

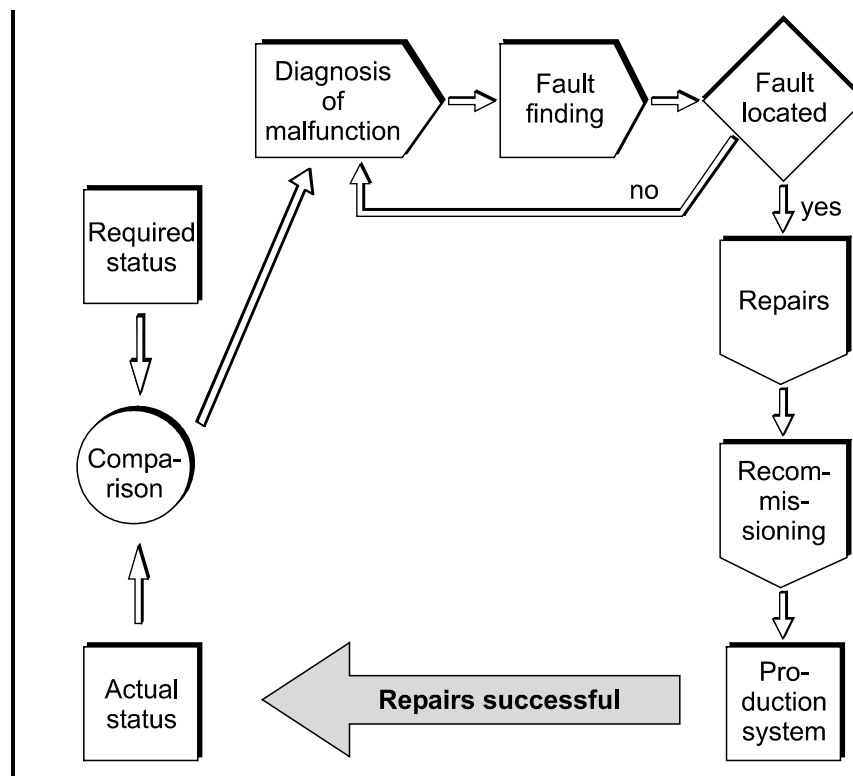
Chapter 6

Faultfinding

6.1 Systematic repairs in the event of malfunction

In the event of an inadvertent interruption, repairs are to be carried out according to the following plan.

Fig. 6.1



6.1.1 Prerequisite for systematic repairs

The basic prerequisite for systematic repairs and faultfinding is knowledge of the system. This means that only when you have familiarised yourself with the system and know how it is structured, will you be able to carry out systematic repairs.

Familiarisation with the system by:

- closely observing the installation.
- making available the entire system documentation.
- knowing the product and processing technology.
- exchanging information with the user or operator.

Structuring of the system into:

System and controller structure

- Program flow charts
- Function charts
- Description

Mechanical design

- Structure and support unit
- Function units
- Adjustment

Drive technology

- Electrical system
- Hydraulics
- Pneumatics
- Mechanical system

Final control element

- same as previous (see Drive Technology)

Control system

- Electrical relay control
- Programmable logic controller

Signal generator

- Binary sensors
- Analogue sensors
- Digital sensors

Power supply

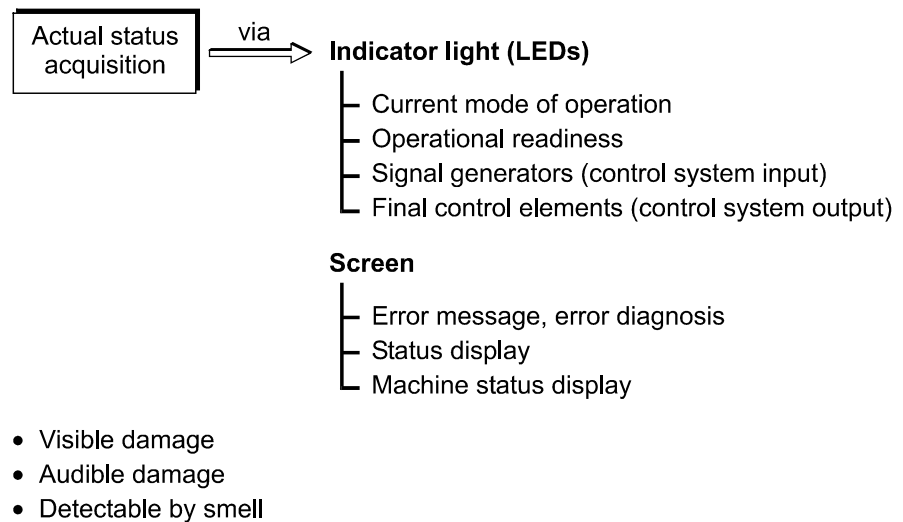
- Electrical
- Hydraulic
- Pneumatic

6.1.2 Procedure

The first thing that must be done in the event of an error signal is to establish the actual status. The following options are available for this:

- Discussing the fault with the user (Does the system operate incorrectly?)
- Start failure
- Stopping during process step
- Faulty process
- Incorrect working practice

Fig. 6.2



6.2 Faultfinding

The actual faultfinding starts once the actual status has been established and compared with the required status. This comparison frequently leads to the discovery of the error source, if the fault is

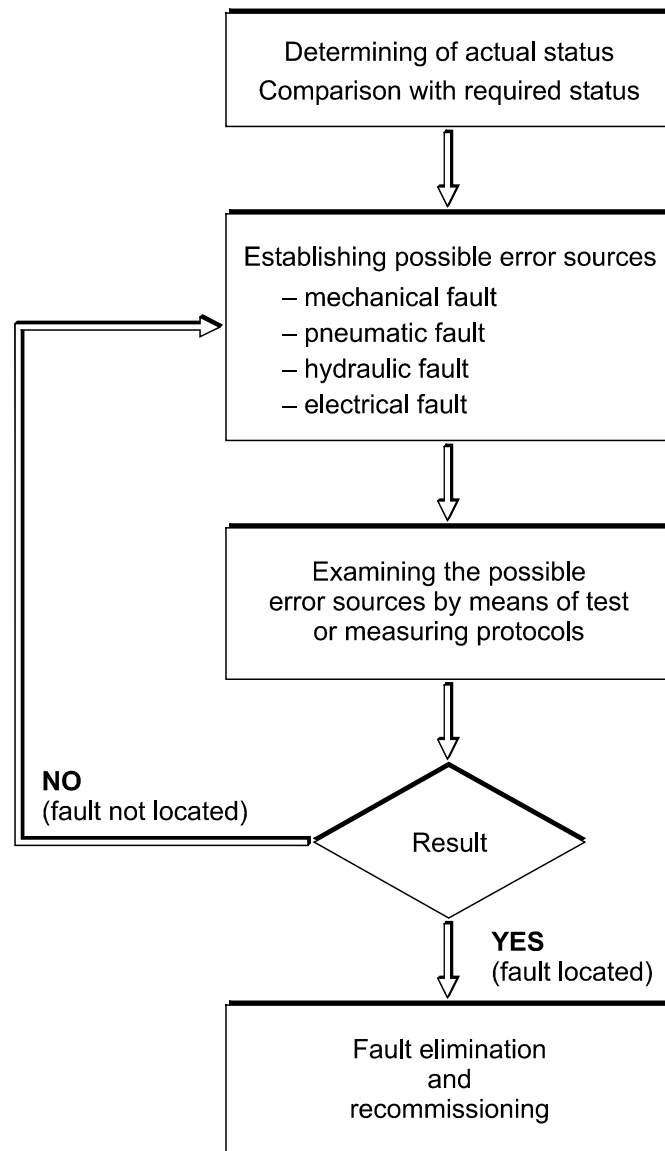
- visible (e.g. mechanical damage to a signal generator),
- audible (e.g. leakage on a valve),
- detectable by smell (e.g. cable burnt out)

If this is not the case, the fault can only be found and eliminated by means of a systematic procedure.

6.2.1 Systematic faultfinding

Again, the required/actual status comparison forms the basis for systematic faultfinding.

Fig. 6.3



6.2.2 Fault documentation

Once a fault has been found, it is not sufficient just to rectify this, but at the same time the cause of the problem should be determined. A useful tool for this is a faults list, which should be kept with the installation. This list describes the malfunctions and their causes. It may take a number of different forms.

The following is an example:

Machine malfunctions list						
Mach. No.	Date Time	Fault	Cause	Fault index *	Rectified by	Measure

This list can be useful in detecting frequently recurring faults and their causes. The fault index makes it easier to establish the nature of the error.

- A = Incorrect working practice
(e.g. a retaining screw is not properly tightened on an assembly part)
- M = Mechanical fault
(e.g. sensors are maladjusted)
- E = Electrical fault
(e.g. relay is not energised or solenoid does not switch)
- S = Controller error
(e.g. program or program part is not activated)
- L = Leakage fault
(e.g. air escaping from threaded connection)
- B = Operator error
(e.g. shut-off valve not closed)
- W = Service error
(e.g. filter not cleaned)

Example:

Mach. No.	Date Time	Fault	Cause	Fault index *	Rectified by	Measure
1303	31.7.95	Distribution station; Gravity feed magazine does not operate correctly	Microswitch S1 maladjusted	M	DEL	

6.2.3 Fault analysis

With the help of the faults list, it is possible to establish whether a fault or damage occurred and thus to pinpoint weak points in the system. Once these have been identified, it is advisable to introduce technical improvements. If damage has occurred, the following procedure should be adopted.

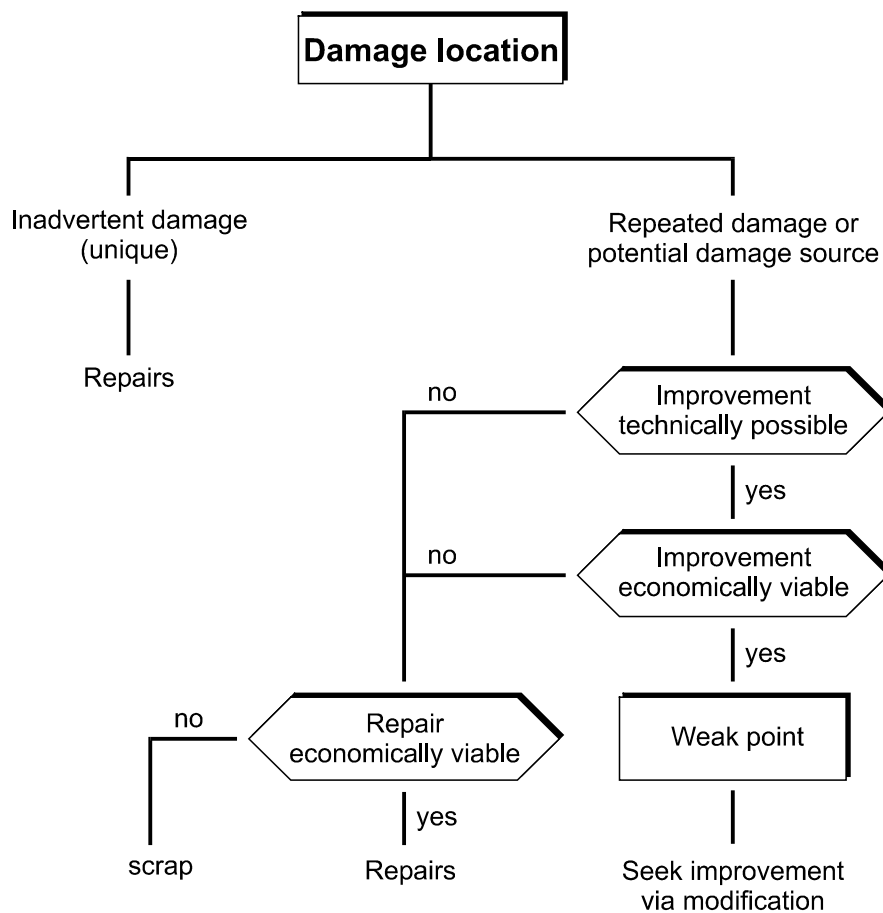


Fig. 6.4

6.3 Safety while faultfinding

The following points must be considered before working on the line:

- Is it possible to switch off the power supply?
 - ⇒ Generally, switching off the power for large production lines is not feasible, as the continued operation of other parts of the system may be desirable or required.
- Is it possible to localise the fault without power?
 - ⇒ It is not possible to check the function of sensors without electrical power, for example. It is also impossible to trace signals in the control system. The functions of actuators can only be checked using the manual override. The switching functions cannot be checked, even using the manual override, if the pneumatic or hydraulic power is switched off.
- What will happen when the power is switched off?
 - ⇒ Consideration must be given to the load conditions of cylinders and motors.
 - ⇒ Suspended loads will no longer be held with the power supply switched off.
 - ⇒ With regard to the control system, please note that a programmable logic controller will generally return to its initial position and all signal latches and flags will be deleted.

Faultfinding with power switched off is only feasible for faults that are immediately obvious. It is important to switch off the power during repair work, however, as this involves manual intervention in the system. In hydraulic systems, switching the pump off and emptying the accumulator is mandatory.

Example: A workpiece is ejected by a pneumatic cylinder and jams mechanically.

Conclusion

Exhaust air restrictors are no longer effective and the cylinder will "shoot" forward when the mechanical lockup is cleared. Due to the danger of accidents, the power must be switched off during all mechanical lockups!

Caution

- Switch off the power if personnel or equipment are not endangered, by suspended loads, for example!
- Switch off the power in the event of fires or leaks!
- Switch off the power if the fault can be identified immediately!
- Switch off the power when repairing machines or lines!

6.3.1 Recommissioning and powering up the system

The positions of the drives must be known when switching on the power. Cylinders controlled by impulse valves will not be in their home positions after the power is shut off. Switching the power back on can cause sudden, dangerous cylinder movements.

The following rules must be observed when switching the power back on:

1. Ensure that no one is in the work area.
2. Safety precautions must be observed (close safety screens).
3. Reduce the system pressure setting.
4. Slowly increase the pressures to their specified values (Soft start).

6.3.2 Faultfinding in lines with the power switched on

Faultfinding in the signal input

In practice, faults that cannot be spotted immediately can only be found by proceeding in a systematic manner. A precondition for this systematic approach is that the system is powered up to permit signals to be tracked. Tracking signals involves determining whether a sensor has been correctly approached or actuated. This must be performed with great care and thoroughness, however.

Caution Uncontrolled actuation of sensors can trigger actions in the system leading to a serious danger of accidents!

The following rules must be observed when checking sensors:

1. Reduce the system pressure.
2. Disconnect the sensor's signal line (3-wire sensor).
3. Interrupt the power supply at the power valve.

If the sensor was checked and found to function correctly, continue faultfinding by systematically tracing the signal path. In purely pneumatic control systems, the signal path can of course be traced by disconnecting the hoses.

Caution **Danger!**
Disconnecting hoses in the control section may lead to cylinder movements.

It is advisable to reduce the working pressure of the power valves when tracing signals in purely pneumatic control systems.

Faultfinding in the power section involves checking the function of switching valves. This often requires testing whether the signal from the control system is arriving correctly. Solenoid valves normally have an LED to indicate incoming signals. To check the mechanical switching operation in the valve, however, it may be necessary to remove the coils from the valve or disconnect the valve plug.

*Faultfinding
in the power section*

Uncontrolled disconnection of coils or plugs can cause sudden cylinder movements.

Danger!

Disconnecting the return coil of an impulse valve can also trigger a cylinder movement.

Caution

One option for checking power valves is to test the valve functions using the manual override.

Danger!

Uncontrolled use of the manual override can lead to uncontrolled cylinder movements!

Caution

The following rules must be observed when using the manual override:

1. The action that will be triggered by the override must be known
 2. Reduce the system pressure.
 3. Lock outputs on the valve as required.
- If the flow control valves or restrictors require checking, please observe the drive carefully while changing the setting. If no change occurs, restore the original setting.
 - Manual work on the power section of a line may only be performed while the system is depressurised.

*Faults in the speed
control system and
drive*