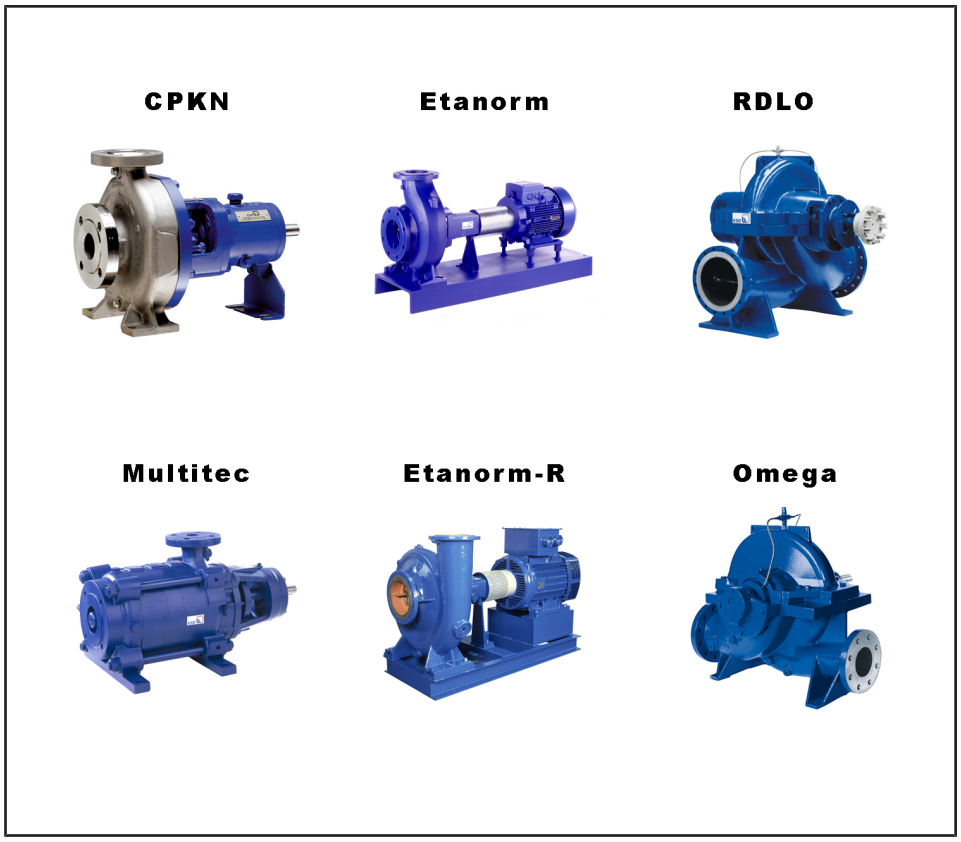
Pump Used as a Turbine

CPK / CPKN
Etanorm / Etanorm-R
Multitec
Omega
RDLO

Supplementary Operating Manual



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Supplementary Operating Manual

Original operating manual

Contents

1 General

1.1 Principles

This supplementary operating manual is supplied as an integral part of the type series and variants indicated on the front cover.

It supplements the installation/operating manual of the pump (set) type and variant indicated on the front cover and specifically describes its use as a turbine.

1.2 Target group

This supplementary operating manual is aimed at the target group of trained and qualified specialist technical personnel.

1.3 Other applicable documents

The other applicable documents are listed in the relevant installation/operating manual of the pump (set).

1.4 Symbols

Table 1: Symbols used in this manual

Symbol	Description
✓	Conditions which need to be fulfilled before proceeding with the step-by-step instructions
▷	Safety instructions
⇨	Result of an action
⇨	Cross-references
1. 2.	Step-by-step instructions
	Note Recommendations and important information on how to handle the product

2 Safety

DANGER

All the information contained in this section refers to hazardous situations.

In addition to the present general safety information the action-related safety information given in the other sections must be observed.

2.1 Key to safety symbols/markings

Table 2: Definition of safety symbols/markings

Symbol	Description
DANGER	**DANGER** This signal word indicates a high-risk hazard which, if not avoided, will result in death or serious injury.
WARNING	**WARNING** This signal word indicates a medium-risk hazard which, if not avoided, could result in death or serious injury.
CAUTION	**CAUTION** This signal word indicates a hazard which, if not avoided, could result in damage to the machine and its functions.
	**Explosion protection** This symbol identifies information about avoiding explosions in potentially explosive atmospheres in accordance with EC Directive 94/9/EC (ATEX).
	**General hazard** In conjunction with one of the signal words this symbol indicates a hazard which will or could result in death or serious injury.
	**Electrical hazard** In conjunction with one of the signal words this symbol indicates a hazard involving electrical voltage and identifies information about protection against electrical voltage.
	**Machine damage** In conjunction with the signal word CAUTION this symbol indicates a hazard for the machine and its functions.

2.2 General

This supplementary operating manual contains additional applicable information. General installation, operating and maintenance instructions that must be observed to ensure safe operation and prevent personal injury and damage to property are given in the installation/operating manual.

The safety information in all sections of this supplementary operating manual and in the relevant installation/operating manual must be complied with.

The supplementary operating manual must be read and completely understood by the responsible specialist personnel/operators.

The contents of this supplementary operating manual must be available to the specialist personnel at the site at all times.

The operator is responsible for ensuring compliance with all local regulations which are not taken into account in this supplementary operating manual.

2.3 Intended use

In addition to the applications described in the applicable documents the pump (set) can be used as a turbine.

- Only use as turbines pumps/pump sets which are in perfect technical condition.
- Do not use as turbines pumps/pump sets which are in partially assembled condition.
- The pump (set) must only be used as a turbine with the fluids described in the data sheet or the relevant installation/operating manual.

Prevention of foreseeable misuse

- Never exceed the permissible operating limits specified in the data sheet or the relevant installation/operating manual.
- Observe all safety information and instructions in this supplementary operating manual.
- If the system-induced runaway speed of the pump used as a turbine exceeds the maximum permissible speeds of the pump in turbine mode and the motor/ generator, runaway of the pump used as a turbine must be prevented by suitable means.

2.4 Personnel qualification and training

All personnel involved must be fully qualified to install, operate, maintain and inspect the machinery this manual refers to.

The responsibilities, competence and supervision of all personnel involved in installation, operation, maintenance and inspection must be clearly defined by the operator.

Deficits in knowledge must be rectified by sufficiently trained specialist personnel training and instructing the personnel who will carry out the respective tasks. If required, the operator can commission the manufacturer/supplier to train the personnel.

Training on the pump (set) must always be supervised by technical specialist personnel.

2.5 Consequences and risks caused by non-compliance with these operating instructions

- Non-compliance with this supplementary operating manual will lead to forfeiture of warranty cover and of any and all rights to claims for damages.
- Non-compliance can, for example, have the following consequences:
  - Hazards to persons due to electrical, thermal, mechanical and chemical effects and explosions
  - Failure of important product functions
  - Failure of prescribed maintenance and servicing practices
  - Hazard to the environment due to leakage of hazardous substances

2.6 Safety awareness

In addition to the safety information contained in this manual and the intended use, the following safety regulations shall be complied with:

- Accident prevention, health and safety regulations
- Explosion protection regulations
- Safety regulations for handling hazardous substances
- Applicable standards and laws

2.7 Safety information for the operator/user

- Fit protective equipment (e.g. contact guards) supplied by the operator for hot, cold or moving parts, and check that the equipment functions properly.
- Do not remove any protective equipment (e.g. contact guards) during operation.
- Provide the personnel with protective equipment and make sure it is used.

- Contain leakages (e.g. at the shaft seal) of hazardous fluids handled (e.g. explosive, toxic, hot) so as to avoid any danger to persons and the environment. Adhere to all relevant laws.
- Eliminate all electrical hazards. (In this respect refer to the applicable national safety regulations and/or regulations issued by the local energy supply companies.)
- If shutting down the pump does not increase potential risk, fit an emergency-stop control device in the immediate vicinity of the pump (set) during pump set installation.

2.8 Safety information for maintenance, inspection and installation work

- Modifications or alterations of the pump are only permitted with the manufacturer's prior consent.
- Use only original spare parts or parts authorised by the manufacturer. The use of other parts can invalidate any liability of the manufacturer for resulting damage.
- The operator ensures that all maintenance, inspection and installation work is performed by authorised, qualified specialist personnel who are thoroughly familiar with both the supplementary operating manual and the installation/ operating manual.
- Only carry out work on the pump (set) during standstill of the pump.
- The pump casing must have cooled down to ambient temperature.
- Pump pressure must have been released and the pump must have been drained.
- When taking the pump set out of service always adhere to the procedure described in the supplementary operating manual.
- Decontaminate pumps which handle fluids posing a health hazard.
- As soon as the work is completed, re-install and/or re-activate any safety-relevant and protective devices. Before returning the product to service, observe all instructions on commissioning.

2.9 Unauthorised modes of operation

Never operate the pump (set) as a turbine outside the limits stated in the data sheet and in the installation/operating manual of the pump (set).

The warranty relating to the operating reliability and safety of the supplied pump (set) is only valid if the equipment is used in accordance with its intended use.

3 Transport / Temporary Storage / Disposal

NOTE

Observe all information given in the installation/operating manual of the pump (set).

4 Description of the Pump (Set)

4.1 General description

The "General description" in the installation/operating manual of the pump (set) generally also applies when the pump is used as a turbine.

DANGER

Pump set running hot

Explosion hazard!

- ▷ Never use pumps as turbines in potentially explosive atmospheres.

- If mechanical seals are used, they must generally be bi-directional and suitable for the pressure of the maximum turbine head.
- The direction of rotation of a pump used as a turbine is generally opposite to that in pump mode. The shaft nuts must be secured accordingly.
- When the pump is used as a turbine, its discharge side becomes the turbine inlet and its suction side becomes the turbine outlet.

4.1.1 Multitec

DANGER

Bursting of the suction casing

Pressure overload at the suction casing!

- ▷ In systems with Multitec pumps and shut-off elements on the suction side of the pump, the nominal pressure of the suction casing must not be exceeded by the suction head.
  If required, conduct a transient flow analysis which takes the supply and discharge lines into account.

CAUTION

Damage to the machinery by dry running if the fluid level falls below the turbine outlet and the gate valves at the turbine inlet (pump discharge nozzle) are closed

Damage to mechanical seals and/or bearings

- ▷ Seal the shaft with double mechanical seals with external fluid reservoir, or with a gland packing with external flushing or liquid quench.
- ▷ Never use product-lubricated plain bearings.
- ▷ Select designs with rolling element bearings.

4.1.2 Omega, vertical design

CAUTION

Damage to the machinery by dry running if the fluid level falls below the turbine outlet and the gate valves at the turbine inlet (pump discharge nozzle) are closed

Damage to mechanical seals and/or bearings

- ▷ Seal the shaft with double mechanical seals with external fluid reservoir, or with a gland packing with external flushing or liquid quench.
- ▷ Never use product-lubricated plain bearings.
- ▷ Select designs with rolling element bearings.

4.2 Function

The direction of flow and rotation of the pump in turbine mode is opposite to the direction of flow and rotation in pump mode.

The flow is accelerated in the casing components. The impeller converts the energy, which is then transferred to the generator via the shaft and coupling.

5 Installation at Site

5.1 Piping

The discharge line must not be fitted with a non-return valve. This applies in addition to the relevant installation/operating manual of the pump (set).

5.2 Checking the direction of rotation

The direction of rotation is established automatically in turbine mode. It opposes the direction of rotation in pump mode.

1. Separate the turbine from the generator.
2. Fully open the isolating valves.
3. Open the start/stop valves until the turbine starts rotating.
   The turbine always rotates in the correct direction of rotation.
4. Close the start/stop valves and let the turbine come to a standstill.
5. Check the direction of rotation of the generator by switching it on and off again immediately.
6. If the direction of rotation differs from that of the turbine, interchange the terminal connections at the generator.
7. If the direction of rotation of the generator matches that of the turbine, connect the generator to the turbine via the coupling.
8. Mount the coupling guard.

5.3 Preventing "runaway" of the pump used as a turbine

The system-induced runaway speed of the pump used as a turbine must not exceed the maximum permissible speeds of the pump and the generator. If this cannot be ensured, take suitable measures to prevent runaway of the pump used as a turbine also in the event of a power failure.

Runaway can be prevented, for example, by fitting a mechanical brake or a bypass line with a pneumatically actuated bypass valve combined with a quick-closing valve in the pipeline of the turbine, which closes automatically in the event of a power failure.

If a mechanical brake is used for the generator, the maximum permissible torque at the shaft indicated in the data sheet must not be exceeded during the braking process.

6 Commissioning/Start-up/Shutdown

6.1 Start-up

6.1.1 For asynchronous motors as generators up to 250 kW

✓ The system has been primed and vented.

1. Open the isolating valves.
2. Close the bypass valve (if any).
3. Open the start/stop valve.
   ⇨ The turbine starts rotating.
4. Once the synchronous speed has been reached, connect the generator to the mains.

6.1.2 For generators with higher ratings and other generator types

1. Have the permissible starting current for the electric mains determined by the operator.
2. Define and implement a suitable start-up procedure for the required starting current ratio.

6.2 Operating limits

DANGER

Non-compliance with operating limits for pressure, power/output, torque and no-load speed

Destruction of the pump (set) and the generator!

- ▷ Only use motors approved for use as a generator.
- ▷ Observe the operating limits indicated in the data sheet and the installation/operating manual of the pump (set).
- ▷ Never operate the pump with a turbine head exceeding that indicated in the data sheet.
- ▷ Never operate the pump with higher fluid temperatures or fluid densities than indicated in the data sheet.
- ▷ The runaway speed at the intersection of the system curve and the no-load speed curve must not exceed the maximum permissible speed indicated in the data sheet.
- ▷ The torque determined by the intersection of the system curve and the flow resistance curve of the turbine at locked rotor (turbine characteristic at n = 0) must not exceed the permissible torque.
- ▷ The P/n value established during operation must not exceed the maximum P/n value indicated in the data sheet.

DANGER

Runaway of the pump (set) used as a turbine in the event of a power cut or power failure

Destruction of the pump (set) and the generator!

- ▷ The system-induced runaway speed of the system must not exceed the maximum permissible speeds of the pump and the generator.
  (⇨ Section 5.3, Page 11)

CAUTION

Permissible torque exceeded by increased locked-rotor torque

Overloading of coupling and/or shaft!

- ▷ Shaft and coupling have to be suitably dimensioned for the locked-rotor torques.

6.3 Maximum operating pressure

NOTE

Observe all information given in the installation/operating manual of the pump (set).

DANGER

Bursting of the suction casing

Pressure overload at the suction casing!

- ▷ In systems with Multitec pumps and shut-off elements on the suction side of the pump, the nominal pressure of the suction casing must not be exceeded by the suction head.
  If required, conduct a transient flow analysis which takes the supply and discharge lines into account.

6.4 Shutdown

1. Slowly close the start/stop valve.
2. When the synchronous speed of the generator has fallen below that of the mains network, disconnect the generator from the mains.
3. If required (e.g. for a maintenance inspection), close the isolating valve and drain the pump.

7 Maintenance/Inspection

NOTE

Observe all information given in the installation/operating manual of the pump (set).

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