Chapter 7

Trouble-shooting of pneumatic systems
7.1 Documentation

The documentation of a pneumatic system comprises the following:

- Function diagram
- Circuit diagram
- Operating instructions
- Data sheets

When the system is modified, the documentation and the machine history should be updated to reflect any changes, in order to facilitate trouble-shooting and elimination of faults.

7.2 The causes and effects of malfunctions

In general, malfunctions of a system fall into the following categories:

- Wear and tear on components and lines which can be accelerated by:
  - Ambient medium (e.g. aggressive air, temperature)
  - Quality of compressed air (e.g. excessive humidity or lubrication)
  - Relative motion of components
  - Incorrect loading of components
  - Incorrect maintenance
  - Incorrect mounting and connection

These influences can lead to the following malfunctions or failures of the system:

- Blocking of lines
- Seizure of units
- Breakages
- Leakages
- Pressure drop
- Incorrect switching
A systematic procedure for finding and eliminating faults reduces commissioning and downtimes of a pneumatic control system.

Faults generally occur either:
- Due to external failure of the machine components or due to stoppages
- Internal failures within the control system.

Experience has shown that the occurrence of control system failure is rare compared with external sensor or machine failure.

If a fault occurs, this manifests itself through the malfunction or downtime of a machine. A fault can be eliminated as follows:
- Fault elimination by operating or maintenance personnel
- Fault elimination through customer services.

External faults and most internal faults can be identified and often solved by an experienced operator. If the problem cannot be quickly solved, the characteristics of the machine at the point of failure and the status of the control system should be recorded. Using this information, the maintenance engineer can make a decision as to the kind of failure that has occurred and the necessary actions to be taken.

Fault diagnosis should be carried out without delay at the time of failure and steps taken to eliminate the fault. Therefore, machine downtime will be minimal.
**Preventive maintenance**

Premature wear or failure of components can be the result of design or planning errors. If the following points are taken into consideration during the planning phase, this minimises the risk of premature machine failure.

- Selection of the appropriate components and signal generators. They should be adjusted to suit the environmental and operational conditions of the system (e.g. switching frequency, heavy loads)
- Protection of components against contamination
- Mechanical absorption of the actuating forces through additional shock absorbers
- Short line lengths, fitted with amplifiers where necessary

**Fault finding in pneumatic systems**

As a rule, a newly-designed and installed pneumatic system will run trouble-free for some time after initial adjustments have been carried out. It is important to proceed systematically when faults occur. Even more complex controls can be divided into smaller units and then examined independently of each other for faults.

If the operator is unable to rectify the fault, then maintenance or customer services personnel will have to be called upon.
It frequently occurs that sections of pneumatic systems are extended without enlarging the necessary air supply. Malfunctions which can be caused by under-sized air supply are:

- The piston rod speed is not always correct
- The force at the power cylinder drops for a short time during a pressure drop.
- Switching times are too long

The same symptoms may occur as the result of changes in orifice cross-sections caused by contamination or kinked lines or if leakage is causing a pressure drop.

Apart from the corrosive damage caused to surfaces by condensate which is, in many cases extremely aggressive, there is the considerable danger of seizure of valve components if they need to be reset by spring force after being held in one switching position for a considerable time. Lubricants without additives have a tendency to emulsify and create resin or gumming. All close-tolerance sliding fits in valves are particularly susceptible to these resistances to movement.

In a pneumatic system, a service unit should generally be connected upstream in the compressed air supply section. This filters the dirt particles from the compressed air supply.

During assembly or maintenance work, dirt particles (e.g. thread particles, sealing agents, etc.) may remain in the pressure lines and get into the valve during operation.

In the case of systems which have been in service for some time, may find their way into the lines. This contamination of the lines may produce the following effects:

- Sticking or seizure of slide-valve seats
- Leaks in poppet valves
- Blockage of flow control valve nozzles.
7.3 Maintenance

Systematic maintenance helps to prolong service life and improve the functional reliability of pneumatic control systems.

A detailed maintenance plan should be drawn up for every pneumatic system. A maintenance plan lists the maintenance tasks and time intervals. In the case of complex control systems, the maintenance documentation must include a function diagram and circuit diagram.

The time intervals between individual maintenance work to be carried out is dependent on the period of use, the wear characteristics of the individual components and the ambient medium. The following maintenance work must be carried out frequently and at short intervals:

- Service unit
  - Check the filter
  - Drain water regularly
  - Refill and set lubricator, if a lubricator is used.
- Check signal generators for possible deposits of dirt or swarf

The following maintenance work can be undertaken at greater time intervals:

- Check the seals of the connectors for leaks
- Replace lines connected to moving parts
- Check the rod bearings in the cylinders for wear and replace if necessary
- Clean or replace filter elements
- Check function of safety valves
- Check mountings