Isolation of Mechanical and Electrical Equipment

Learning Outcome

When you complete this module you will be able to:

Describe the general procedures involved in the isolation of plant equipment.

Learning Objectives

Here is what you will be able to do when you complete each objective:

1. Outline and discuss the general requirements for the mechanical and electrical isolation of equipment.

2. Describe the typical safe isolation of a pump and driver, a steam boiler, and a sodium zeolite softener.

GENERAL

To prepare for maintenance, inspection, or overhaul of any equipment requires proper isolation of the equipment involved. Some important aspects of equipment isolation, and the associated work permits, are the following:

1. The employer must be willing and prepared to bear the cost of necessary procedures to ensure that the safeguarding of life and property is a priority at all times. Shortcuts to minimize production losses should not be allowed.

2. Anyone involved in the isolation of equipment must be properly trained in the operation of that equipment. The person must know functions, isolating points, etc. of all connections to suction, discharge, supply, exhaust, drain and flare headers from a pump, compressor or any other piece of mechanical equipment, as well as any electrical connections that may be present. Also, the person performing an isolation must be very familiar with valve and breaker locations, plant equipment identification systems, and any other information that will guarantee isolations are correct.

3. Authorized procedures must be in place for the safest possible method of isolating the equipment in question, and these procedures must be adhered to.

4. It must be understood that both Operating and Maintenance Departments are responsible for the isolation of any equipment before work commences. For example, if the operating department isolates a piece of equipment, the maintenance people who will work on the equipment should verify that the isolation is complete and correct. In other words, everyone must take responsibility for their own safety. If a person is not sure a piece of equipment is safe to work on, a qualified individual should be asked to point out the isolating points, and to explain the isolation.

5. Various types of permits (safety, hot, entry, electrical, etc.) might be necessary before work can be started, and may require updating from time to time as work progresses. These permits must bear the signatures of the parties involved. Also, “Do Not Operate” tags must be in place, as specified by a permit, and the person signing a permit should verify this. In all cases, a person working under a permit must take responsibility for their own safety, and for the safety of anyone working under their supervision.

AG_3_0_1.jpg
P

6. Sometimes, particular safety precautions may be specified on a safe work permit. For example, instructions to “check vessel oxygen content before entering” may be written on the permit. Any person accepting a permit, by signing it, must ensure these instructions are carried out.

7. Monthly safety meetings must be conducted to ensure all personnel are properly trained in the use of personal protective equipment. Equipment isolation is a topic that should be included in those meetings, so that everyone understands permit systems which are in use. The importance of maintaining safety equipment in good condition should also be stressed.

Only generalities have been discussed here, but each industrial workplace will have safety procedures implemented that must be followed.

TYPICAL EQUIPMENT ISOLATION

The standard devices that are used to isolate piping and vessels are valves and blank flanges. Valves must be secured in either closed or open positions using locked chains and/or wire seals. In most cases (particularly those associated with potentially explosive work, fires, toxic fluid contact, or vessel entry) a single closed valve is insufficient for isolation purposes. In such instances a blind flange is installed in the piping. Alternatively, some situations can be addressed by the use of a double block and bleed assembly. In this arrangement, the piping consists of two block valves separated by a section of piping with a “T”. The “T” line contains a third vent or drain valve, known as a bleed. Proper isolation, in this case, consists of chain locking both block valves in the closed position, and chain locking the bleed valve in the open position.

The following are examples of equipment isolation:

Isolation of a Pump and Driver

Referring to Fig.1, the pump is driven by a steam turbine. Header valves, usually located on top of pipe racks, are shown connected to their respective headers. The turbine drain valve drains the casing to atmosphere. The pump casing drain is shown having two valves; a requirement when the pumped fluid is of an explosive, corrosive or poisonous nature. In this situation the pump casing is drained into a “closed drain”. The effluent must be discarded in a manner that will not endanger life, property, or the environment. In the event that the fluid being pumped does not present a hazard, the pump casing drain may have only a single valve.

All possible hazards must be considered before an isolation is undertaken.

AG3_fig1.gif

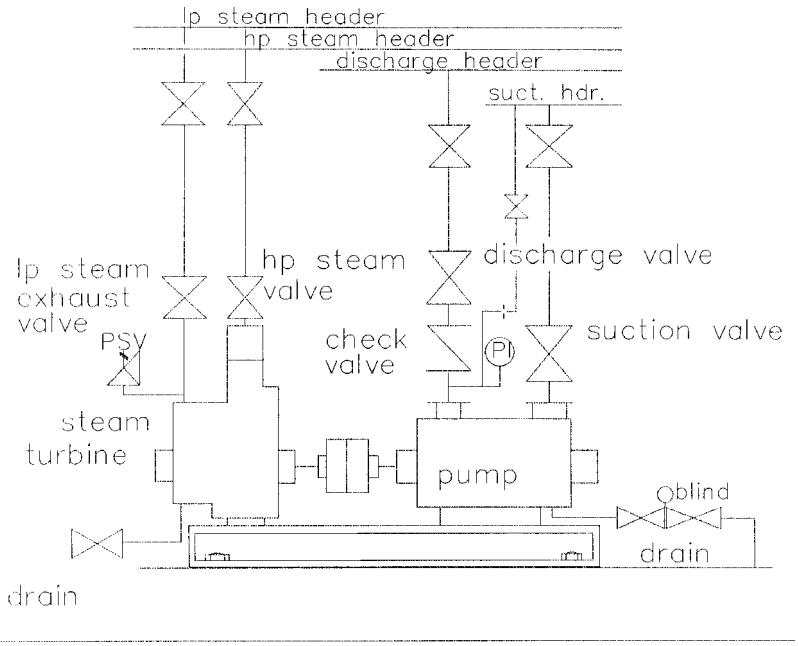


Figure 1
Steam Turbine Driven Pump

The procedure to isolate the equipment shown in Fig. 1 is as follows:

AG_3_0_5.mov
V

- Close the high pressure steam supply valve.
- Close the turbine (lp steam) exhaust valve.
- Open the turbine casing drain.
- Close the pump discharge valve.
- Close the pump suction valve.

AG_3_0_6.mov
V

- Close the minimum flow line isolating valve.
- Open the pump casing drain.

After the pump has been depressurized and drained, if the pump drain line is a "closed drain", the line should be broken between the two drain valves (with the downstream valve closed), and a suitable blind flange installed.

Note that this is a minimum isolation only. In many cases, further isolation could be necessary. In many cases a double block and bleed arrangement may be present. In this situation both block valves should be closed and the bleed (vent) valve should be opened prior to opening the system.

Prepare **DO NOT OPERATE** tags and place these in full view on all isolation valves of the arrangement. Depending on the application or plant safety procedures, it may be necessary to "chain lock" the valves.

When an electric motor is used to drive the pump, one or a combination of the following procedures must be used, depending on the installation:

1. Open the breaker.
    - Install a "Lockout" clamp and lock, on breaker lever.
    - Have maintenance personnel also place a lock on the clamp.
2. Remove fuses - to be done by a qualified electrician.
3. Remove motor control.
    - Ensure that only properly qualified personnel do the isolation procedures.

AG_3_0_2.jpg
P

AG_3_0_3.jpg
P

Enter the completed equipment isolation procedures in the logbook.

AG_3_0_4.mov
V

Recommended procedure, when performing an isolation, is to isolate the driver first. This ensures that a piece of equipment, particularly if it is started remotely, cannot be started while an isolation is being done. For example, a person could be operating valves at a pump when it is suddenly started. At the very least the person would be startled, and a reflex action could lead to injury. Worse still, the person's hands or clothing could get caught on the shaft.

If the driver is isolated first, the driven equipment itself is also protected from possible damage. Suppose a person had just opened the breaker on a lubricating oil pump that supplies oil to the bearings of a large boiler feed pump. If the feed pump breaker were to be closed at that time, it could be started with no lubricating oil, damaging the pump. Therefore, as a general rule, always isolate a driver first.

AG_3_0_8.mov
V

NOTE : The procedures discussed in this module serve only as examples of the type of isolation procedures that must be followed to ensure the safe isolation of any piece of equipment. It is the responsibility of all personnel involved to personally review and check the isolation procedures of their workplace to ensure that there is no possible way for anything to enter the isolated process equipment, that contents are drained, and that the equipment is depressurized. For electrical equipment, personnel must ensure that it is de-energized, and that there is no way of accidentally reconnecting power. Rotating equipment must be secured against inadvertent movement.

Isolation of a Steam Boiler

Assume that the water tube boiler represented in Fig. 2 is to be inspected both externally and internally. The preliminary work that must be completed might include:

- Notification of the Boiler Inspector.
- Isolation and draining of the boiler by closing or opening the necessary valves.
- Cool down of the boiler.
- Ventilation of enclosed spaces.
- Preparation for hydrostatic test.

The best possible method of ensuring the boiler is isolated would be to install blind flanges in the headers leading to and from the boiler.

AG_3_0_7.mov
V

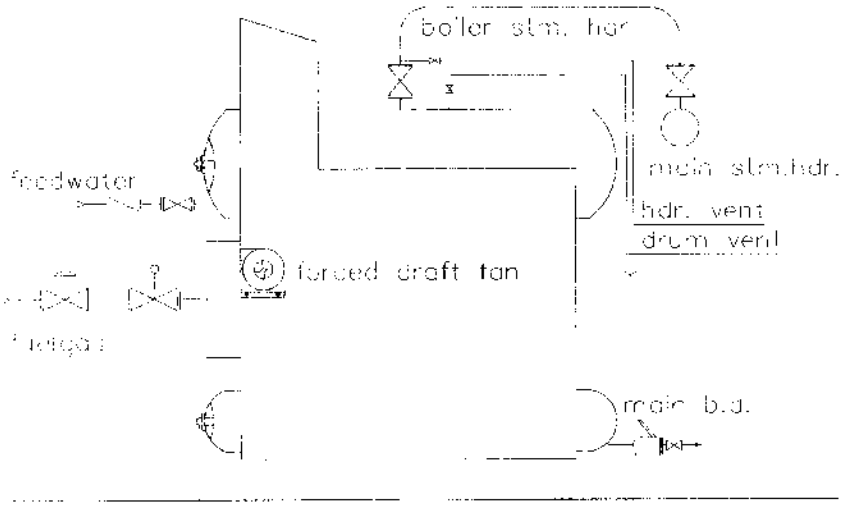
Blind flange lists must be prepared ahead of time, and will contain information such as:

- Date installed.
- By whom.
- Blind flange and tag number.
- Location.
- Size of blind (use the diameter of the inside of the bolt circle for ease of installation).
- Spacing to be installed (upstream or downstream).
- Date removed.
- By whom.
- Operator.
- Other useful information, as is required.

A “Tag” board must be in place for easy verification of tags.

Referring to Fig. 2, after the preliminary work has been done, the procedure to isolate the boiler is:

- Disconnect electrical power from the motor driving the forced draft fan using the procedures described earlier for motor isolation.
- Install a blind flange downstream of the fuel gas valve.
- Install a blind flange downstream of the feedwater isolation valve.
- Install a blind flange upstream of the quick-opening blowdown valve with a spacer on the boiler side.
- Install a blind flange on the upstream side of the boiler steam stop valve. Leave the header drain valve open.



AG3_fig2.gif

Figure 2
Simple Stream Boiler

The boiler in Fig. 2 is now ready for cleaning and inspection. Enter the above procedures in the logbook.

Isolation of a Sodium Zeolite Softener

In Fig. 3, the softener is shown in operation, delivering water to the deaerator. Isolation is required to replace the sodium zeolite.

AG3_fig3.gif

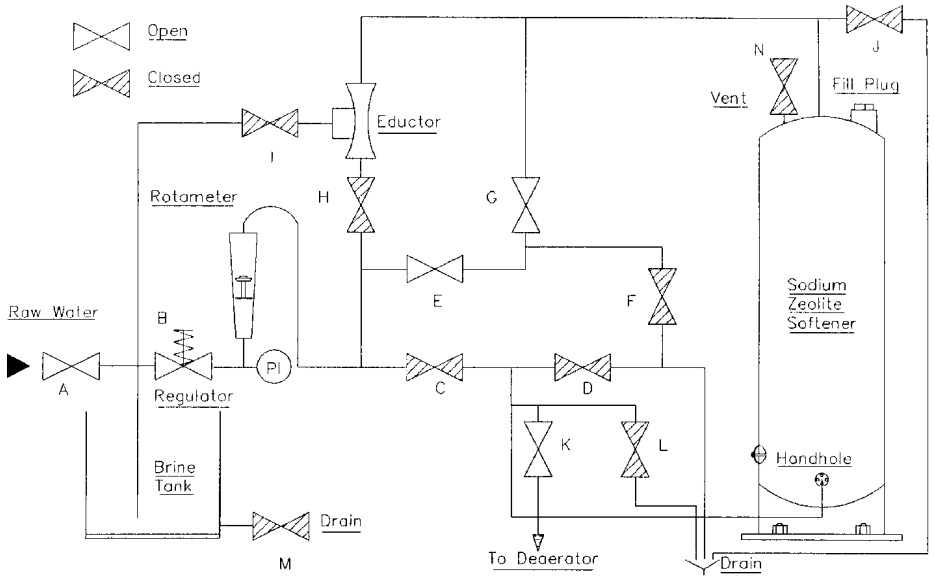


Figure 3
Sodium Zeolite Softener

To isolate the softener proceed as follows:

- Close the effluent valve (K).
- Close the supply valve (A)
- Open the drain valve (L).
- Open the vent valve (N).

The valves K, A, L, and N are tagged in their respective positions.

Depending on the piping arrangements, other valves might have to be operated to ensure all lines are drained and no water can enter the vessel. Ventilation might also be required, and other safety precautions would have to be specified.

Enter the procedure in the logbook.