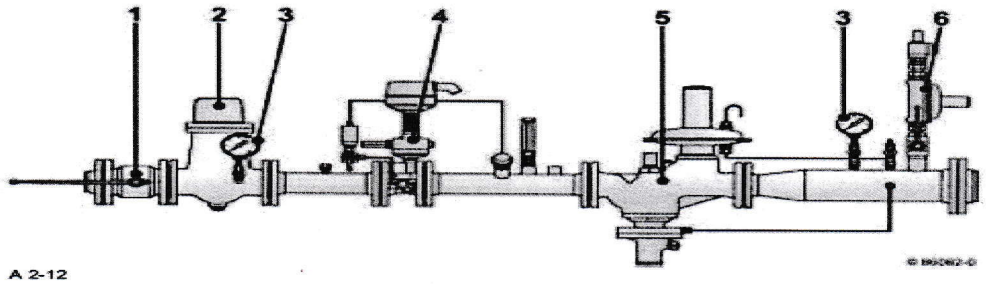


Figure 3.18: Gas control system

The gas system consists of mainly the following sections.

i. Shut-off
ii. Gas filter
iii. Gas pressure regulator
iv. Flexible connection
v. Shut-off system (ball valve)
vi. Voltmeter with quantity translator
vii. Gas pressure controller with safe cut-off system
viii. Monitoring system for leaked gas quantities

Gas regulator system regulates the correct gas admission to the mixture unit and the main cylinder. The stepper motor operates the actuators using control air to supply the right amount of gas to the mixture unit and the main cylinder at a time. It also regulates the gas supply with increasing load. The valves in the regulating unit we controlled by PLC through actuators and opening or closing the valves are accomplished using control air. (compressed air)

Gas regulator system regulates the correct gas admission to the mixture unit and the main cylinder. The stepper motor operates the pneumatic actuators to supply the right amount of gas to the mixture unit and the main cylinder at a time. It also regulates the gas supply with increasing load. The control valves are using commanded from the PLC and operated using

control air form the air compressor. In case of an emergency shut down the gas regulation unit shuts off the gas admission valves.

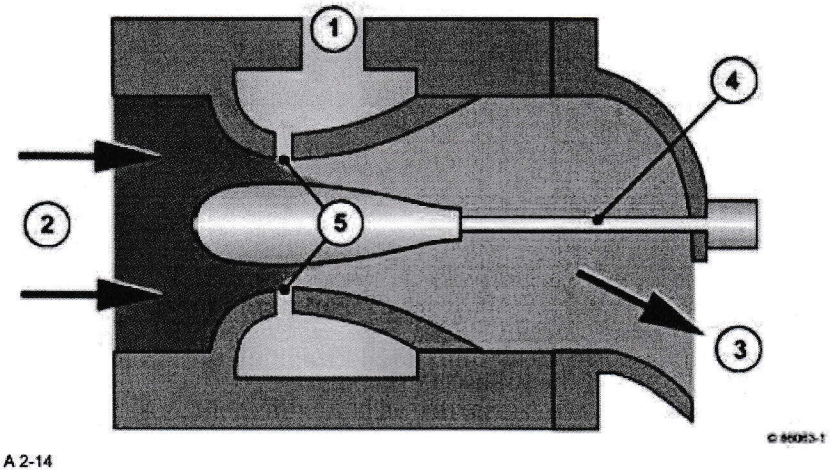


Figure 3.19: Gas Admission Valve

1. Gas inlet
2. Air inlet
3. Gas-air mixture outlet
4. Connection linkage to the stepper motor
5. Gas gap

Gas-air mixture, formation of mixture

The mixing of gas and air to combustible mixture takes place immediately upstream of the turbocharger, in the so-called mixer. The mixer is a venturi pipe ,i.e. flow-beneficial narrowing of the pipe which widens up again gradually. the design causes only very slight loss of pressure to the flow and thus minimal reduction of filling into the cylinders. at the narrowest point the flow is at its highest speed. the under pressure created over a ring-shaped gap makes the gas mix into the main flow radially from outside. his way of mixing has the advantage that the ratio of gas and air remains almost constant even if the mixture sucked through changes considerably, and only leaves the so-called lambda window, in which the engine operates safely and economically, for short periods.

The adjustable gas gap serves to adjust the gas-air mixture.teh quantity of mixture is controlled by the throttle valve.

Speed governor

The speed governing has the task of controlling the engine speed by adjusting the rotary valve position. This control is carried out electrically through the tem system. With an electronic speed governing the actual speed is picked up by a pulse pick-up. The pick-up signal is sent to the tem system and compared with the set peed. If the speed is different the actuator is controlled by the tem system. The actuator is connected to the rotary valve and so it can adjust the speed.

Actuator

The actuators are distinguished by:

- High adjustment forces which work in both directions
- Low power consumption
- Not sensitive to slow changes in the voltage in the power supply
- A DC motor controls the controller output shaft through an intermediate gear. The position of the controller output shaft is also passed to the TEM system.

The actuator is connected to the rotary valve through an Adjustable linkage.

The actuator is fitted to the free side of the engine

3.3.3 Ignition System

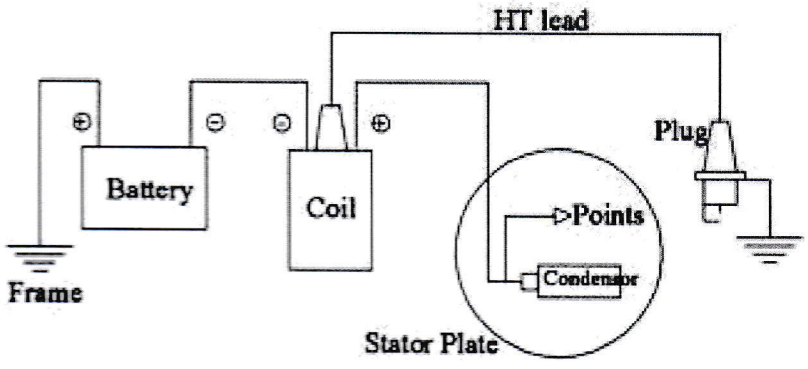


Figure3.20: Distributorless ignition systems

In the distributorless ignition system the spark plugs are fired directly from the coils. The spark timing is controlled by an Ignition Control Unit (ICU) and the Engine Control Unit

(ECU). The distributorless ignition system may have one coil per cylinder, or one coil for each pair of cylinders.

Some popular systems use one ignition coil per two cylinders. This type of system is often known as the waste spark distribution method. In this system, each cylinder is paired with the cylinder opposite it in the firing order. The ends of each coil secondary leads are attached to spark plugs for the paired opposites. These two plugs are on companion cylinders, cylinders that are at Top Dead Center (TDC) at the same time. But, they are paired opposites, because they are always at opposing ends of the 4 stroke engine cycle. When one is at TDC of the compression stroke, the other is at TDC of the exhaust stroke. The one that is on compression is said to be the event cylinder and one on the exhaust stroke, the waste cylinder. When the coil discharges, both plugs fire at the same time to complete the series circuit.

Since the polarity of the primary and the secondary windings are fixed, one plug always fires in a forward direction and the other in reverse. This is different than a conventional system firing all plugs the same direction each time. Because of the demand for additional energy; the coil design, saturation time and primary current flow are also different. This redesign of the system allows higher energy to be available from the distributorless coils, greater than 40 kilovolts at all rpm ranges.

The Direct Ignition System (DIS) uses either a magnetic crankshaft sensor, camshaft position sensor, or both, to determine crankshaft position and engine speed. This signal is sent to the ignition control module or engine control module which then energizes the appropriate coil.

The advantages of distributorless ignition system are:

- No timing adjustments
- No distributor cap and rotor
- No moving parts to wear out
- No distributor to accumulate moisture and cause starting problems
- No distributor to drive thus providing less engine drag

The major components of a distributorless ignition are:

i. ECU or Engine Control Unit
ii. ICU or Ignition Control Unit

iii. Magnetic Triggering Device such as the Crankshaft Position Sensor and the Camshaft Position Sensor

iv. Coil Packs

3.3.4 Lubricating System

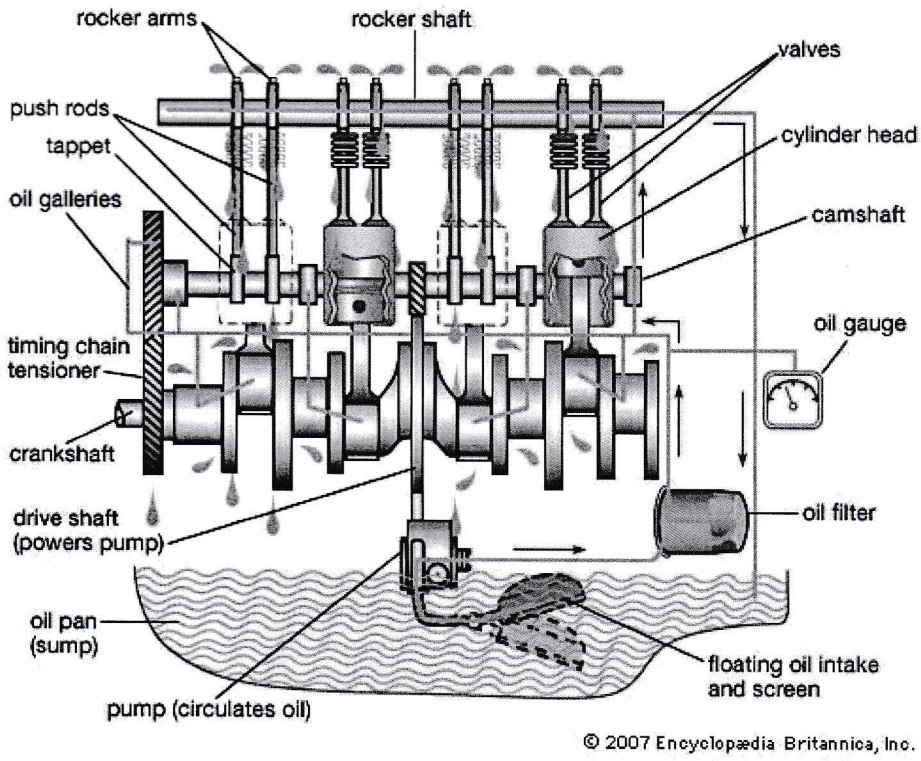


Figure 3.21: Lubricating system

The lube oil rescues the friction of the components which rub against each other and feeds heat away from the rubbing positions, the piston head and the turbocharger. a film of lube oil on the running surfaces of the cylinders reduces the sliding friction of the pistons and piston rings. Furthermore, the lube oil keeps impurities in suspension and caries them to the lube oil filter. the lube oil pump sucks the lube oil from the lube oil sump, feeds it through the lube oil cooler and the lube oil filter into the engine's lube oil circuit.

The lube oil pressure in the engine circuit is set by a lube oil control valve, the bypass valve is fettered so as to avoid the flow of lube oil being interrupted when the lube oil filter is dirty.

if the lube oil pressure is so high that the lube oil pump is at risk, the overpressure valve opens and allows the excess lube oil carried flow back into the lube oil sump.

Lube oil system provides the engine with:

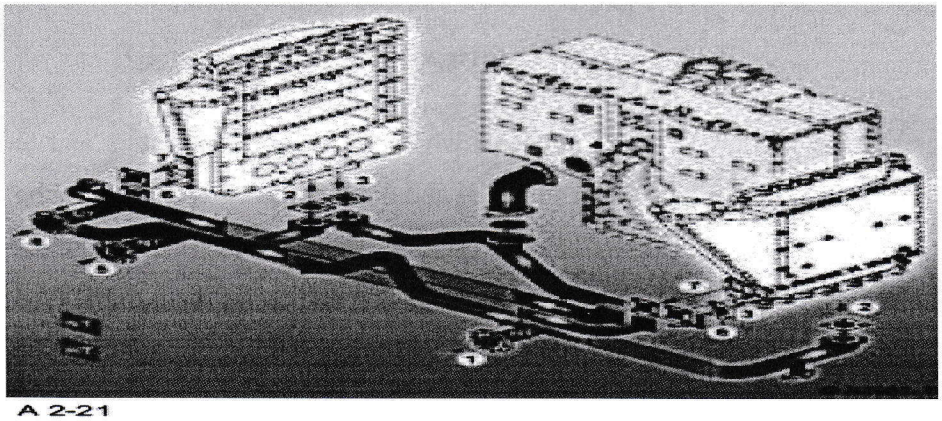
- Proper lube oil flow
- pressure of lube oil
- temperature and viscosity
- oil quality within limits
- pre-lubrication to provide a certain pressure before starting the engine,

Lube oil system auxiliaries can be divided into the following groups,

i. Lube oil storage and transfer system,
ii. Lube oil cleaning system,
iii. Lube oil cooling system,
iv. Lube oil pressure control system

3.3.5 Cooling System

Coolant diagram, mixture cooler



A 2-21

HT = high temperature circuit
1 Feed line
2 Mixture cooler inlet
3 Mixture cooler outlet
4 Engine inlet

LT = low temperature circuit
5 Feed line
6 Mixture cooler inlet
7 Mixture cooler outlet
8 Discharge line

During combustion the chemical energy in the gas is converted into heat energy. only some of these can be converted into mechanical energy in the engine. the remaining residual heat is mainly led away with the exhaust gas and the coolant. The temperature of the coolant is controlled and monitored automatically. if the temperature exceed the maximum set values the engines is turned off by the tem system.The whole cooling system of the engine is divided into two parts. The one part works in the engine site and the other section works outside the engine room.

The Deutz TCG 2020vk Engine's first cooling system is a close cooling system in which the coolant circulate in a circle through the engine. The coolant absorbs heat from engine block and from the other components and then it goes to the heat exchanger where it is cooled. After its cooling it comes to the engine again and absorbs heat. Thus it is circulated. There are several kinds of instruments work in the system. The main components are water pump, heat exchanger, thermostat valve, temperature sensor etc.

The second part of the cooling system consists of a cooling tower, a water pump and piping arrangement. This system starts from the cooling tower from where the water comes to the heatexchanger and exchange heat. The water actually absorbs heat from the coolant which comes from engine and goes to the cooling tower and become cooled by air. Thus the circuit works.

3.3.6 Intake and Exhaust System

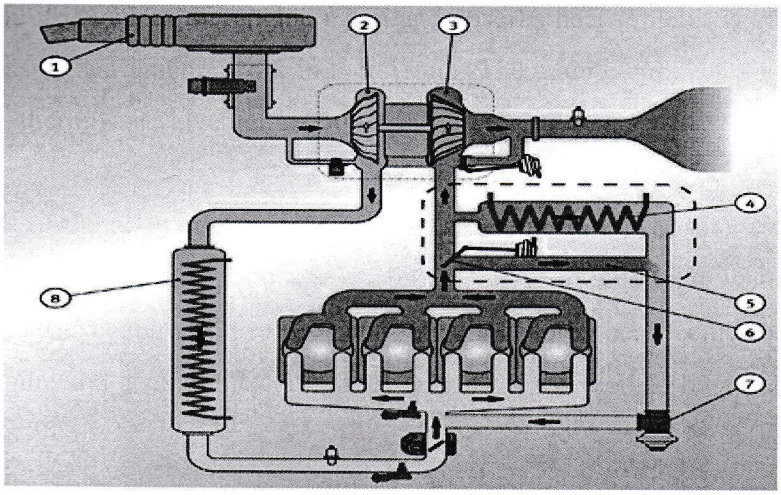


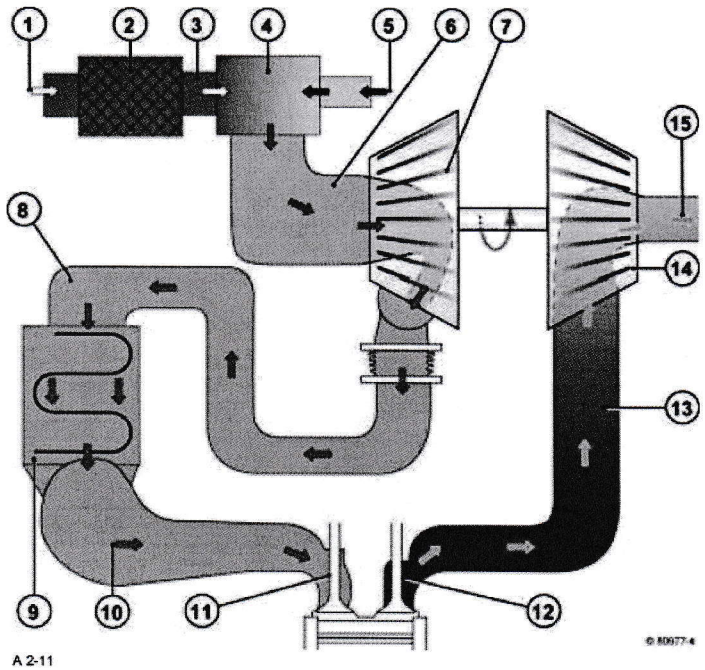
Figure 3.22: Intake and Exhaust system

The picture above shows a block diagram of the cooled exhaust gas recirculation system: 1. Air Filter; 2. Turbocharger (compressor); 3. Turbocharger (turbine); 4. EGR cooler; 5. Bypass duct; 6. Bypass flap (vacuum-controlled in this case); 7. EGR valve; 8. Charge air cooler

In this system the combusted gas goes to exhaust manifold during the exhaust stroke and passes out through the turbine which is set in the exhaust manifold. As a result the turbine rotates. There is a compressor which is placed in the suction line of the engine coupled by a shaft with the turbine. As the turbine rotates, it makes the compressor also rotated which draws the air-fuel mixture to the engine with more volume.

The intake and exhaust gas system leads the exhaust gases to turbocharger and after that out of the power house, thus ensuring that emissions and noise are kept on an acceptable level. The exhaust gas system consists of pipes, flexible bellows to compensate for thermal expansion, and an exhaust gas silencer. The exhaust gas system is equipped with a ventilation unit and explosion vests located at strategic places.

3.3.7 Turbo Charging System



1. Intake air
2. Air filter
3. Filtered air
4. Gas-air mixer
5. Gas
6. Mixture to the compressor
7. Centrifugal impeller
8. From the compressor to the mixture cooler
9. Mixture cooler
10. Cooled mixture
11. Inlet valve
12. Exhaust valve
13. To the exhaust turbine
14. Turbine wheel
15. To the silencer

Turbo charging forces compressed air into an engine to improve the engine's performance. With turbochargers, a smaller, more fuel efficient engine can replace a larger, less fuel efficient engine. The smaller engine achieves similar performance, while reducing exhaust emissions.



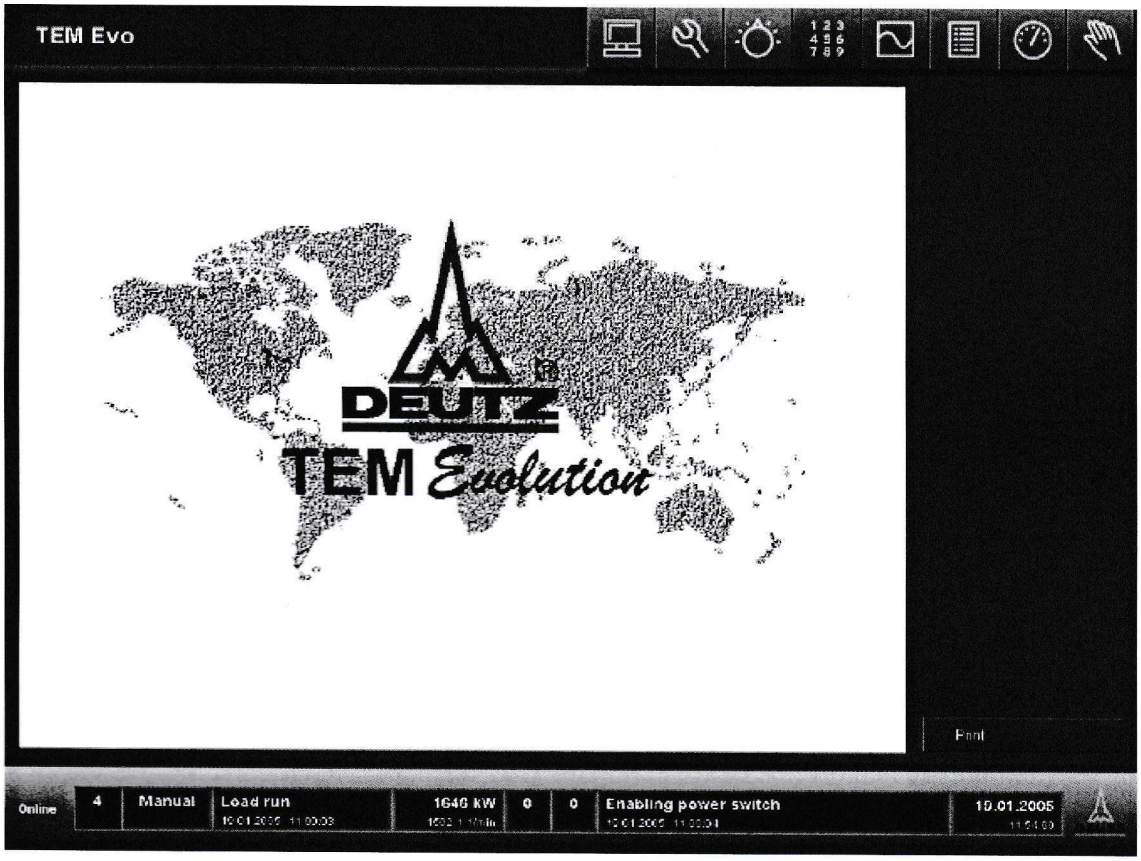
Figure 24: Turbocahreger

The turbocharger is driven by waste exhaust gases forced through an exhaust housing onto a turbine wheel. The turbine wheel is connected by a common shaft to a compressor wheel so that both wheels rotate simultaneously when the exhaust gases hit the turbine wheel. Rotation of the turbo assembly compresses the intake air routed through a compressor housing, forcing the compressed air into the engine's cylinders. The increased amount of air forced into the engine creates more power than a similarly sized non-turbocharged engine and power similar to a larger, non-turbocharged engine. Turbochargers operate at very high temperatures, high speeds and high pressures. Optimum performance can only be achieved by the proper operation, maintenance and service.

CHAPTER FOUR

Operating System

TEM EVO Touch Screen Operation



In the operating system there is a Total Electronic Management (TEM) system which holds the engine's all of the instantaneous information like the temperature, pressure, run hour, RPM, produced power, alarm and fault list, total shutdown time etc. If any fault is occurred in the engine then the TEM system will shutdown the engine automatically and if any abnormal condition is appeared in any system of the engine then the TEM system will give alarm in the panel board. From the panel board the starting and shutdown task is also done.

Engine Starting Sequence

i. Engine ready for start
ii. Start preparation
iii. Start switch on
iv. Idle running Synchronizing
v. Loading
vi. Normal operation

Engine Shutdown Sequence

i. Unloading
ii. Synchronizing close
iii. Start switch off
iv. Engine stopped

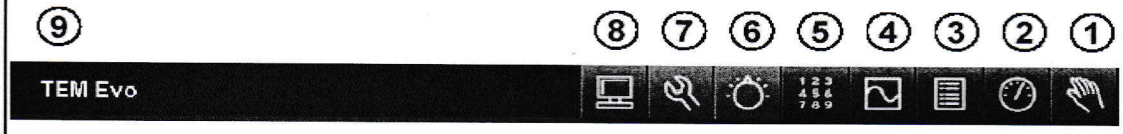
4.1 The TEM System

The TEM (Total Electronic Management) Evolution system controls the entire Deutz engine. The TEM operating terminal interface is of touch screen type. Touching softly on the screen, on top of any of the appropriate button activates that function.

In the title bar on top of the screen, 8 push buttons are present for 8 different masks. Their Descriptions and functions are given below.

Title bar

In the title bar are shown the respective mask title and a bar with push buttons. Via the push buttons you can activate 8 mask groups as shown in the figure below.



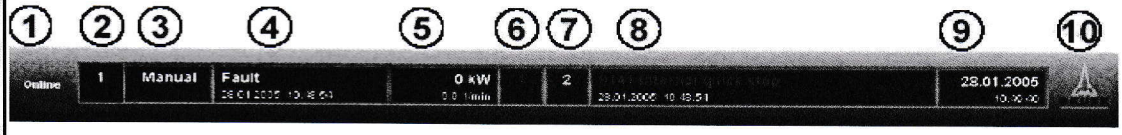
1. Operation
2. Data
3. The TEM-Evo System can monitor and distinguish 600 different events.
4. History
5. Parameter
6. Controller
7. Service
8. System
9. Title of active mask

Figure 4.1: Title bar

When a specific mask needs to be activated, the respective push buttons has to be pressed.

Status line

In the status line find the most important data permanently displayed,. thus giving a quick overview concerning the current status of the genset.



1. Status communication
2. Engine no.
3. Operation mode
4. Status genset
5. current power/speed
6. Number of faults
7. Number of alarms
8. Last message/alarm/fault
9. Date, clock time (control)
10. DEUTZ-Logo

No.	Display	Meaning
1	Online	Communication with PLC OK
	Offline	no communication with control
2	1 – 15	Genset no. as per Parameter "10000 genset no."
3	Manual	Manual mode
	Auto	Automatic operation
4	see table Status	Current status of genset
	Data/clock time	Time output Entry of control into this status
5	current power	currently released power
	current speed	Current speed of the engine
6	Number of faults	Number of pending faults
7	Number of alarms	Number of pending alarms

Figure 4.2: Status line

The following shows the status line & meaning of various indications.

No.	Display	Meaning
8	Last entry in the operation log	Last pending fault, alarm or message. Priority 1. Fault: 2. Warning: 3. Message: The display shows allways the last entry in the operation log with the topmost priority.
9	Date, clock time (control)	Current date and clock time TEM-Evo PLC (on site)
10	DEUTZ-Logo	return to the start screen

Figure: Status meaning

Genset status indications are as follows

Status messages

Status
Fault:
Start disabled
Ready
Start
Self-contained start
Start retry
Idle
Synchronisation
Load run
Shutdown
Oil change
Auxiliaries test mode
Ignition system test mode
Speed governor test mode

Figure 4.3: Status message

When the engine runs, the following mask screen Data displays all the operating parameters. This mask screen is divided into some sub screens. In the picture, the activated sub screen is Overview. Selecting the other sub screens, additional parameters can be seen.

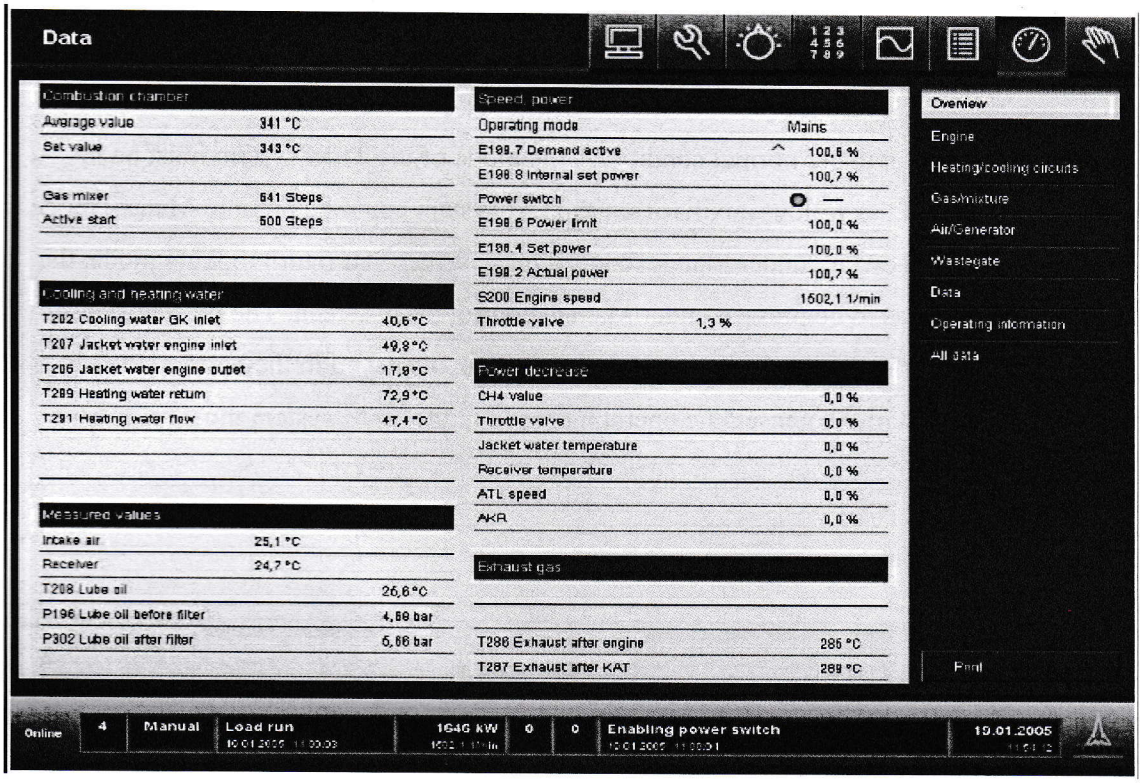


Figure 4.4: Data

The TEM system has a Manual control mask screen from where various test operation can be performed.

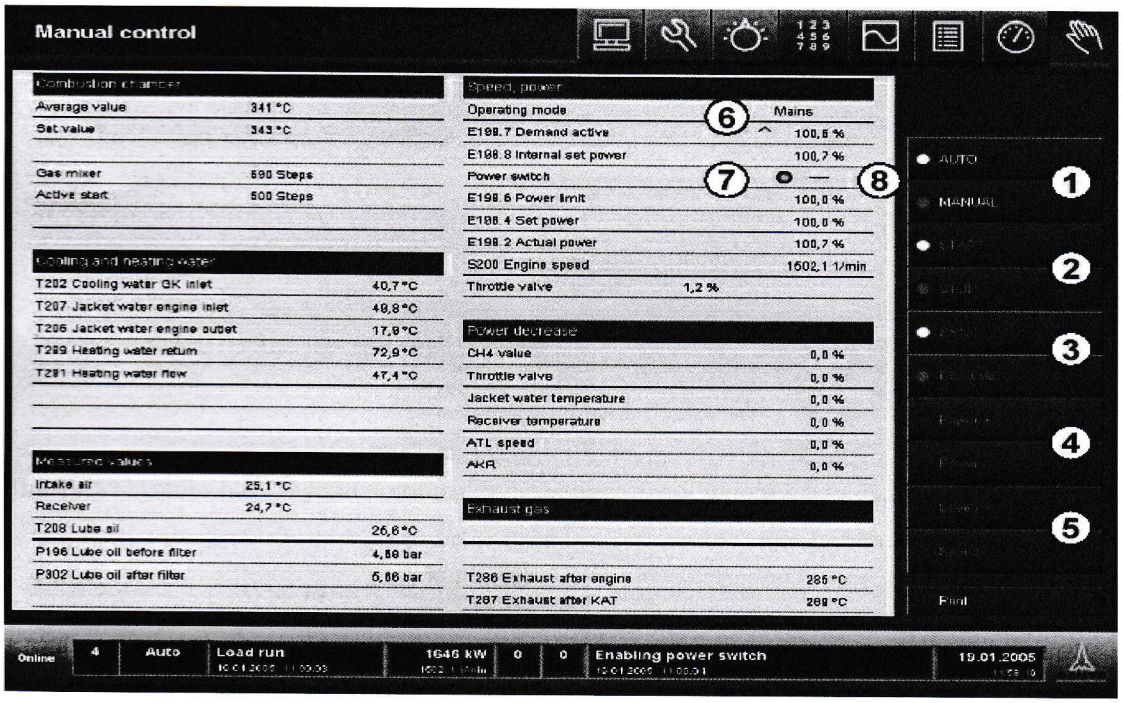


Figure 4.5: Manual control

To operate the genset under normal conditions, the mode of the TEM system must be in Auto. For testing of the various auxiliaries, the TEM system could be put into Manual mode by pressing Manual switch under Manual control mask screen. To return to Auto mode, the push button Auto has to be pressed under Manual control mask screen. The present status of the genset is shown in the third column of the status line, displayed in the bottom. Please remember that, to start the genset, the operating mode of the TEM system must be in Auto mode.

4.1.1 Operation Log

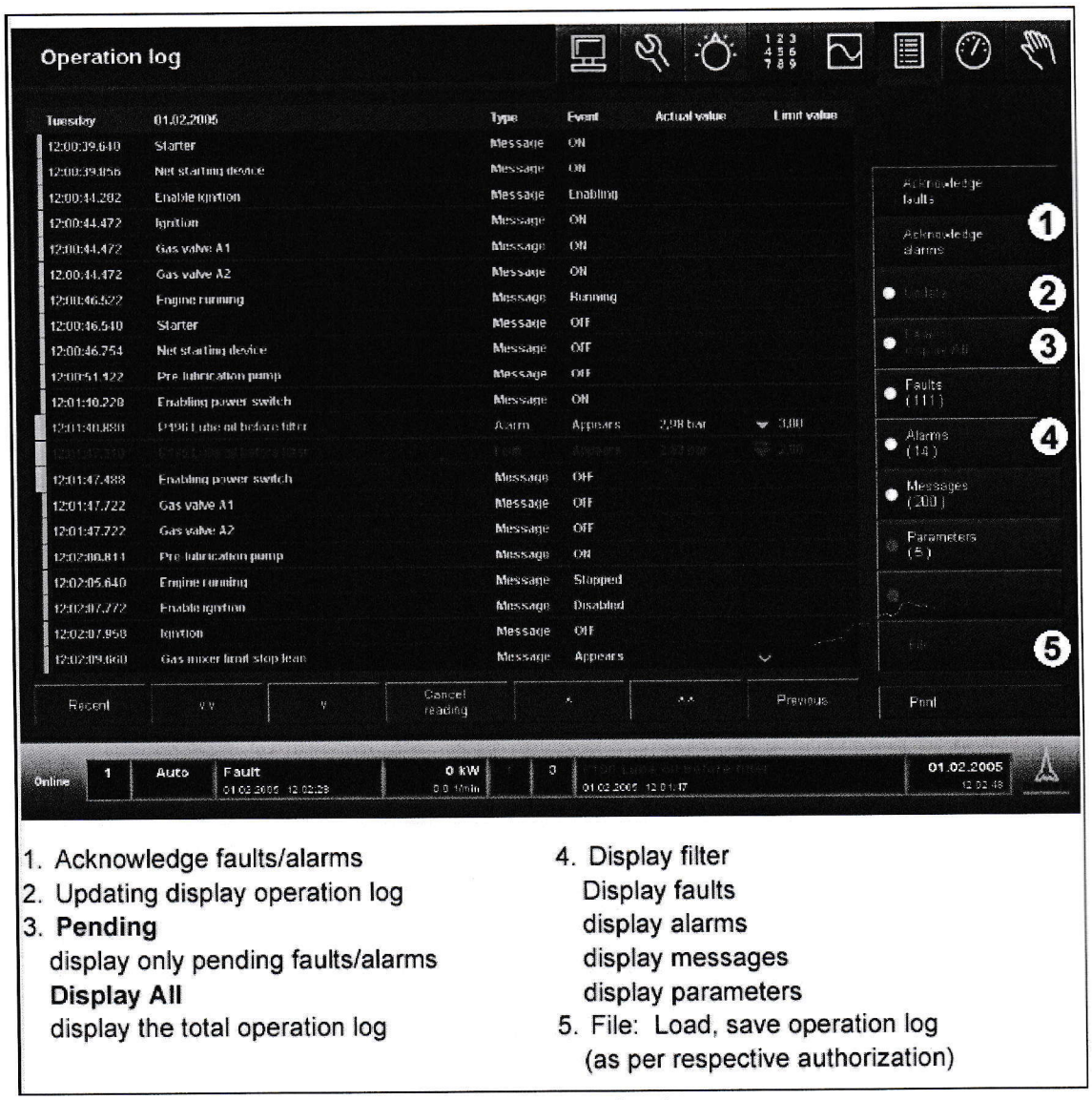


Figure 4.6: Operation log

The sixth column of the status line shows the number of faults present in red color & the seventh column shows the number of alarms present in yellow color. When there's any fault

condition occurs, then genset immediately shuts off & it can't be start again until the cause of the fault has been eliminated & the fault condition within the TEM system has been acknowledged. Any single fault condition will prohibit the genset operation. The alarm indicates warning for any unusual situation going to happen or already happened. Alarm condition doesn't prohibit genset operation, but the cause of the Alarm has to be identified & the cause should be eliminated so that a subsequent genset trip wouldn't occur. Once the reason of the fault & alarm conditions are eliminated, they should have to acknowledged from the

4.1.2 Operation Log Mask Screen.

The faults & alarms could be acknowledged following the direction given below.

Push button	Explanation:
Acknowledge faults	Acknowledgement of pending faults faults can only be acknowledged in case that they have been selected (see filter selection)
Acknowledge alarms	Acknowledge pending alarms Alarms can only be acknowledged, if they have beem selected (see filter selection)
●	Update: the new entries are permanently read and displayed
●	Pending/Display all (fault/alarms) Pending: only pending alarms/faults are displayed DisplayAll: All entries are displayed, the display depends on the filter selection. If the push button is actuated, the data are read-in again by the control.

The faults & alarms could be acknowledged following the direction given below.

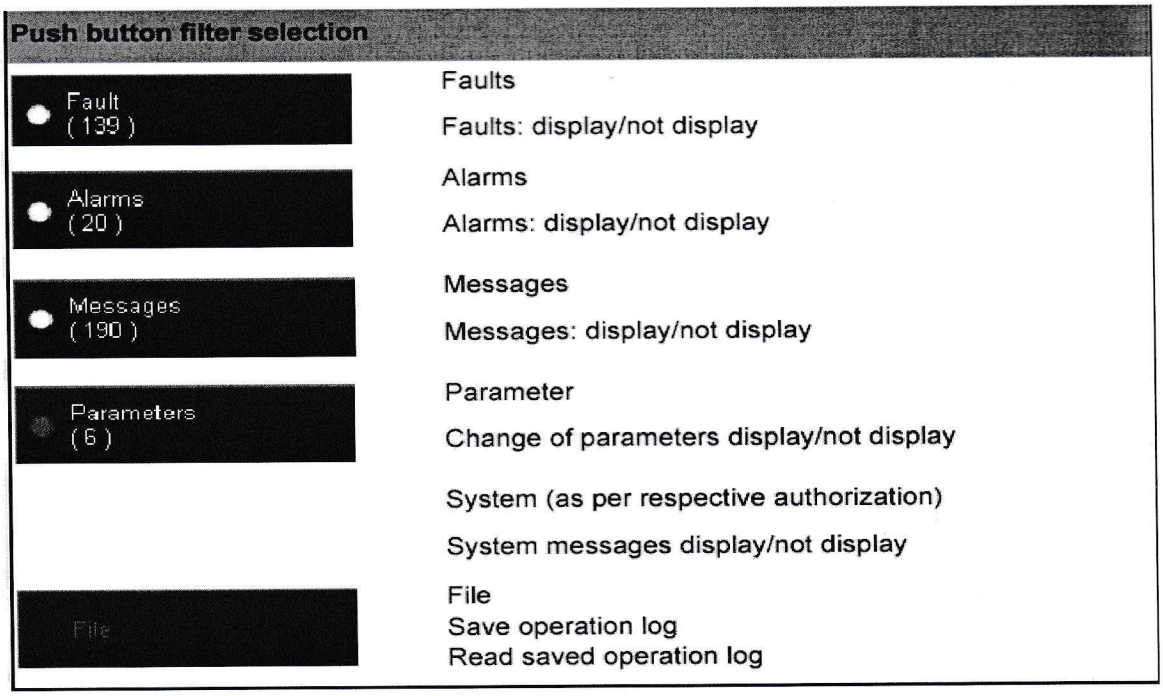
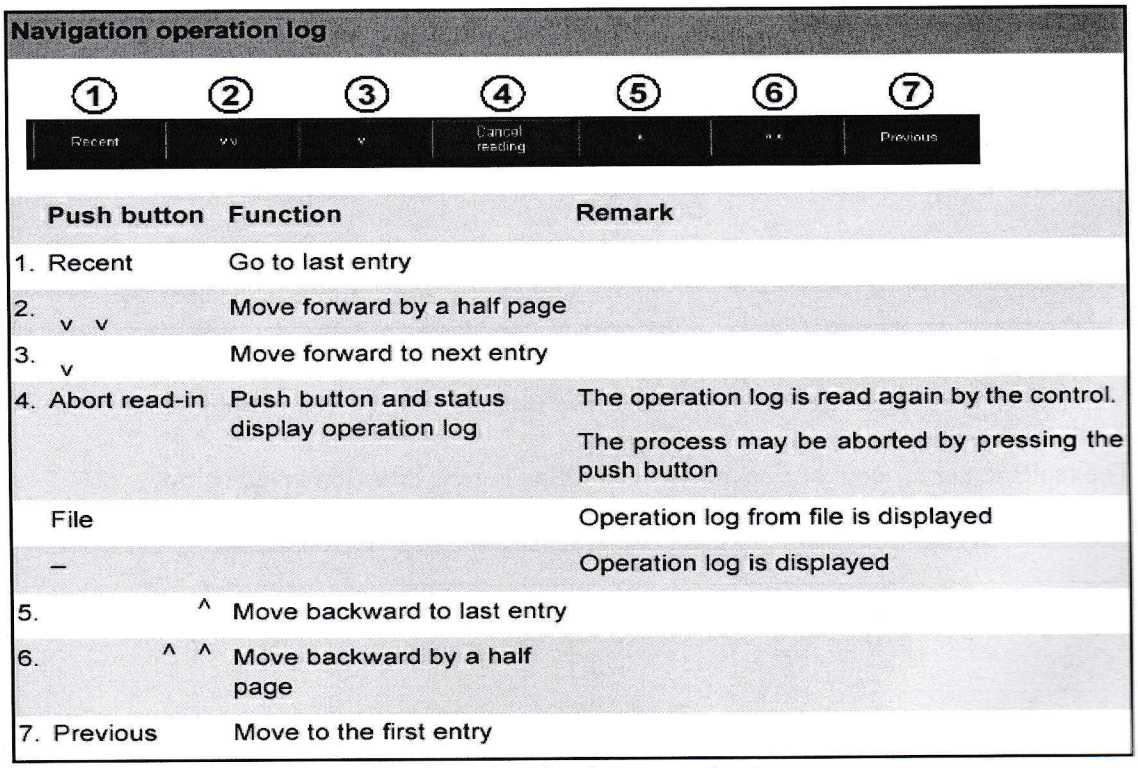


Figure 4.7: Direction mask

Navigation within the Operation log mask screen is shown in below.



	Push button	Function	Remark
1.	Recent	Go to last entry	
2.	v v	Move forward by a half page	
3.	v	Move forward to next entry	
4.	Abort read-in	Push button and status display operation log	The operation log is read again by the control. The process may be aborted by pressing the push button
	File		Operation log from file is displayed
	–		Operation log is displayed
5.	^	Move backward to last entry	
6.	^ ^	Move backward by a half page	
7.	Previous	Move to the first entry	

Figure 4.8: Navigation operation log

The following shows the status of the genset to be understood from the color of the bar, on the left of the time indication.

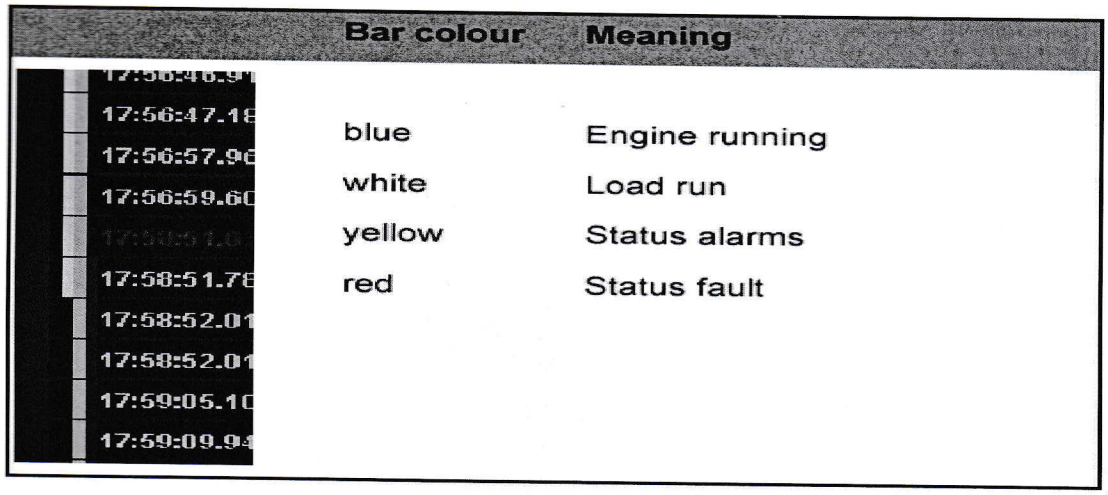


Figure : Color meaning

Other than fault & Alarm conditions, there are indications about Messages within the Operation log mask screen. Messages are the actual happenings within the TEM system. Messages are recorded within the TEM system according to the time they happen. As such all faults, alarms & messages are recorded within the TEM system according to the time they occurred & they can be viewed within the Operation log mask screen later. Operation log helps in analyze engine operation, diagnosis of any abnormal operation of the genset, i.e. cause of faults & alarms. When there's a day change between two events, a color bar indicates that for easy understanding.

Change of the day

Bar with weekday + date crosswise over all columns

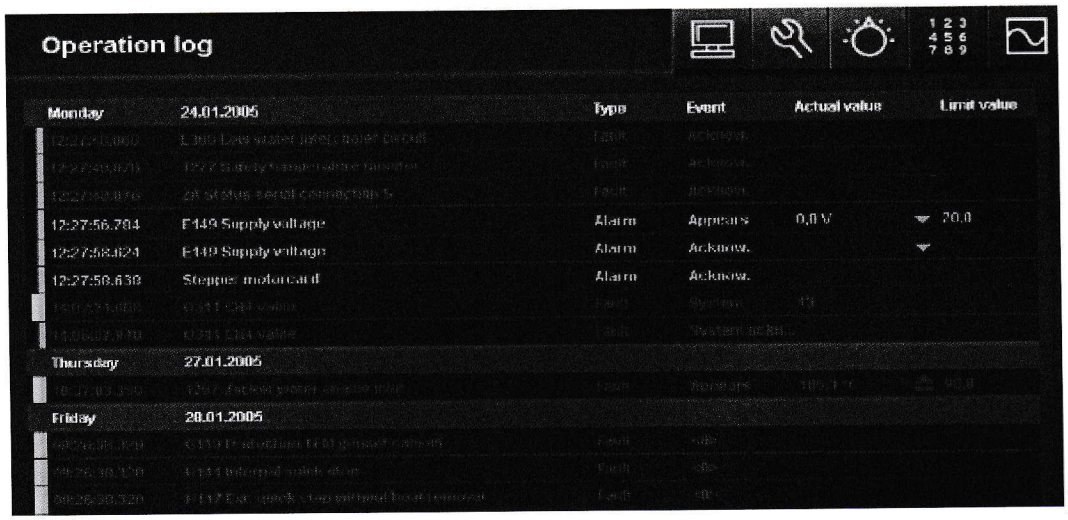


Figure: Operation log

Following are some symbol with their explanation within the Operation log mask screen.

Measured value

Symbol	Explanation:
!	Sensor error
	Message of exceeding the limit value
	Message of undershooting the limit value
	Alarm exceeding the limit value
	Alarm undershooting the limit value
	Fault exceeding the limit value
	Fault undershooting the limit value

Figure: Measured value

History Mask

The TEM system keeps record of all engine parameters for every second for last six minutes. This is called 6 minute history. The TEM system also keep record of all engine parameters, one slice every six minute interval for last 40 hours. The history can be plotted against time to have a clear understanding about the happenings within the engine. The history can be updated in real time manner to have a continuous process picture. The history plot is very much useful in tracing the parameter change before any engine trip occurs.

The History mask screen is shown in below.

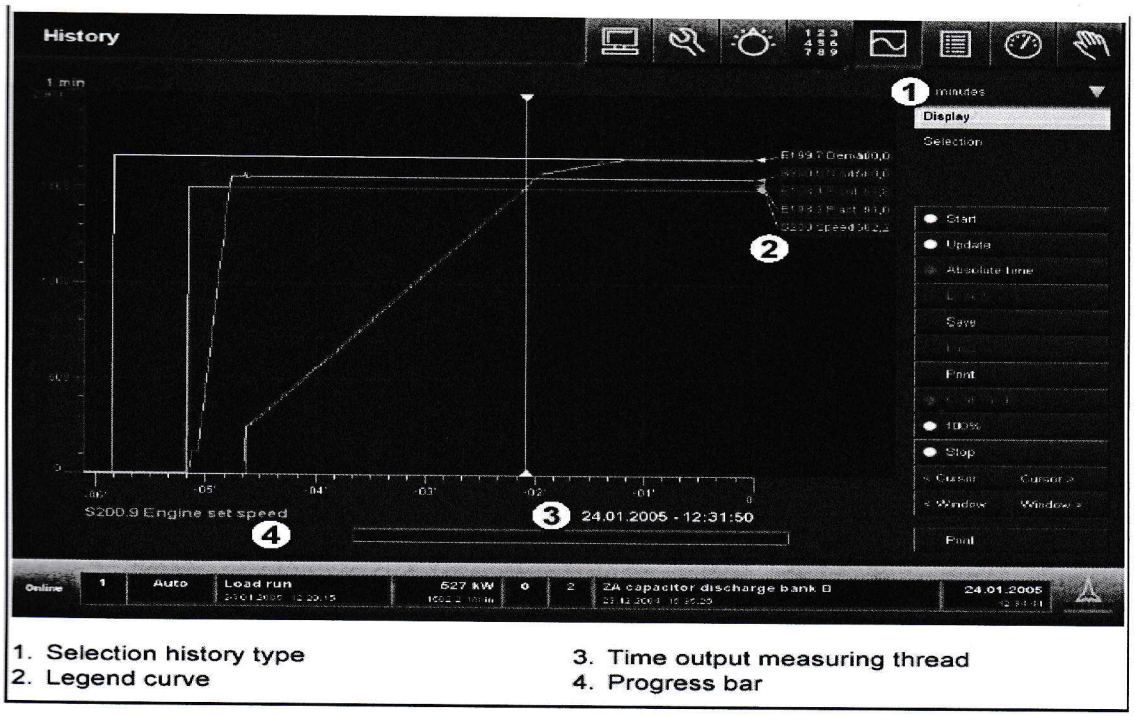


Figure 4.9: History mask

Following are the various control push buttons within the History mask screen

Push button history		
Start	activated	The control data are displayed the curve is read-in again
	deactivat-ed	Read-in of curve is stopped
Update	activated	The data are continuously read-in (hitherto Realtime-Scope)
	deactivat-ed	Read-in is stopped
Absolute time	activated	Working cycle hystory: deactivated 6 minute hystory: Display clock time 40h history: Display day, clock time
	deacti-vated	6 minutes: Display in minutes 40h history: Display in days:hours
Continued	activated	Curves are read-in in the background Only one time of history is possible at the same time (6min etc.), the others are disabled
	deacti-vated	After a change of mask the curves must be read-in again.
100%	activated	Commutation between ZOOM and standard display (400 points)
	deacti-vated	Curves in float are displayed (4000 points)
Stop	activated	Curve is stopped measuring thread is activated: By a touch the thread can be set into the curve, in the legend the values on the thread are displayed, additional functions are activated

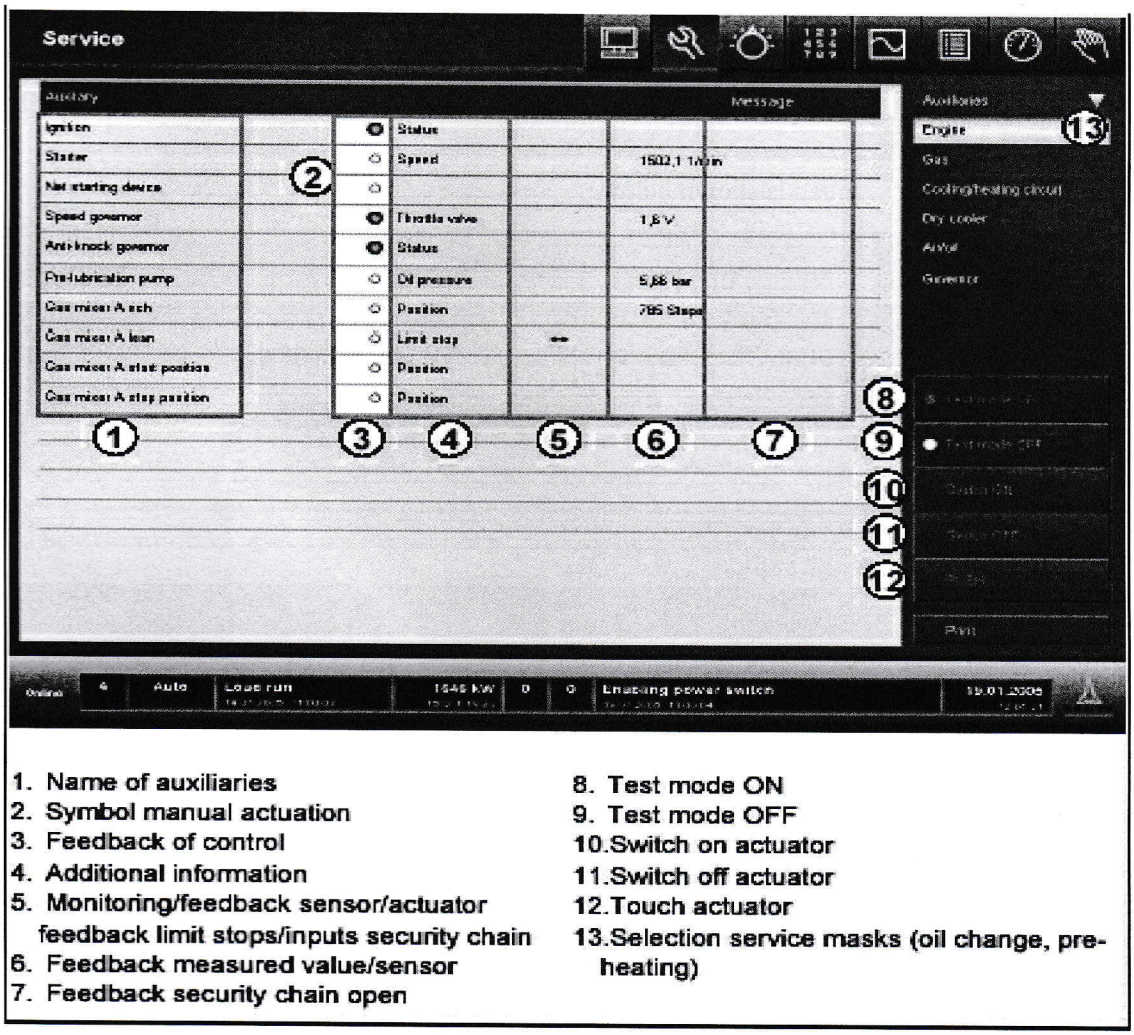
Figure 4.10: Push button history

If required, from the Service mask screen, various auxiliaries can be switched on for test only. Before activating any auxiliaries from the Service mask screen, the genset operating mode must be put to manual instead of Auto, within the Manual mask screen. Please note that these testing can only be done while the genset is at stopped condition. After selecting the Service mask screen, the appropriate sub screens has to be selected. Such as, to operate the cooling pumps, Cooling/Heating sub screen has to be selected.

From there the Test mode has to be turned on. Then the appropriate cooling pump (either engine cooling pump or intercooler pump) has to be selected by pressing on it & it'll be highlighted indicating its selection status. Then that specific pump can be turned on pressing Switch ON & be turned off pressing Switch OFF.

The pre-lubrication pump can be operated from the Engine sub screen.

Service Mask Screen



1. Name of auxiliaries
2. Symbol manual actuation
3. Feedback of control
4. Additional information
5. Monitoring/feedback sensor/actuator feedback limit stops/inputs security chain
6. Feedback measured value/sensor
7. Feedback security chain open
8. Test mode ON
9. Test mode OFF
10. Switch on actuator
11. Switch off actuator
12. Touch actuator
13. Selection service masks (oil change, pre-heating)

Figure 4.11: Service Mask

Oil change of the engine has to be done through Oil change mask only.

The Oil change mask screen is shown below.

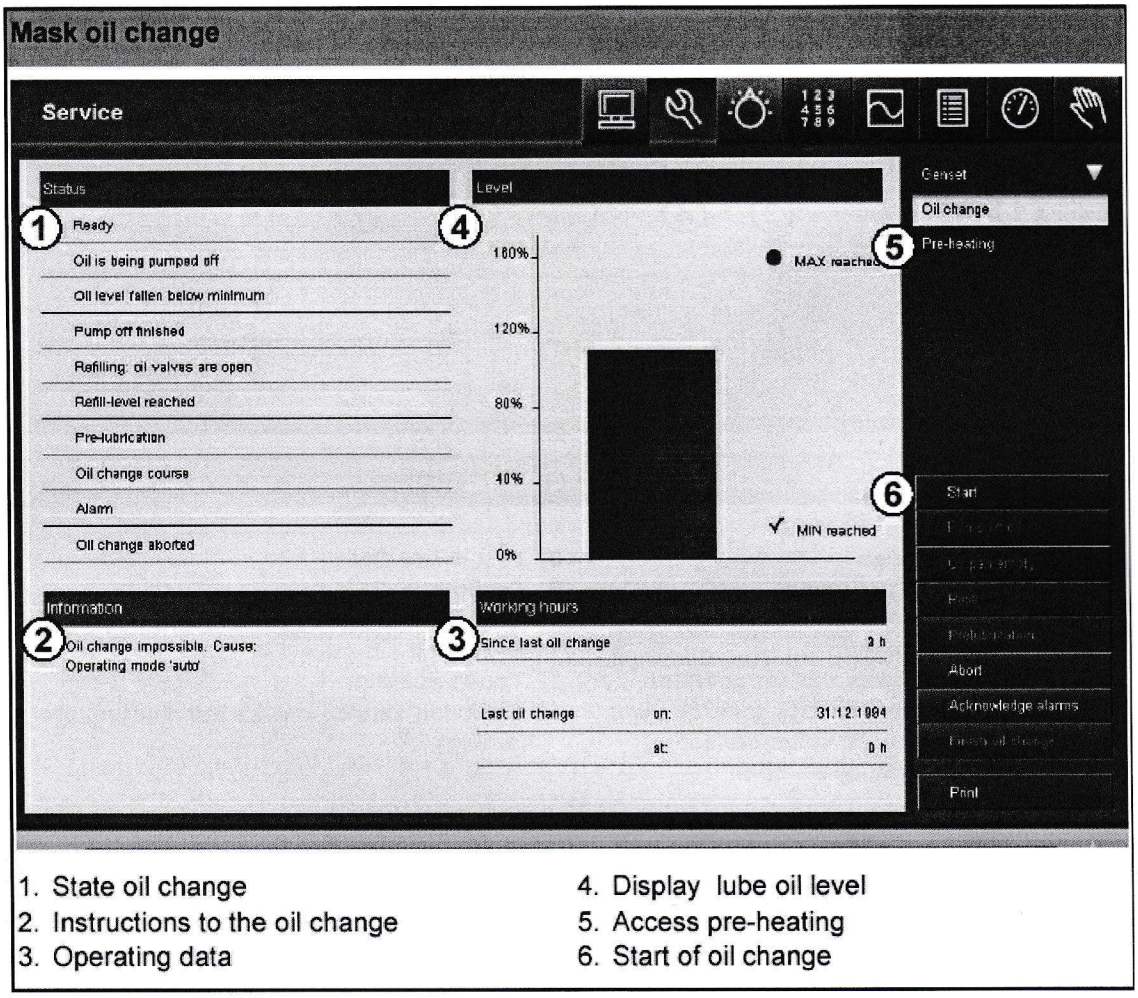


Figure 4.12: Oil change mask

Oil level within the engine sump should be in & around 100%. While running, some portion of the oil got burned & as such oil level drops after certain period of operation. When the oil level drops below certain level, the TEM system automatically turns on the solenoid valves, fixed within the lube oil filling lines, through which the engine sump is being replenished with required quantity of lube oil. When the level reaches the normal level, the solenoid valves will automatically shut off. In case of higher than normal level, the engine will not run. The excess oil has to be removed before engine could be started.

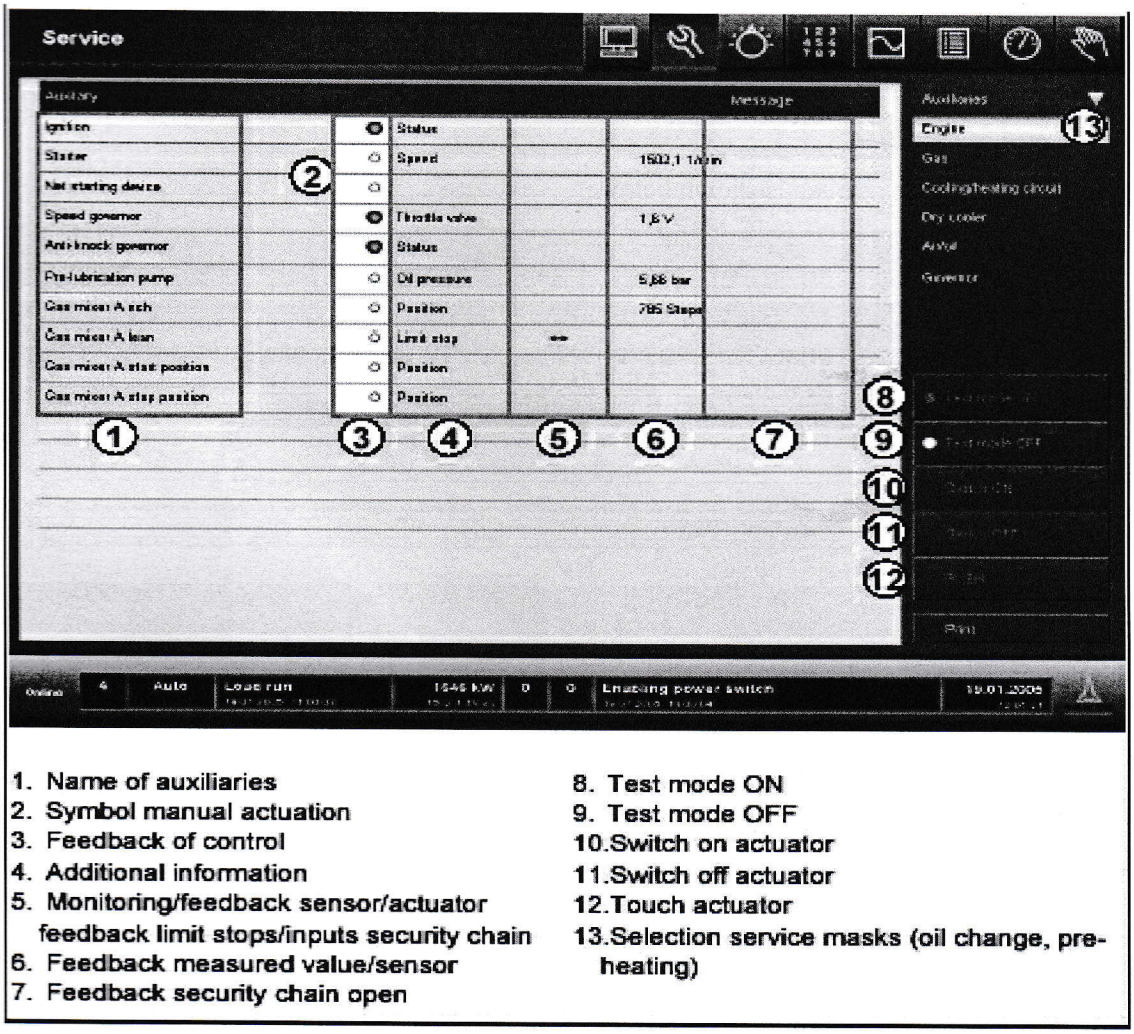


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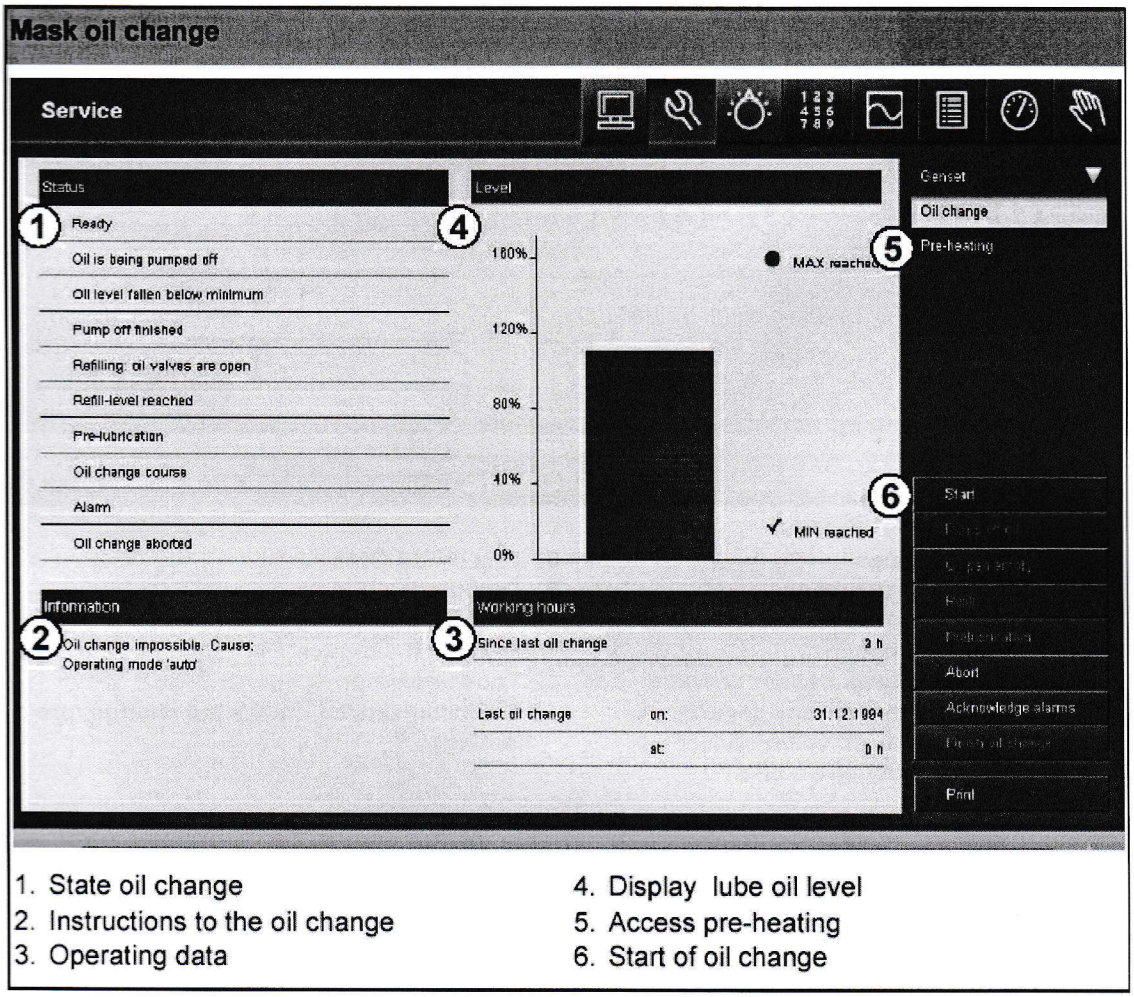


Figure 4.12: Oil change mask

Oil level within the engine sump should be in & around 100%. While running, some portion of the oil got burned & as such oil level drops after certain period of operation. When the oil level drops below certain level, the TEM system automatically turns on the solenoid valves, fixed within the lube oil filling lines, through which the engine sump is being replenished with required quantity of lube oil. When the level reaches the normal level, the solenoid valves will automatically shut off. In case of higher than normal level, the engine will not run. The excess oil has to be removed before engine could be started.

4.2 PPU Operation

This section describes the PPU (Protection & Paralleling Unit) which measures, monitors & protects all the electrical parameters of the alternator. The PPU is capable of measuring three phase voltage, frequency, and three phase current, real & reactive power, power factor of the alternator. It is also capable of measuring three phase voltage & frequency of the busbar. PPU also keeps accumulated reading of energy consumed. Additionally the PPU can perform the paralleling (synchronization) of the genset with the bus. The front side of the PPU is shown below.

The front side of the PPU is shown below.

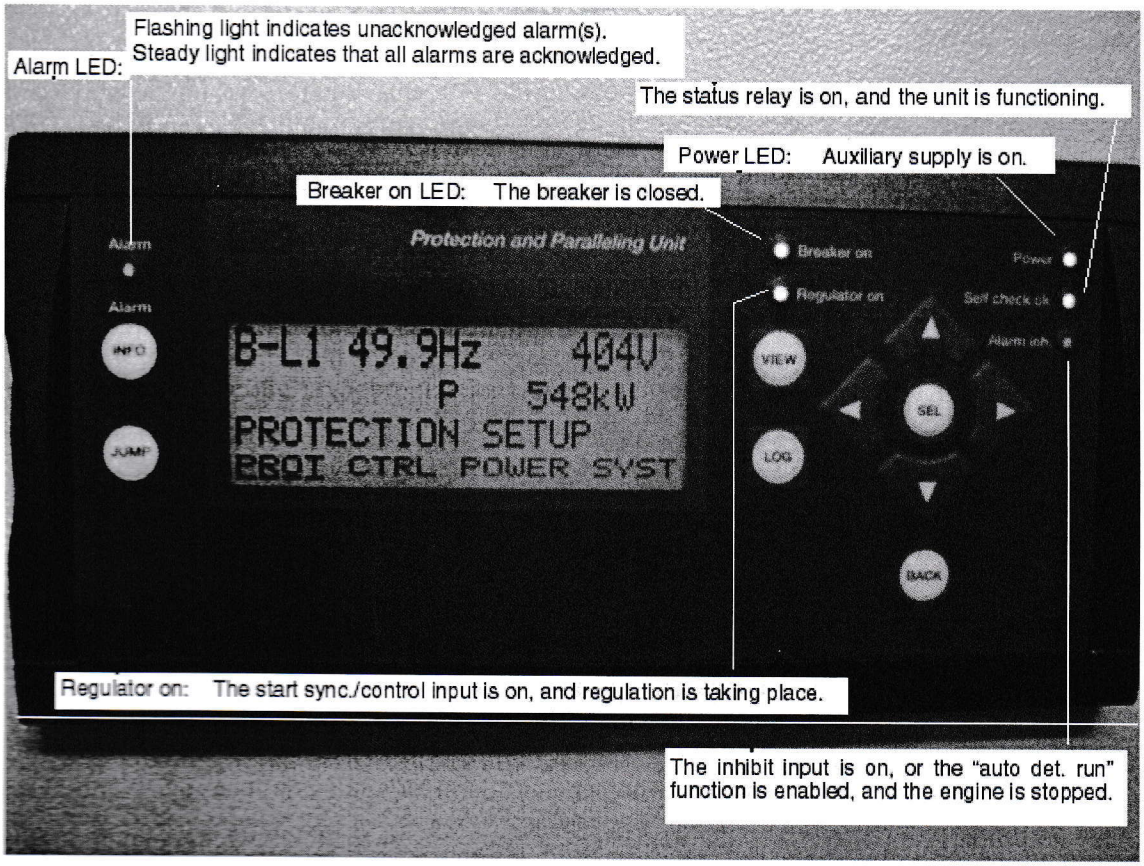


Figure 4.13: PPM display

Whenever any abnormal electrical parameter is monitored by the PPU, which is beyond the limit values set within the PPU, it triggers alarm, which in turn gives signal to the TEM system to shut off the genset. Without acknowledging the alarm(s) within the PPU, the fault condition in the TEM system can not be acknowledged & thereby genset can not be re-started. Usually the associated faults within the TEM system, triggered from the PPU are i)

E121 Generator protection / Quick stop with heat removal, ii) Security chain & iii) Generator protection fault.

When there's any alarm within the PPU, the red alarm LED will blink to indicate the faulty condition within the PPU. Pressing the INFO button will show the alarm(s) within the PPU & the alarm(s) can be acknowledged by pressing the SEL button located in the center on the four direction cursor keys. Please check that the ACK is underlined before attempting to acknowledge the alarm(s) by pressing the SEL button. After acknowledging the Alarm(s), pressing the BACK button will take back to the usual screen of PPU where various electrical parameters are displayed.

It is highly advisable to understand the cause of the PPU alarm before acknowledge (reset) the alarm(s) within PPU & to re-start the genset

4.3 Standard Operating Procedure

To operate the engine continuously and effectively without hazard the duty engineer is to check some parameters when appropriate.There is a list below which is done in order to operate engine safely.

The inspection list is as follows:

4.3.1 Things to Check Before Starting the Genset

1. Check & be sure that everything is alright around the genset.
2. While starting, it is better not to stand very close to the genset.
3. Check in the TEM screen whether any alarm or fault is appearing. If yes, then eliminate the cause of these alarms & faults & then acknowledge them in the Operation log mask screen.
4. Now check for Ready to be appear in the status line.
5. Operation mode must be in Auto, if it is not Auto, make it Auto within the Manual mask screen.

Before putting the genset in to operation by synchronization with the power plant bus, the bus must has to be charged with 11kV PDB supply.

1. Then turn on the Demand switch.

2. Initially there will be pre-lubrication for some time to priming the engine.

3. Then starter motor will crank the engine & eventually the engine will start.

4. Check in the TEM operating terminal Data mask screen for engine speed & be sure that it is 1000 or in the vicinity.

5. Check in PPU for Voltage & Frequency.

6. Synchronization will appear in the status line of the TEM operating terminal, indicating that the genset is ready for closing the breaker.

7. Then close the breaker closing switch & if everything is alright the breaker will be closed, i.e. synchronization with charged power plant bus will take place.

8. Then gradually the genset will be loaded up as per base load setting in the Common Control (CC) panel & keep continue operating by feeding power to the grid.

4.3.2 Things to Check While Genset is Running

During working of engine the duty engineer has to check the following status in order to operate the engine continuously and effectively.

1. Periodically keep log of various engine parameters from the TEM screen & electrical parameters from the PPU.

2. Observe the genset operation visually & check for any abnormality.

3. Check for engine sound.

⇒ Check for lube oil system in the TEM screen

- Lube oil Temperature
- Lube oil Pressure
- Lube oil Level.

⇒ Check for the cooling system within the installed gauges-

- Temperature & Pressure of Jacket cooling system, Temperature & Pressure of Mixture cooling system
- Temperature & Pressure of Raw water cooling system.

⇒ Check for leak in the following systems-

- Jacket cooling system, Mixture cooling system, Lube oil system, Exhaust system

⇒ Check in the gas regulator system for the following-

•Gas pressure in the gauge situated in the inlet section of the gas train.

•Gas pressure in the gauge situated in the middle section of the gas train.

⇒ Check in the air inlet system-

•Position of the red button indicating under pressure in the Air filters.

⇒ Check for normal reading for the following electrical parameters in the PPU-

•Power

•Current

•Voltage

•Power Factor

•Operating Hours

4.3.3 Things to Do While Shutting of the Genset

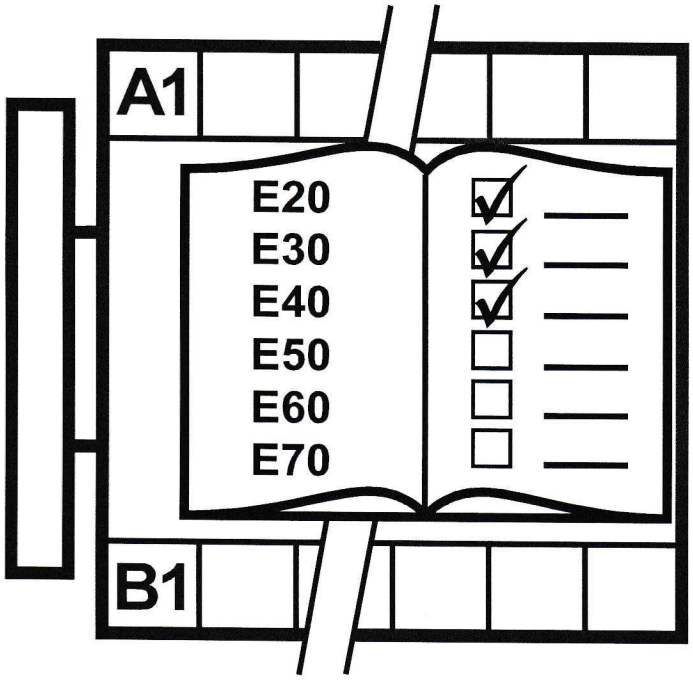
1. Turn off the demand switch
2. Automatically the genset will be de-loaded by the CC panel PLC
3. After opening of the breaker automatically, turn off the breaker closing switch
4. The cooling pumps & the pre-lube pump will run for some time after the genset is stopped, which is a normal procedure of the TEM system.

4.3.4 Points to be Noted

1. Jacket cooling pump, engine cooling pump, MK /NK pump are the same thing.
2. Mixture cooling pump, inter-cooler pump, charge cooling water pump & the GK pump are the same.

CHAPTER FIVE

Maintenance



5.1 Maintenance Schedule

The maintenance schedule lists measure for maintaining the nominal condition and thus the operation reliability of the engine and the appropriate maintenance intervals. The maintenance work procedures are described in the specified job cards.

The intervals prescribed in the maintenance schedule are maximum values and assume that installation, purpose and operating conditions comply with specifications. It must be ensured that all operating media such as combustion gas, lube oil and coolant are of the prescribed quality. You will find information about this in operating media.
This maintenance schedule only applied for this engine itself and parts attached to the engine. System parts must be serviced at the interval and according to the instructions specified by the manufacturer. You will find the appropriate information in the enclosed manufacturer documents.
The work described must be performed by technically skilled persons or authorized specialists. The competencies are listed in the table of Deutz maintenance and service schedules.

5.2 Selection and Structure

On reaching the specified intervals of time (Months or operating hours), the specified in the maintenance schedule must be carried out.

Always use the jobs card referred to in the maintenance schedule.

Depending on the speed and gas group, the engine is assigned an appropriate maintenance schedule.
The maintenance schedule consists of several section which should be used in parallel.

- The maintenance measures independent of operating hours.
- The actives to be carried out after reaching the specified time intervals in months are list here.

- The maintenance measures dependent on operating hours.
- The actives to be carried out after reaching the specified time intervals in operating hours (Deutz maintenance and service schedule) are listed here.
- Maintenance measure outside the Deutz maintenance and service schedules.
- The actives for which the time intervals are determined by analysis are listed here.
- The copy forms for proof of maintenance carried out.

5.3 DEUTZ Maintenance and Service

Maintenance work dependent on operating hours is classified according Deutz maintenance and service schedules. All the work listed must be performed carefully according to the maintenance schedule determined specifically for the engine.

Deutz maintenance and service schedules		Executed by
E10	Each due once after commissioning and after E50,E60,E70	Technically skilled persons
E20	Daily check	
E30	Periodic maintenance (small scope)	
E40	Periodic maintenance (medium scope)	
E50	Periodic maintenance (extended scope)	Authorized specialist
E60	Intermediate overall	
E70	Complete overall	

Please note that Deutz maintenance and service schedules may be added or omitted depending on the speed and gas group.

Make sure to observe the dates for Deutz maintenance and service schedule according to the number of hours your engine has been in operation. Arrange the necessary appointment with your responsible service partner in good time. Report any irregularities of your engine when you arrange the appointment. Sign a service contract with your service partner if necessary. All the due maintenance work including repairs if agreed is then planned and expertly by the

service partner according to the contract. Your service partner will be glad to give you the details.

Definition of activities in the maintenance schedule

Adjust	Adjust torque, dimensions, pressure etc; extra work may be necessary to renew parts.
Drain water	Drain condensed water for example.
Renew	Renew parts, function groups and liquids.
Recondition	Material removal within the permitted tolerances to reinstate a nominal condition.
Check	Check according to criteria in the jobs card. If not all criteria are fulfilled, the cause must be found and the nominal condition reinstated.
Clean	Cleaning by hand or machine (automatic), renew of cleaning parts may be necessary.
Visual inspection	Visual inspection according to criteria in the job card. If not all criteria are fulfilled, the cause must be found and the nominal conditions reinstated.
Overall	Check function groups, rework or renew parts.
Maintain	Maintain according to job card, checking of functions; reworking or renewal of parts may be necessary.
change	Change lubes oil for example.

The maintenance intervals also depend on the quality of the Natural combustion gases.

5.4 Overview of Specific Maintenance Schedules

This engine is built exclusively for the purpose intended according to the scope of delivery as defined by the equipment manufacturer (use for the intended purpose). Depending on its defined by a performance code or an abbreviations for the gas type which is punched into the rating plate. The plate is described in detail.

5.5 Maintenance Schedules

Valid for:	Engine type:	V-16 Engine
	Speed :	n= 1500 rpm (50 Hz application)
	Fuel gas:	Natural gas

Type of application: Current generators

The following activities must be carried out according to the maintenance intervals.

Maintenance work independent of operating hours.

⇒ As required

⇒ Monthly

⇒ After every 4 months

⇒ After every 6 months

⇒ After every 12 months

⇒ After every 24 months

Maintenance work independent of operating hours.

E 10	Maintenance	once in special cases
E 20	Inspection	daily
E 30	Maintenance (small scope)	after every 1,500 hours
E 40	Maintenance (medium scope)	after every 3,000 hours
E 50	Maintenance (extended scope)	after every 12,000 hours
E 60	Intermediate overall	after every 24,000 hours
E 60	Complete overall	after every 48,000 hours

Maintenance work dependent of operating hours outside the Deutz maintenance and service schedule

Lube oil analysis: Initial analysis after 300 operating hours.

All other lube oil changes and analyses are to be agreed between the owner and the lab on the basis of the results of the analysis.

as required	Monthly	after 4 monthly	after 6 monthly	after 12 monthly	after 4 monthly	Description
×						Check suction air intake filter, renew if necessary ;according to E50,but Earlier if the maintenance indicates is showing record.
×						Maintain crankcase vent; according to E40,but earlier if the maintenance Indicate is showing record.
×						Trial run after maintenance work 1
×						Run in engine; after maintenance work such as changing bearing, piston cylinder liner 2
×						Clean the engine
	×					Trial run 3
	×					Maintaining the battery; according to E30,but monthly if 3 is applicable
		×				Gas analysis
			×			Check percentage of corrosion protection agent or antifreeze in the coolant
			×	×		Inspect pressure drop in gas filter
				×		Renew gas filter insert
				×		Gas pressure sensor, check set gas pressure
				×		Check gas pressure regulator
				×		Check shutoff valves of the gas control system
				×		Check the entire gas control system for leaks
				×		Lube oil change 4
				×		Renew lube oil filter cartridge 4
					×	Renew the coolant

5.5.1 Maintenance work independent of operating hours.

To be performed by maintenance officers

To be performed by authorized experts

This activity must be performed when the engine on standby has not been operated for longer than one month. The engine must be preserved during long periods out of action.

The lube oil must be changed if the maintenance intervals determined in the lube oil analysis are not reached within 12 months. The lube oil filter cartridge must be used.

5.5.2 Maintenance work independent of operating hour

E10	E20	E30	E40	E50	E60	E70	Description
1× after 50 hours	(daily)	after every 1,500 hours	after every 3,000 hours	after every 12,000 hours	after every 24,000 hours	after every 48,000 hours	
×	×	×	×	×	×	×	Visual inspection of the system
×		×	×	×	×	×	Test and function run
×		×	×				Checking valve clearance
		×	×	×	×	×	Maintaining the battery 1
		×	×	×	×	×	Checking speed governor linkage
		×	×	×	×	×	Maintaining crankcase bleed valve 1
				×	×	×	Renewing crankcase bleed valve 1
		×					Renewing spark plugs, renewing if necessary
			×	×	×	×	Renewing lube oil filter carriage 3
			×	×	×	×	Checking ignition time
			×	×	×	×	Auxiliary unit test using the TEM system
				×	×	×	Renewing suction air intake filter, clearing suction air filter housing
				×	×	×	Checking engine fasting
				×	×	×	Checking starter pinion and ring gear

				×	×	×	Renewing or overhauling cylinder heads
				×			checking combustion chambers
				×			checking combustion liners
					×	×	Renewing combustion liners
				×			Checking and end scoping intercooler
					×	×	Checking intercooler
				×			Checking and cleaning turbocharger 4
					×	×	Renewing or overhauling turbocharger 4
				×	×		Cleaning gas mixer
						×	Renewing gas mixer
					×		Checking rubber compensators
						×	Renewing rubber compensators

For engine with this equipment

Only 50 hours as per E50 To E70

For other lube oil filter changes.

E10	E20	E30	E40	E50	E60	E70	Description
1× after 50 hours	(daily)	after every 1,500 hours	after every 3,000 hours	after every 12,000 hours	after every 24,000 hours	after every 48,000 hours	
					×	×	Checking hose pipes, vibration dampers and flexible lines
					×	×	Checking engine side fittings and control instruments
					×	×	Renew viscosity tensional vibration dampers 1
					×		Checking crankshaft axial clearance
					×		Checking camshaft axial clearance
					×		Checking valve tappet
						×	Renewing valve tappet

					×		Checking con rod liners
					×	×	Renewing con rod bearings
					×		Checking piston
						×	Renewing piston
					×		Checking piston pin
					×		Renewing piston rings
					×	×	Checking camshaft
						×	Renewing camshaft bearing
						×	Renewing con rods
						×	Renewing drive side crankshaft sealing ring
						×	Renewing free side crankshaft sealing 1
						×	Measuring crankshaft, checking for tears, polishing
						×	Checking and clearing wheel drive and control
							Renewing main bearing and axial bearing
						×	Renewing or overhauling turbocharger 4
						×	Renewing or overhauling lube oil pump
						×	Renewing or overhauling pressure limiting valve
						×	Renewing rubber compensators

For engine with this equipment

Only 50 hours as per E50 To E70

For other lube oil filter changes.

CHAPTER SIX

Troubleshooting

6.1 Problem List

During the practicum period at SS Steel Mill Limited we have experienced various kinds of problems relevant to engine and other associate parts at the power generation section of SS Steel Mill Limited. We have noted the problems, the time that took to solve the problems, and the solution of the problems. Here is the list of the problems and the shut down time.

Date	GS#1	GS#2	GS#3	GS#4	GS#5	Total Down Time	Remarks
26-9-2015	NBD	NBD	NBD	20 min	NBD	20min	Receiver Temperature high
29-9-2015	NBD	NBD	18 min	18min	18 min	54 min	ACB Problem
1-10-2015	11 min	11 min	NBD	NBD	NBD	22 min	Furnace Problem
3-10-2015	NBD	NBD	NBD	NBD	NBD	Nil	
6-10-2015	NBD	NBD	34 min	NBD	NBD	34 min	Receiver Temperature high
8-10-2015	30 min	NBD	NBD	NBD	NBD	30 min	Engine Does Not Start
10-10-2015	3 hr	3hr	3hr	3hr	3hr	15 hr	Low Gas Pressure
11-10-2015	NBD	1 hr 5 min	NBD	NBD	NBD	1 hr 5 min	Backfire
13-10-2015	NBD	NBD	12 min	NBD	NBD	12 min	Reverse Power

15-10-2015	NBD	NBD	16 min	16 min	16 min	48 min	Furnace Problem
17-10-2015	NBD	25 min	NBD	NBD	NBD	25 min	Electricity Back Flow
20-10-2015	NBD	NBD	NBD	NBD	NBD	Nil	
22-10-2015	NBD	NBD	NBD	NBD	4 hr	4 hr	Receiver Temperature high
24-10-2015	NBD	NBD	NBD	NBD	NBD	Nil	
31-10-2015	NBD	NBD	3 min	3 min	3 min	9 min	Furnace Problem
1-11-2015	NBD	NBD	NBD	NBD	NBD	Nil	
3-11-2015	NBD	NBD	NBD	26 min	NBD	26 min	Engine Overheated
5-11-2015	NBD	NBD	1 hr 40 min	NBD	NBD	1 hr 40 min	Receiver Temperature high
7-11-2015	NBD	NBD	NBD	NBD	NBD	Nil	
8-11-2015	NBD	NBD	NBD	NBD	NBD	Nil	
11-11-2015	2 hr 40 min	NBD	NBD	NBD	NBD	2 hr 40 min	Output low
12-11-2015	28 min	28 min	NBD	NBD	NBD	56 min	Furnace Interlock
17-11-2015	NBD	NBD	5 min	5 min	5 min	15 min	Furnace Problem
20-11-2015	NBD	NBD	NBD	NBD	1 hr 25 min	1 hr 25 min	Receiver Temperature high
22-11-2015	NBD	NBD	NBD	NBD	NBD	Nil	
25-11-2015	NBD	NBD	NBD	NBD	34 min	34 min	Engine Overheated
29-11-2015	NBD	NBD	7 hr	7 hr	7 hr	21 hr	To change fins

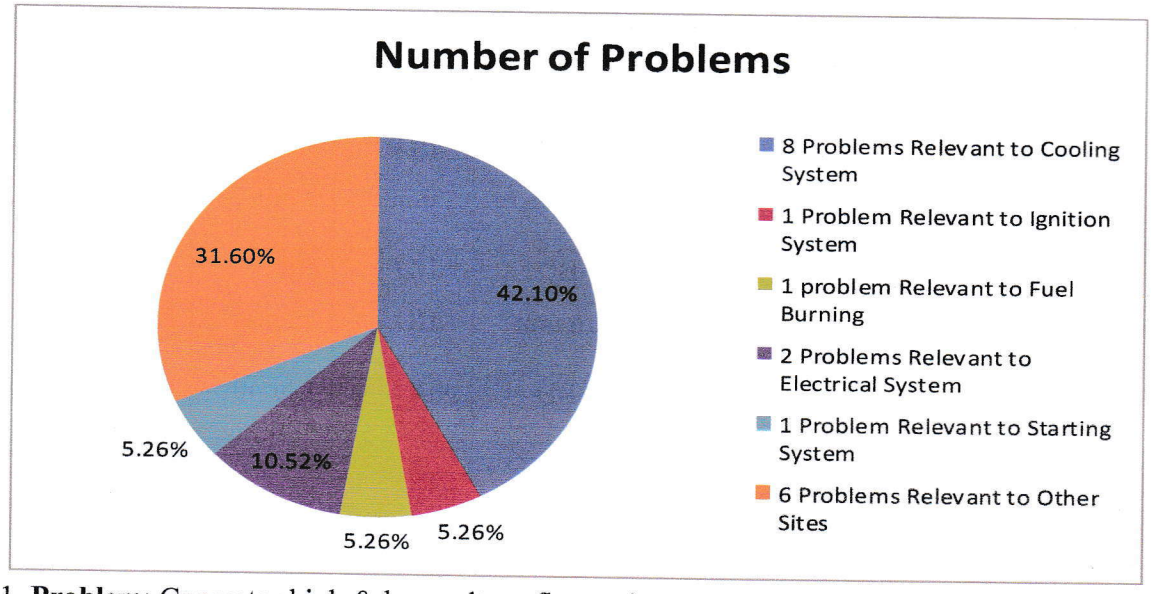
Total days = 65 Total shutdown time = 2304 minutes

(Note: The problem gas pressure low is not relevant to the industry. It is a problem over the country which depends on the availability of gas in the gas line. So we did not take it in account.)

6.2 Analysis

6.2.1 Features of the Problems

From solving the 19 major problems for which the engines were to shutdown, we have come to a point that for the whole problems it consumed total 38 hours 24 minutes of engine shutdown. Among them



1 .**Problem**: Generator high & low voltage fluctuation.

Solve: At generator fluctuate to high & low voltage, then adjust the busber or generator syncroninizing system.

2. **Problem**: Over current.

Solve: Generator power function is down when current is increased, so adjust the PF in limit.

3 .**Problem**: Over load.

Solve: Generator capacity is 1344kw & efficiency lose of 10%,so it shouldn't be operated more then 1200kw.

4. **Problem:** Lub oil level.

Solve: The generator lub oil level is (30% - 120%)in this limit.

5. **Problem:** Receiver temperature high.

Solve: Gas cooling system, cooling tower, water low, jacket water pump, row water pump & mixer pump is check the leakage & lub oil system.

6.**Problem**:Gas control system.

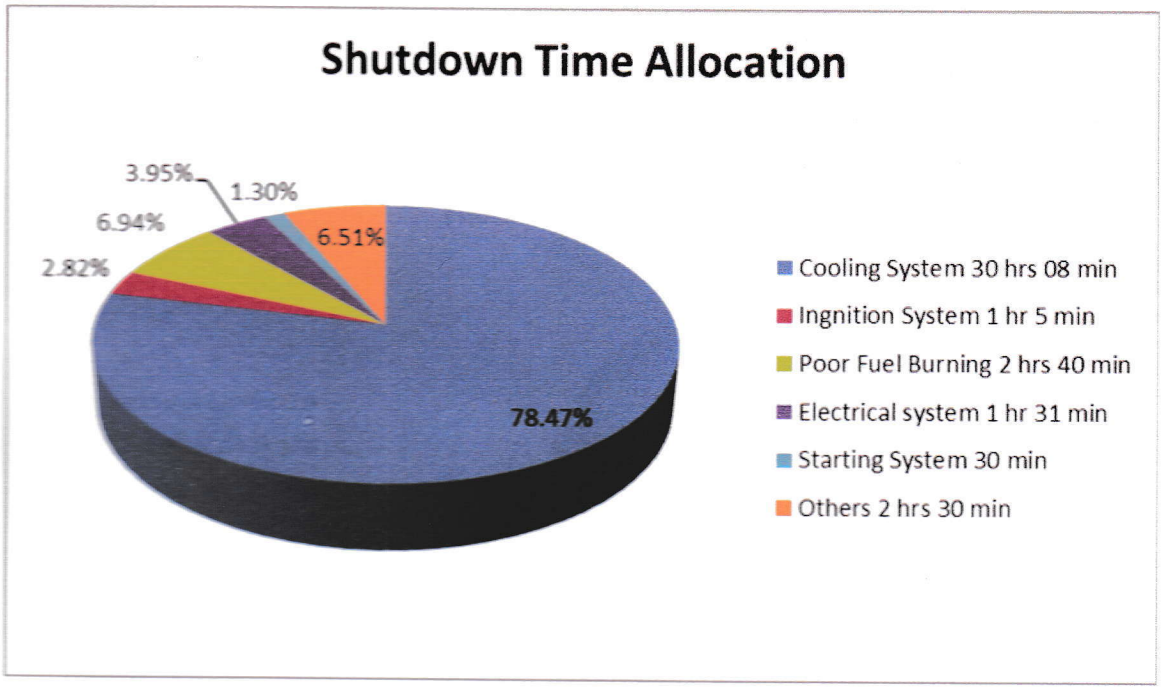
Solve:Generator gass pressure is low don't run of minimum 0.5 bar need to pressure for generator running.

6.2.2 Time Consuming Aspect

Among all of the problems there are a few problems which are responsible for maximum shutdown.

- ⇒ There were 8 problems belongs to cooling system specifically for presence of dust in the air and it consumed about 30 hours 08 minutes from total 38 hours 24 minutes of engine's shutdown.
- ⇒ There is a problem which occurred due to ignition system and it took 65 minutes of engine's shutdown.
- ⇒ There is a problem belongs to the presence of carbon in fuel that accumulated some space in the combustion chamber and in the spark gap which consumed 2 hours 40 minutes.

Here is a time consuming chart according to the problems.



6.3 Cost Analysis

Ingot production is dependent on the electricity supply and electricity is generated by five generators. If we count all of the individual engine's shutdown time, then we will get the total shutdown time is 2304 minutes.

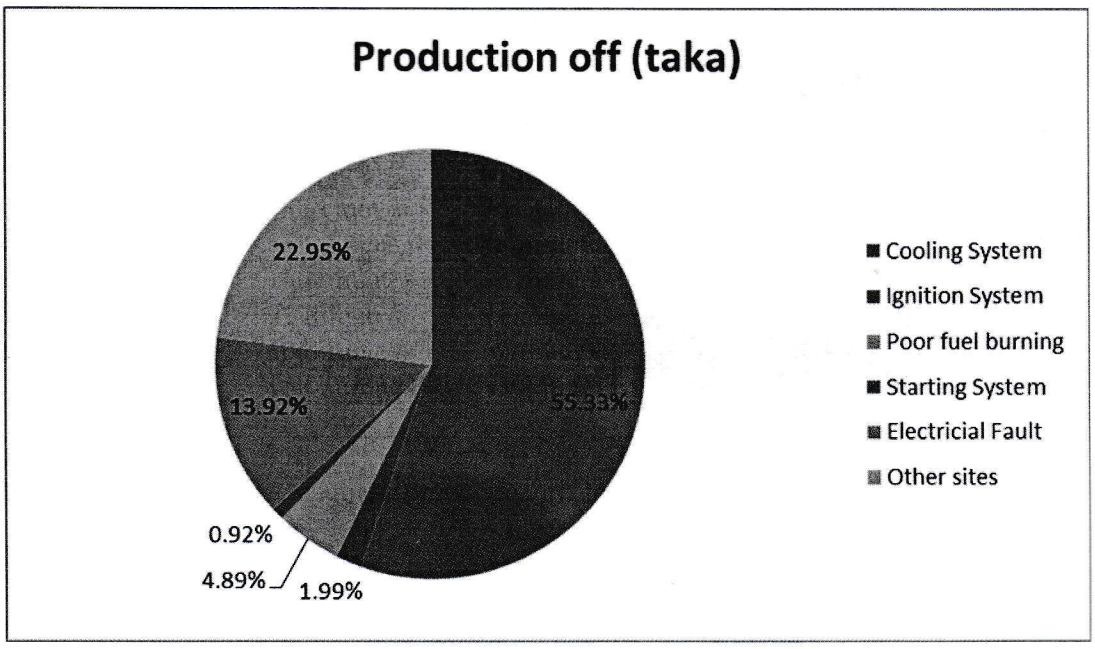
As the production capacity of the plant is 130 tons per day, the production per minute is
130 ton*1000 =130000 kg/day
=5416.67 kg/hour
=90.30 kg/minute

Price of the products = 62500 taka / ton
=62.5 taka / kg

Fault Location	Total Time	Total Production Off (time)	Total Production Off (kg)	Total Production Off (taka)
Cooling System	1808 minutes	361.6 min	32652.48	2040780
Ignition System	65 minutes	13 minutes	1173.9	73368.75
Poor Fuel Burning	160 minutes	32 minutes	2889.6	180600
Electrical Fault	91 minutes	91 minutes	8217.3	513581.25
Starting System	30 minutes	6 minutes	541.8	33862.5
Other sites	150 minutes	150 minutes	13545	846562.5

Total production off =3688755 taka

(Note: As there are five engines, production off has to be count averagely by the five engines)



- There is no any protecting equipment in coming dust to the cooling tower
- The area of the holes of the cooling fins are small that they become jammed quickly.

6.5 How the Trouble-shooting were Done

Receiver Temperature High

First time:

Detection: Checked the engine temperature (ok)-Checked the water temperature of cooling tower (detected).

Cause: Cooling water temperature is high.

Why: Cooling tower's fins are block by dusts. So air cannot pass easily through fins.

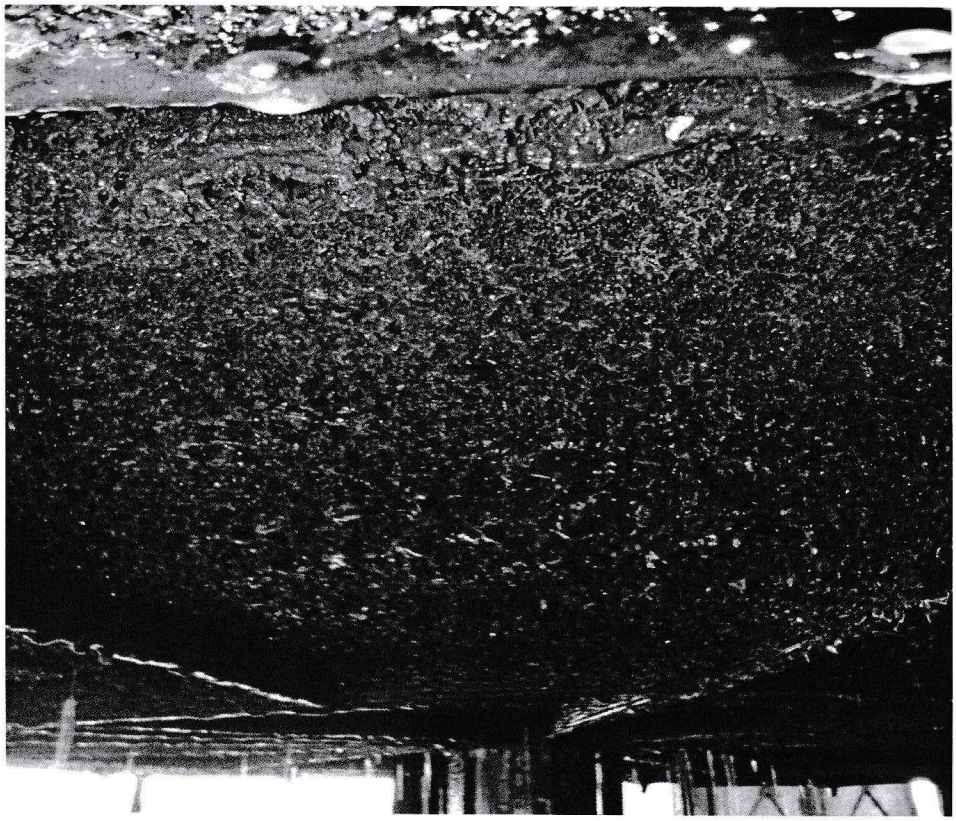


Figure 6.1: Fins of cooling tower

Solution: The cooling water was removed from tower basin and then recovered by softened water. Chemical was given into water and then started engine again.

Second time:

Detection: Checked the engine temperature (ok)-Checked the water temperature of cooling tower(ok)-Checked the water pump (ok)-Checked the LT heat exchanger(ok)-Open the temperature sensor of receiver(detected)

Cause: Temperature sensor is damaged

Solution: Change the temperature sensor

Third time:

Checked the cooling water temperature(detected)

Cause: Cooling water temperature is high.

Why: fins are jam by dust.So air cannot pass through fins.

Solution: fins were changed.

Fourth time:

Detection: Checked the engine temperature(ok)-checked the cooling water's amount and temperature(ok)-checked the water pump(ok)-Checked the inside coolant temperature(detected).

Cause: Dissembled the LT heat exchanger and found the heatexchanger is jam.



Figure 6.2: Scale in heat exchanger

Solution: Dissembled the heatexchanger and remove the slush.

Fifth time:

Checked engine temperature(ok)-checked the water label and temperature(ok)-checked water pump(ok)-checked inside coolant temperature(detected)

Why: Receiver is jam

Solution: Dissembled the heatexchanger and remove the slush.

Backfire

Detection: Checked the ignition timing(detected)

Cause: Ignition timing problem

Solution: Set the ignition timing properly

Output low:

Checked the ignition timing by timing gun(ok)-Checked the air filter(ok)-checked the gas flow line(ok)-checked the filter(ok)-checked the mixture unit(ok)-checked the sparkplugs(detected)

Cause: Spark gap has been reduced by carbon.

Solution: Clean the carbon and check the spark gap and set the sparkplugs again.

Engine Overheated:

First time :

Checked the outer circuit's coolant's label and temperature(ok)-checked the lubricating oil label(ok)-checked heat exchanger(detected)

Cause: Heatexchanger is jam by slug.

Solution: Dissembled the heatexchanger and clean the slug.

Second time:

Checked the cooling water label and temperature(detected)

Cause: Cooling water temperature is high

Why : Fins are jam by dust. So,air cannot pass through fins easily.

Immediate solution: Change the cooling water and mix chemical with it. Then start engine again.

Engine Does Not Start

Checked the starter motor's connection(ok)-checked the battery's connection(detected)

Cause: Battery terminal's connection problem

Why: Carbon is accumulated in the battery terminal's joint.

Solution: Put off the terminal's cable joint and clean the carbon and join the cable again.

Electricity Back Flow

Shutdown the relevant engine-go to the junction box and check the fuses(detected)

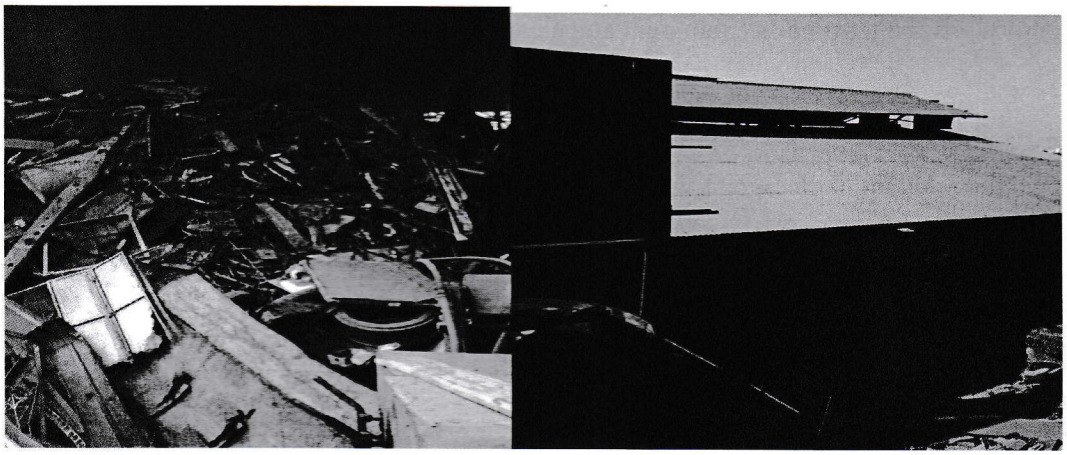
Cause: Magnet fuse damaged.

Solution: Change the fuse;

Minor Problem (no need to shutdown the engine)

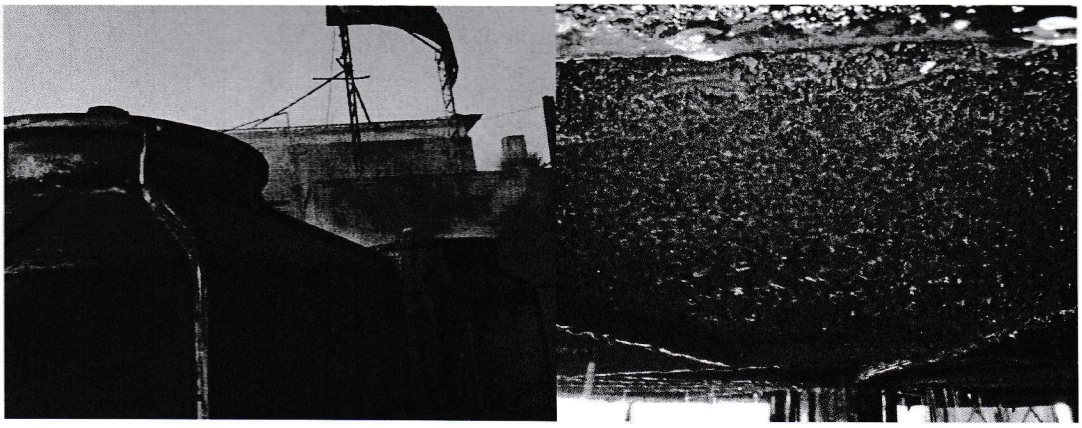
- Air filter change when air filter is jammed.

6.6 Discussion With Picture



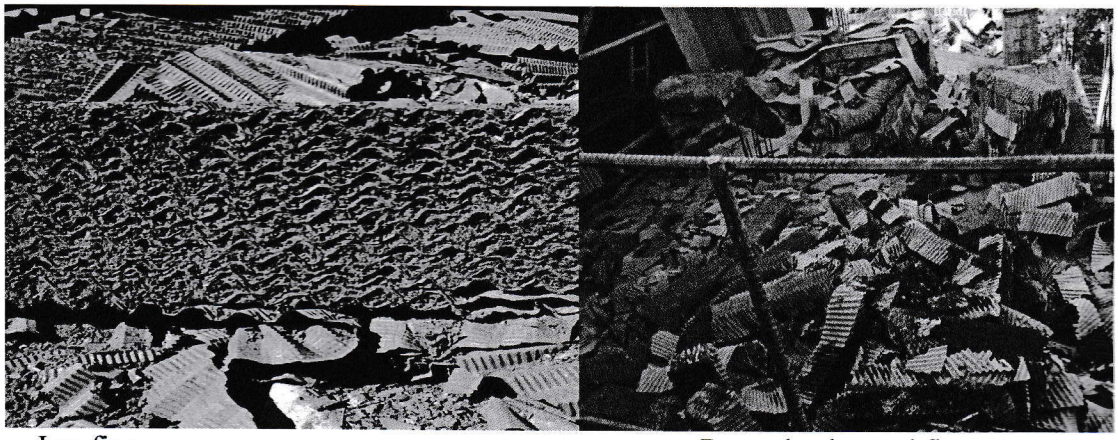
Dust are coming with raw materials

Dust come through the gaps



Cooling fan draws dust

Fins become jam



Jam fins

Recently changed fins

Figures 7.1: How dust goes to cooling system

CHAPTER SEVEN

Conclusion

7.1 Limitations

SS Steel (Pvt.) Ltd is a company which is a combination of various kinds of mechanical engineering relevant work. The industry is divided into several sections. The sections are individual. So we could not go beyond the section except of which we were permitted. Moreover, as it is a production company, when the production is off due to engine's problem, that time engineers rush to solve the problem, so we could not get them at all in that time. Furthermore, there is no any training section in the industry that we could get more knowledge on the subject maters.

7.2 Recommendations

As air holds dust everywhere more or less, So it will not be possible to remove the dust absolutely form the air. But it may be possible to reduce the dust from raw materials if appropriate steps can be taken. After all, the number of problems appeared in the cooling system can be reduced. There are some actions which can be taken to do it.

1. The dust can be removed from the raw materials before bringing to the plant.
2. A dust net can be used in surrounding of the cooling tower.
3. A few chimneys can be used instead of keeping hole in the tinny roof to flow smoke and dust.

7.3 Conclusion

In this present era the demand of steel mills are increasing rapidly. During this practicum period it is seen that, steel mill industry is a combination of various kinds of mechanical engineering related work. There are many phenomenon which are to bring into account to run a steel mill industry. The dust phenomenon is an important factor that interrupts in the continuous power generation if it is not protected well.SS Steel Mill Limited is an up growing company which has a plan to increase it's capability of 130 tons per day to 250 tons per day.

The company will also enhance it's power generation capability from 7.5 MW to 15 MW. Before starting the new section of the plant the company can bring into account the dust phenomenon that is discussed in this report. As a result the electricity will be generated more steadily which will let produce ingot without interruption.

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7.5 Appendix

BDC	Bottom Dead Centre
Busbar	The metal (often copper) bar system which is the distribution media for the 3-phase high voltage system
CCU	Central Control Unit
Charge air	The intake air required for the combustion process in the engine
CPU	Central Processing Unit
CT	Current Transformer
DC	Direct Current
ESD	Emergency Shutdown
Genset	Engine generator set
HT	High Temperature
Jacket water	The cooling water circulating in the engines internal parts
LT	Low Temperature
NDE	Non Driving End. The end of the engine where the flywheel is not located.
PLC	Programmable Logic Controller.
Power factor	The extent to which the voltage zero differs from the current zero. (p.f = kW / kVA)
PT	Potential Transformer
RPM	Revolutions Per Minute
TDC	Top Dead Centre
Turbocharger	A compressor device used to increase the pressure of the charge air driven by the exhaust gases from the engine it serves.
Viscosity	The resistance of fluid to flow
NBD	No Break Down
TEM	Total Electronic Management