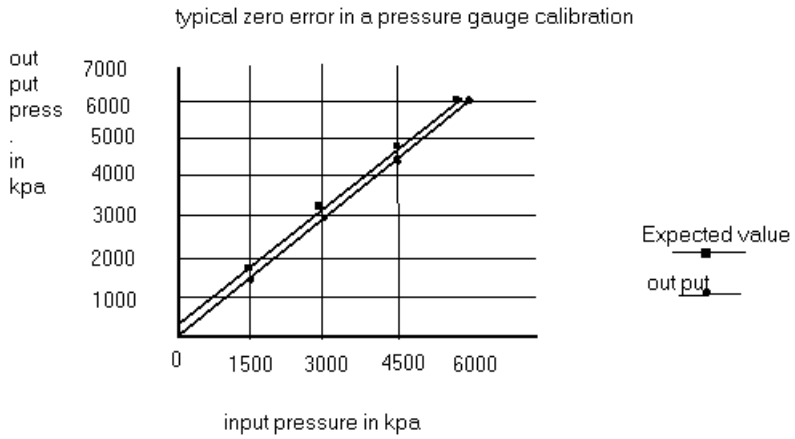
# Instrumentation in general

**1. Explain the following:**

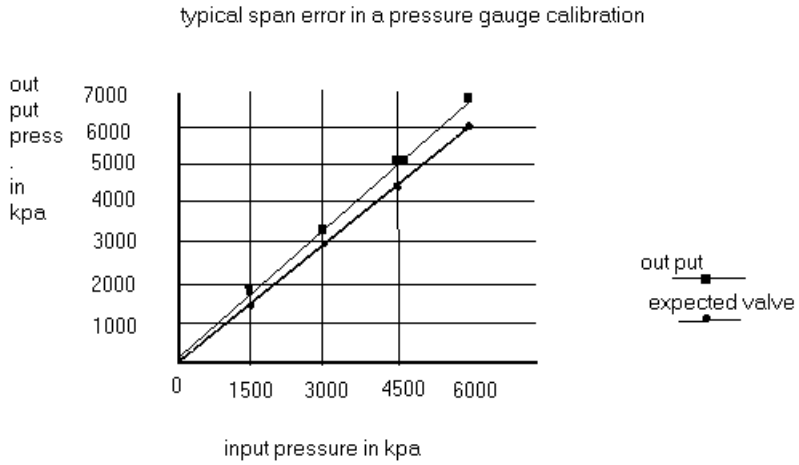
a) Zero error b) span error c) Repeatability

d) Proof pressure e) adjustable range f) model number

**Zero error**: The linear error throughout the scale or range of an instrument.




**Span error:** the non-linear error throughout the scale or range of an instrument




**Repeatability:** Reproduction of the same reading on its upscale and down scale measurement.

**Proof pressure:** 1.4 times the maximum working pressure the instrument body can withstand.

**Adjustable range**: The range between which and instrument can be calibrated or set.

**Model number:** A unique instrument identification number provided by the manufacturer.

**2. What is 'switch differential' on a pressure/temperature/level/flow switch?**

The 'switch differential' is the difference between the switch 'actuation' and 'reset' points (values).

**3. How to select a measuring instrument or a switch for a particular process?**

Following parameters are to be considered while selecting an instrument for a process application.

- process chemical characteristic
- process normal operating pressure
- process maximum working pressure
- the required measurement range or the required set point

**4. Explain the difference between 'line break protection' and a 'line break detection' system?**

**Line break protection:** it is to prevent the process line break due to extra high pressure. For example: the high-pressure switch in the station oil discharge line.

**Line break detection**: it is to detect the process line break. For example: the low-pressure switch in the gas lift manifold.

**5. Explain the following with its application areas.**

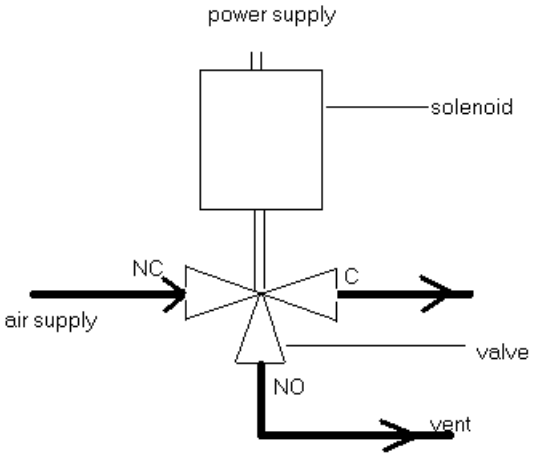
**a) Micro switch b) limit switch c) proximate**

**Micro switch:** small changeover switches having a common, normally open and normally closed terminal. Often used in Instrument Switches.

**Limit switch**: changeover switch having a common, normally-open and normally-close terminal. Often used on ESDV status detection and in the door operation.

**Proximate:** works on the change in magnetic flux. Often used on ESDV status detection and in the door operation.

**6. What is a 'solenoid valve'? How does it work?**




A typical three way solenoid valve

A solenoid is a coil wrapped around a piece of iron. When power is applied to the coil the iron piece becomes a temporary magnet and it pulls the plunger up. The plunger in turn changes over the port connections on the valve.

**7. How many types of solenoids are there?**

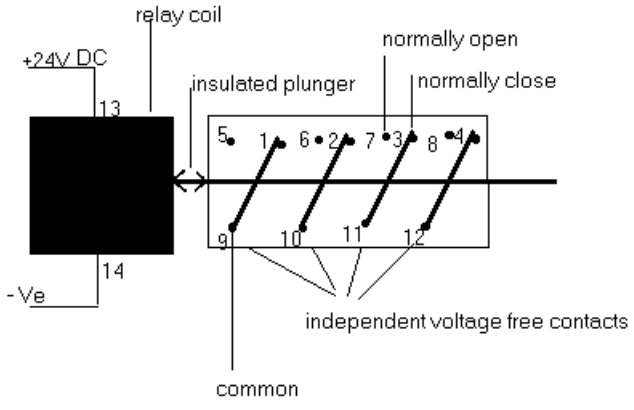
There are basically two types of solenoids. They are:

1. Normally closed type and 2. Normally open type

**8. How many port solenoid valves are there?**

There are many different port configuration solenoids available. A few of the commonly used solenoid valves are:
2port solenoid valve, 3port solenoid valve, 4 port solenoid valve and 5 port solenoid valve…etc.

**9. What is a 'relay'? Draw a sketch of a simple relay.**




A typical example of an electrical relay

An electrical relay consists of a coil with an iron core at the centre (solenoid) and a set of voltage free contacts. When power is applied to the coil the iron core at the centre becomes a temporary magnet and pulls the plunger, thereby all the voltage free contacts simultaneously change their polarity from closed to open and open to closed.

Relays are available with various operational voltage such as 12V DC, 24V DC, 110V AC, 240V AC …etc.

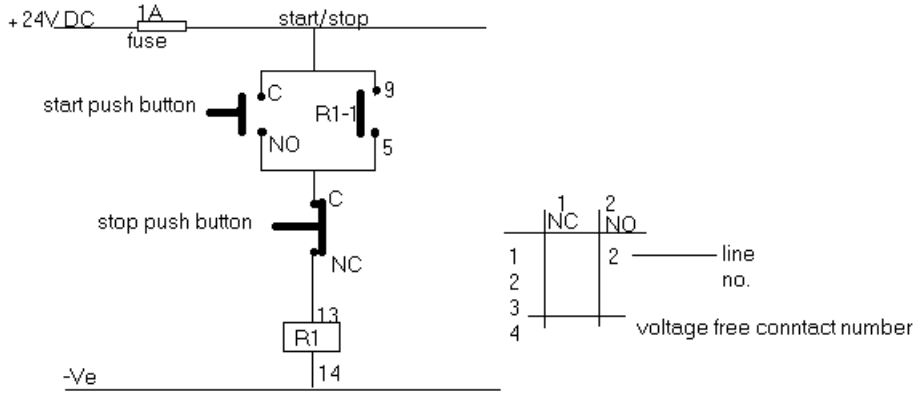
Relays are available with different voltage free contact types, such as single pole double throw, single pole single throw…etc.

Relay contact status is always shown in the relay's de-energized (no power) condition.

**10. What is a voltage free contact?**

These are the relay's contacts that work independent of the relay coil power supply. For example: the relay coil may be operating on 24 V DC and its contact may carry 240V AC to operate another piece of equipment.

**11. Draw a simple start and stop circuit.**




A typical example of a start/stop circuit

**12. What is memory latch/self holding contact?**

'Memory latch' is the function initiation that is held in the memory until it is erased. In the above drawing:

Start push button is a spring return wired for normally opens.
Stop push button is a spring return wired for normally closed.
Relay R1 is denergised and its contact selection is normally open.

Once the start push button is pressed and released the relay R1 energizes and its first pair of contacts change from normally opens to closed and holds the relay R1 energized. The relay contact R1-1 remembers that the start was initiated and keeps in the memory. The memory gets erased once the button is pressed.

**13. What is an ‘interface relay’? Where is it used?**

It is a relay exclusively used as an interface between two separate power supply operations or between two different logic operations. For example, 24V DC logic starting an electrical heavy duty motors…etc.

**14. What is a ‘timer’?**
Timer is an electrical relay consisting of a coil with an iron at the centre (solenoid) and a set of voltage free contacts that change over after a preset time, depending on the type of the timer.

**15. How many types of timers are there?**

There are basically two types of timers. They are:

**Time delay pick-up – TDPU:** When power is applied to the timer coil (energized), its contacts change over after the present time. When the power is removed from the coil (de-energized), its contacts change over instantaneously.

**Time delay drop-out – TDDO:** When power is applied to the timer coil (energized), its contacts change over instantaneously. When the power is removed from the coil (de-energized), its contacts change over after the preset time.

A combination of ‘time delay pick-up’ and ‘time delay drop-out’ timer is also available.

**16. What is an ‘electrical safety barrier?**

Electrical safety barrier is an instrument used to provide a separation between intrinsically safe and non-intrinsically safe part of the instrument loop. Normally this segregation is provided between the control room and the field instruments.

**17.How many types of safety barriers are there?**

Following are the commonly used safety barriers:

- Current limiter
- Voltage limiter
- Interface voltage free contact barrier

**18. How does a safety barrier work?**

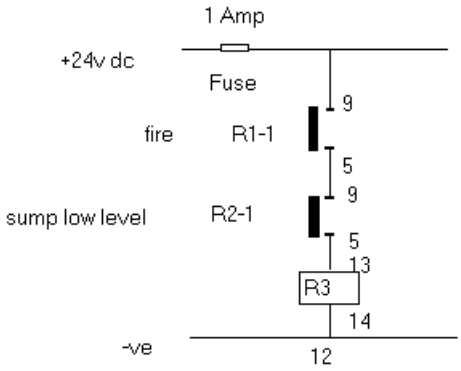
Generally every barrier is protected by a fuse, ziner diode, resistor and earthling system.
Fuse protects the circuit against high current drawn.
Ziner diode maintains the maximum voltage level across the terminals
Resistor restricts dead short grounding.

**20. What is an ‘and gate’? Give an example.**

In an ‘and gate’ all the input conare required to close to energies a relay.

In a digital input, all the inputs should be ‘1’ to get an out put of ‘1’.

In the drawing, the relay contact ‘R1-1’ and R2-1 should close to energies the relay R3.

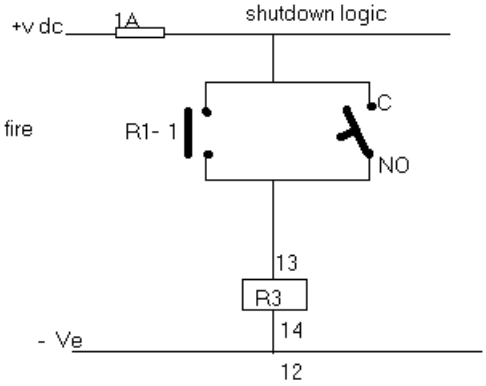



*A typical example of an ‘and gate’*

**21. What is an ‘or gate’? Give an example.**

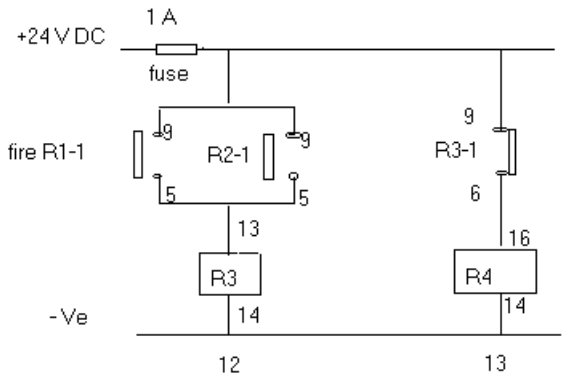
In an ‘or gate’ any one input contact is required to close to energies a relay.
In a digital input, any one input should be ‘1’ to get an output of ‘1’.

In the drawing, either the relay contact ‘R1-1’ or the ‘override’ key contact should close to energies the relay R3.




A typical example of an 'or gate'

**22**. **What is a ‘nor gate’? Give an exam**




*A typical example of an ‘nor gate’*

In a ‘nor gate’ all the contacts are required to be open energies a relay.

In digital inputs, all the inputs should be’ 0’ to get an output of ‘1’.

In the above drawing, the relay contact ‘R1-1’ and the relay contact R2-1 must be open to energies the relay R4.

**23. What is a ‘primary element’ and ‘final (end) element’?**

**Primary element**: It is the sensor which senses the process to be measured or monitored, such as a pressure, temperature, level, flow transmitters thermocouple, RTD…etc.

**Final element:** It is the end element used for controlling the process parameters, such as a control valve, IGV, governor…etc.

**24. What ‘air supply pressure’ is required for a pneumatic transmitter?**

Air supply to a pneumatic instrument is 140kpa or 20psi

**25. What is the output of a pneumatic transmitter in psi and kpa?**

Output of a pneumatic transmitter is 20-100kpa or 3-15psi.

**26. What is the function of a ‘relay’ in a pneumatic transmitter?**

A relay in a pneumatic instrument works as a proportional booster to transmit the transmitter signal a long distance. Pneumatic relay amplifies the flapper-nozzle back pressure.

**27. What is a ‘negative feed back’ (force balance) principle?**

Negative feedback is to balance the process pressure caused on the force bar by the sensor, to achieve a balanced (pre-ranged) output. If there is no

negative feedback the output will saturate to a minimum or maximum for a small deflection by the sensor.

**28. What will be the output of transmitter if the nozzle is blocked?**

If the transmitter nozzle is blocked, the transmitter output will go to maximum.

**29. What is the function of a relay restriction in a pneumatic transmitter?**

A relay restriction is provided to minimize the nozzle pressure on the flapper.

**30. What will be the relay's output, if a flapper-nozzle's output is 50kpa?**

The relay output will be 50kpa. A pneumatic relay proportionately boosts the flapper-nozzle output in an instrument.

**31. What supply voltage required for an electronic transmitter?**

Supply voltage to an electronic transmitter is 24-28V DC.

**32. What is the output of an electronic transmitter?**

Output of an electronic transmitter is 4-20 m A.

**33. What is a 'sensor' in transmitter? How many types of sensors are there?**

A sensor is part in a primary element used for sensing the process parameters. Generally sensors are available in 'low', medium' and 'high' ranges.

**34. What is the function of range selection jumper on an electronic transmitter?**

Range selection jumpers on the amplifier are used to arrange the transmitter calibration range to 'narrow', 'medium' or 'wide' range.

**35. What is the advantage of a local recorder (example: M-40)?**

Local recorders are used as a temporary recording facility near the process measurement point. Generally it is used for observation, study or for troubleshooting purposes. For example: well head pressure recording, vessel level recording…etc.

**36. What are a 'receiver type' and a 'sensor type' local recorder?**

**Receiver type:** where the recorder element receives the process 20-100kpa signal through a transmitter.

**Sensor type:** where the recorder element directly senses the process pressure.

**37. What has to be done to re-range a local flow recorder (example: M-40)?**

The recorder's sensor 'range spring' has to be replaced to suit the recorder's new rang, then re-calibrate the recorder.

**38. What precaution has to be taken while working on a transmitter used in a control loop?**

To work on a transmitter used in a control loop, the controller has to be in manual from auto mode. A continues watch on the process parameter is required.

**39. What is a signal selector relay? Give an example with the inputs and outputs.**

There are two types of signal selector relays: 'low signal selector' and high signal selector' relay.

Low signal selector: it accepts two or more input signals and the output is the lowest of the input signals.

High signal selector: it accepts two or more input signals and the output is the highest of the input signals.

**40. Why is a computing relay (Sort berg) used in an 'anti-surge control' system? Write its output formula.**

Computing relays are used for multiplying and dividing the input signals.

The computing relay used in the solar anti-surge control panel is to measure the 'true' flow with respect to the design parameters. The flow measured across the orifice plate is measured against the discharge pressure. The following is the computing relays output formula:

$$\text{Out put} = \sqrt{(\text{flow\_tx\_output} - 20)}\ 6\ (\text{dish.press\_tx \_ output} - 20) + 20$$

**41. Write the expansion form of 'IGV'? What does it do? Give some examples of where it is used?**

IGV stands for 'inlet guide vane'.

IGVs are used to control an inlet flow (load) where the equipment speed is constant.

For example: the blower IGV controls the inlet gas flow
IGV inside a gas turbine controls the inlet airflow

# Process in general

## Separators

### 1. What is the separator back pressure? What happens if a separator's back pressure is increased or decreased?

Separator back pressure is the pressure maintained on the liquid surface. Maintaining the uniform back pressure is critical. Rising in the back pressure may result in less production of oil and vice versa.

### 2. Why is back pressure maintained in a separator?

Separator back pressure maintained to push the oil from the separator to the surge tank and also to provide a steady suction pressure to the compressors and blowers.

### 3. What is a separator? Explain the parameters measured during a well test.

- A vessel used in gathering station for conducting a 3 phase test of the process fluid, such as oil, gas and water.
- 3 phase test is to measure the quantity of oil, gas and water (BSW) a well can produce for the known quantity of gas injection (gas lift) and the opening of the choke (bean)
- Each test separator is used for testing only one well at a time.
- Though a well is normally tested for 24hrs. at times, period tests are also conducted.

### 4. What is the function of a 'net oil computer' in a test separator's process measurement?

A process of computing the BS&W (water) in the gross oil.

The loop involves a field capacitance chamber (+capacitance probe) in the oil outlet line, an oil turbine meter, a capacitance dividing unit in the control room.

The flow measured by the oil turbine meter is sent to the NOCS unit where it divides the oil flow measured by the turbine meter into net oil and BS&W.

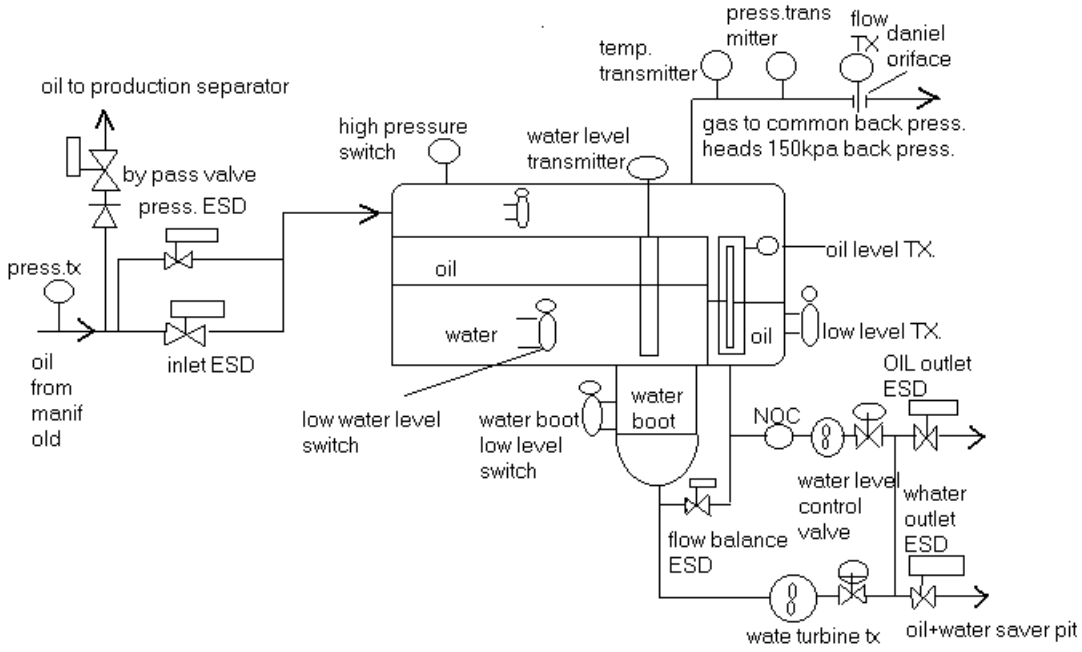
### 5. Why is separator's gas output generally than the gas input (gas lift)?

Gas from a test separator is approximately equal to the sum of gas injected into the well through gas lift, and the gas produced by the well.

**6. What happens to the well connected to a test separator when the test separator shutdown?**

When a test separator shutdown and its inlet ESDV closes, the oil is diverted to the bulk separator through a bypass valve.

**7. Draw a sketch of a test separator and identify the instrument components, control loop and ESDVs.**




*A typical test separator P&I*

**8. Why is a high pressure switch provided on a separator? What is the shutdown setting on it?**

High pressure switch is provided on the test separator to protect it against the process high pressure. High pressure switch is set at 400kpa↑ *(Refer to the station drawings for the exact setting parameters)*

**9. What may happen if the high level switch fails to detect a high level in the separator?**

If the high liquid level switch fails to detect a high level, the process liquid will carry over into the gas discharge line to the compressors, blowers and to the flare.

**10. What may happen if the low level switch fails to detect a low level in the separator?**

If the low liquid level switch fails to detector a low level, the process gas pressure may enter the surge tank and may possibly rapture the surge tank, which is a low pressure vessel.

**11. Explain the function of all the ESDVs of a test separator.**

- Inlet pressuring ESD is to balance the pressure across the inlet ESD.
- Inlet main ESD is to close in case of any emergency.
- By-pass valve to divert the well flow to production separators in case the inlet ESD closes.
- Oil outlet ESD to surge tank.
- Water outlet ESD to surge tank.
- Flow line balance ESD between the oil and water compartments.

**12. Why is a field reset push button provided for opening/closing an ESDV?**

The field reset push button in the field for each ESDV is to ensure that the area and the process around, is healthy before opening the ESDV.

**Surge tank**

**1. What is the application (purpose) of a surge tank in an oil station?**

A surge tank is a storage tank; it receives oil from the production and test separators. Surge tanks provide higher capacity and stability to the liquid. There are two surge tanks in every gathering station working in a parallel mode. Also the surge tanks separate the AP (atmospheric) gas from the crude oil. It also provides a buffer function to the transfer pumps.

**2. What is the advantage of two surge tanks in an oil station?**
Two surge tanks provide for higher capacity and stability to the liquid.
Each surge tank can be taken for maintenance separately.

**3. What is the height of a surge tank in an oil station?**

Each tank is 9.15 Mts. (30 feet) in height, having a capacity (volume) of 1680 BBL/267 M3 (refer to the station drawings for the exact parameters)

**4. Write the formula for calculating the surge tank oil level in kpa?**

Liquid head in kpa =pgh

p= Density of the liquid
g= Gravity
h=Height of the liquid column

**5. What is 'blanketing gas? What does it do?**

'Blanketing gas' is a gas phase maintained above the oils surface. The blanketing gas restricts atmospheric air entering inside the tank, preventing an explosive gas mixture in the tank.

**6. What is a normal surge rank blanketing gas pressure?**

Blanketing gas is maintained at 0.5 – 1.0 kpa pressure (refer to the station drawings for the exact parameters) through a regulator above the liquid surface.

**7. What is a "dehydration tank"? Give an example?**

Dehydration tank is a settling tank, specifically used for separating water from the crude oil. For example: the big storage tanks used in the main pumping stations at Fahud, Qarn Alam, Yibal…etc.

**8. What is 'skimming' in a Dehydration Tank operating process?**

It is a process for recovering oil from dehydration water.

**9.Why and what sort of instrumentation is provided on skimming line?**

Generally a capacitance probe is installed to detect the water in the oil line.

**10. What is the difference between an atmospheric flare, low pressure flare and a high pressure flare? Give some examples.**

**Atmospheric flare:** the flare used to went very low pressure gas to atmosphere. For example: the flare line from a surge tank top.

**Low pressure flare**: the medium pressure flare, generally used for the process line. For example: station back pressure to flare.

**High pressure flare**: the flare used for flaring the spill over gas from the HP (high pressure) grid to flare.

**Pump**

**1. Write the manual operating sequence of a pump (start and stop).**

Start sequence:

- open the suction valve full
- Bleed the pump casing to ensure that there is no trapped gas/air.
- Open the discharge valve partially.
- Initiate a start to the electrical motor.
- Open the discharge valve fully.

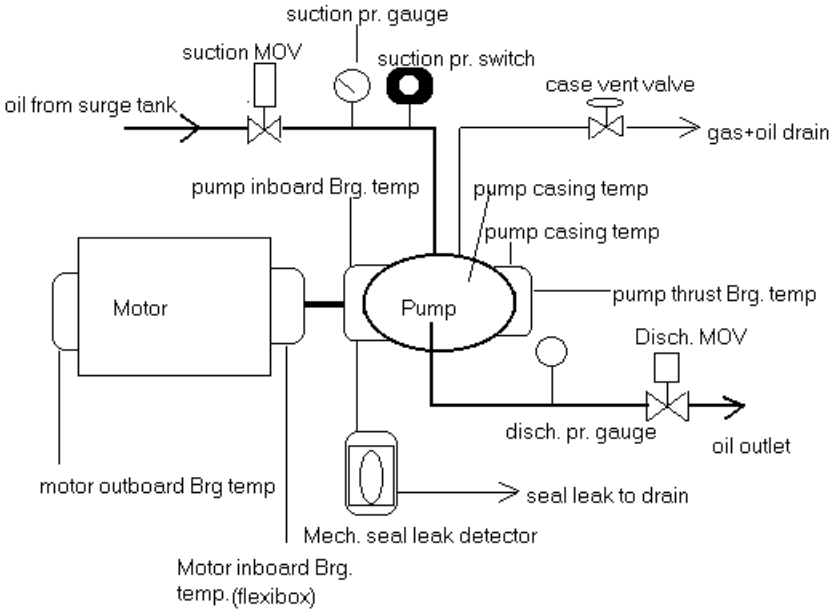
Stop sequence:

- Initiate a stop to the electrical motor.
- Close the discharge valve fully.
- Close the suction valve fully.

**1. What is a 'line break protection' system?**

In is to prevent a process line break due to extra high pressure.
For example: the high pressure switch on the station oil discharge line.

**2. Draw a small sketch of a pump, showing the in-board, out-boards and thrust bearing locations.**




A typical example of a pump P&I detector

**3. What is 'cavitations' in pump operation? What are the symptoms of capitation in a pump?**

Cavitations are an abnormal operating situation where the pressure of the liquid is reduced below its vapor pressure, gas will breakout. If the pressure is recovered above the vapor pressure, the gas bubbles will implode again. This process is called 'cavitations'. It can cause serious damage to the pump. If a pump is having cavitations problems the following abnormalities are noticed.

- low or no discharge pressure
- low or no discharge flow
- abnormal sound (gravel flowing sound)
- high casing temperature
- …Etc.

***P.S: cavitation can also occur in control valves***.

**4. What may happen to a pump if it is operating at a high discharge pressure?**

If a pump is operating on a high discharge pressure the following may happen:

- Pump seal may leak.

- Shutdown on high casing temperature.
- …etc.

**5. Explain the techniques (methods) of controlling a tank level through a motor driven pump.**

Tank level can be controlled by the following two methods:

**Control loop with a level control valve:**
A normal motor driven pump and a level control loop on the tank with a lavel control valve in the discharge line can control the tank level. Level control loop measured and controls the tank level by closing or opening the pump discharge line level control valve. Here the pump rotates at a constant speed.

**Control loop with a turbine/motor speed control:**
Either with a gas turbine or a variable speed motor, a pump can control the tank level. Tank level controller output may be fed to the gas turbine or motor to vary its speed to maintain the tank level. (Note: in this loop there is no level control valve).

**6. List the shutdown protection system generally installed on a pump.**

Generally, the following alarm and shutdown protection are provided on a pump:

**Low suction pressure:**

- Pressure switch is set at 3.5kpa ↓ (Refer to the station drawings for the exact setting parameters), continuously monitoring the pump suction pressure. Normal suction pressure to the pump is from the surge tank's static head of around 36kpa.
- In case the pump gets a low suction pressure below 3.5kpa, the switch initiates only:

- 'Low suction pressure' alarm on the control panel.

- If the alarm condition exists for 10sec. Then the logic initiates:

- 'Low suction pressure' alarm on the control panel.
- The pump shutdown (10sec delayed shutdown).
- Pump shutdown status is sent to SCADA.

**Pump bearing high temperature:**

- "j" type (iron constantan/iron) thermo-couples on the pump inboard and outboard bearing, continuously record and monitor the bearing temperatures.
- In case the bearing temperature exceeds $96^0$c (Refer tot the drawings for the exact setting parameters),then the logic initiates:

- 'High pump bearing temperature' alarm on the control panel.
- The pump shuts down.
- Pump shutdown status is sent to SCADA.

**Pump casing high temperature:**

- "j" type (iron constantan/iron) thermocouple on the pump casing continuously records and monitors the casing temperature.
- In case the casing temperature exceeds $80^0$c (Refer to the station drawings for the station drawings for the exact setting parameters), then the logic initiates:

- 'High pump casing temperature' alarm on the control panel.
- The pump shutdown.
- Pump shutdown status is sent to SCADA.

**Mechanical seal leak:**

- An on-line mechanical seal pot (a float chamber) in the seal drain continuously measures any leak above the set limit (through the drain restriction). In case of the leak, the switch initiates:

- 'High seal leak' alarm on the control panel.
- The pump shutdown.
- Pump shutdown status is sent to SCADA.

**Motor bearing temperature:**

- "j" type (iron constantan/iron) thermocouples on the motor inboard and outboard bearing, continuously record and monitor the bearing temperatures.
- In case the bearing temperature exceeds $90^0$c (refer to the station drawings for the exact setting parameters), then the logic initiates:

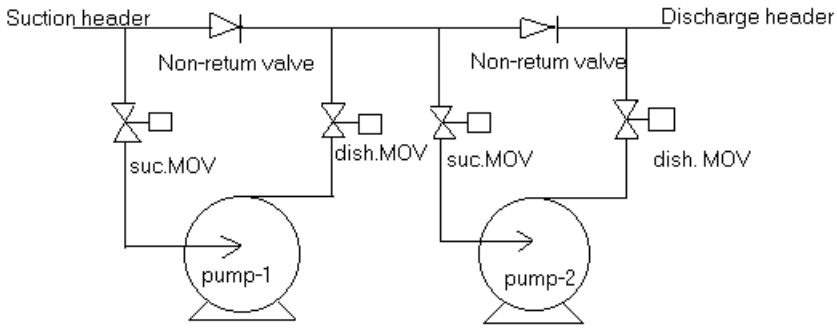
- High motor bearing temperature' alarm on the control panel.
- The pump shutdown.
- Pump shutdown status is sent to SCADA.

**7. At what % of the discharge MOV opening does the main motor start and why?**

The main motor starts at 10% opening of the discharge MOV (refer to the station drawings for the exact setting parameter). This is to prevent the main motor tripping on overload.

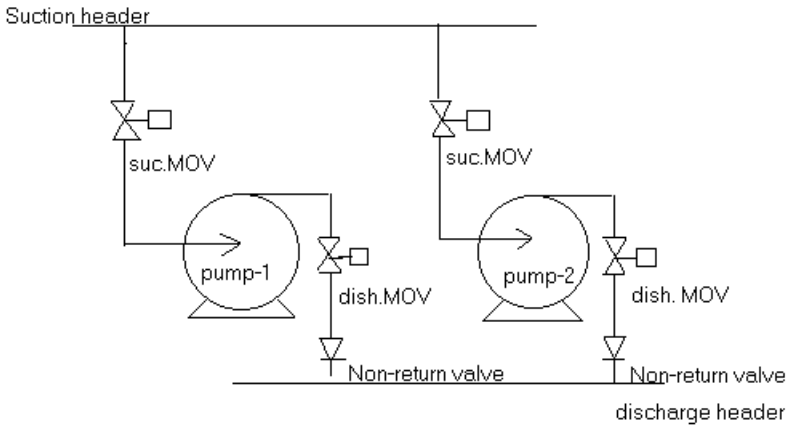
**8. What is 'series' and 'parallel' pumps? Draw a small sketch of the both types of pump installations.**

**Series pumps:** while both pumps are running, one pump discharges goes to the suction of the other pump.



A typical example of pumps in series

**Parallel pumps**: while both pumps are running, both pumps discharge the liquid to a common header.



A typical example of pumps in parallel

**9. Explain the advantages/purpose of series and parallel pumps.**

**Series pumps**: pumps in series can discharge the liquid at higher pressure.
**Parallel pumps**: pumps in parallel can discharge more volume of liquid.

**10. What care has to be taken while starting a series pump?**

To avoid seal failure due to high suction pressure, first start the second pump in series prior to starting the first pump.

**11. What is the purpose of a pump discharge ‘high pressure switch’?**

Pump discharge ‘high pressure switch’ works as a line break protection switch. It shutdown the pump at a set high pressure, thus preventing the line break.

## Gas lift

**1. What is gaslight flow? What does it to?**

- It is a process for lifting the oil from an oil-well by injecting a known quantity of high pressure gas.
- The rate of gas lift flow (injection) is determined by the production programmer based upon the well-test result.

**2. What is 'line break detection' system?**

Line break detection system is to detect a process line break.
For example: the low pressure switch on the gas lift manifold.

**3. What does individual gas lift pressure represent?**

Individual gas lift pressure represents the amount of pressure required to lift the liquid column in the oil well.

**4. Why is there a pressure switch downstream of the control valve in gas lift?**

The pressure switch works as a line break detector. If the gas lift line breaks the process pressure drops downstream of the control valve and the pressure switch shutdown (closes) the control valve. There is no alarm facility for this detection system.

**5. Wht will happen to the gas lift flow, when an oil will quits?**

If the oil well quits, the gas lift flow becomes zero.

**6. What will happen to the gas lift pressure, when an oil well quits?**

If the oil well quits, the gas lift pressure saturates the upstream pressure.

**7. Why is the gas lift flow rate (flow set point) different for every oil well?**

The gas lift flow set point is set to derive the maximum oil output to the minimum gas out. Also the gas lift flow set point depends on the oil well depth, process line size and chokes valve back pressure.

**8. Why is there no gas lift flow for some oil wells?**

Self flowing wells do not require gas lift.

**9. Why are there so many gas lift selector switches on the selector box?**

Each gas lift selector switch is meant for one particular gas lift. Gas lift selector box will have switches for as many number of gas lifts in the field.

**10. What will happen to the gas lift connected to a particular separator when the separator inlet ESDV closes?**

When the separator inlet ESDV closes, all those gas lifts selected on the gas lift selector box will shutdown (by closing the gas lift control valve through a solenoid valve).

## Station in general

**1. How is the station back pressure controlled in sequence through gas turbines, blower and station back pressure valve? Draw a simple sketch and explain.**

**Function**

- A method of controlling the LP and HP gas in an oil gathering station.
- It also works as part of the gas optimization program, by minimizing the gas to flare.
- This control system came into force after the installation of 'Foxtrot' gas compression station and the blowers in feud oil gathering stations.
- The control system is incorporated in Feud 'b' 'c' 'd' and 'e' gathering stations.

**Operation**

A master suction pressure set point is derived to the Blowers, Solar gas compressors and the station recycle valve by a reduction of 3kpa respectively.

For example:

Master suction pressure set point set at 150kpa, goes to the following:

- blower suction pressure controller as 150kpa
- solar suction pressure controller as 147kpa
- station recycle controller as 143kpa

**What happens in this condition is:**

**Low suction header pressure**

- Since the Blower's suction pressure set point is the highest, the blower effectively closes the IGV to bring up the suction pressure by reducing the export to 'f' station.
- Further if the suction back pressure goes down, the solar turbine whose suction pressure set point is next in the order, lowers its speed to bring up the suction pressure.
- As a last control, the station recycle valve opens to maintain 143kpa in the suction header by delivering the gas compressor discharge to the common suction header.
- The condition may occur due to a separator shutdown, low gas pro9duction, oil wells quitting, gas lift failure.

**High Blower discharge pressure**

- The Blower discharge pressure controller output overrides its suction pressure controller output and closes it s IGV to bring down the high discharge header pressure.
- The condition resets automatically when the discharge pressure becomes normal.
- This control system is to prevent any Blower discharge line breakage.
- The condition may occur due to any Ruston turbine shutdown or turbine low speed in 'f' station.

**High solar compressor discharge pressure**

- The solar discharge pressure controller output overrides its suction pressure controller output and the turbine speed is brought down to a maximum of its minimum discharge flow (just above its individual recycle valve opening).
- The condition resets automatically when the discharge pressure becomes normal.
- This control system is to prevent any gas compressor discharge line breakage.
- The condition may occur due to a gas injection well quitting, many gas lift injection has closed or HP grid header pressure going high.

**Low Low suction header pressure at 143kpa**

- The station recycle valve opens and puts the gas compressor discharge into the suction header.
- This is to prevent the Solar and Blower from a low suction shutdown.

- On a vailability of the suction gas pressure, the solar turbine will speed-up and the Demag Blower's IGV will open full.
- The condition may occur due to two or more separators having shutdown in the station.

**3. Why is there an 'oil saver pit' at an oil station?**

Oil saver pit collects all the low pressure liquid that drains from the separators, scrubbers, tanks…etc.

**4. To which point does the 'saver pit' pump discharge the oil?**

Oil save pit pump discharges the oil to the suction of the station transfer pumps.

**5. To which point are the compressor's high pressure scrubbers drained?**

Gas compressor high pressure scrubber drains are connected to the separator's inlet header.

**6. What is a 'cyclone separator'? What is the difference between an ordinary scrubber and a cyclone separator?**

During its operation as the name says, the 'cyclone separator' makes a cyclone noise. In a cyclone separator, the process gas enters the separator at a tangential angle. In other scrubbers the process gas enters at the center of the center of the vessel.

**7. What is an 'oil manifold'? What is the advantage of an oil manifold?**

- A junction where all the oil wells join together to a specific main header.
- It is used for diverting a well to the required separator.
- A choke may be in line with the manifold to maintain the well back pressure.
- It also helps in balancing the load among the separators.

**AWARENESS IN GENERAL**

**1. What are the following gases:**

**a) Rich gas b) lean gas c) sour gas**

**Rich gas**: A gas containing condensate or wet gas. A gas from a gas well or an oil well.

**Lean gas**: A dry gas produced through an NGL or gas plant. A gas without condensate.

**Sour gas:** A gas containing/contaminated with H2S. Special care has to be taken while handling this gas. It is corrosive and health hazardous. Stations handling sour gas are generally designated as $H_2S$ areas.

**2. Where are the following items:**

**a) Propane b) glycol c) shell sol d) lube oil e) chemical injection**

**Propane:** propane is a hydrocarbon, in the liquid form it is used I a chillier (heat exchanger) to cool a gas.

**Glycol:** It is a hygroscopic chemical used for absorbing water from a process fluid. Glycol is regenerated (water is removed) by heating in a heater up to 100 Deg C and circulated back to the process operation.

**Shell sol:** A chemical used for cleaning rusty parts. Hand gloves have to be worn for the safe handling of shell sol.

**Lube oil:** oil exclusively used for lubricating and cooling a bearing, shafts…etc. The grade and quality of lube oil depends on the equipment operation and speed.

**Chemical Injection**: A process of injecting and chemical into a process to achieve a certain process requirement.

**3. What are the following:**

**a) Oil well b) gas well c) gas injection well d) water well**
**e) Water injection well**
**Oil well:** A well which produces crude oil and gas.
**Gas well:** A well which produces only gas.
**Gas injection well**: An abandoned or specifically drilled dry well, used for injecting the excess gas produced in an oil gathering station.
**Water well:** A water supply well used for la feed to an RO plant or for injecting into a water injection well.
**Water injection well:** An abandoned oil well or a well specifically drilled for injecting the water produced in an oil gathering station.

**4. What is the function of the following:**

**a) Oil rig b) work-over rig c) seismic survey d) water rig**

**Oil rig**: A unit used for drilling an oil or gas well.
**Work over rig**: A rig used specifically for working on an existing oil or gas well.
**Seismic survey:** A team searching and estimation of oil and gas reserves.
**Water rig:** A rig used for drilling a water supply well.

**5. What are these stations?**

**a) Oil station b)gas station c)booster station d)NGL e)R.O. plant**

**a) Main pumping station l) fire water pumping station**

**Oil station:** a station for collecting (gathering) the crude oil from an oil field. The process may involve the separation of oil and gas, compression of the gas, re-injection of the gas to oil wells, storage and export of the crude oil to the main tank form.

**Gas station**: a station purely used for handling gas. The process may involve the removal of sulfur, water, NGL…etc. the inlet gas to the station is a rich gas (wet gas) and the outlet is a lean gas (dry gas).

**Booster station**: an intermediate station used to boost the flow rate when the receiving station is far away from the main pumping location.

**NGL**: a process plant for liquefying the natural gas by compressing and cooling the gas. The plant receives rich gas for compression and cooling to remove the LPG (liquid petroleum gas). The gas discharge from the plant is a lean gas (dry gas)

**R.O.Plant**: reverse Osmosis Plant. A plant that provides good quality drinking water with a balanced pH and free of micro-organism and salt.

**Water Injection Plant**: a plant exclusively used for pumping dehydrated water into the water injection wells.

**NOCS**: crude oil stabilization plant. The plant process in removing the dissolved gas from crude oil before exporting the oil for shipment.

**Main oil pumping station:** a station where the oil gathered from all the stations is pumped prior to being sent to MAF.
**Fire water-pumping station:** a station exclusively used for providing the firewater to the fire hydration system using electrical and emergency back-up diesel pumps.

**6. Explain the meaning of the following words:**

**a) Flash point b) ignition point**

Flash point: the temperature at which a petroleum product ignites momentarily (without a spark), but does not burn continuously

Ignition point: the temperature at which a petroleum product ignites in presence of air.

**7. What is a double block &bleed system?**

A double block and bleed valve is a safe practice for isolating and de-pressurizing a process line. In this process the upstream and downstream of

the process line is isolated to ensure total blocking of the process, and the process is bled to where the work is to be carried out.

**8. What are the advantages of DCS over the SPEC-200 control system?**

DCS stands for distributed control system. There are many advantages of DCS over the SPEC200 system, which is almost outdated. The following are some of the advantages of the DCS system.

- Number of instruments on the control panel is minimized to a VDU (visual display unit).
- A graphical interface of the station P&I on the VDU.
- Time trend of the process parameter can be seen read and recorded.
- Remote control operation facility.
- Fast operation and minimum.
- Control parameters settings can be easily changed.
- Controller tuning can be easily adjusted.
- The P&I loop can be easily modified.
- Long duration of history can be logged and recalled.
- A maximum number of control loops can be operated.

**Proportional + integral:**

In this case, an extra bellows with variable restriction is added to the system. Suppose input pressure shows a sudden increase. This drives the flapper towards the nozzle, increasing output pressure until the prop. Bellows balances the input as in the previous case. The integral bellows is shill at the original output pressure because the restriction prevents. Pressure changes from being transmitted immediately. As the increased pressure on the output bleeds through the restriction. The integral bellows slowly moves the flapper closer to the nozzle. There by closing a steady increase in output pressure (as dictated by the integral mode) the variable restriction allows for variation of the leakage rate and hence the integration time.

**Proportional + derivative:**

In this case a variable restriction is placed on the line leading to the balance bellows, thus as the input pressure increases, the flapper is moved towards the nozzle with no impedance because the restrictions prevent an immediate

response of the balance bellows. Thus the output pressure rises very fast and then, as the increased pressure leaks in to the balance bellows, decreased as the balances bellows moves the flapper beak away from the nozzle adjustment of the variable restriction allows for changing the derivative time constraint.