

TECHNICAL TRAINING - SWAPPING DOWNTIME FOR PRODUCTIVITY!

Industrial Pneumatic Systems – Syllabus [Detailed]

1. Fundamentals of Fluid Power Systems.

- The three states of matter.
- Definition of a fluid.
- Derivation of the terms *Pneumatic & Hydraulic*.
- The purpose of using a Fluid Power Systems.

2. So which should I use; Pneumatics or Hydraulics?

- Understanding efficiency as applied to Pneumatic & Hydraulic systems.
- Economic efficiency of Pneumatic systems compared with Hydraulic & Electrical.
- What can Pneumatics do?
- Advantages / Disadvantages of Pneumatics.

3. Be safe around Pneumatics!

- Be safe around Pneumatics!
- Demonstration of the dangers of Pneumatics!!

4. Pressure: Units & Conversions.

- S.I Units.
- Pressure defined.
- Atmospheric pressure.
 - Conversions within common ways of expressing pressure:
 - Pascal, Kilopascal, Mega Pascal.
 - Atmospheres.
 - PSI.
 - Bar.
 - KG/CM².
 - mm / Inches Mercury.
- Practice conversions.

5. Gauge & Absolute pressure.

- Gauge pressure, absolute pressure and their applications.
- Practice conversions.
- Comparison of Pressure and Vacuum scales.

6. Pneumatic Symbols & Circuits to ISO 1219/1, 1219/2.

- Cutaway, Pictorial and Graphical Diagrams.
- History of BS 2917 & ISO 1219-1, ISO 1219-2.
- Examination of ISO 1219/1 Document.
- Symbol Categorisations.
- Examination of ISO 1219/2 Document.
- Graphical example of a pneumatic circuit drawn to ISO 1219/1, 1219/2.

7. First principals of Pneumatic Circuit Drawing.

- Principal of Directional Control Valve (DCV) envelopes.
- Mechanisms of actuation and return.
- Valve port numbering techniques.
- Valve actuation numbering techniques.
- The concept of Mono Stable & Bi-Stable.
- The concept of Normally Open & Normally Closed.
- 2 port / 2 position valves and how they work.
- 3 port / 2 position valves and how they work.
- 5 port / 2 position valves and how they work.
- Valve distribution manifolds.

8. Design & Build! Session 1

- Single acting cylinder controlled using 2-port 2 position valve.
- Single acting cylinder controlled using 3-port 2 position valve.
- Double acting cylinder controlled using 5-port 2 position valve.

9. Production & Preparation of Compressed air.

- Compressor Plant Layout.
- Compressors:
 - Single & Two stage reciprocating piston compressors.
 - Screw Compressors.
- Compressor volumetric efficiency's.
- Selecting the correct compressor.
- Compressed air Receivers.
- Contamination in compressed air.
- Driers and water separators.

10. Distribution Networks & further Preparation of Compressed air.

- Distribution networks - general features.
- Network pipe sizing and equivalent lengths due to fittings.

11. The Service Unit & final Preparation of Compressed air.

- Filters:
 - Standard Filters.
 - Micro Filters.
- Water separators:
 - Manual.
 - Automatic.
- Pressure Regulators:
 - With venting.
 - Without venting.

12. Service Unit Ancillary Equipment.

- Shut-off valves.
- Soft-start valves.
- Quick release couplings.
- Bernoulli's Principal.
- Lubricators & Micro-fog lubricators:
 - To use or not to use a lubricator.

- Factors governing the amount of lubrication used.
- Setting the correct quantity of lubrication.
- Pressure switches:
 - Standard Mechanical type. (vacuum and positive pressures).
 - Digital type (vacuum and positive pressures).
 - Hysteresis in switches.
- Pressure gauges:
 - Bourdon Tube type.
 - Digital type.

13. Strip & Rebuild a Pneumatic Cylinder.

- How to check if a cylinder's seals are damaged.
- How to check if a cylinder is suitable for proximity sensing.
- How final position damping is achieved.
- Systematic cylinder dismantling techniques.
- Examination of cylinder components including piston rod, piston seals, piston magnet, piston bushing, piston rod bushing, piston rod seal, piston rod scraping ring, final position damping mechanism, piston rod threads, cylinder to end-cap seals.
- How to install a new seal set.
- Correct re-building techniques.
- Testing a rebuilt cylinder.
- How to correctly mount and align the rebuilt cylinder without damaging the rod bushing and seal!

14. Actuator Designs: Linear, Semi-rotary & Rotary.

- Linear Actuators:
 - Single Acting Cylinders.
 - Single Acting Spring Return Cylinders.
 - Double Acting Cylinders.
 - Double Acting Cylinders with final position damping.
 - Thru-Rod Cylinders.
 - Tandem Cylinders.
 - Duplex Cylinder arrangements.
 - Cylinders suitable for magnetic proximity sensing.
 - Rod-less Cylinders.
- Semi-Rotary Actuators:
 - Vane type.
 - Rack and pinion type.
- Rotary Actuators:
 - Pneumatic Motors.

15. Design & Build! Session 2

- Double acting cylinder reciprocating circuit with start stop.
- Double acting cylinder reciprocating circuit with Hand | Off | Auto start stop.

16. Vacuum Pumps, Generators & Ejectors.

- Vacuum Pumps.
- Vacuum Generators.
- Vacuum Ejectors.

17. Controlling Speed, Force & Direction.

- Controlling Cylinder Speed:

- Simple restrictors.
- Simple variable restrictors.
- Uni-Directional variable restrictors.
- Meter-in or Meter-out flow control?
- Quick exhaust valves.
- Controlling Cylinder output Force:
- Controlling Cylinder Direction:
 - Sliding spool type.
 - Poppet type.

18. Design & Build! Session 3

- Reciprocating circuit with Hand | Off | Auto start stop with speed control.
- Reciprocating circuit with Hand | Off | Auto start stop with speed control with reduced pressure.
- Reciprocating circuit with Hand | Off | Auto start stop with speed control and quick exhaust.

19. Dwell Control using N/O & N/C Timers.

- Design of integral components.
- Normally Open design (time delay rising) vs. Normally Closed design (time delay falling).
- Timing charts for time delay rising and time delay falling.

20. Design & Build! Session 4

- Reciprocating circuit with Hand | Off | Auto start stop with speed control, quick exhaust valve and dwell in the out-stroked position.
- Reciprocating circuit with Hand | Off | Auto start stop with speed control, quick exhaust valve and dwell in the in-stroked position.

21. Implementing Pneumatic Logic with AND | OR | NOT logic functions.

- Introduction to Logic Control [AND OR NOT].
- Boolean Equations.
- Logic Diagrams.
- Truth Tables.
- Pneumatic Logic diagrams.
- Pneumatic Logic components.

22. Design & Build! Session 5

- Single acting spring return cylinder to extend if buttons A AND B but NOT C are activated.
- Single acting spring return cylinder to extend if buttons A OR B AND C but NOT D are activated.

23. Proximity Detection using Low-Level Pneumatics.

- Applications of Low-Level Pneumatics.
- Amplifiers N/O & N/C.
- Sensors:
 - Gap type.
 - Reflex type.
 - Air Barrier type.
- Bleed relays:
 - Bleed Relay activated by wire.
 - Bleed Relay activated by ball.

24. Design & Build! Session 6

- Single acting spring return cylinder to eject parts travelling on a conveyor belt when detected by an Air-Barrier sensor and Amplifier.
- Double acting cylinder to eject parcels travelling on a conveyor belt when detected by a Cat's Whisker and Bleed Relay.

25. Hydro-Pneumatics, What, Why & When?

- Limitations of Pneumatics vs. Hydraulic systems.
- Principal advantages of Hydro-Pneumatics.
- Examination of a typical Hydro-Pneumatic circuit.

26. Open floor discussion!

- Open floor discussion session!