USER MANUAL

Project : High Pressure Air Station

Dear User,

Neometrix is grateful for this opportunity provided to us to offer our products & services to you. We sincerely hope that you will be delighted to use our system and give us more opportunities to serve you.

Neometrix is very focused on Aviation and Railway industries and offers complete range of systems & services which can be of immense use to you. We specialize in Hydraulic/ Servo Hydraulic Test Rigs, Fuel System Test Rigs, Pneumatic System Test Rigs, Oxygen/ Special Gases system Test Rigs, Very High Pressure Systems, Electronic & Electrical Test Rigs. Our services include among others, the followings:

- State of the art Test Rig Design, Development, Fabrication, Installation, Commissioning, Training & Support.
- Refurbishment/ Up gradation of the Existing Test Rigs.
- Maintenance (AMC) contracts of Existing Test Rigs.
- Operations Contract for the Test Rigs.
- Setting up of complete Testing Infrastructure including civil infrastructure.

The following pages talk about some of our systems in brief. Please feel free to contact us for details of any particular system of your interest.

Neometrix is committed to offer its best solutions & services to you all the times and **wish to become your preferred supplier for these services**.
With Best Regards,

Shailendra Pratap Singh
CEO

Neometrix Defence Limited. E-148**, Sector-63, NOIDA- 201 301**
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Warnings:

1. Make sure that all electronic products are earth-grounded, to ensure Personal safety and proper operation.

2. All sensors are very sensitive; please never try to touch them.

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Table of Contents

Sr. No.	Description	Page No
1	Neometrix Engineering Introduction	4-7
2	Introduction of the System	8-10
3	System Specifications	11
4	Do's & Don'ts for the System	12
5	Working of the System	13
6	Hydraulic Testing-Manual	14-16
7	Hydraulic Testing-Auto	17-22
8	Pneumatic Testing	23
9	Pneumatic Testing-Manual	24-26
10	Pneumatic Testing-Auto	26-36
11	Cylinder Filling Operation	37
12	Purging Operation	38
13	DAS Control System	39
14	Safety Measure	40
15	Trouble Shooting	41
16	Component Description	42-60

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1- Neometrix Engineering INTRODUCTION:

Neometrix Engineering Pvt. Ltd. is a complete engineering solutions company based in New Delhi/ Noida.

We specialize in CUSTOM BUILT Turnkey Engineering Solutions.

We have expertise in various engineering domains like Hydraulics, Servo Hydraulics, ATF (Fuel), Mechanical, Pneumatic, Oxygen/ Helium (High Purity Gases), Electronics/ Electrical Test Benches, and Complete PC Based Automation Solutions.

We have experts in Mechanical Engineering, Chemical Engineering, Electrical/ Instrumentation Engineering, Software, Civil Engineering, Aeronautical engineering and other engineering fields.

The company has a team of ~30 highly qualified engineers and has an experience of more than 75 successfully delivered projects. We are very closely working with HAL, RDSO, Railways, Defense Establishments, Labs and Private Industries.

The founders are graduates from IIT Kanpur and the company remains very closely linked with IITs. We utilize the expertise available there as and when required.

We have an exclusive relationship with Parker USA **(**www.parker.com) for supplying Hydraulic Systems to HAL. Parker is world leader in Hydraulics (Fluid Motion & Control).

We have an exclusive relationship with Haskel USA **(**www.haskel.com) for supplying very high pressure systems. Haskel is world leader in very High Pressure products.

We are alliance partners of **National Instruments USA (**www.ni.com), world leader in PC Based Test Measurement and Automation.

With such alliances and our own engineering capabilities, we are in a position to deliver you state of the art world class Test Rig.

Neometrix is a member (as Industry Partner with ministry of HRD & Ministry of Railways) of TMRS (TECHNOLOGY MISSION FOR RAILWAY SAFETY) and we are working on several Railway Safety projects with IIT Kanpur & RDSO.

Neometrix values its association with HSL and wishes to become its most preferred partner for such services.

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2- Introduction of the System:

The system is designed to test the performance of the High Pressure Pipes and Fittings both hydraulically and pneumatically, respectively. These tested pipes and fittings are to be used in Submarines and Dredgers.

These Pipes and Fittings should be able to sustain high pressure under static loading. The system consists of two systems-

1- **Hydraulic Testing System**

2- **Pneumatic Testing System.**

The High Pressure Air Station works under following programs:-

(a). **Hydraulic Testing**:

Under this testing, Pipes of different dimensions are to be tested hydraulically with water for different stages of pressure which are as follows:

S.No.	Pressure Ranges	Time Duration
(i).	50 Bar	2 mins.
(ii).	100 Bar	2 mins.
(iii).	150 Bar	2 mins.
(iv).	200 Bar	2 mins.
(v).	250 Bar	2 mins.
(vi).	300 Bar	2 mins.
(vii).	400 Bar	2 mins.
(viii).	600 Bar	10 mins.

(b). **Pneumatic Testing:**

In this testing high pressure fittings are to be tested pneumatically with air under three different pressure programs, which are as follows:

First Program:

S.No.	Pressure Ranges	Time Duration
(i).	20 Bar	2 mins.
(ii).	100 Bar	2 mins.
(iii).	150 Bar	10 mins.

Second Program:

(i).	20 Bar	2 mins.
(ii).	100 Bar	2 mins.
(iii).	150 Bar	2 mins.
(iv).	200 Bar	10 mins.

Third Program:

(i).	20 Bar	2 mins.
(ii).	100 Bar	2 mins.
(iii).	150 Bar	2 mins.
(iv).	200 Bar	2 mins.
(v).	300 Bar	10 mins.
(vi).	400 Bar	10mins.

3- System Specifications

(a). Hydraulic Testing

Medium	Water
Pressure Ratings	50-600 Bar
Air supply Pressure Range	8-10 Bar
Flow Rate	40CFM
Temperature Range	25-45degree C

(b). Pneumatic Testing

Medium	Air
Pressure Ratings	20-400 Bar
Air Supply Pressure Range	400 Bar
Flow Rate	80 CFM
Temperature Range	25-45degree C

4- Do's & Don'ts for the System

Do's:

1. Read the User Manual fully before operating the System.
2. Before operating the system, please have a look on the circuit.
3. Check for the proper working of the components operation.
4. Check the Cylinder Pressure before Pneumatic Testing and Tank level before Hydraulic Testing.
5. Always open the Valve and Pressure Regulator Gradually.
6. Check for the Pressure readings of Nitrogen Bank before Purging.

Do Not:

1. Never try to adjust the Pressure Regulators setting.
2. Touch any circuitry inside the panel.
3. Never try to adjust Pressure Transmitter settings.
4. Enter the testing room during testing periods.

5- WORKING OF THE SYSTEM

The System consists of two totally different systems for **Hydraulic (600Bar)** and **Pneumatic (400Bar)** testing.

The System is consisting dual working mode i.e. Automatic and Manual.

In Automatic mode the Test will be perform according to the predefined sequence automatically as per the testing Procedure and also with an option for a particular test according to the requirement in an Manual Mode of Testing with Control Panel.

In manual mode the test will be done with Toggles Switch and Potentiometer on the Panels.

Mode Selection- The mode selection can be done with the Mode Selector Provided on Reduction Chest Panel with an option-

1-Automatic Mode.
2-Manual Mode.

(1). **Hydraulic Testing:-**

Select the Manual Mode from the Selector Switch. System working under manual mode will be indicated by green light on the Reduction Chest Panel in Testing Room. This is done so that there is no miscommunication between the operator in the Panel room and the man in Testing Room.

Please don't change any setting of Relief valve / Air Pilot Switch.

(A) Hydraulic Testing- Manual Mode:

Operational Steps:

(A) Prefilling Operation:

1. Firstly select the Manual Mode from the selector switch.

2. Bring the pipes to be tested in the testing room and place them gently over the pipe test bed with the help of Mono beam Crane.

3. Now connect these pipes with the hoses, open the Prefilling Valve and Pressure Supply Port Valve in which Pipe is connected.

4. Before opening the water supply check the water level in the tank to ensure that no air will be sucked by the pump. The water level should be above suction valve. Do read water level with the help of level indicator (2.0).

5. Start the prefilling pump (13.0) from the Toggle Switch provided on JB-2 wait till the water spell out from the other end for few minutes so that all the air trapped inside the Pipe is removed.

6. Now do hand tightening of the Dummy, stop the Pump and close the Prefilling supply valve. Then go for the full tighten as per required for the testing Pressure.

7. Ensure that Supply Port (16.1, 16.2, and 16.3) in which Pipe is connected is Open otherwise close.

8. Keep Vent Valve (15.0) switch at OFF position.

9. Change the selector switch to Auto Mode.

10. Close the Door.

(B) <u>Pressurization Operation:</u>

1. Take the air pressure reading from the Air Line pressure gauge (18.2).Ensure that the supply should be above 7 Bar.

2. Open the Supply valve (16.5) to Hydraulic Pressure Regulator and Drive Air Supply valve (17.0).

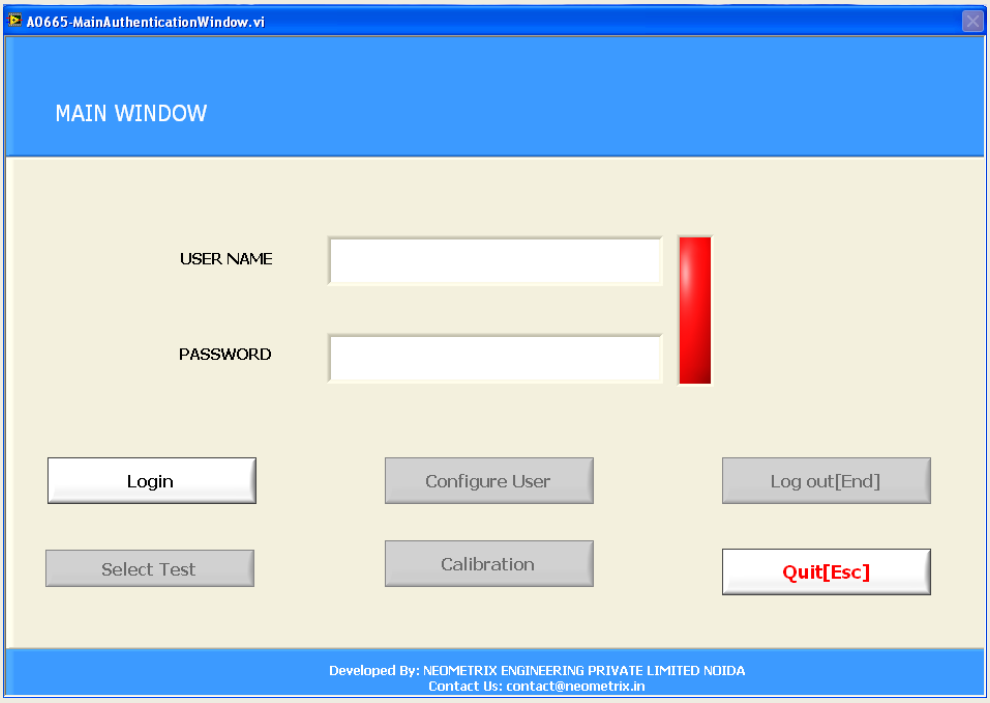
3. Now, Rotate Potentiometer (Drive Air controller) in Clockwise Direction very precisely as per the required Pressure. Since the Hydraulic Pump Nominal Ratio=110 so Increase drive air accordingly. Observe Drive air pressure in Regulated Pressure Gauge (18.1).

4. Regulate the Compressed air supply with the help of Potentiometer (Drive Air controller) according to the required pressure and observe the regulated pressure on pressure gauge (18.1).

5. After obtaining required pressure lower down the Drive Air to Zero and after waiting for the time open the vent vale with the help of Toggle switch. (Activation for the switch should be done from the Hydraulic Panel by positioning Activation Toggle switch at Off Position.)

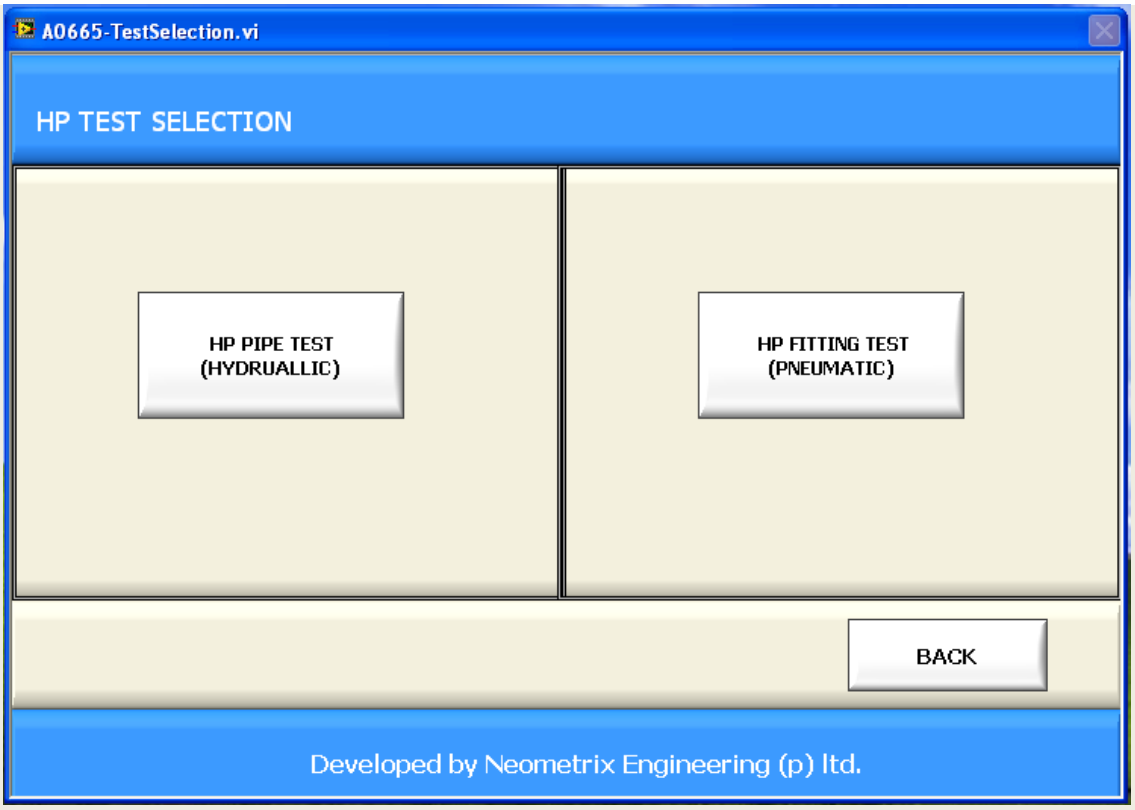
(B) Hydraulic Testing- Auto Mode: Connection and Prefilling operation will be same as done in Manual Mode.

Switch on the computer and open the HPA test File from the Desktop the Main Menu Window will appear as show below-



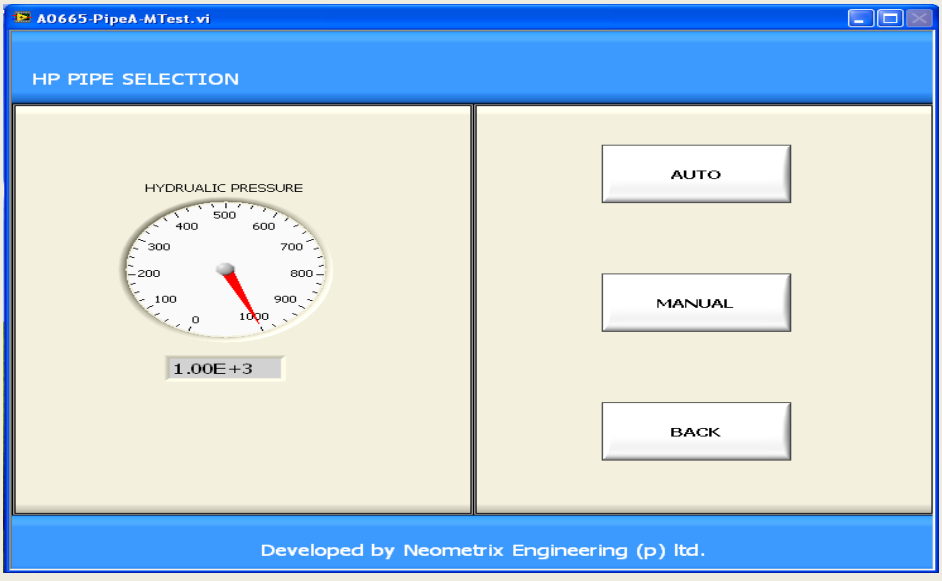
Username and Password- Enter Username and Password and click on Login icon to start test.

Select Test- To start Click Select Test.
After clicking the select icon the window will appear as shown -



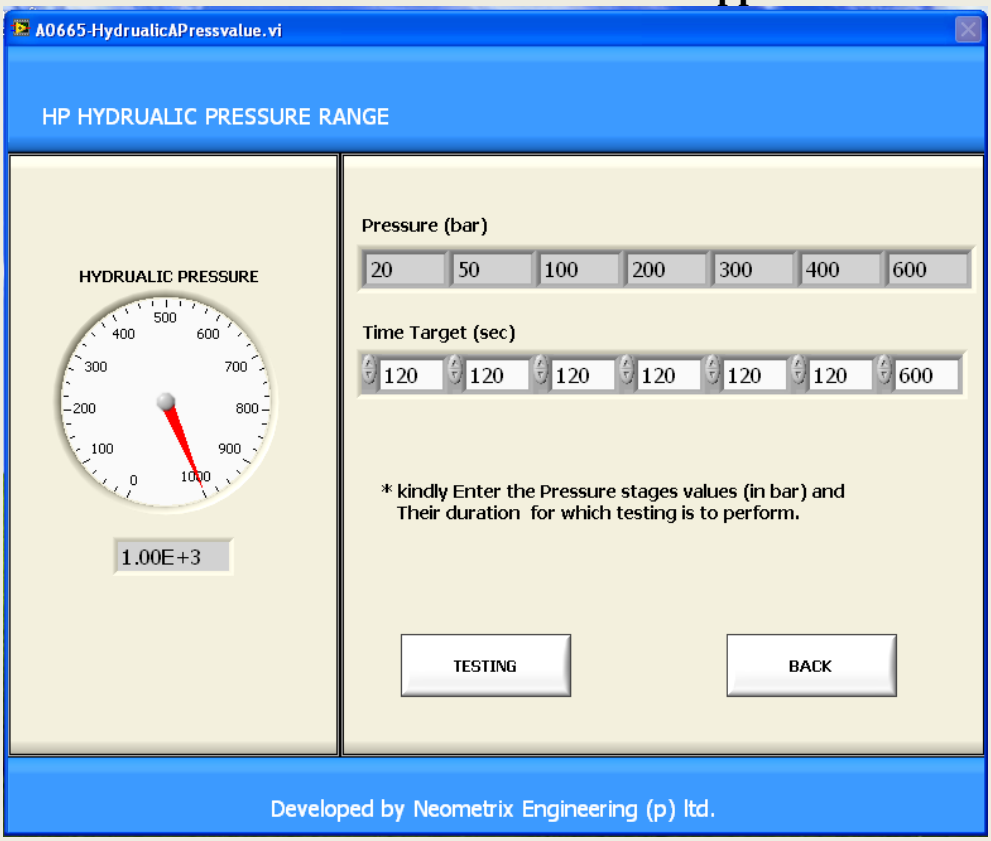
Now select the Type of Testing.

If Hydraulic testing the window will appear as shown



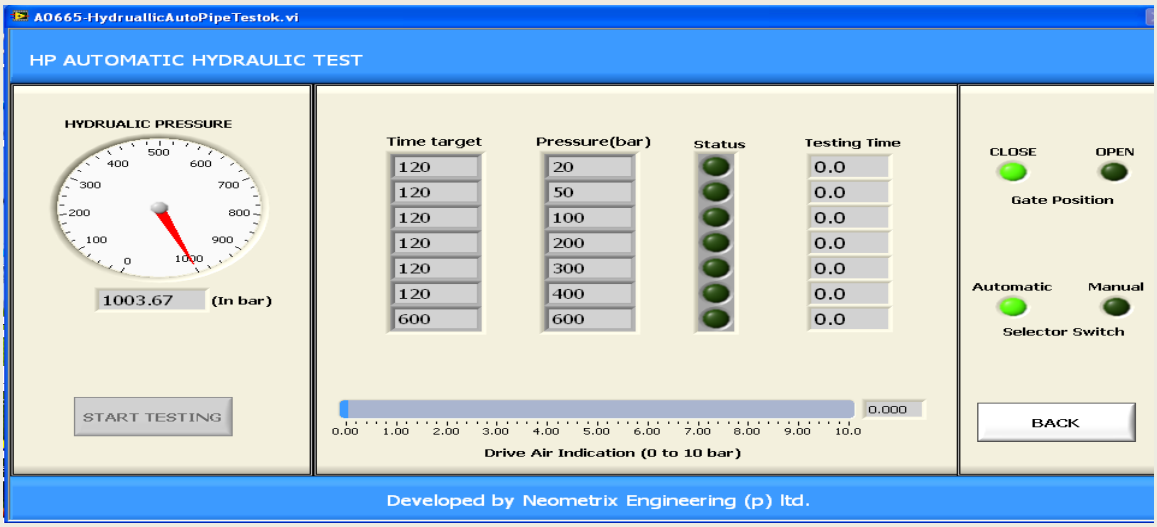
Now Select the Mode for Testing.

If Auto Window will be selected then it will appear as shown-



It has an option to change the Time for the Testing.
Click Testing after entering the required Testing Time.

During Testing the shown window will appear.



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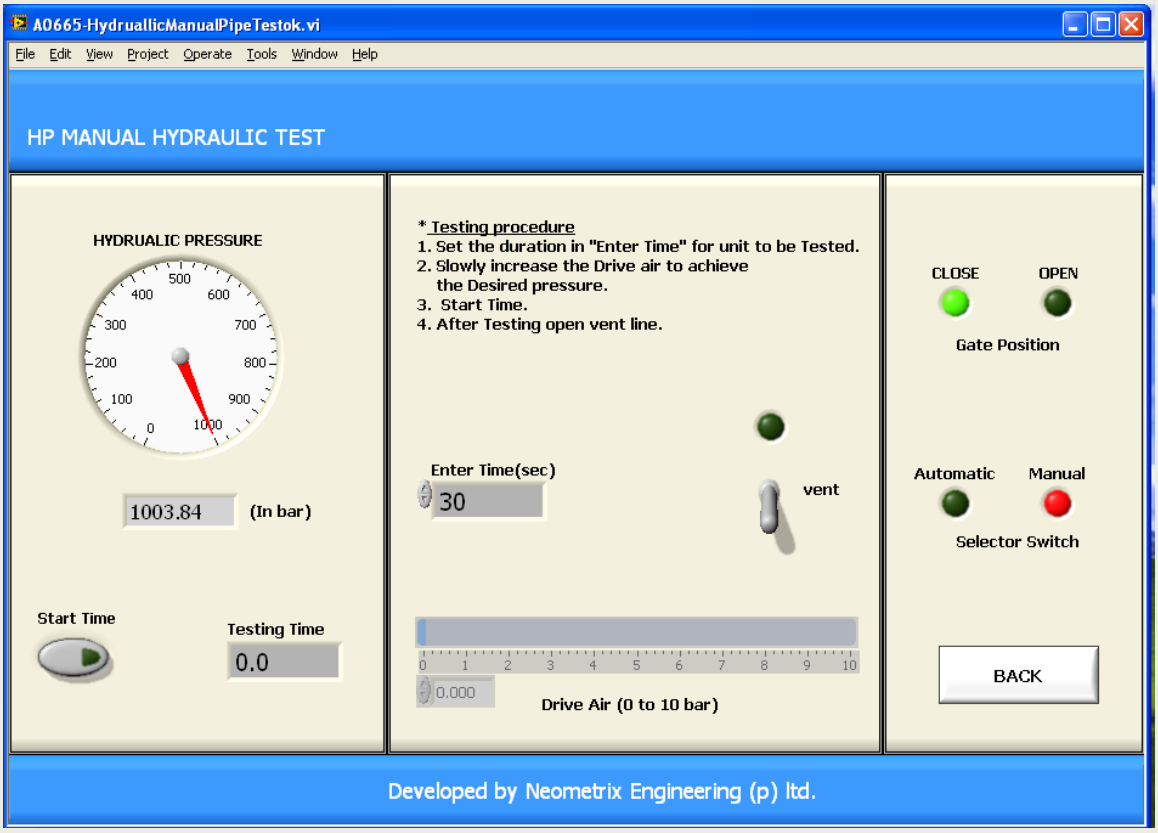
Click start Test. Once Test start it will complete it automatically.
If Manual Mode selected Window will appear as shows-



In this mode the test will done as per the sequence and step user followed.

(B). <u>Pneumatic Testing</u>:

Pneumatic Testing belongs to High Pressure Air Fittings. Pneumatic testing is to be done with air as working medium and at ambient temperature. Likewise Hydraulic testing of pipes pneumatic testing is to be done in a number of pressure stages ranging from 20 Bar to 400 Bar.

The fittings to be tested include Tees, Crosses, Adapters, Connectors and many more of different types and dimensions. These fittings after testing are to be used in Submarine piping.

The test procedure can be followed in two modes, namely;

(a) Manual Mode

(b) Auto Mode

(B)Pneumatic Testing- Manual Mode:

Installation Procedure:

1. Firstly bring the fittings to be tested to the Fitting Test Bench (31.0) and place it over flat surface.

2. Now assemble the hoses (33.1 & 33.2) at one end of the fitting, which is considered as pressure inlet port and hoses (33.3 & 33.4) at other end which is considered as outlet port.

3. Ensure that all the valves are in closed position.

4. After this check the HPA cylinder pressure available at the Cylinder banks placed at outer platform with the help of pressure gauges (8.2).

5. Select Manual mode from the selector switch.

Testing Operation:

1. Please ensure that all the valves on the Distribution Valve Chest and Reduction Valve Chest are closed.

2. Now keeping all other valves close, open ball valve (10.2 & 6.5) gradually.

3. An air at the pressure of 400 Bar will rush in to testing line up to Reduction Valve Chest.

4. On the Reduction Valve Chest Pressure Regulator (20.2) which is to be set at 400 Bar will allow air with a pressure of 400 Bar to go after.

5. The pressure of supply air to Reduction Chest is shown by Pressure Gauge (25.2).

6. Now we have to follow the first Program according to which we need to open ball valve (26.1) by positioning Toggle switch to Open Position.

7. In this line Pressure Regulator (16.0) is set at 20 bar which is shown by pressure gauge (21.0).Here this pressure is needed to be contained for 2 mins and then the ball valve (26.1) is closed and then next stage comes.

8. Similarly in the next stage ball Valve (26.2) is opened and testing is done at 100 Bar.

9. This process is repeated for every stage of each program.

10. There are three programs in this testing including:

    (a) Ist Program : 20 Bar, 100 Bar, 150 Bar
    (b) IInd Program : 20 Bar, 100 Bar, 150 Bar, 200 Bar
    (c) IIIrd Program: 20 Bar, 100 Bar, 150 Bar, 200 Bar, 300 Bar, 400 Bar.

11. These programs are to be followed as per the above procedure carefully and whole test procedure is observed through a Video TV Camera fitted in Testing Room, and receiving it in Panel Room.

(B)Pneumatic Testing-Auto Mode:

In this mode of operation the whole testing is to be controlled with the help of a DAS (Data Acquisition system) through a computer operated program. This program helps to control the proceedings of the testing operation from a remote.

Testing Operation:

1. Installation of UUT is same as in Manual system.
2. Position the selector Switch to Auto Position.
3. Once the installation is done, everyone should get out of the Testing Room and lock the protective rolling gate with the help of Gate Control panel.
4. An indicator on the computer screen will show whether Protective rolling gate is properly closed or not.
5. Once the installation is done, check on the computer screen that all the valves (Reduction Chest) are in closed positions.
6. Check the pressure of air in the air bank (29.0) with the help of pressure transmitter (9.1) reading on the computer screen. If it is 400 Bar, then testing can be started otherwise start the compressor.
7. Now open ball valve (6.5) and air under pressure is fed to the reduction valve chest in the testing room.
8. Air pressure at Reduction valve chest is shown by pressure transmitter (9.2) on the computer screen.

9. Now to start the Testing Procedure, firstly we have to select the program according to which testing will take place.

10. By selecting for first program i.e.

S.No.	Pressure Ranges	Time Duration
(i).	20 Bar	2 mins.
(ii).	100 Bar	2 mins.
(iii).	150 Bar	10 mins.

Testing will start automatically, by pressurizing UUT for 2 mins at intermediate stages and for 10 mins. at final stage.

This procedure will follow same for second and third program i.e.

(i).	20 Bar	2 mins.
(ii).	100 Bar	2 mins.
(iii).	150 Bar	2 mins.
(iv).	200 Bar	10 mins.

and,

(i).	20 Bar	2 mins.
(ii).	100 Bar	2 mins.
(iii).	150 Bar	2 mins.
(iv).	200 Bar	2 mins.
(v).	300 Bar	2 mins.
(vi).	400 Bar	10 mins.

11. The operator can select the Testing program randomly in any order he requires.

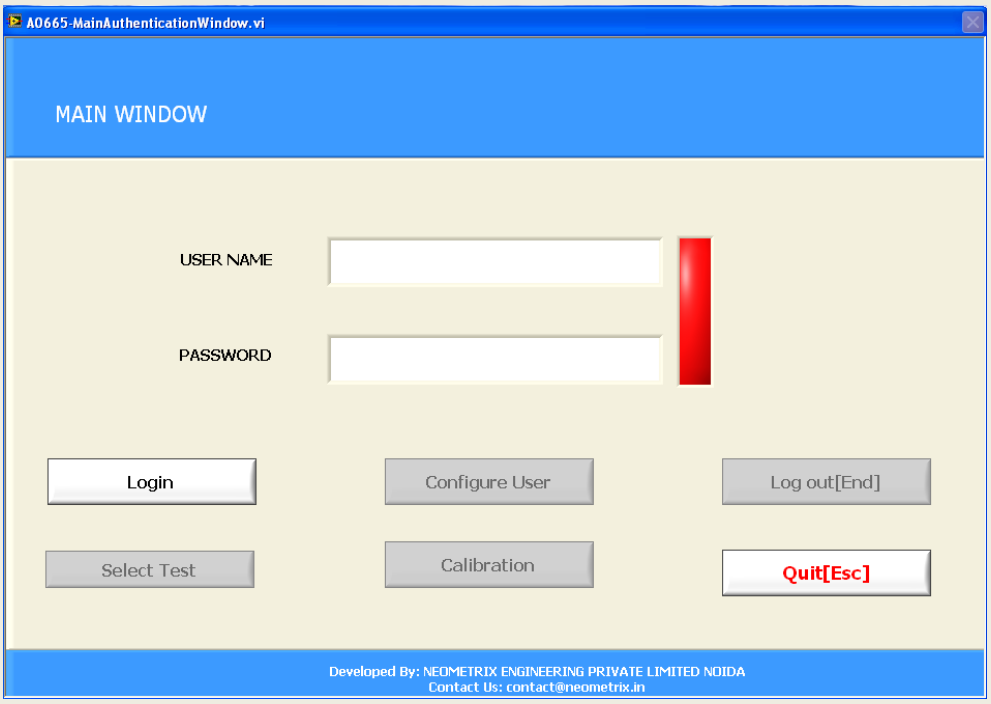
12. Testing pressure for each stage can be observed on the computer screen with the help of pressure transmitter (9.3).

13. After each testing Program the pressurized air is vented to the atmosphere via bleed silencer (13.2), to reduce the noise pollution.

Below are the related Software Screens for Pneumatic Testing of Fittings:

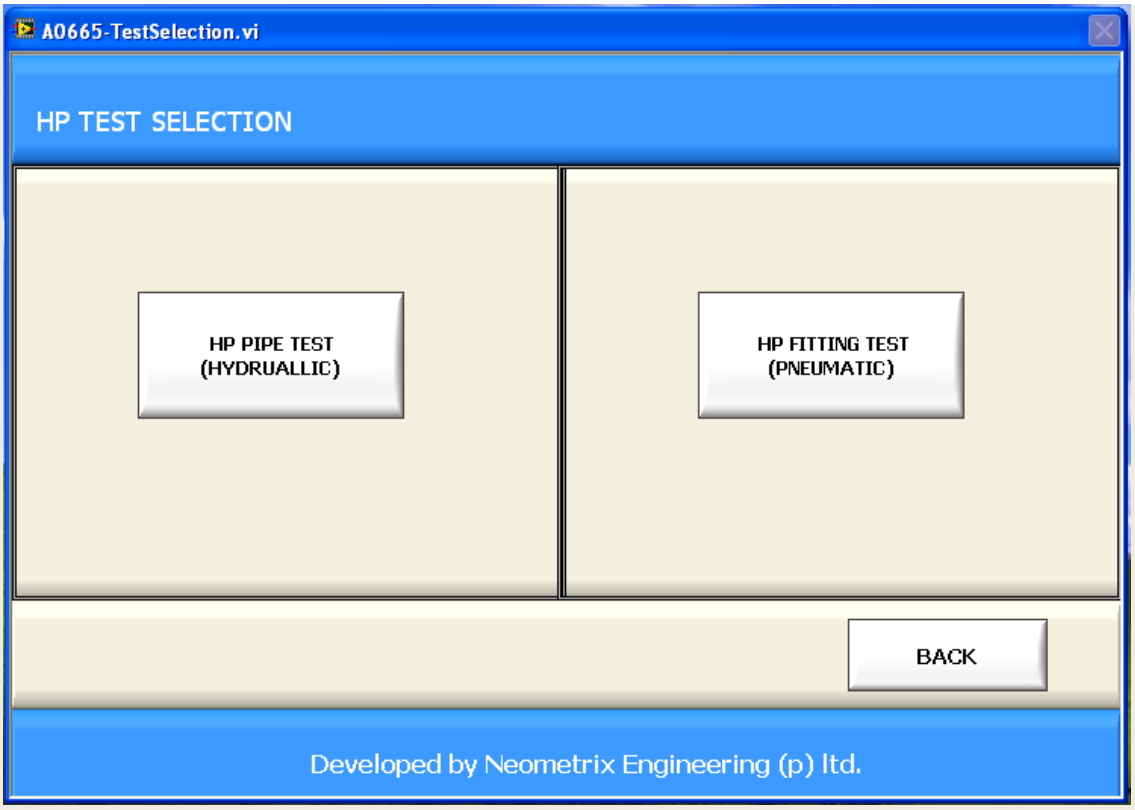
(a) Auto Mode-Connection operation will be same as done in Manual Mode.

Switch on the computer and open the HPA test File from the Desktop the Main Menu Window will appear as show below-



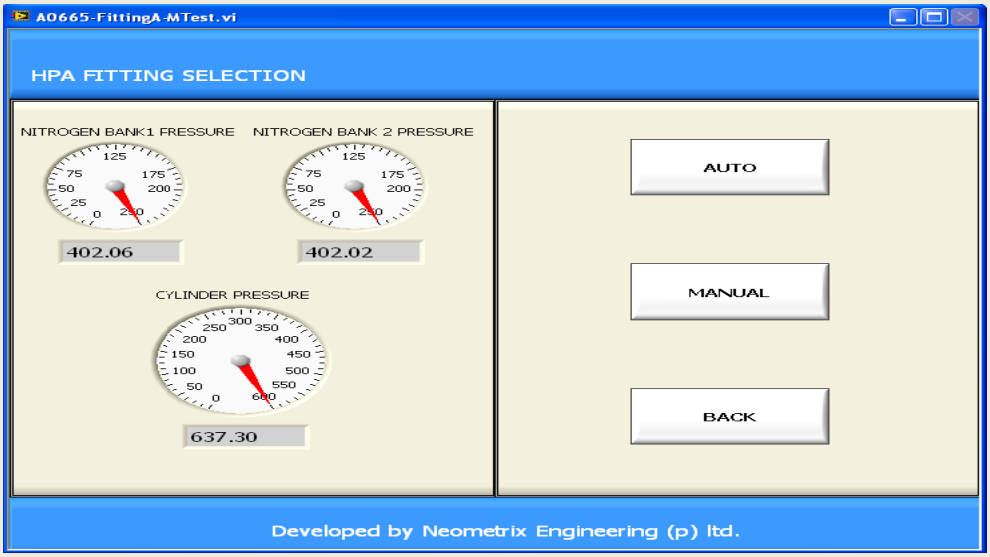
Username and Password- Enter Username and Password and click on Login icon to start test.

Select Test- To start Click Select Test
After clicking the select icon the window will appear as shown -



Now select the Type of Testing.

If Pneumatic testing is Selected the window will appear as shown



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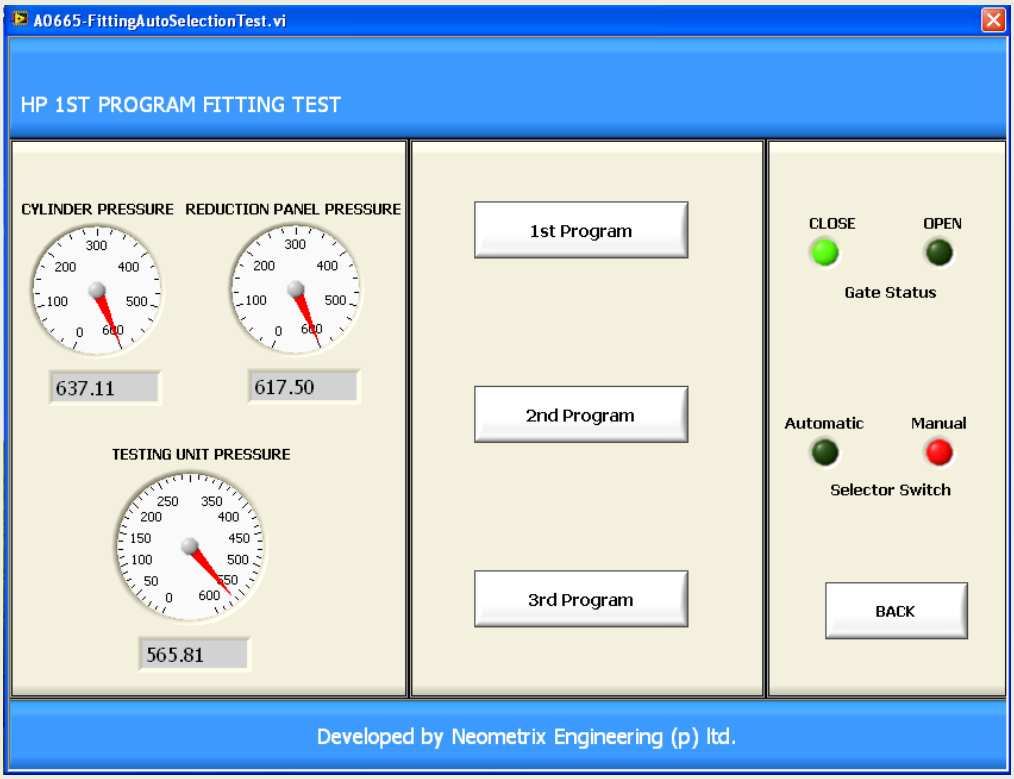
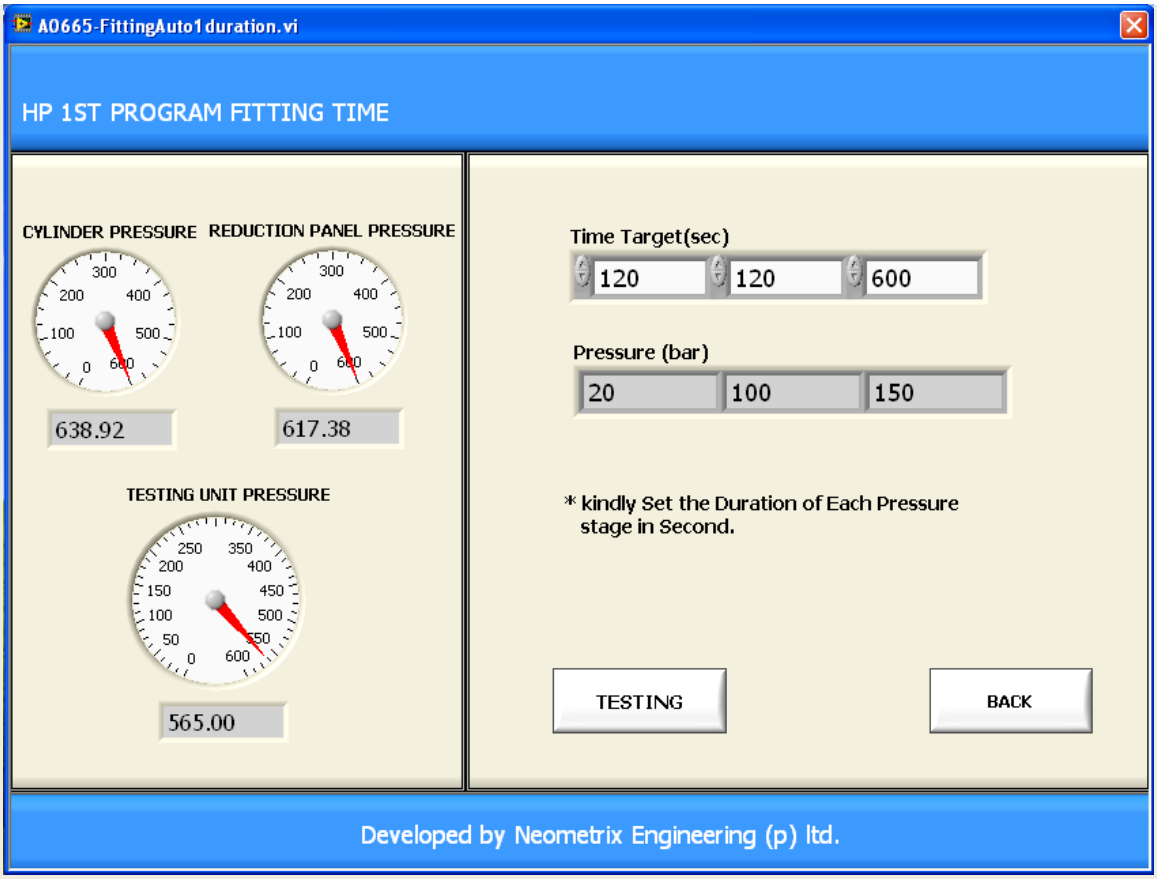
Now Select the Mode for Testing.

If Auto Window will be selected then it will appear as shown-



Select the Program as per the Requirement.

If the First Program will be selected then the Shown window will be appear.



Click Testing. Once Test start it will complete it automatically.

If Second Program is selected Window will appear as shows-

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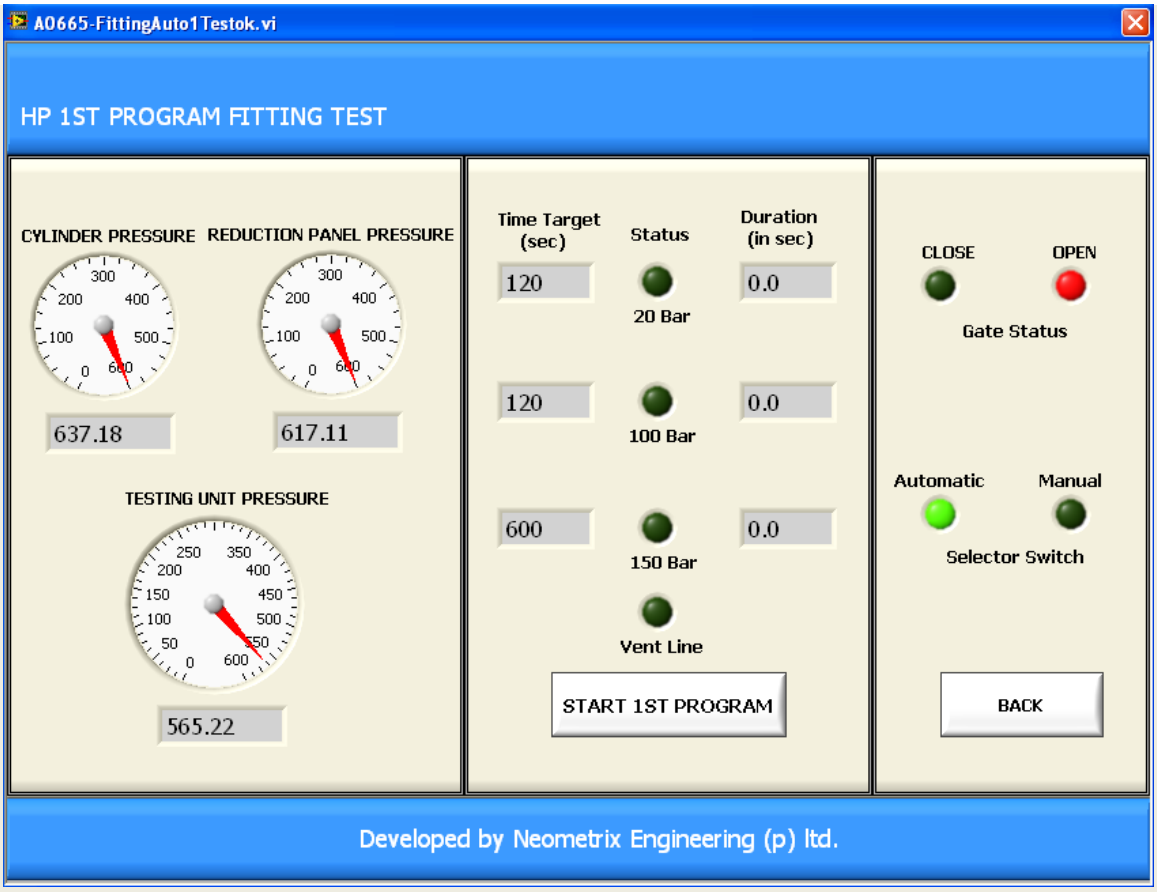

Click Testing. Once Test start it will complete it automatically.

If Third Program is selected Window will appear as shows-

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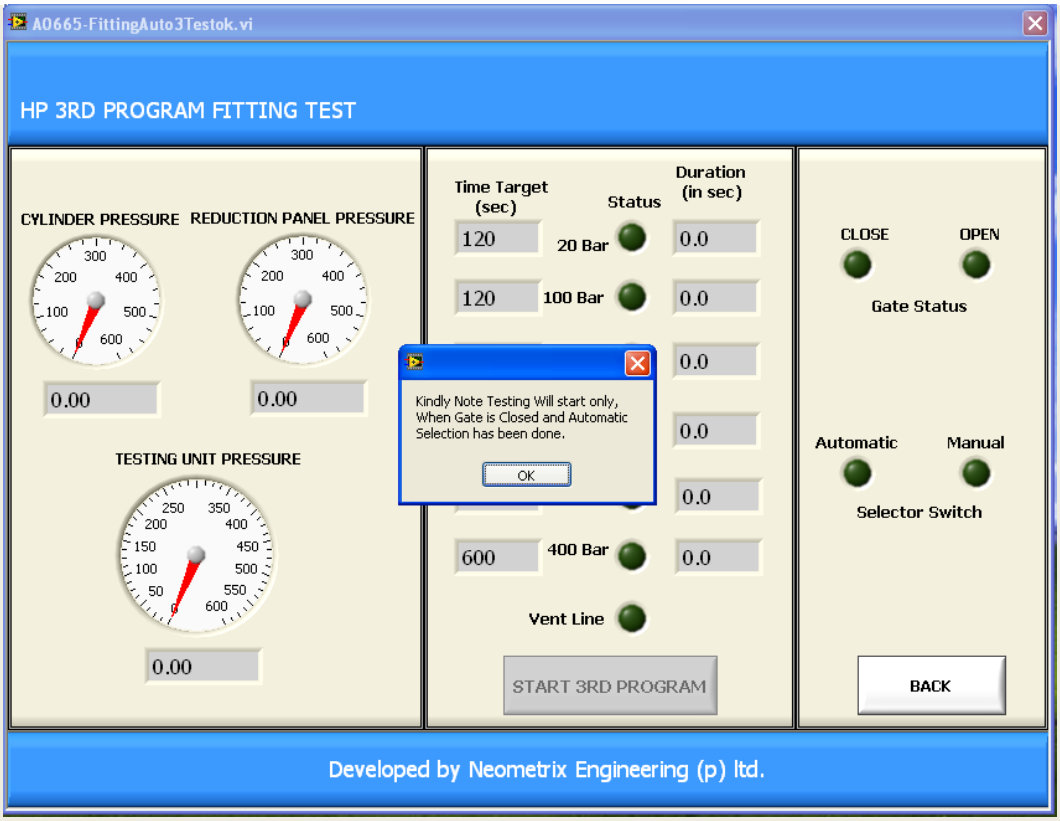


Click Testing. Once Test start it will complete it automatically

Cylinder Filling Operation:

1. First of all check whether all the Valves are in closed position or not.
2. Ensure all the valves on Distribution Valve Chest and Reduction Valve Chest are closed.
3. Now start the Compressor placed in Compressor Room.
4. Pressure Gauge (8.1) will show the pressure building up in the Compressor. And Pressure gauge (8.2) will show Cylinder Pressure.

5. Once the Cylinders are filled at 400 Bar the Compressor will automatically shut off.

6. Relief Valve (14.1 & 14.2) are set at 410 Bar for safety of the circuit against high pressure. These will maintain a pressure of 400 Bar in the line.

Purging Operation:

1. Purging is a method for priming and cleaning of the whole system tubings and components. Here Purging is done with nitrogen at 150 Bar from two of the nitrogen banks.

2. For this operation, first check ball valve (6.1 & 6.2) are in close position.

3. Also check the pressure of both the banks (1.1 & 1.2) on Distribution Valve Chest Panel placed in Panel Room with the help of pressure gauges (4.3 & 4.4) the pressure should be 150 Bar.

4. Now open ball valve either (6.3 or 6.4) depending upon line having higher pressure. Also ensure that ball valve (6.5) is kept close at this time of purging.

5. After few minutes of purging it is exhausted through electrically operated ball valve (26.7) in to the atmosphere via Vent Silencer (13.2) which reduces the noise level to a great extent thus saving environment from noise pollution.

6. Close the exhaust valve (26.7) and also ball valves (6.3 & 6.4)

NEOMETRIX

DAS Control System:

A data acquisition system is a device designed to measure and logs some parameters. The purpose of the data acquisition system is generally the analysis of the logged data and the improvement of the object of measurements.

The data acquisition system is normally electronics based, and it is made of hardware and software. The hardware part is made of sensors, cables and electronics components (among which memory is where information is stored). The software part is made of the data acquisition logic and the analysis software (and some other utilities that can be used to configure the logic or to move data from data acquisition memory to a laptop or to a mainframe computer). An example: Data logging, carried out by a data acquisition system (DAS), can be used to measure parameters such as temperature, pressure and humidity in high pressure systems ; the measurement data are then stored for analysis to improve accuracy and better control over the system parameters. Another example: a data acquisition system can be placed on a race car to measure RPM and vehicle speed to analyze car's behavior once it's back to pits and improve the car setup.

Safety Measures:

1. **Keep all the vent valves closed during air filling operation.**
2. **Do not disturb the settings of all the relief valves and pressure regulators without system engineer's consult.**
3. **Pneumatic Pump should not run idle during start of operation.**
4. **Vent valves should be opened slowly to avoid any accidental flush of high pressure helium gas.**
5. **Hoses should be properly fitted in the cylinders before filling them to avoid any accident or damage to the unit.**
6. **Make sure that inlet air supply pressure should not fluctuate.**
7. **Pressure settings of pressure regulator and relief valve should not be disturbed from pre-set values.**
8. **Ensure a free water supply in the water tank, so that water level does not fall below minimum.**
9. **Filters and strainers should be washed regularly to ensure their better performance.**
10. **High-Pressure Pump should not be run idle, as it would affect its working.**
11. **Do not open Ball valve () during testing.**

Trouble Shooting-

1- If software is not responding any Command-**Restart the Computer.**

2- If the Hydraulic Pressure is not Building then check the following thing-

1- Drive Air Supply Pressure (7-10Bar).

2- Drive Air Supply Valve-Open.

3-Prefilling Valve is closed.

4-Vent Valve should close.

5-Pressure Regulator may be set at Low Pressure- Increase It ranges.

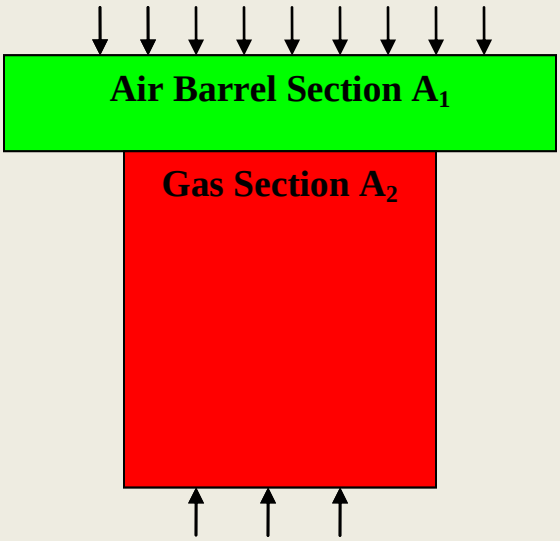
3-If the Pneumatic Pressure is continuously decreasing check the Vent Valve and **Close it.**

4-If any problem in the Pressure Transmitter supply check the Power supply.

Component Description:

(1) Pneumatic Pump:

Haskel a name which have revolutionized by introducing the Air Driven pumps have the capacity of producing the Pressure up to 7000 Bar from simple Air drive pressure of 7 Bar. Pump works on the Area / ratio Principle.



Diagrammatic Presentation depicting principle of Pneumatic Pump

Haskel Pneumatic Pump consists of a large area reciprocating air drive piston directly coupled by a connecting rod to a small area liquid section piston. The liquid section piston operates in a high- pressure liquid barrel section. Each liquid barrel end cap contains high pressure inlet and outlet check valves. The air drive section consists of a cyclic spool and pilot valves that provides continuous reciprocating action when air is supplied to the air drive inlet.

The ambient temperature of the air drive section is maintained at -4 to +65 degree C. Lower temperature will cause excessive air/gas leakage, higher temperatures reduce seal life.

The high pressure liquid barrel section has a temperature of around 115^0 C

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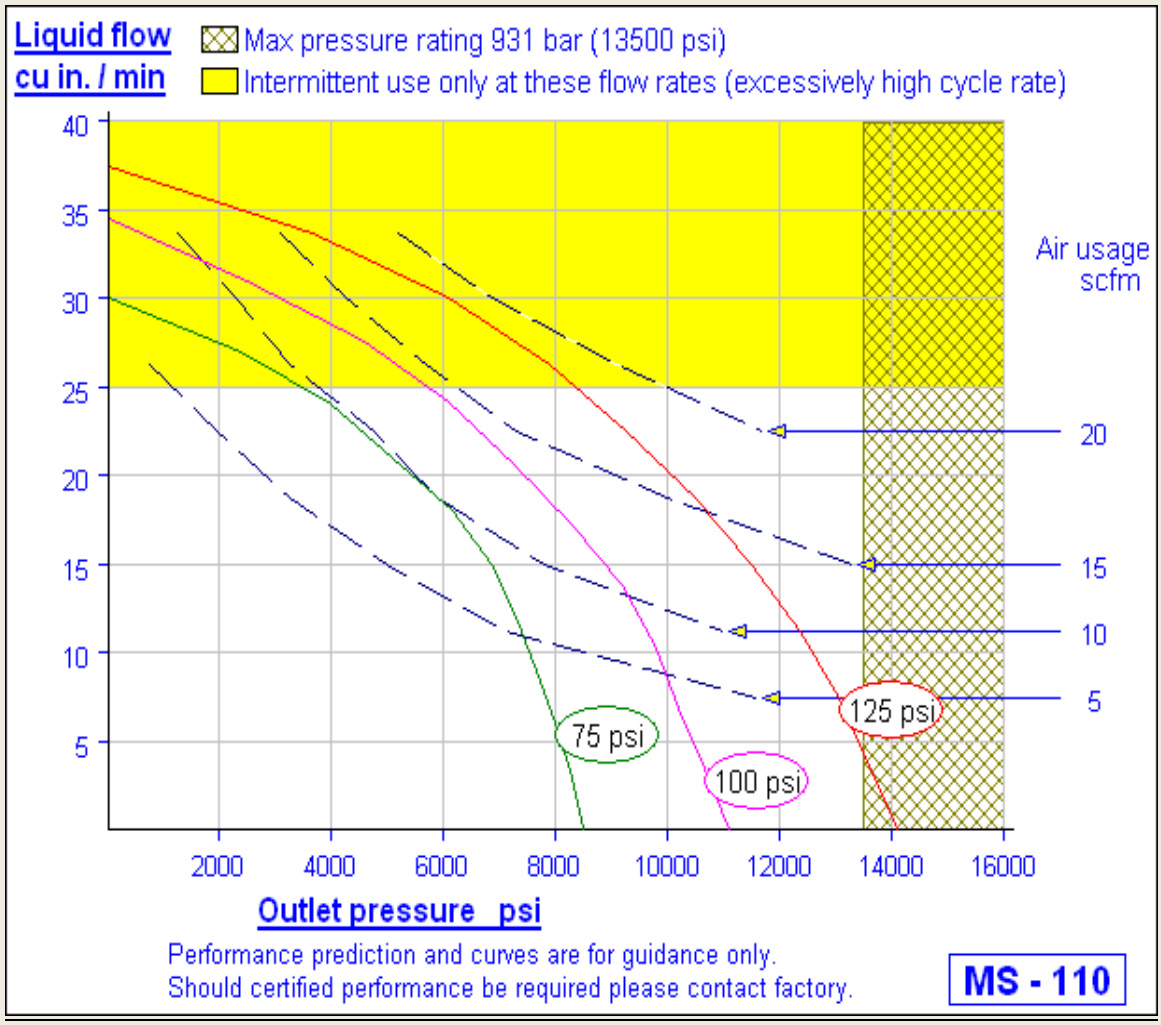
Performance Graph:



(2) Pressure Regulator:

Pressure Regulator is a pressure controlling device that can control the incoming pressure between specified inlet and outlet pressure ranges for the particular pressure regulator.

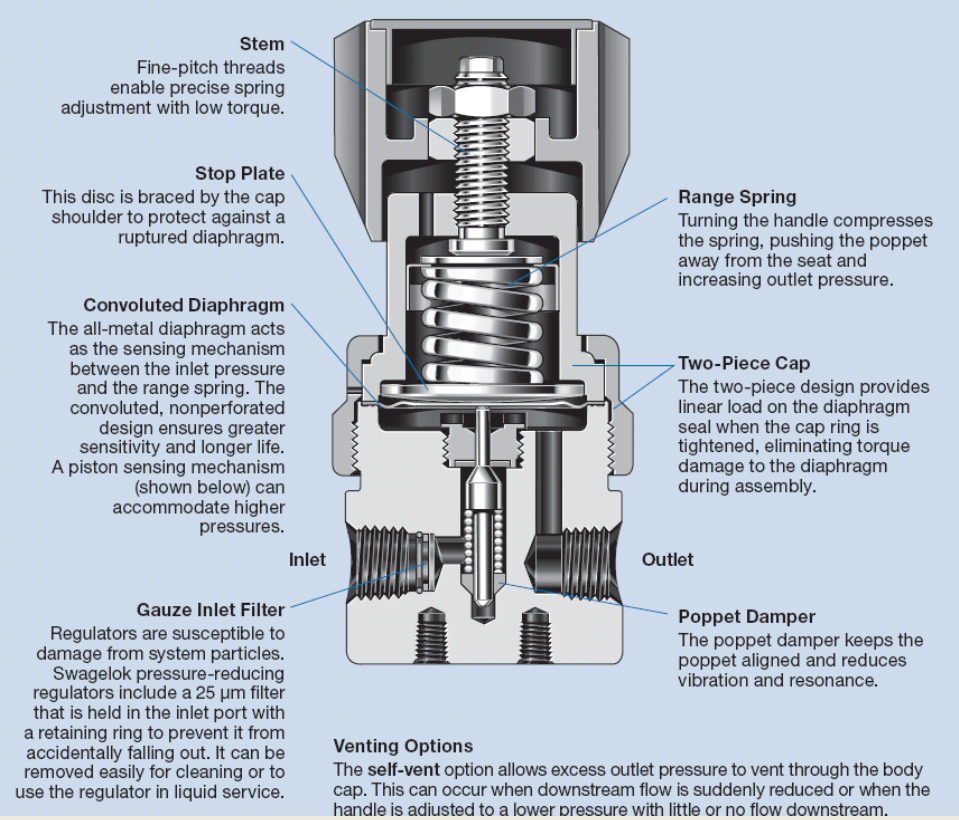
Pressure regulator's primary function is to match the flow of gas through the regulator to the demand for gas placed upon the system. If the load flow decreases, then the regulator flow must decrease also. If the load flow increases, then the regulator flow must increase in order to keep the controlled pressure from decreasing due to a shortage of gas in the pressure system.

A regulator includes a loading element, a measuring element, and a restricting element.

Restricting Element: This element is a type of valve arrangement. It can be a globe valve, valve, poppet, or any other type of valve that is capable of Operating as a variable restriction to the flow.

Loading Element: This element is what applies the needed force to the Restricting element. This can be any number of things such as a weight, a spring, a piston actuator, or more commonly the diaphragm actuator in combination with a spring.

Measuring Element: This element tells us when the inlet flow is equal to the outlet flow. The diaphragm is widely used because not only is it used for measuring but as well for loading purposes.



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(3) Pressure Gauges:

Pressure gauges are simple pressure indicating mechanical device which shows the existing pressure in the line. These gauges are filled with a liquid called Glycerin.
This liquid does not wet the glass of the instrument and is a viscous liquid. This is filled so as to prevent the pressure gauge against any type of sudden high pressure shock and continuous vibrations during operations and prevents it from giving faulty readings.
These gauges work on Bourdon Tube principle according to which there is a flexible tube filled with a liquid which when pressurized expands and shows it on calibrated dial.

(4) Pressure Transmitter:

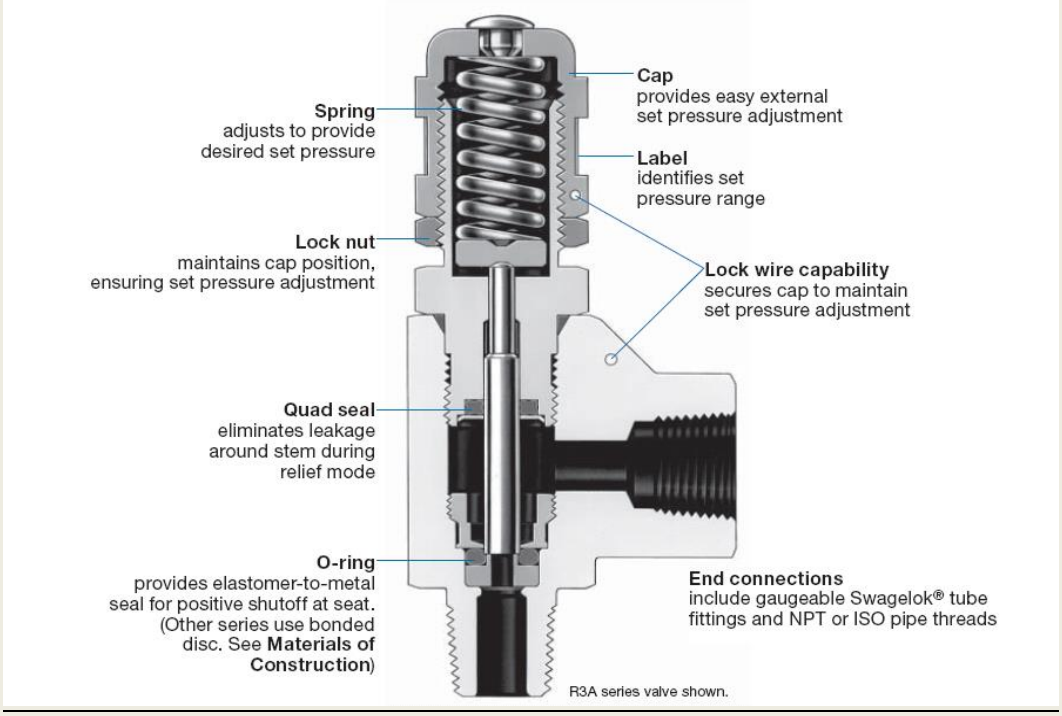
Pressure Transmitter is an electronic device which provides us pressure reading on our computer screens through DAQ card system.
This device is connected on pressure line from where it senses pressure and transfers the data through cables to DAQ Card on our computer screen. This reading is of high accuracy and precise.
A pressure transmitter measures pressure, typically of gases or liquids. Pressure is an expression of the force required to stop a fluid from expanding, and is usually stated in terms of force per unit area. A pressure sensor generates a signal related to the pressure imposed. Typically, such a signal is electrical, but optical, visual, and auditory signals are not uncommon. A pressure transmitter allows the outside

air pressure to be exposed to the negative side of the pressure sensing diaphragm, via a vented cable or a hole on the side of the device, so that it always measures the pressure referred to ambient barometric pressure.

(5) <u>Relief Valve:</u>

The relief valve is a type of valve used to control or limit the pressure in a system or vessel which can build up by a process upset, instrument or equipment failure, or fire.

The pressure is relieved by allowing the pressurized fluid to flow from an auxiliary passage out of the system. The relief valve is designed or set to open at a predetermined set pressure to protect pressure vessels and other equipment from being subjected to pressures that exceed their design limits. When the set pressure is exceeded, the relief valve becomes the "path of least resistance" as the valve is forced open and a portion of the fluid is diverted through the auxiliary route. The diverted fluid (liquid, gas or liquid-gas mixture) is usually routed through a piping system known as a flare header or relief header to a central, elevated gas flare where it is usually burned and the resulting combustion gases are released to the atmosphere. As the fluid is diverted, the pressure inside the vessel will drop. Once it reaches the valve's reseating pressure, the valve will close. The blow down is usually stated as a percentage of set pressure and refers to how much the pressure needs to drop before the valve reseats. The blow down can vary from roughly 2-20%, and some valves have adjustable blow downs.



(6) Solenoid Valve:

A solenoid valve is an electromechanical valve for use with liquid or gas controlled by running or stopping an electric current through a solenoid, which is a coil of wire, thus changing the state of the valve.

The operation of a solenoid valve is similar to that of a light switch, but typically controls the flow of air or water, whereas a light switch typically controls the flow of electricity. Solenoid valves may have two or more ports: in the case of a two-port valve the flow is switched on or off; in the case of a three-port valve, the outflow is switched between the two outlet ports. Multiple solenoid valves can be placed together on a manifold.

A solenoid valve has two main parts: the solenoid and the valve. The solenoid converts electrical energy into mechanical energy which, in turn, opens or closes the valve mechanically. A Direct Acting valve has only a small flow circuit, shown within section E of this diagram (this section is mentioned below as a pilot valve). This Diaphragm Piloted Valve multiplies this small flow by using it to control the flow through a much larger orifice.

(7) Ball Valve:

A ball valve is a valve that opens by turning a handle attached to a ball inside the valve. The ball has a hole, or port, through the middle so that when the port is in line with both ends of the valve, flow will occur.

When the valve is closed, the hole is perpendicular to the ends of the valve, and flow is blocked. The handle or lever will be inline with the port position letting you "see" the valve's position. Ball valves are durable and usually work to achieve perfect shutoff even after years of disuse. They are therefore an excellent choice for shutoff applications.
The body of ball valves may be made of metal, plastic or metal with a ceramic center. The ball is often chrome plated to make it more durable.

(8) Level Indicator:

A Level Indicator is a simple mechanical device which is mounted on the side of the Tank or any fluid containing reservoir used to indicate the level of fluid inside the tank.
Level indicator consists of a graduated scale showing high, medium and low levels with a movable float which acts as an indicator for showing the level of fluid inside the reservoir or tank. This device also acts as a safety device in those applications where fluid flows at a high rate and a continuous supply is required.

(9) Air Breather:

An Air Breather is a mechanical device which contains a fine mesh filter element which is required to filter incoming air in the reservoir.

It is normally attached to the top of a reservoir or tank to allow air to pass in and out of the reservoir or tank.

(10) Suction Strainer:

Suction Strainer is a mechanical device which contains a fine mesh of filter element which is required to filter the incoming and outgoing liquid.

A Suction Strainer consists of a filter element of 5, 10 microns and many more different degrees of filtration. It is fitted to suction end of the tank or at filling end.

(11) Needle Valve:

A needle valve is a type of valve having a small orifice and a threaded, needle-like plunger. It allows precise regulation of flow, although it is generally used for, and is capable of, only relatively small flow rates.

A needle valve has a relatively small orifice with a long, tapered, conical seat. A needle-shaped plunger, on the end of a screw, exactly fits this seat. As the screw is turned and the plunger retracted, flow between the seat and the plunger is possible; however, until the plunger is completely retracted the fluid flow is significantly impeded. Since it takes many turns of the fine-threaded screw to retract the plunger, precise regulation of the flow rate is possible. Needle valves are usually used in flow metering applications, especially when a constant, calibrated, low flow rate must be maintained for some time

(12) **Low Level Switch:**

A Low Level Switch is an electro-mechanical device which senses the level of fluid in a chamber and opens or closes a digital switch to indicate a change of state.
Low Level Switch indicates the user the low level of fluid inside the reservoir and can generate a signal to give user a warning against low level achieved.
This device is mainly used in those applications where a fall in level of fluid in reservoir would cause damage to the system.

(13) **Electric Pump & Motor:**

A pump is a device used to move fluids, such as gases, liquids or slurries. A pump displaces a volume by physical or mechanical action. One common misconception about pumps is the thought that they create pressure. Pumps alone do not create pressure; they only displace fluid, causing a flow. Adding resistance to flow causes pressure. Electric Pump is a power consuming pump which is used to deliver a fluid from one point to other at high pressure.

Pump is driven by a prime mover i.e. electric motor which is connected to the pump with the help of coupling.

An electric motor is a device using electrical energy to produce mechanical energy, nearly always by the interaction of magnetic fields and current-carrying conductors. The reverse process, that of using mechanical energy to produce electrical energy, is accomplished by a generator or dynamo.

(14) Hose:

A hose is a hollow tube designed to carry fluids from one location to another. Hoses are also sometimes called tube or pipes (the word pipe usually refers to a rigid tube, whereas a hose is usually a flexible one), or more generally tubing. The shape of a hose is usually cylindrical (having a circular cross section).

Hose design is based on a combination of application and performance. Common factors are Size, Pressure Rating, Weight, Length, Straight hose or Coil hose and Chemical Compatibility.

Hoses are made from one or a combination of many different materials. Applications mostly use nylon, polyurethane, polyethylene, PVC, or synthetic or natural rubbers, based on the environment and pressure rating needed. In recent years, hoses can also be manufactured from special grades of polyethylene (LDPE and especially LLDPE). Other hose materials include PTFE (Teflon), stainless steel and other metals.

Hoses can be used in water or other liquid environments or to convey air or other gases. Hoses are used to carry fluids through air or fluid environments, and they are typically used with clamps, spigots, flanges, and nozzles to control fluid flow.

(15) Air Filter:

An air filter is a device which removes solid particulates such as dust, pollen, mold, and bacteria from the air. Air filters are used in applications where air quality is important, notably in building ventilation systems and in engines, such as internal combustion engines, gas compressors, diving air compressors, gas turbines and others.

Air Filter is a mechanical device which filters the incoming air with the help of filter element which can be of different mesh sizes.
Filter element can vary from 2 microns to 10 microns. An air filter can restricts the dust particles from entering in to the system and also reduce the moisture content of the incoming air.

(16**) <u>Check Valve (NRV)</u>:**

A check valve, clack valve, non-return valve or one-way valve is a mechanical device, a valve, which normally allows fluid (liquid or gas) to flow through it in only one direction.

Check valves are two-port valves, meaning they have two openings in the body, one for fluid to enter and the other for fluid to leave. There are various types of check valves used in a wide variety of applications. Check valves are often part of common household items. Although they are available in a wide range of sizes and costs, many check valves are very small, simple, and/or cheap. Check valves work automatically and most are not controlled by a person or any external control; accordingly, most do not have any valve handle or stem. The bodies (external shells) of most check valves are made of plastic or metal.

An important concept in check valves is the cracking pressure which is the minimum upstream pressure at which the valve will operate. Typically the check valve is designed for and can therefore be specified for a specific cracking pressure.

(17**) <u>Silencer</u>:**

A Silencer is a pneumatic device which is used to reduce the level of noise when high pressure gas or air is vented in atmosphere. Silencer damps the sound waves by distributing through different channels. This device consists of a barrel of differential area at sections and small orifices so as to divide the high pressure air through different channels.

The Silencer is typically a hollow cylindrical piece of machined metal (usually steel or aluminum) containing expansion chambers that attaches to the exhaust or vent line of the system. Another type is the "integral"

Silencer, which consists of expansion chambers surrounding the barrel. The barrel is pierced with openings or "ports" which bleed off gases into the chambers. This type of silencers is part of the firearm, and maintenance of the silencer requires that the firearm be at least partially disassembled.

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