Meat and meat products processing

Level-III

Based on May 2019, Version 2 Occupational standards

Module Title: -Monitoring Boiler Operation

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LG-36 LO#1 Set up Equipment

Instruction sheet

This learning guide is developed to provide you the necessary information regarding th following content coverage and topics:

- Checking of equipment prior to operation
- Ensuring cleanliness of equipment
- Applying relevant communication skills

This guide will also assist you to attain the learning outcomes stated in the cover page Specifically, upon completion of this learning guide, you will be able to:

- Check of equipment prior to operation
- Ensure cleanliness of equipment
- Apply relevant communication skills

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the “Information Sheets”.
4. Try to understand what are being discussed.
5. Ask your trainer for assistance if you have hard time understanding them.
6. Accomplish the “Self-checks” which are placed following all information sheets.
7. Ask from your trainer the key to correction (key answers) or you can request your traine to correct your work. (You are to get the key answer only after you finished answerin the Self-checks).
8. If you earned a satisfactory evaluation proceed to “Operation sheets
9. Perform “the Learning activity performance test” which is placed following “Operatio sheets”
10. If your performance is satisfactory proceed to the next learning guide,
11. If your performance is unsatisfactory, see your trainer instructions or go back t “Operation sheets”.

Information Sheet 1 Checking equipment prior to operation

1.1 Introduction

A boiler is an enclosed vessel that provides a means for combustion heat to be transferred into water until it becomes heated water or steam. The hot water or steam under pressure is then usable for transferring the heat to a process. Water is a useful and cheap medium for transferring heat to a process. When water is boiled into steam its volume increases about 1,600 times, producing a force that is almost as explosive as gunpowder. This causes the boiler to be extremely dangerous equipment that must be treated with utmost care.

The process of heating a liquid until it reaches its gaseous state is called evaporation. Heat is transferred from one body to another by means of (1) radiation, which is the transfer of heat from a hot body to a cold body without a conveying medium, (2) convection, the transfer of heat by a conveying medium, such as air or water and (3) conduction, transfer of heat by actual physical contact, molecule to molecule.

Boiler cooking is designed for cooking sausages, meat product, offal's, hams, liver, meat and bone broths. They are used mainly in meat processing plant to cook food and boiled meat, as well as to melt fat.

1.1.1 The boiler system

The boiler system comprises of feed water system, steam system and fuel system or electric system. The feedwater system provides water to the boiler and regulates it automatically to meet the steam demand. Various valves provide access for maintenance and repair. The steam system collects and controls the steam produced in the boiler. Steam is directed through a piping system to the point of use. Throughout the system, steam pressure is regulated using valves and checked with steam pressure gauges. The fuel system includes all equipment used to provide fuel to generate the necessary heat. The equipment required in the fuel system depends on the type of fuel used in the system.

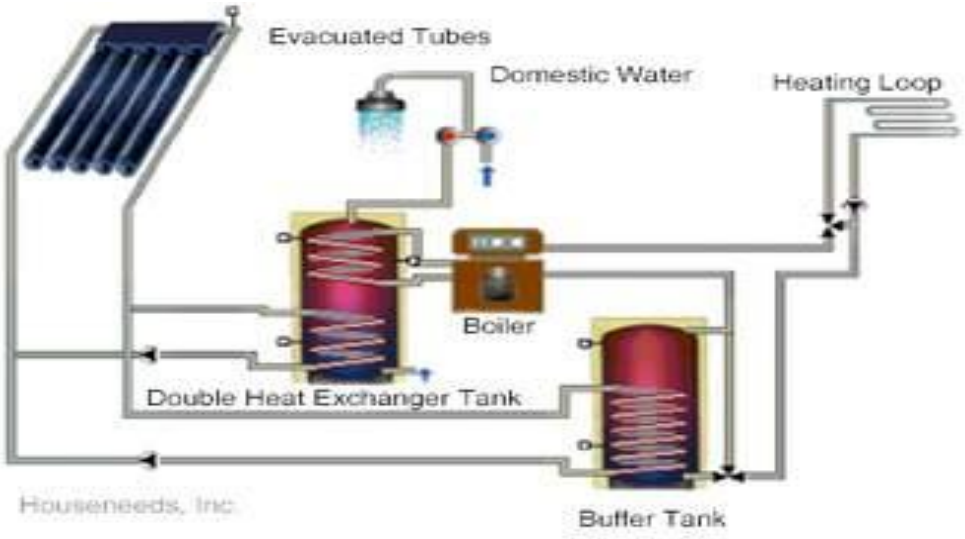

Figure. 1 Boiler system and system diagram

The water supplied to the boiler that is converted into steam is called feed water. The two sources of feed water are:

a) Condensate or condensed steam returned from the processes and

b) Makeup water (treated raw water) which must come from outside the boiler room and plant processes.

For higher boiler efficiencies, the feed water is preheated by economizer, using the waste heat in the flue gas

1.1.2 Boiler Types and Classifications

There are virtually infinite numbers of boiler designs but generally they fit into one of two categories:

1.1.2.1 Fire tube or “fire in tube” boilers;

Contain long steel tubes through which the hot gasses from a furnace pass and around which the water to be converted to steam circulates. Fire tube boilers, typically have a lower initial cost, are more fuel efficient and easier to operate, but they are limited generally to capacities of 25 tons/hr. and pressures of 17.5 kg/cm2.

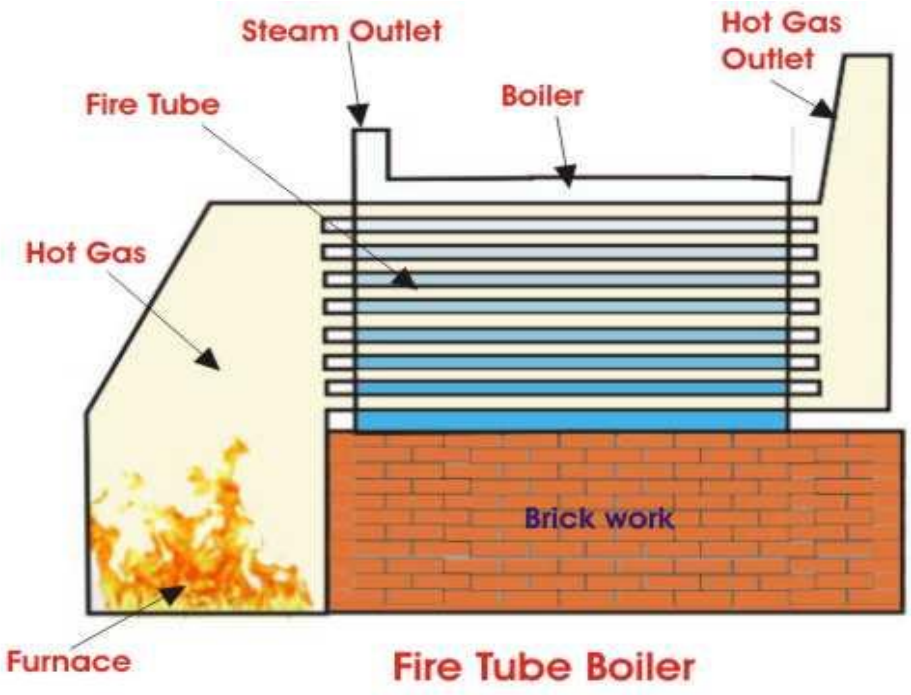

Figure 2 fire tube boiler system diagram

According to the location of furnace there are two types of fire tube boiler and these are external furnace and internal furnace type. There are mainly three types of external furnace fire tube boiler.

- Horizontal return tubular fire tube boiler.
- Short fire box fire tube boiler.
- Compact fire tube boiler.

1.1.2.2 Types of internal furnace fire tube boiler

I. Horizontal tubular.

II. Vertical tubular fire tube boiler.

1.1.2.3 Water tube or “water in tube”

This boilers in which the conditions are reversed with the water passing through the tubes and the hot gasses passing outside the tubes. These boilers can be of single- or multiple-drum type. These boilers can be built to any steam capacities and pressures, and have higher efficiencies than fire tube boilers. Water tube or “water in tube” boilers in which the conditions are reversed with the water passing through the tubes and the hot gasses passing outside the tubes (see figure 3). These boilers can be of single or multiple-drum type. These boilers can be built to any steam capacities and pressures, and have higher efficiencies than fire tube boilers.

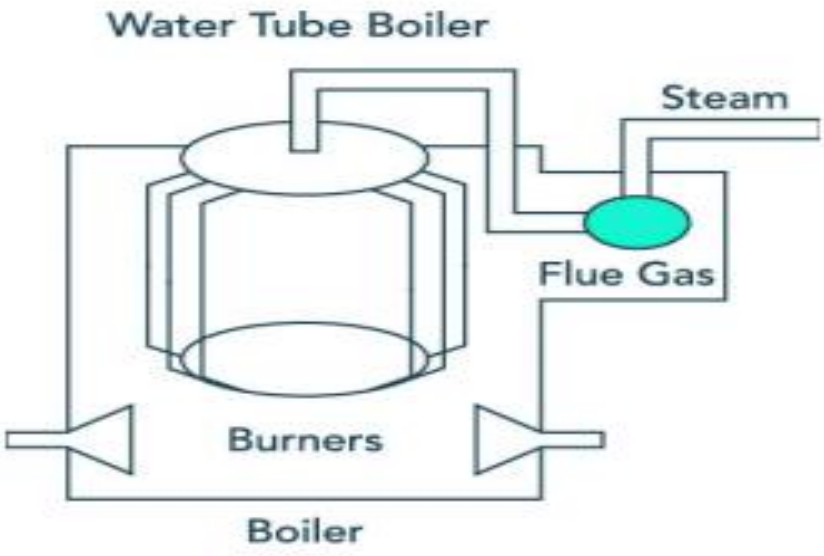

Figure 3. Water tube boiler diagram

1.1.2.4 Electric Boilers

Electric boilers can be installed in small to medium sized flats or houses to produce the hot water for both your heating system and domestic hot water use (normally via an indirect cylinder for your domestic hot water requirements). The most commonly installed boilers either use gas or oil to heat the water, an electric boiler will heat the water via an electric element or multiple elements.

Figure 4. Electric steam generator boiler

They are a popular choice for flats and homes where gas is not an option and oil are either impractical or too expensive. They tend to be limited as to the amount of Domestic Hot Water (DHW) they can produce instantly therefor we always recommend using an indirect hot water cylinder for the domestic hot water, especially if the property has a bath fitted. The smaller boilers, i.e., from 0.5 kW to 15 kW outputs the electric boilers are available in 240-volt, Single Phase, after 15 kW the units require a Three Phase power supply. They are often fitted in new build homes and flats as they are cheaper to install and maintain. Also, with no gas emissions, they are seen by many as a more environmentally friendly choice, as the electric power supplied can be from renewable sources such as wind, solar or tidal electric production.

1.1.2.4.1 Electric boilers work

The boiler itself is very simple. It can come in various shapes and forms, but typically you will see a unit that has the water running through it, being heated via a heating element, just like you would a kettle. You will sometimes see long slim units that are designed to create maximum surface area to heat the water.

1.1.2.4.2 Disadvantages of electric boilers

Of course, if electric boilers were the best solution, you would see them everywhere, but you don't. There are downsides to electric boilers – let me run you through the key points. Gas is considerably cheaper than electricity, at about 30% of the price. That means the cost of heating water using electricity is going to be a lot higher, even if you have a very efficient system.

That much is fairly obvious, but even when you compare electric boilers to other forms of electric heating, the electric boiler doesn't necessarily come out on top. If you compare it to infrared, for example, an electric boiler will be more expensive to run. Electric boilers probably have their place in certain properties. They are a simple, easy-to-install option but for many people there are going to be better ways to heat the home out there to look at. If gas isn't an option, infrared, heat pumps or even oil boilers are all likely to be cheaper to run than electric boilers.

1.1.3 Boilers for meat industry.

Boiler cooking is designed for cooking sausages, meat products, offal's, hams, liver, meat and bone broths. The professional boilers manufactured are multifunctional equipment for the thermal treatment of food products and much more. They are used mainly in meat processing plants to cook food and boiled meat, as well as to melt fats.

The multifunctionality of our boilers is the result of a wide range of options and configurations that you can choose from. We are obliged in this way, in the first place, our extensive experience, accumulated by us throughout all these years, as well as the knowledge of our qualified personnel.

Construction: the entire boiler is made of acid resistant steel with a silicone seal. Regardless of the version, direct heating is used, that is, in the oil layer, which guarantees the uniformity of the heating and prevents the burning of the product. The lid and the container are thermally insulated. Each device is equipped with a microprocessor controller that allows you to control the set temperature, the waiting time, the operating time and the central temperature, whenever the process requires it. The kettle and lid are thermally insulated.

1.1.4 Feature of Cooking Boilers

The boiling boiler is designed for fast, gentle and efficient cooking of boiled sausages, sausages, wieners and other products requiring heat treatment in a high humidity environment at temperatures up to 110^0C. The use of cooking chambers allows to unload more expensive smoking and cooking equipment, to optimize the process of production of cooked products. Due to the compactness of the cooking chambers, it is possible to save the areas of the thermal separation.

1.1.4.1 Advantages of Cooking chambers

Cooking chambers are equipped with a special humidification system, which allows creating in the shortest possible time a high relative humidity in the chamber, thanks to special fine-dispersion spray nozzles. A very small droplet size allows moisture to saturate the air to a maximum state before the air enters the heating elements, which, in combination with the high air flow created by a powerful circulation system based on high-performance fans, minimizes moisture condensation on the chamber walls and a non-hot tap water from the camera, which leads to significant energy savings. And the most efficiently communicates the heat to the product.

1.2 Checking equipment used for operation

According to enterprise-specific requirements the following instruction will be check out for pre operation set.

- water to be boil;
- Checking parts of boiler;
- Checking availability of heating source or energy source

- Availability material used in operation;
- Preparation of steam line to address where processing
- Cleaning

1.2.1 Planning for a Cleaning

The first decision is what solvent to clean with. There are five commonly used cleaning solvents. Each has advantages and disadvantages. If you have been operating a plant for a while, you may simply go with the solvent and procedure you used last time. But it is worth a look to see if this time—due to the chemical composition of the deposit, or for a variety of reasons, including waste-handling costs—another solvent might be better suited. Cleaning boilers that have been using oxygenated treatment can be a particular challenge, as the oxide is very tenacious and slow to dissolve. If you have been using OT, and this is the first time you will be cleaning the boiler after starting OT, you will want to discuss the process with other units that have already cleaned their OT units to get the benefit of their experience. The solvents discussed below are primarily for the iron removal stage. Another set of chemicals is used specifically to remove copper in separate copper stages. Inhibited Hydrochloric Acid. Inhibited HCl is still used, particularly in boilers where it is difficult to ensure complete circulation of the solvent. It is very effective at removing silica deposits from the tubes if ammonium bifluoride is added.

It is definitely not recommended on boilers with a history of corrosion fatigue failures, as it has been shown to increase the failure rate following a cleaning. If there is any copper in the boiler deposit, provision must be made for removing the copper, which will otherwise plate-out on the bare steel tube. In the past, thiourea was commonly added to complex the copper, and it is still used occasionally.

There have been times on some boilers where the thiourea has been inadequate to remove copper in very localized areas of the boiler, and this causes problems. There may also be environmental ramifications for using this chemical when attempting to dispose of the cleaning wastes. For these reasons, a separate copper-removal stage is often recommended before or after (or both) the acid stage, using a variety of copper-removal solvents.

1.2.2 Determining When to Clean

The standard method for determining when to chemically clean a boiler is to take a boiler tube sample and have the deposit amount measured a deposit weight density (DWD) and the composition of the deposit analyzed. But there are other conditions besides the DWD that require that the boiler be cleaned. These include;

- One or more failures due to an under-deposit corrosion mechanism, particularly hydrogen damage. The first priority must be to prevent further damage by removing the deposits via a complete chemical cleaning.
- Major contamination event or multiple small events, particularly condenser tube leaks. Contamination events increase the amount of deposit in the boiler and its corrosiveness. Chemical cleaning removes the deposits and the contamination underneath the deposits before they corrode to failure.
- Replacement of boiler tubing. The rule of thumb is to chemically clean if you are replacing more than 10% of the surface area of the boiler. This helps to create a uniform layer of oxide on all the tubes.
- A major change in the boiler fuel or burner design. Changing fuels, such as from coal to gas, or modification of the burners can result in changes to the area of high heat flux in the boiler. When implementing such a major change, it is best to start with a clean boiler.
- A change in the chemical treatment regime. Such changes would include moving from one chemical treatment to another, say from all-volatile treatment to oxygenated treatment (OT).

1.2.3 Using Deposit Weight Density to Determine When to Clean

The standard DWD test should not only provide a deposit loading but also an analysis of chemical composition of the deposit on the tube. This chemical analysis of the deposit can be done quantitatively, using an inductively coupled plasma emission spectrometer (ICP-ES), but it is more commonly determined semi-quantitatively using electron dispersion spectroscopy (EDS). Occasionally, X-ray diffraction data is also provided to indicate the chemical compounds that are present.

Optimally, the tube sample for DWD should be about 18 inches long and from the highest heat flux area of the boiler. This is typically above the burners or on the underside of the nose arch. The idea is to find the tube in the boiler with the most deposit in a high-heat area. You cannot use a tube that has failed, because some or all of the deposit will have been removed by the failure.

DWD is determined by removing the deposit in a carefully measured area of the tube. The tube is split and the deposit on the fire-facing (hot) side is analyzed separately from the insulation-facing (cold) side. As far as chemical cleaning is concerned, the side that counts is the hot side. The change in the weight of the tube divided by the water-touched area where the deposit was removed produces the DWD result. This can be expressed in gram/ft2 or gram/meter2 (g/m2, SI, International System of Units). The conversion is 1 g/ft2 is equal to 10.76 g/m2.

Currently, the most common method of deposit removal for the DWD test is bead-blasting with glass beads (NACE TM0199-99). The other method that is occasionally used is to dissolve the deposits in a solvent, typically, inhibited hydrochloric acid, HCl (ASTM D3483-83 [2005] Test Method B). In general, the solvent method produces slightly higher DWD results on the same tube, as some small amount of metal is removed with the deposit.

1.2.4 Cleaning

1.2.4.1 Chemical Cleaning

Like some of those tests your doctor is always after you to get, boiler chemical cleaning is something that most of us would rather not think about but that we all agree is necessary. Adding to our general discomfort with the process are new Environmental Protection Agency regulations, which make the disposal of chemical cleaning wastes more expensive. Here is a review of what to do, when, and some things to watch out for. Everyone knows (or should know) that boiler tubes containing deposits create long-term reliability problems for the boiler.

Deposits insulate the water in the tubes from the fire, causing the metal temperature to increase dramatically between the deposit and the tube metal. Long-term overheating of

the metal will result from prolonged operation with heavy tube deposits. The tubes will first bulge and then fail. Because the deposits tend to be widespread, this generally means that large sections of boiler tubing will be damaged and require replacement.

The deposits also concentrate any boiler water chemistry and contamination that collects under them. The increased metal temperature caused by the deposit increases the rate of corrosion caused by any phosphate, caustic, or chloride underneath the deposit. With the exception of corrosion fatigue, all the water-side boiler tube failure mechanisms occur under deposits. Get rid of the deposits and you also stop the water-side tube failures.

1.2.4.2 Good procedure of cleaning

There are few things more important to a smooth chemical cleaning than a well-thought-out and well-documented cleaning procedure. This will require the time and effort of the plant's operation and engineering staff to customize and prepare a cleaning procedure for each unit. Cleaning vendors can provide a general outline of the cleaning process, and a consulting engineer can help also, but your operators know where the valves are and which leak-by and which don't. There will be three classes of valves: those that stay closed the entire cleaning process, those that must stay open the entire process, and those that need to be opened and closed, depending on where you are in the cleaning process.

There are also valves that the cleaning vendor will be responsible for opening and closing, such as those going to the waste disposal (frac) tanks and chemical injection points. Each valve that comes in contact with the solvent (or potentially could come in contact with the solvent) needs to fall into one of these groups and be tagged accordingly. Be on particular lookout for possible contamination routes where the solvent can get to a place where it was not designed to go. If a contamination route would be very serious, can a blank flange be installed? If not, can a telltale be set up to provide early detection of contamination?
One more aspect of deciding when to clean is the actual scheduling—determining whether a plant should clean at the beginning, during, or at the end of an outage. Chemically cleaning at any point except the very end of an outage leaves the tubes vulnerable to some general corrosion.

The passivation step at the end of the chemical cleaning is generally neither long enough nor at a high enough temperature to create a robust protective layer. It is often difficult to ensure that the boiler gets really dry after the cleaning or can be laid-up properly in a wet condition. The superheater is always back-filled during cleaning to minimize the risk of contamination. So, unless it can be drained and dried, this area will remain wet until the unit is fired sufficiently to dry it out. Therefore, the typical recommendation is to perform the chemical cleaning at the very end of an outage.

Heating the boiler for chemical cleaning using an auxiliary boiler or steam from another unit adds complexity and cost to the cleaning. So, as a rule, it is best to wait until the unit can be warmed using its own burners or igniters and when the fans and instrumentation associated with the fuel system (such as flame scanners) are working properly and have been fully tested.

Many a utility has waited for days with the chemical cleaning vendor on site and ready to go while its staff tried to get a fire in the boiler. For this reason, some utilities have decided not to schedule chemical cleanings during an outage at all; instead, they take a weekend outage separate from the overhaul for this purpose.

Self-check 1	Written and choose

Name _____ ID: _____ Date _____

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Choose the best answer (3 point)

1. _____ is a water returned from line after a processing

   A. Treated water B. condensed C. steam

2. Which boiler is popular choice for flats and homes where gas is not an option and oil are either impractical or too expensive?

   a) Fire in tube boiler
   b) Fuel boiler
   c) Electric boiler

3. Which is one not boiler system?

   a) Water feeding
   b) steam
   c) Fuel system
   d) No answer

4. What is Deposit Weight Density effect in cleaning?

   a) Chemical residue
   b) Food residue
   c) Oxygen residue
   d) Steam condenses

Test II: Short Answer Questions

1. What is the feature of electric boiler? 2pts
2. What are the advantages of heating chamber? 2pts
3. What are states checked before startup operation?2pts
4. Define about makeup water 2pt

Information sheet 2 Ensuring cleanliness of equipment

2.1 Introduction

Examination of equipment as hygienic as free from food hazard and dangerous in process. Checking and confirming cleanliness of equipment used for service, operation and process is important to keep the food safety and quality. Any food contact equipment has been cleaned by cleaning instruction of the enterprises. Cleanliness of equipment checked according to organization procedure. Using chemical agent which detect/ identify chemical residue.

2.1.1. Routine testing of steam boilers

Routine testing of boiler controls, limiting devices and feed water quality is essential to ensure the boiler continues to be safe, reliable and efficient. The routine tests recommended by the manufacturer should be carried out as a minimum.

2.1.1.1 What to expect After Cleaning

When the cleaning is finished, the chemical cleaning solvent is rapidly and completely drained from the unit. Usually, two full boiler volume rinses follow, with partial rinses in addition to these in some cases. Conductivity is used as an indicator to see how well the solvent has been removed from the boiler. In some cases, the last rinse is treated with chemical to raise the pH to a normal boiler pH range, and the boiler is fired to 180F to 200F so that it can be drained hot and dried out.

As noted above, optimally, the boiler will be started as soon as rinses are complete and the normal boiler piping can be restored. Depending on the design of the boiler, it may be difficult to flush out all the iron oxides that were released by the cleaning but were not fully dissolved. This can contribute to “black water” samples and high iron levels in the boiler following the cleaning. Some utilities have used boiler dispersants for a time to promote the suspension and removal of any remaining deposits in the boiler through the normal drum blowdown.

However, in certain circumstances, more frequent testing may be needed. For example, where the water quality is poor and there is a high dependence on water treatment, more frequent testing of the water and blowdown of the boiler may be required. These tests and the results should be recorded or logged (either electronically or manually) and must include:

- the results of the test and comparison against required values;
- identification of the operator;
- the date of the test; and
- any corrective action taken, if necessary.

  Clear written instructions of how and when to carry out routine tests should be kept on site.

2.1.2 Hygiene and sanitation requirements

Applying the hygienic necessities and incorporating sanitation system around boiler and steam running line or applicable place.

2.1.3 Enterprise-specific requirements

Al ways following the strategies of cleaning achievement is used to sustaining productivity. Enterprise specification is modernized valuable and studied information used for more profitable and qualified or and capable impression.

2.1.4 Occupational Health and Safety requirements

2.1.4.1 OHS legal requirements

At work area to prevent mental and physical health and safety problem so regulated must interpreted. Avoiding from hazardous material and non-harmful activities. During ensuring cleanliness following the standard operation legislation and using PPE such as;

- aprons
- eye and facial protection
- head-wear
- lifting assistance
- mesh aprons protective boot covers
- glove
- protective head and hair covering
- uniforms
- waterproof clothing
- work, safety or waterproof footwear

2.1.5 Quality Assurance (QA) requirements

Quality assurance (QA) is any systematic process of determining whether a product or service meets specified requirements. Quality assurance can be defined as "part of quality management focused on providing confidence that quality requirements will be fulfilled." The confidence provided by quality assurance is twofold—internally to management and externally to customers, government agencies, regulators, certifiers, and third parties. An alternate definition is "all the planned and systematic activities implemented within the quality system that can be demonstrated to provide confidence that a product or service will fulfill requirements for quality."

To sustain qualified product doing according to quality assurance system is achievable option and following quality control method of the enterprise without weakness and paleness

2.1.6 Quality Control

Quality control can be defined as "part of quality management focused on fulfilling quality requirements." While quality assurance relates to how a process is performed or how a product is made, quality control is more the inspection aspect of quality management. An alternate definition is "the operational techniques and activities used to fulfill requirements for quality."

2.1.7 Standard Operating Procedures (SOPs)

A standard operating procedure (SOP) is a set of step-by-step instructions compiled by an organization to help workers carry out routine operations. SOPs aim to achieve efficiency, quality output and uniformity of performance, while reducing miscommunication and failure to comply with industry regulations.

2.1.8 Ability to performing the task to production requirements

Performing the task describes the core job responsibilities of an employee. It is also called "in-role prescribed behavior" (Koopmans et al. 2011) and is reflected in specific work outcomes and deliverables as well as their quality and quantity. Task performance is reflected in specific work outcomes and deliverables as well as their quality and quantity.

- **Task Structure**

Next, leaders must determine if the task at hand is one that is highly structured or one that that is unstructured. Highly structured tasks are ones that tend to be repetitive and unambiguous, so they are more easily understood by followers, which leads to a more favorable situation for the leader. If tasks are unstructured, then the leader will have followers who are less likely to understand the task, which will make for a less favorable leadership situation.

2.1.9 work instructions

It is a work guide, job aid or standard operating procedure – describes in detail how an activity within a process (or procedure) is performed. It used to reduce risk and retain SOP trail work instruction Clarity avoids errors and saving times. Crucially, this avoids the blame game. When things go wrong the tendency is to blame or hold people responsible, which is natural. But if this happens often it can have an impact on staff morale. Having clear work instructions minimizes this problem. is important duties or behavior waited from all manufacturer/worker staff.

2.1.10 Good Instruction Look

Work instructions should make crystal clear how employees perform their tasks. There should be no room for interpretation. They should not be vague. You want to minimize the chance of them confusing your workers. This means your instructions should be as a performance.

Self-check 2	Written test

Name _____ **ID** _____ **Date** _____

Instruction

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Short Answer Questions 2points each

1. what is the purpose of ensuring cleanliness of boiler system?
2. Explain the methods used for ensuring cleanliness
3. Elaborate the work instruction
4. Describe OHS in ensuring cleanness
5. What does a good instruction look like?

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Rating: _____

Trainer Name: _____ Date: _____

Note: Satisfactory rating > 4 points Unsatisfactory - below <5 points

Information 3 Applying relevant communication skills

3.1 Introduction

Being able to communicate with each other form bonds, teamwork, and what separates humans from other animal species. Because Communication drives our lives and better ourselves.

3.2 Applying numeracy skills to workplace requirements

By smearing the following personalities, you will be applying your numeracy skill

3.2.1 Opinion Giver

The opinion giver, like the opinion seeker, is concerned less with the facts surrounding a specific problem, but is more concerned with ensuring the group sticks to its values. This person will offer suggestions and insight on how the group can employ its values while making specific decisions.

3.2.2 Elaborator

The elaborator takes the ideas that other people have had within a group and tries to flesh out the ideas in a meaningful way. The evaluator can also help a group understand specific rationales for the decisions it has made, or think through how the implementation of a specific decision would practically work.

3.2.3 Coordinator

The coordinator tries to find the common links between the various ideas that group members have and combine them in some kind of succinct package. Furthermore, the coordinator tries to coordinate the various activities that the group or team must accomplish along the way.

3.2.4 Orienteer

The orienteer is akin to a group or team's mapmaker. This person's role is to show where the group has been in an effort to understand where the group is right now. Furthermore,

this person will point out when the group has gotten completely off topic and try to refocus the group back to the decision at hand.

3.2.5 Information Seeker

The information seeker focuses on ensuring that the group has accurate and relevant information as it goes about problem solving. This person asks to see relevant data to ensure the accuracy of the information the group uses while attempting to problem solve.

3.2.6 Reading and interpreting workplace documentation

The following written document and order are prepared as all worker be aware and get information for needed purpose. The following the evidence may found in you work organization.

- Read process documentation
- Read license of the enterprise
- Accountability of employee and responsibility
- Warning notes
- Material data sheet
- Process operation procedure

3.2.7 Sharing information

3.2.7.1Task Roles

The first type of roles that individuals can take-on within a group are all centered around the tasks that the group needs to accomplish. These roles are all pro-social and help the group strive towards achieving the group or team's goal.

3.2.7.2 Initiator-Contributor

The initiator-contributor is all about providing new and keen insight and ideas to the group. This person may help the group brainstorm new and novel ways to go about understanding or looking at a particular problem.

3.2.7.3 Information Giver

The information giver is someone within a group that has some kind of authoritative understanding or specific expertise that can help inform a group's decision making process. This person can often use her or his own knowledge or personal experiences to help inform a group's decision-making process.

3.2.7.4 Speaking clearly and directly

I. clearly speaking

Speaking clearly and effectively can make it much easier to communicate ideas accurately. You'll need to slow down your speech, enunciate each syllable, and practice your diction. Take the time to practice speaking, and correct yourself if you mess up. There are three ways of speaking

a. **Take a deep breath;** Calm yourself down before you start speaking, so that your lungs won't run out of air. Distill your thoughts – do not spill them. If you dive into speech without taking time to ground yourself, you may speak more quickly and slur your words. Take the time to center yourself, and proceed mindfully from there.

b. **Articulate your words;** Pronounce each syllable individually. Syllable. Take it very slowly, at first, until each sound is clear and distinct.

Gradually speed up your speech and decrease the space between words until you are speaking normally.

- Make sure you actually stop the air for consonants like 't' and 'b'. Differentiate between your vowels.
- Don't expect to speak with perfect clarity right away. You may need to practice this for several hours each day, and you may need to practice more to master difficult words.
- Practice when you're alone – in the car, or walking down the street; when cleaning, or knitting, or standing in front of the mirror. You can slow down your syllables in conversation, but you may make more progress if you devote some serious time to honing your speech.

c. **Speak more slowly**; It can be incredibly helpful to give your words an extra second or two to fully come out of your mouth. Pausing also works, because pausing allows the person you're speaking to, to digest all of the words you've just sai

Self-Check 3	Written Test

Name _____ **ID** _____ **Date** _____

Instruction: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Short Answer Questions

1. List numeracy skills to workplace requirements (4 point)
2. Write down three ways of speaking clearly and directly (3 point)
3. Explain detail information seeker (3points)
4. Who is elaborator? (2point)
5. Who is orienteer? (2point)
6. What are the common causes of communication problem? (2point)

You can ask you teacher for the copy of the correct answers

Answer Sheet

Score = _____

Rating: _____

Trainer Name: _____ Date: _____

Note: Satisfactory rating - >8 points Unsatisfactory - below <8 points

LG-37 LO#2 Operate Equipment

Instruction sheet

This learning guide is developed to provide you the necessary information regarding th following content coverage and topics:

- Loading Equipment and programming according to work instructions
- Operating equipment
- Identifying and complying Occupational Health and Safety (OHS)
- Identifying production problems and taking corrective action
- Applying relevant regulatory requirements

This guide will also assist you to attain the learning outcomes stated in the cover page Specifically, upon completion of this learning guide, you will be able to:

- Equipment loads and program according to work instructions.
- Equipment operates according to manufacturer's specifications and workplac requirements.
- Identify occupational Health and Safety (OHS) requirements and complied with.
- Apply relevant regulatory requirements

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the “Information Sheets”.
4. Try to understand what are being discussed.
5. Ask your trainer for assistance if you have hard time understanding them.
6. Accomplish the “Self-checks” which are placed following all information sheets.
7. Ask from your trainer the key to correction (key answers) or you can request you trainer to correct your work. (You are to get the key answer only after you finishe answering the Self-checks).

Information sheet 1: Loading Equipment and programming

1.1 Introduction

For production before operation all necessary material has available to production area. Loading material have done according to workplace requirement by considering OHS and QA strategies of the organization. The load material for production must processed with in time programmed. Because the quality of material will decline as long as from next process.

1.2 Loading Equipment as workplace requirement

After preparing equipment for operation required materials such as meat or meat product, holding on materials for before or after processing to handling product, lifting assistance.

Material handling equipment (MHE) is mechanical equipment used for the movement, storage, control and protection of materials, goods and products throughout the process of manufacturing, distribution, consumption and disposal. The different types of handling equipment can be classified into four major categories: transport equipment, positioning equipment, unit load formation equipment, and storage equipment.

1.2.1 Using Transport equipment

Transport equipment is used to move material from one location to another (e.g., between workplaces, between a loading dock and a storage area, etc.), while positioning equipment is used to manipulate material at a single location. The major subcategories of transport equipment are conveyors, cranes, and industrial trucks. Material can also be transported manually using no equipment.

1.2.1.1 Conveyors

Conveyors are used when material is to be moved frequently between specific points over a fixed path and when there is a sufficient flow volume to justify the fixed conveyor investment. Different types of conveyors can be characterized by the type of product being handled: unit load or bulk load; the conveyor's location: in-floor, on-floor, or overhead, and

whether or not loads can accumulate on the conveyor. Accumulation allows intermittent movement of each unit of material transported along the conveyor, while all units move simultaneously on conveyors without accumulation capability.

For example, while both the roller and flat-belt are unit-load on-floor conveyors, the roller provides accumulation capability while the flat-belt does not; similarly, both the power-and-free and trolley are unit-load overhead conveyors, with the power-and-free designed to include an extra track in order to provide the accumulation capability lacking in the trolley conveyor. Examples of bulk-handling conveyors include the magnetic-belt, troughed-belt, bucket, and screw conveyors. A sortation conveyor system is used for merging, identifying, inducting, and separating products to be conveyed to specific destinations, and typically consists of flat-belt, roller, and chute conveyor segments together with various moveable arms and/or pop-up wheels and chains that deflect, push, or pull products to different destinations.

1.2.1.2 Cranes

Cranes are used to transport loads over variable (horizontal and vertical) paths within a restricted area and when there is insufficient (or intermittent) flow volume such that the use of a conveyor cannot be justified. Cranes provide more flexibility in movement than conveyors because the loads handled can be more varied with respect to their shape and weight. Cranes provide less flexibility in movement than industrial trucks because they only can operate within a restricted area, though some can operate on a portable base. Most cranes utilize trolley-and-tracks for horizontal movement and hoists for vertical movement, although manipulators can be used if precise positioning of the load is required. The most common cranes include the jib, bridge, gantry, and stacker cranes,

1.2.1.3 Manual Handling Equipment

Commonly used to assist in moving smaller loads where larger equipment would struggle, manual handling equipment such pallet trucks, trolleys and sack trucks can be an essential part of any material handling.

1.3 Programming for operation

Setting parameter

Boiler has controlled and monitored by setting its program at standard processing method or according to workplace requirement. Those parameters must be programmed in computer system of control board.

- Setting water level
- Steam temperature
- Pressure
- Selecting chemical detergent
- Time of steaming
- Time of cleaning

Operating program has held according to production requirement based on SOP of organization. The time of operation for batch process and continuous process adjustment must record.

Process operation program prepares graduates to work as process operators in processing industries such as food and beverage production. The program involves the study of chemical engineering technology courses such as unit operations, process control, industry safety, process simulation, and quality control. There is a considerable emphasis on the hands-on-job training as a significant part of this program.

Process operators should have good hand-eye coordination, vision, hearing and manual dexterity, strong communication skills, and are able to work well with others in a team environment.

1.3.1 Program Goals

Apply the science and skills required to achieve optimal performance in the operation and management of engineering operations with particular emphasis on the meat processing industries.

• Application of quality principles and control of industrial processes.

• Exploring technical errors and failures in industrial equipment and equipment.

- Maintain a professional and environmentally friendly performance.
- Understand the application of the professional and ethical responsibilities of operator in chemical plant.
- Ability to work independently or part of a team.
- Acquire effective communication skills that maintain a positive working environment in the chemical plant.

Self-check 1	written test

Direction: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test II: Short Answer Questions

1. What is the purpose of equipment loading? (2point)
2. What is the purpose of programing operation? (2 point)
3. How should operator program for operation? (3points)
4. What are the disadvantages of manual handling material? (2point)
5. Explain the basis of programing operation?

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Rating: _____

Trainer Name: _____ Date: _____

Note: **Satisfactory rating - 5 points** **Unsatisfactory – below 5 points**

Information sheet 2 Operating equipment

2.1 Introduction

Operation is the task performing between machine and human interaction. Different machine or different process contain own operating system and procedure. The boiler we use in our production process has its operating system and procedure specified by manufacturer manual. A boiler is one of those machineries that gets the ship going.

A boiler is something, which though not required continuously in operating a ship, cannot be done away with. Moreover, it's a dangerous equipment which generates steam at extremely high pressure, and it is for this reason that proper care should be taken while operating it. In this article we have brought to you a step-by-step procedure for starting and stopping a boiler on a ship. With this procedure you can never go wrong, as far as boilers are concerned. Starting and stopping a boiler was never so easy.

2.2 Boiler operating

Proper operation and maintenance of your boiler and its distribution system can save significantly on energy bills. Since many boiler systems operate at an average efficiency of only 65 to 75%, the remainder of your heating fuel bill is going up the chimney or down the drain.

2.3. Important PPE for boiler operation

Figure 10. Aprons, uniforms, eye protection, glove, waterproof footwear

2.1.1 Starting a Boiler

It is to note that the following steps may not apply to all types of boilers and each boiler requires some additional steps to be followed as per its system design. However, the basic steps remain the same:

I. Ensure that the vent valve on the boiler is open and check there is no pressure in the boiler.
II. Check that the steam stop valve is closed.
III. Check that all the valves for fuel are open, and let the fuel circulate through the system until it comes to the temperature required by the manufacturer recommendation.
IV. Check and open the feed water valves to the boiler and fill the water inside the boiler drum to just above the low water level. This is done because it is not possible to start the boiler below the low water level due to safety feature which prevent boiler from starting. Also, the level is not filled much because if filled too much, the water inside the boiler might expand and over pressurize the boiler.
V. Start the boiler in automatic mode. The burner fan will start the purging cycle which will remove any gases present in the furnace by forcing it out through the funnel.
VI. After the pre-set purge time the pilot burner will ignite. The pilot burner consists of two electrodes, through which a large current is passed, via the transformer, producing the spark between the electrodes. The pilot burner is supplied with diesel oil and when the oil passes over, the former ignites.
VII. The main burner which is supplied by heavy oil catches fire with the help of pilot burner.
VIII. Check the combustion chamber from the sight glass to ensure the burner has lit and the flame is satisfactory
IX. Keep a close eye on the water level as the pressure increases and open the feed water when the level of water inside the gauge glass is stable.
X. Close the vent valve after the steam starts coming outside.
XI. Open the steam stop valve.
XII. Once the working steam pressure is reached, blow down the gauge glass and float chambers to check for the alarms.

The following low-cost or no-cost items will typically pay for themselves in less than one year and should be incorporated into your regular

A. Have your service company perform a detailed analysis of your system. The check should include analysis of firing rate, flue draft, air/fuel ratio, stack temperature, combustion air setting, flue carbon dioxide and oxygen readings, and control calibrations.
B. Adjust, repair or recalibrate controls and settings as needed. If the proper air/water level is not marked on your sight glass (if present) have it marked.
C. Scale (mineral deposits) inside the boiler reduces the efficiency of the boiler and may lead to stress problems and leaks. Proper chemical treatment of boiler water will reduce scale build-up and control condensate water pH and corrosion potential. When the boiler is shut down, inspect for scale deposits, accumulation of sediment or boiler compounds on the water-side surfaces.
D. Stack flue gas temperatures should be no more than 150° greater than the steam or water temperature. Clean and scrape fire-side tubes to remove soot and scale if the desired temperature split is exceeded. Add stack thermometer if necessary.
E. Check boiler insulation, refractory, brick work, and boiler casing for hot spots and air leaks; repair and seal as necessary.
F. Replace boiler door gaskets if they do not provide a tight seal.
G. Proper combustion air intake ensures maximum safety as well as efficiency. Interlock combustion air intake with burner operations.
H. If your boilers are large, a daily log of boiler operation may be helpful. Chart boiler pressure, temperature, CO2, O2, steam or condensate flow, and other data from the boiler. Variations from normal can indicate the need for tube and nozzle cleaning, pressure or linkage adjustments, and related air/fuel or draft adjustments.
I. Small, frequent boiler blowdowns are more effective than larger, less frequent blowdowns. Schedule blowdown when needed as indicated by regular boiler water tests, rather than by a fixed schedule. Inspect nozzles or cups of oil-fired burners on a regular basis and clean if needed. Inspect oil line strainers and replace if dirty.
J. Eliminate gas pilots and install intermittent ignition electric pilots.
K. In steam systems, inspect steam traps on a regular basis.

The inspection must be performed when the equipment is actually operating.

- Shut off equipment or steam valve, wait a few minutes and then restart. Listen to the trap to hear whether it opens and closes as expected.
- Inspect condensate tank vents. Steam plumes from the roof vents are an indication of one or more defective traps in the condensate return system.
- Use a surface pyrometer to check condensate line temperature surface downstream of trap while equipment is operating. This line should be slightly cooler than the steam line feeding the equipment.
- If it is lukewarm or cold, the trap is allowing condensate to pass through, probably because of a flooded float or worn-out thermostatic element. If the condensate line is about the same temperature as the entering steam line, the trap is probably passing steam and should be replaced.
- This situation can be caused by dirt and sediment or by defective or worn valves and seals. Malfunctioning traps may be rebuilt for future use.

L. Clean radiators, fin tube convectors, and coils. Check perimeter radiation units for blockage of air passages, by objects placed on top of or in front of radiation covers. Maintain a one-foot clearance in front of convectors, radiators or registers when possible.

M. Maintain the lowest steam pressure that is adequate to meet space heating or process demands. Reduce steam pressure during low demand periods. Where high pressure steam is required for turbines or other processes which operate only a portion of the year, reduce the system steam pressure for the rest of the year.

N. Shut down boilers when their heating function is unneeded, but don't cut back heating levels in areas where there is a possibility that freezing damage could result. Boilers that are shut down should be properly drained and dried out to prevent the possibility of freezing or corrosion.

O. Oversized boilers short-cycle and waste fuel during start-up and shut down periods. If the boiler is oversized, adjust or modify the firing rate to better match building load. Time the on and off periods of burner operation to get a better handle on cycle periods; take outside air temperature into account. For multiple-boiler plants, make sure one boiler is loaded to the maximum before a second boiler is put into service.

P. When outdoor temperatures are moderate, switch boiler control to manual low-fire setting. The boiler will operate longer between cycles at a higher overall efficiency. Shut one boiler down during mild weather to improve operating efficiency.

Q. Tag all drained, disconnected, or idle equipment that might be unsafe or harmed by inadvertent use or operation.

R. Don't disregard safety in the interest of saving energy. Maintain adequate ventilation and combustion air. Maintain proper lighting in boiler.

2.1.2 Stopping a boiler

I. If the boiler is needed to be stopped for longer duration for maintenance or opened up for survey, change the fuel to distillate fuel.

II. If separate heating arrangement for heavy oil is present then there's is no need to change over to distillate fuel and the oil is kept on circulation mode.

III. Stop the boiler automatic cycle.

IV. Close the steam stop valves.

V. Close the boiler feed water valves.

VI. When the boiler pressure is just reduced to over atmospheric pressure the vent valve is kept open to prevent vacuum formation inside the boiler.

Self-check 2	written test

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Short Answer Questions

1. Elaborate the activity of pre start boiler operation. 2pts
2. Elaborate start operation steps. 2pts
3. Elaborate all steps of operation. 4pts
4. What are situations monitored in operating boiler?2pts
5. What we do when outdoor temperatures are moderate?3pts
6. What shall we do to save the energy in operation system?2pts
7. How to boiler operation stop? 3pts
8. What is end activity of operating boiler operation?2pts

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Rating: _____

Trainer Name: _____ Date: _____

Note: Satisfactory rating - 10 points Unsatisfactory - below 10 points

Information sheet 3: Identifying and complying Occupational Health and Safety

3.1 Introduction

To provide for the health and safety of persons at work and for the health and safety of persons in connection with the use of plant and machinery; the protection of persons other than persons at work against hazards to health and safety arising out of or in connection with the activities of persons at work; to establish an advisory council for occupational health and safety; and to provide for matters connected therewith.

The main aim is to ensure the health and safety of employees at work and also aims to protect people other than those employees at a workplace from hazards arising out of or in connection with the activities of the employees at the workplace.

3.2 Identifying OHS

What is dangerous about this job?

Boilers work at a high heat adjacent to pressurized vessels which put their operators at a risk of burns and explosions.

- Burning of fuel used in boilers may lead to fires, carbon monoxide poisoning, etc.
- Boiler operators come into contact with various substances used in boilers (fuel, water additives, etc.) which may lead to eye and skin
- disorders.
- Boiler operators work in a noisy, hot and humid environment that may cause tiredness and general ill-feeling

3.2.1 Enterprise OHS policies,

Enterprise OHS policies should relate and specific occupations Boiler maker implementation for; boiler-house inspector; boiler-house mechanic; boiler-operator helper; boiler-shop supervisor; boiler-tube blower; control-room operator; steam-generator operator; steam-power-plant operator; steam-supply operator procedures and programs

3.2.2 OHS regulatory requirements

Under section 44 of the Occupational Health and Safety Act, 1993 (Act No 85 of 1993), I, Tito Titus Mboweni, Minister of Labor, after consultation with the Advisory Council for Occupational Health and Safety, hereby incorporate in the Vessels under Pressure Regulations, 1996, the health and safety standards specified in the Sched

3.2.2.1 International Regulation

International Standards Organization, standard specifications ISO 831 Rules for the construction of stationary boilers.

- ISO 3807 Dissolved Acetylene cylinder - Basic Requirements.
- ISO 4705 Refillable seamless steel gas cylinders.
- ISO 4706 Refillable welded steel gas cylinders.
- ISO 5730 Stationary shell boilers of welded construction. (Other than water tube boilers.)
- EEC 87-404 Directive for the construction of simple pressure vessels.
- EEC 84-525 Directive for the construction of seamless, steel gas cylinders.
- EEC 84-526 Directive for the construction of seamless unalloyed aluminum and
- aluminum alloy gas cylinders.
- EEC 84-527 Directive for the construction of welded unalloyed steel gas cylinders.
- EN 50 052 Cast Aluminum Alloy Enclosures for Gas filled High Voltage Switchgear End Control gear
- EN 286-1 Simple unfired pressure vessels designed to contain air nitrogen; Part 1 Design and manufacture of simple pressure vessels.
- EN 303-PT 1 Heating Boilers - Heating boilers with forced draught burners - Terminology, general requirements, testing and marking.
- EN 303-PT2 Heating Boilers - Heating boilers with forced draught burners - Special 87/404/EEC - SIMPLE PRESSURE VESSELS REGULATION

This document specifies quality levels for imperfections in arc-welded joints in aluminum and its alloys. It applies to material thicknesses above 0,5 mm.

Three quality levels are given in order to permit application to a wide range of welded constructions. They are designated by symbols B, C and D. Quality level B corresponds to the highest requirement on the finished weld. The quality levels refer to production quality and not to the fitness for purpose (see 3.2) of the product manufactured.

This document is applicable to all types of welds (e.g., butt welds, fillet welds and branch connections), to manual, mechanized and automated welding, and to all welding positions. It is applicable to the following welding processes:

- metal inert gas welding (MIG welding); gas metal arc welding /USA;
- tungsten inert gas welding (TIG welding); gas tungsten arc welding

3.2.2.2 Requirements set out in standards and codes of practice

The boiler parts have designed and operated according to requirement set out standard and codes of practice. Design parts must incorporate are;

- Provisions of pressure safety relief valves
- Provisions of temperature safety valves
- Provisions of vacuum safety valves
- Provisions of rupture disks
- Spare safety valves
- Closed spring type valves
- Safety valves with lifting devices
- Temperature safety relief valves
- Safety valve caps
- Safety valve drains
- Material safety data sheet

Self-check 3	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test 1: short answer

1. What is dangerous about this job? 3pts
2. What is the enterprise policy?2pts
3. What design parts must incorporate?3pts
4. What is the regulation on operation relating to OHS?2pts

Note: Satisfactory rating - 5 points **Unsatisfactory - below 5 points**

Information sheet 4: Identifying production problems and taking corrective action

4.1 Introduction

During operation technical problem or machine faulty can affect processing performance that leads to producing quality lost product. When the operation problem is faced justly identifying and taking correction very important to relief the product from defects. If the problem is over your experience reporting for required part.

4.2 Problems Being Faced in the Boilers

Major problems occurring in the boilers are agglomeration, high temperature corrosion, slagging, fouling, caustic embrittlement and fatigue failure.

I. Agglomeration

Agglomeration problem mainly occurs on the fireside in the fluidized bed boilers. Agglomeration is basically the ash-related problem of biomass-fired boilers. Ashes which are formed from high-sulfur and low-ash fuel agglomerate, if they are prone to sulfating condition for long time.

The degree of sulphation varies with both time and temperature. It varies proportionally with increase in temperature and time. Ashes agglomerate when there is a production of 50–60% or more amount of calcium sulfate and Ca–K-silicates in the deposit. Loop seal and bed ashes are more prone to agglomeration than fly ash. Fly ash produces weaker deposits than bed ashes, but they all will agglomerate with respect to time.

The rate of agglomeration increases if the temperature increases from 850 to 950□°C. Agglomeration occurs first due to carbonation and then due to sulphation at lower temperatures. The agglomeration tendency of ash increases with the increase in iron or alkali metal content. Silvennoinen reported that alkali silicate mixture of low melting point is produced when alkali-rich ash reacts with the free quartz which is present in the sand and this mixture forms an adhesive bond between the fluidizing bed particles, thus leading to agglomeration. The low-melting alkali chlorides may enhance the stickiness of fly ash

particles and increase the ash deposition rate on the superheater tubes. The deposited alkali chlorides may increase the corrosion rate of super heaters, as the chloride

- **Possible solutions for agglomeration**

Additives such as sulfur, kaolin and ammonia sulfate can be used to reduce agglomeration on superheater tubes. David's son reported that if kaolin is added to the bed material before the combustion, then this would surely resolve the problem of agglomeration. In one of the studies, it was reported that the agglomeration temperatures for wheat straw and bark was determined to be 739 and 988°C, respectively. However, if kaolin is added to the bed, the initial bed agglomeration temperatures increased to 886 and 1000°C, respectively. When kaolin was added to the bed, the com-positions of the coatings were altered toward higher melting temperatures, mainly because of their decreased potassium content as kaolin absorbs the major potassium species. However, Kaolin is expensive to be used commercially against deposits.

The problem can also be counteracted if ammonium sulfate or sulfur is added as a substitute of kaolin. The reactions between the additives such as sulfur and alkali chlorides form alkali sulfates and the chlorine is released into gas phase as HCl. The alkali sulfates have higher melting points than the corresponding alkali chlorides and will, therefore, have a smaller tendency to stick to the superheaters as deposits. The deposit formation and the corrosion potential of the superheaters can, therefore, be minimized.

II. Slagging

Based on the different methods involved in ash deposit over the heating surface, two types of ash deposition are observed, i.e. slagging and the fouling. Boiler slagging and fouling are two main factors that adversely affect the efficiency of boilers. Fireside of the boiler is mainly affected by these problems. These two processes lead to frequent non-operation of soot blowers. Slag is the molten ash and incombustible by-product that remains as residue after coal.

Slagging is the deposition of partially fused residues on furnace walls or surfaces exposed to radiant heat. It takes place in the hottest parts of the boiler. Slag is formed when molten

softened ash particles are not cooled to solid state when they reach with the hot surface. It reduces the heat absorption in the furnace, increases furnace exit gas temperature, decreases boiler efficiency and availability due to unplanned shutdowns leading to losses in the operation. It has been found, that serious slagging mainly occurs on the walls of the furnace. Flue gases in the center of the furnace make it to deflect on other two sides of the walls; thus, leading to the impingement of the pulverized-coal flame on to the side walls of the furnace.

- **Possible solutions for slagging**

The process of slagging cannot be prevented completely. It can, however, be reduced using several ways such as ensuring even distribution of heat to avoid localized temperatures. It can also be minimized by adding a conditioner to the molten ash particles carried by the flue gas which is taken up by those molten particles and produces a nucleating effect when those particles cool, causing them to solidify more rapidly, thereby preventing deposit formation or resulting in considerably a greater number of friable deposits.

Formation of deposits on the convention surface can be reduced by keeping appropriate temperature at the exit of the furnace and also by removing sufficient amount of heat. Apart from the above stated solutions, height, width and depth ratio of the furnace should be proportional so that potential of ash particles impacting on the furnace surface is limited.

III. Fouling

Fouling is the formation of sintered ash deposits on conventional heating surfaces such as reheaters and super heaters that are not directly exposed to flame radiation. It takes place as the suspended fly ash cools down along with flue gases. Excessive fouling may lead to an increase in gas temperature and deposition rate which leads to continually changing conditions in the boiler, hence, reducing its efficiency.

Temperature variation for high temperature fouling lies in the range from 900 to 1300^{0}C, and for low temperature fouling, this range is from 300 to 900^{0}C. Fouling in boilers is

caused due to reduction in heat transfer, which further leads to sufficient loss of superheat and hot flue gas temperatures. Major factors that lead to the removal of fouling are the deposit strength and the adhesive bonding between the heat transfer surface and ash deposit.

- **Possible solutions for fouling**

There are no permanent solutions for fouling, but there are certain technologies which can help in minimizing the deposition problems in boilers. Some of these processes are pulse detonation wave technology, intelligent soot blower, chemical treatment technology, anti-fouling coatings, etc. These technologies can help in reducing the fouling problem to some extent in boiler tubes depending upon their efficiency.

Finishing remarks and recommendations can be drawn according to the results shown. Soot blowers can be used to clean the heated plane of boilers during operations, with blowing medium as water and steam. Water or steam is directed at the deposit through a nozzle which causes the deposit to fracture and corrode away. There are some ash actions prediction tools such as Ash.

Pro SM used to review the slagging and fouling situation in coal-fired boilers. Integrated boiler with computational fluid dynamic (CFD) simulations with ash actions models is used to deter-mine ash development, transport, deposition, deposit growth and strength development. Some of the other methods, which are used for prevention from fouling in boilers, are wet pretreatment of brown coal-fired power utility boiler, using mineral additives in coal-fired utility boiler, monitoring of fouling tendencies, chemical treatment technology: targeted in furnace injection (TIFI) technology, etc.

IV. Caustic embrittlement

The process of caustic embrittlement occurs in boilers and leads to formation of cracks on the riveted mild steel plates. The temperature ranges from 200 to 250^{0}C, which further leads to deposition of concentrated hydroxide on the water-side of the boiler. We can also explain caustic embrittlement as a phenomenon where boiler becomes brittle, due to accumulation of caustic soda.

Caustic embrittlement is also known as stress corrosion cracking. Caustic embrittlement is caused due to the presence of caustic soda in the boiler feed water, which is in direct contact with the steel and drums of the boiler. In the boiler, when the water evaporates, the concentration of sodium carbonate increases. Sodium carbonate is used for the softening of water via. lime soda process. During this process, there are chances that some of the sodium carbonate particles may be left behind.

With the passage of time, the concentration of sodium carbonate increases, and it undergoes hydrolysis to form sodium hydroxide. When the concentration of sodium hydroxide increases by a certain amount, it makes water alkaline. This alkaline water enters into small cracks of inner walls of the boiler. Evaporation of this water leads to a continuous increase in the amount of sodium hydroxide present in the boiler tubes. This sodium hydroxide attacks the iron present on the boilers and dissolves it; thus, forming sodium ferrate, which further leads to caustic embrittlement.

- **Possible solutions for caustic embrittlement**

Caustic embrittlement in boilers is a natural process and can be prevented temporarily by adding a combination of chemicals consisting of a sufficient amount of sodium sulfate

Self-check 4	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test 1: write complete answer

1. List operation liability problems 2pts
2. Explain the problems and solution for Agglomeration 3pts
3. Clarify the problem and solution for Slagging 4pts
4. Describe problem and solution to Fouling 3pts
5. Elaborate cause of Caustic embrittlement 3pts

Answer Sheet

Score = _____

Rating: _____

Trainer Name: _____ Date: _____

Note: Satisfactory rating - 5 points **Unsatisfactory - below 5 points**

5.1 Introduction

There is a wide range of safety and monitoring equipment that can be fitted to boilers, designed to help protect the boiler from operating outside the set parameters and shut it down to prevent a dangerous situation. This may include equipment such as alarms, water-level controls, burner controls and pressure-relief valves

5.2. Environmental protection standards

5.2.1 Emissions and Discharges

Check the condition of the wastewater treatment plant and location of discharge points for wastewater from the facility;

- Note the color and appearance of adjacent watercourses;
- Note whether the wastewater treatment plant discharges to a local watercourse or the municipal wastewater treatment works. Higher environmental risks will be associated with facilities discharging to water courses;

5.2.2 General Housekeeping

Check the standard of housekeeping at the facility, e.g. do areas look clean and tidy, is there build-up of waste on floors and surfaces, is there evidence of any recent spills or releases of raw materials/product/effluent;

5.3 Controls and protocols

5.3.1 Parts needs to be checked

Each of the boiler systems has a number of devices that allow it to function efficiently and safely. Common fittings include steam traps, pressure gauges, insulation, pumps, and valves. To maintain safe and efficient boiler operation, these fittings must be maintained properly. Safety sensors, electrical circuits, and the efficiency of combustion must be checked as well.

I. Steam traps

The purpose of a steam trap is to remove condensate, air, and non-condensable without the loss of live steam. The different types of steam traps in use include thermostatic, float-thermostatic, inverted bucket, bimetallic, and impulse types. In the event of failure, steam traps will either be closed or open. A closed stream trap will not pass any condensate through, while a steam trap that fails open will blow live steam through the trap, wasting energy and money because of the loss of live steam. The steam loss can add up to tens of thousands of dollars per year. Steam traps should be tested several times a year for proper operation. Among the common methods used to test steam traps are sight, sound, temperature, and conductivity.

II. Pressure gauges

For safety, any pressure gauge that seems to not be operating perfectly must be removed and checked for calibration. You can ensure pressure gauge accuracy by scheduling checks and recalibration using proper test equipment.

III. Insulation

Another area of testing that leads to immediate results and energy savings is pipe insulation testing. Insulation that is missing, loose, damaged, or inadequate will cost thousands of dollars in energy costs per year. Fortunately, a thermal imager will easily and quickly spot these insulation problems. Again, an advantage of the thermal imager is that it allows portability and ease of use.

IV. Pumps

Pumps are one of the most common devices in central energy plants. Boiler systems use hot water, feedwater, and condensate pumps. The failure of a pump can cause the shutdown of a critical process or area. In many buildings' downtime is very expensive, with thousands of dollars per minute of lost production not unheard of.

V. Valves

The central energy plant has many valves. Boiler plants use valves for the control of hot water, feedwater, condensate, and steam. Modulating valves are often used to control

temperature at terminal units, air handling units, and steam to hot water heat exchangers. A valve that is malfunctioning can cause improper operation and high energy costs. You can use a thermal imager to detect small steam leaks for early valve repack and repair. A valve that is not opened properly may show a high temperature difference across the valve. A shutoff valve may leak through slightly, which will affect system operation. A thermal imager can show the temperature difference on either side of the valve, indicating a leak.

VI. Safety limits, sensors, and control

A boiler system has numerous safety limits, sensors, and controls. The failure of these components can lead to boiler shutdown or a potentially catastrophic boiler explosion. Examples of these components include a flame sensor as well as steam pressure, gas pressure, temperature, and steam pressure devices. You should check their accuracy and operation with certified diagnostic test equipment to ensure safe and efficient operation. With sensors, compare a reading at the diagnostic test equipment to the reading of the actual sensor. If not within factory tolerance it should be replaced. You can check a flame sensor by measuring the milliamp output of the sensor when it is exposed to the boiler flame.

VII. Electrical systems

Another major area where diagnostic equipment is vital in a boiler plant is the electrical system. One of the major worries is that incoming electrical power from the utility will fail, be interrupted, or have the wrong current, voltage, or phase. Fortunately, power quality analyzers can show incoming power quality issues and monitor for problem.

5.3 Export Control Act

As article 3 of Supervision Administration Regulation for Manufacture of Boiler and Pressure Vessel, Import and export boiler and pressure vessel shall follow the stipulations of the Law of the P. R. China on Import and Export Commodity Inspection, the Implementation Regulations for the Law of the P. R. China on Import and Export Commodity Inspection, and the Provisions for the People's Republic of China on the Supervision and Control of the Import and Export Boilers and Pressure Vessels. The

qualification and administration of manufacture licensing and the supervision inspection of the product safety performance shall be subjected to the Regulations. The boiler and pressure vessel stated in the Regulations are defined as follows:

5.3.1 Boilers System

a) Pressure-resistant Steam Boilers
b) Pressure-resistant Hot Water Boilers
c) Organic Fluid Heaters

5.3.2 Pressure Vessels

Various types of pressure vessels for containing gas, liquefied gas and liquid with maximum working temperature no less than its standard boiling point, and the maximum working pressure no less than 0.1MPa (gauge pressure), and the product of pressure and volume no less than 2.5 MPa.

Various types of gas cylinder containing gas, liquefied gas and liquid with standard boiling point less than 60 °C; the maximum working pressure no less than 0.2MPa (gauge pressure) and the product of pressure and volume is not less than 1.0 MPa

5.3.3 Medical Oxygen Cabins

The Regulations are not applicable to the boilers and pressure vessels, which are installed in ships, locomotives, air crafts, military equipment, nuclear facility, and the electric or gas fueled hot water heaters with rated thermal power less than 0.1 MW and the output hot water temperature no higher than 90 °C.

5.3.4 Emergency control

No person shall for the first time enable gas to be supplied for use in any premises unless there is provided an appropriately sited emergency control to which there is adequate access. Any person installing an emergency control shall ensure that;

(a) any key, lever or hand-wheel of the control is securely attached to the operating spindle of the control;

(b) any such key or lever is attached so that

(i) the key or lever is parallel to the axis of the pipe in which the control is installed when the control is in the open position; and

(ii) where the key or lever is not attached so as to move only horizontally, gas cannot pass beyond the control when the key or lever has been moved as far as possible downwards;

(c) either the means of operating the key or lever is clearly and permanently marked or a notice in permanent form is prominently displayed near such means so as to indicate when the control is open and when the control is shut; and

(d) any hand-wheel indicates the direction of opening or closing of the control.

Where a person installs an emergency control which is not adjacent to a primary meter, he shall immediately thereafter prominently display on or near the means of operating the control a suitably worded notice in permanent form indicating the procedure to be followed in the event of an escape of gas.

Where any person first supplies gas to premises where an emergency control is installed, he shall ensure that the notice required by paragraph (3) above remains suitably worded or shall, where necessary, forthwith amend or replace that notice so as to give effect to the provisions of that paragraph. This regulation shall not apply where gas is supplied in a refillable cylinder except where two or more cylinders are connected by means of an automatic change-over device.

5.4 Relevant Ethiopia Standards

The company undertaking a systematic, documented review of operations against national legal requirements relevant to Environmental, Health, Safety and Social performance and the extent of compliance with that legislation.

5.5 Relevant regulations

Note the extent to which monitoring and testing is undertaken as a requirement of operating licenses and the extent of compliance in recent years;

As Article 3 Implementation Regulations for the Law of the P. R. China on Import and Export Commodity Inspection, and the Provisions for the People's Republic of China on the Supervision and Control of the Import and Export Boilers and Pressure Vessels. The qualification and administration of manufacture licensing and the supervision inspection of the product safety performance shall be subjected to the Regulations.

5.6 Legislation

Boiler systems are required to comply with different legislation, including a number of health and safety and environmental Acts and regulations, which are aimed at ensuring that new and existing boiler systems are continually operated and maintained in a safe manner. The principal sets of health and safety legislation that support the Health and Safety at Work etc. Act 1974 and apply to the use of boiler systems covered by this guidance are:

- The Management of Health & Safety at Work Regulations 1999 (MHSWR);
- The Pressure Equipment (Safety) Regulations 2016 (PER);
- Gas Appliance Regulations 2016 (GAR);

conformity assessment for gas appliances must be carried out by a notified body such as IMQ. The GAR has been in force since 21 April 2018 and is aimed at manufacturers, importers and distributors of: APPLIANCES: appliances burning gaseous fuels used for cooking, refrigeration, air-conditioning, space heating, hot water production, lighting or washing, and also forced draught burners and heating bodies (2) to be equipped with such burners;

Fittings: safety devices, controlling devices or regulating devices and sub-assemblies thereof, designed to be incorporated into an appliance or to be assembled to constitute an appliance. Certification pursuant to the GAR, and hence assessment of conformity with the requirements of the GAR, must be carried out by a notified body such as IMQ, and involves analyzing technical documentation, conducting laboratory tests on the product prototype and subsequent annual production surveillance that the manufacturer decides to have carried out in accordance with the various "modules" laid down by the directives. The tests for assessing conformity with the GAR include combustion tests

with different types of gas (according to customer requirements – countries in which the appliance is to be sold) as well as referencing parts of other Directives (Efficiency and Electrical).

- The Pressure Systems Safety Regulations 2000 (PSSR);
- The Provision and Use of Work Equipment Regulations 1998 (PUWER);
- The Gas Safety (Installation and Use) Regulations 1998 (GSIUR); and
- The Dangerous Substances and Explosive Atmospheres Regulations 2002 (DSEAR). Requirements set out in ETS 5008-2001/Amdt 1-2003 Ethiopian Standard for the Hygienic Rendering of Animal Products

Self-check 5	Writing and choice

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test 1: write short answer

1. Why legislation is important for boiler operation? 3pts
2. What is the Relevant Ethiopia Standards boiler operation depending? 3pts
3. What shall any person installing an emergency control ensure? 3pts

Test 2 choose 2pts

1. They are defined boiler and pressure vessel stated in the Regulations
   A. Pressure-resistant Steam Boilers
   B. Pressure-resistant Hot Water Boilers
   C. Organic Fluid Heaters
   D. All
2. Boiler plants use _____ for the control of hot water, feedwater, condensate, and steam.
   A. Alarm
   B. Valve
   C. Piston
   D. Button
3. The failure of the following system components can lead to boiler shutdown or a potentially catastrophic boiler explosion
   A. Safety limit
   B. Sensor
   C. Control
   D. A&B
   E. All

Operation sheet 1: operating the boiler

1.1. Sequence of boiler operations

The following sequence is provided as a step-by-step example of a typical boiler operation.

I. Ensure that the vent valve on the boiler is open and check there is no pressure in the boiler.
II. Check that the steam stop valve is closed.
III. Check that all the valves for fuel are open
IV. Check and open the feed water valves to the boiler and fill the water inside the boiler drum to just above the low water level.
V. Start the boiler in automatic mode.
VI. supply by heavy oil catches fire with the help of pilot burner.
VII. Check the combustion chamber from the sight glass to ensure the burner has lit and the flame is satisfactory.
VIII. Keep a close eye on the water level as the pressure increases and open the feed water when the level of water inside the gauge glass is stable.
IX. Close the vent valve after the steam starts coming outside.
X. Open the steam stop valve.
XI. Blow down the gauge glass and float chambers to check for the alarms.
XII. Stop the boiler automatic cycle.
XIII. Close the steam stop valves.
XIV. Close the boiler feed water valves.

LAP TEST	Boiler Operation

Name……. ID……..

Date…….

Time started: _____ Time finished: _____

Instructions:

- Use PPE recommended in your information sheet.
- Carryout any OHS regulation your information sheet for boiler operation
- Given necessary prototypes, tools and materials you required to perform the following tasks within 1 hour.
- The project is expected from each student to do it.

Task 1. Perform Boiler Operation and monitoring

Reference

PDF/Book

1. Boiler%20Maintenance%20And%20Troubleshooting%20Best%20Practices%20_%20Fluke.htm
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1. Boilers%20and%20Boiler%20Control%20Systems%20(Energy%20Engineering).html
2. www.youtube.com/watch?v=lsiJiYrey0A
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Answer key

LG36: LO1: Self-check 1

TEST 1.

1. B
2. C
3. D
4. A

TEST 2

1. It is fast, gentle and efficient cooking of boiled sausages, sausages, wieners and other products requiring heat treatment in a high humidity environment at temperatures up to 1100C

2. allows creating in the shortest possible time a high relative humidity in the chamber

minimizes moisture condensation on the chamber walls

3. check out for pre operation set.

- water to be boil;
- Checking parts of boiler;
- Checking availability of heating source or energy source
- Availability material used in operation;
- Preparation of steam line to address where processing
- Cleaning
-

4. A treated raw water which must come from outside the boiler room and plant processes.

SELF CHECK 2

TEST 1

1. free from food hazard and dangerous in process may raise from chemical fault and deposit weight density

2. Routine testing the of deposited

Ph measuring from cleaning water

Using expert's method

3. It is a work guide, job aid or standard operating procedure – describes in detail how an activity within a process (or procedure) is performed

4. At work area to prevent mental and physical health and safety problem so regulated must interpreted. Avoiding from hazardous material and non-harmful activities.

5. make crystal clear how employees perform their tasks. There should be no room for interpretation. They should not be vague

self-check 3

Test 1

1. make crystal clear how employees perform their tasks. There should be no room for interpretation. They should not be vague

Opinion Giver

Elaborator

Coordinator

Orienteer

Information Seeker

2. The person asks to see relevant data to ensure the accuracy of the information the group uses while attempting to problem solve.

3. Take a deep breath;

Articulate your words

Speak more slowly;

4. who elaborator takes the ideas that other people have had within a group and tries to flesh out the ideas in a meaningful way.

5. orienteer is akin to a group or team's mapmaker. This person's role is to show where the group has been in an effort to understand where the group is right now

6. uncommunicatively

diffident

dissolute

LG37 LO2

self-check 1

test 1.

1. To available material requirements

Obeying operation program

Time saving

2. To achieve optimal performance in the operation and management of engineering operations with particular emphasis on the processing

To Exploring technical errors and failures in industrial equipment and equipment's

To Apply of quality principles and control of industrial processes

3. based on SOP of organization. The time of operation for batch process and continuous process adjustment must record.

4. time consuming, low safety and laboring

5. unit operations, process control, industry safety, process simulation, and quality control.

Self-check 2

Test 1 short answer

1. ; Ensure that the vent valve on the boiler is open and check there is no; pressure in the boiler.

   ; Check that the steam stop valve is closed.

   ; Check that all the valves for fuel are open, and let the fuel circulate; through the system until it comes to the temperature required by the; manufacturer recommendation.

2. ; opening and check there is no pressure in the boiler.

   ; steam stop valve closing.

   ; Starting the boiler in automatic mode

   ; supplying by heavy oil catches fire with the help of pilot burner

   ; Closing the vent valve after the steam starts coming outside

   ; Opening the steam stop valve.

   ; blowing down the gauge glass and float

3. ; Check and open the feed water valves to the boiler and fill the water inside the boiler drum to just above the low water level.

   ; Keep a close eye on the water level as the pressure increases and open the feed water

4. switching boiler control to manual low-fire setting.
5. Maintain adequate ventilation and combustion air. Maintain proper lighting in boiler
6. Maintain adequate ventilation and combustion air. Maintain proper lighting in boiler
7. ; changing the fuel to distillate fuel

   ; changing over to distillate fuel and the oil is kept on circulation mode

   ; Stopping the boiler automatic cycle.

   ; Closing the steam stop valves.

   ; Closing the boiler feed water valves

8. If the boiler pressure is just reduced to over atmospheric pressure the vent valve is kept open to prevent vacuum formation inside the boiler.

Self-check 3

Test 1. Short answer

1. : Burning of fuel used in boilers may lead to fires, carbon monoxide poisoning, etc.

: Boiler operators come into contact with various substances used in boilers (fuel, water additives, etc.) which may lead to eye and skin Disorders.

2. : relate and specific occupations Boiler maker implementation for; boiler-house inspector; boiler-house mechanic; boiler-operator helper; boiler-shop supervisor;

3. operated according to requirement set out standard and codes of practice.

4. Occupational Health and Safety, hereby incorporate in the Vessels under Pressure Regulations, 1996, the health and safety standards specified in the Sched

Self-check 4

Test 1 short answer

1. Agglomeration

Slagging

fouling

2. Problem: occurs on the fireside in the fluidized bed boilers. Agglomeration is basically the ash-related problem of biomass-fired boilers

Solution: Adding additives such as sulfur, kaolin and ammonia sulfate to superheated tube

3. Problem: the deposition of partially fused residues on furnace walls or surfaces exposed to radiant heat

Solution: adding a conditioner to the molten ash particles carried by the flue gas which is taken up by those molten particles and produces a nucleating effect when those particles cool, causing them to solidify more rapidly,

4. Problem: the formation of sintered ash deposits on conventional heating surfaces such as reheaters and super heaters that are not directly exposed to flame radiation

Solution: pulse detonation wave technology, intelligent soot blower, chemical treatment technology, anti-fouling coatings,

5. the presence of caustic soda in the boiler feed water, which is in direct contact with the steel and drums of the boiler

self-check 5

test 1 choice

1. D
2. B
3. E

Test 2 written

1. complying of health and safety and environmental Acts and regulations, which are aimed at ensuring that new and existing boiler systems are continually operated and maintained in a safe manner.

2. reviews the of operations against national legal requirements relevant to Environmental, Health, Safety and Social performance and the extent of compliance with that legislation.

3. thereafter prominently display on or near the means of operating the control a suitably worded notice in permanent form indicating the procedure to be followed in the event of an escape of gas.