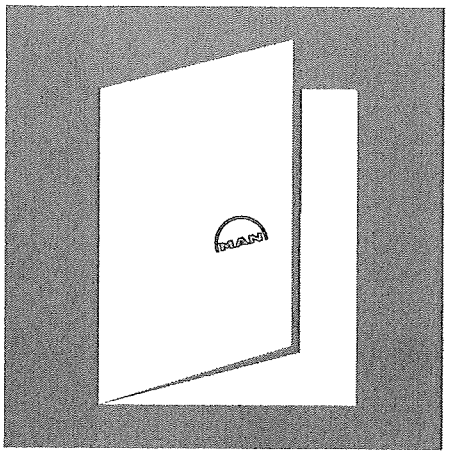
Operating Instructions for Machine Unit KOSAIR 2004

MAN TURBO AG Schweiz

Rev.	Changed	Date	Checked	Date	Change no.	Change description	
Patruno RRM4		05-07-14					
Issued		Date	Checked	Date	Released		Date
Type/Size: A4					Project no.: N.7100175		
Description: Operating Instructions for Machine Unit					Project: KOSAIR 2004		
Document: 837022853			Type: MAN	Part:	Rev.: 0	Lang.: EN	Page



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Basics

1

Introduction

This Chapter addresses all users of machine unit KOSAIR 2004. It contains information about the structure and configuration of the Operating Instructions, makes handling of the Operating Instructions easier for you and enables quick access to the desired information.

1.1 Overview

In *Section 1.2 Operating Instructions* you will find information on the following subjects:

- *Section 1.2.1 Scope of validity*
- *Section 1.2.2 Property rights*
- *Section 1.2.3 Target persons and obligation to read*
- *Section 1.2.4 Contents overview*
- *Section 1.2.5 Access assistance*

In *Section 1.3 Organizational measures* you will find information on the following subjects:

- *Section 1.3.1 Location of Operating Instructions*
- *Section 1.3.2 Manufacturer and contact addresses*

In *Section 1.4 Presentation conventions* you will find information on the following subjects:

- *Section 1.4.1 Warnings and references for use*
- *Section 1.4.2 Text markings*

- *Section 1.4.3 Item numbers und cross-references*

In *Section 1.5 Further literature* you will find references to literature extending beyond these Operating Instructions.

1.2 Operating Instructions

The present Operating Instructions form part of the overall documentation for machine unit KOSAIR 2004 by MAN TURBO AG Schweiz.

The Operating Instructions serve as an instruction for the intended use of the machine unit and as reference material.

The Operating Instructions contain important information for

- operating the machine unit safely, properly, and economically,
- avoiding hazards,
- reducing repair costs and downtimes,
- increasing reliability and service life of the machine unit.

These Operating Instructions are aimed at making you, the user, familiar with correct use and safe handling of the machine unit. To achieve this it is indispensable that you read the complete Operating Instructions and in particular thoroughly study *Chapter 2 Safety*, and follow the instructions in the Operating Instructions.

Note: On a priority basis observe the instructions for operation of the machine unit given by MAN TURBO After Sales Service personnel.

1.2.1 Scope of validity

The information in these Operating Instructions only refers to machine unit KOSAIR 2004 with the following identification:

Machine unit data	Manufacturer	MAN TURBO AG Schweiz
	Project name and project number	KOSAIR 2004
		N.7100175
	Year built	2005
	Site location	Kosice, Slovakia
Operator / User	Company	US Steel
	Address	Kosice, Slovakia

·Engineering company	Company	Air Liquide (Messer AGS) GmbH
	Address	Fütingsweg 34
		D-47805 Krefeld
	Project name	ASU Kosice
	Project number	K70101
	TAG number	V11001 & V16001

1.2.2 Property rights

MAN TURBO AG Schweiz reserve all property rights in these Operating Instructions. The Operating Instructions may only be used for the purpose approved by MAN TURBO and must in particular not be disclosed or made available to third parties.

The owner shall only be allowed to print out the Operating Instructions from a CD-ROM for purposes of his own use; passing on to third parties shall be expressly prohibited.

Any copies, including excerpts, require the prior consent of MAN TURBO.

1.2.3 Target persons and obligation to read

These Operating Instructions address all authorized users of machine unit KOSAIR 2004. The Operator / User of the machine unit determines who will be authorized as user.

Any user of the machine unit must read and follow the Operating Instructions.

The Operating Instructions differentiate between different user roles since the demands placed on the users vary depending in each case on the activity performed by them.

Note: You will find the definitions of the user roles with the requirements for the corresponding roles in *Chapter 2 Safety*. You may assume one or more of these user roles provided you meet the corresponding requirements.

Structure and execution of the Operating Instructions take the different user roles into account. The contents are based on the necessary expertise required for the respective user role.

1.2.4 Contents overview

The Operating Instructions for Machine Unit are subdivided into four parts, according to tasks and subjects:

Basics

The Basics part provides the basic knowledge which any user should have for work on the machine unit.

- *Chapter 1 Introduction*
- *Chapter 2 Safety*
- *Chapter 3 Design and function*

Normal operation

The Normal Operation part contains information which will be required for operation of the machine unit under normal circumstances, i.e. during trouble-free operation. Moreover, Normal Operation contains information for EMERGENCY STOP of the machine unit.

- *Chapter 4 Normal operation*

Special operation

The Special Operation part describes all work deviating from normal operation, such as installation, commissioning, maintenance, troubleshooting, repair, decommissioning, dismantling, and disposal.

- *Chapter 5 Installation and commissioning*
- *Chapter 6 Service, maintenance and troubleshooting*
- *Chapter 7 Decommissioning, dismantling, and disposal*

Annex

The Annex contains Technical Details of the machine unit, an overview of the drawings and schematic diagrams which are part of the Operating Instructions, and an overview of the Operating Instructions for Components.

- *Chapter 8 Annex*

Note: Technical data and drawings for individual components of the machine unit will be found in the separate Operating Instructions for Components. For an overview please refer to *Section 8.5 Operating Instructions for Components*.

Glossary

The Glossary contains definitions of terms which are important for understanding the Operating Instructions.

1.2.5 Access assistance

The Operating Instructions for Machine Unit provide access assistance which enables quick access to the desired information.

Table of Contents

The Table of Contents lists the first three levels of the chapter structure, e.g. 1, 1.1, 1.1.1.

Index

The Index enables the reader to find key words in the text.

List of Figures

The List of Figures provides a list of all illustrations.

List of Tables

The List of Tables provides a list of all tables.

List of Procedures

The List of Procedures provides a list of all procedures. If you are looking for a concrete course of action consult the List of Procedures.

Marginal Notes

Within the individual Sections of the Operating Instructions you can use the Marginal Notes in the page margins for orientation.

Hardcopy version

The hardcopy version of the Operating Instructions for Machine Unit KOSAIR 2004 supplied by MAN TURBO shall be understood as the original Operating Instructions. This hardcopy version of the Operating Instructions is subdivided into various folders:

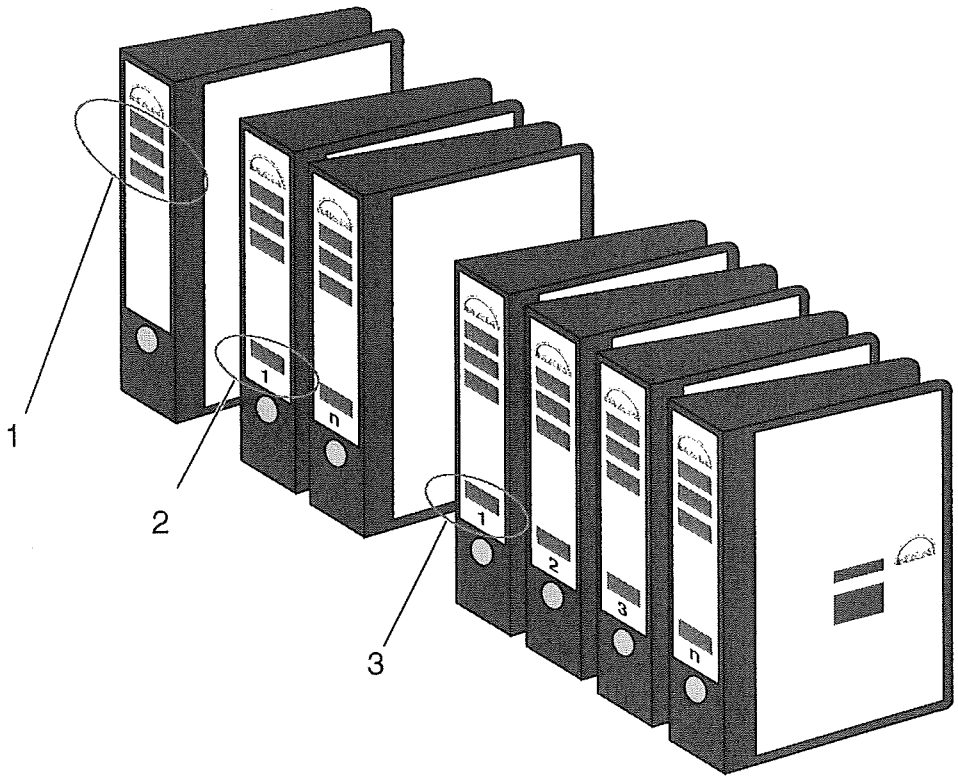


Figure 1-1 Structure of the hardcopy version of the Operating Instructions

1 Operating Instructions for Machine Unit
2 Drawings and schematic diagrams
3 Operating Instructions for Components

CD-ROM

In addition to the hardcopy version, the Operator / User of the machine unit will be handed over one or several electronic operating instructions on CD-ROM. This CD-ROM contains a structured PDF file with navigation assistance and automatic links to drawings and schematic diagrams and to the Operating Instructions for Components.

By printing out the electronic files, the Operator / User of the machine unit may generate any number of hardcopies of the Operating Instructions.

Note: Depending on the selected folder width, the number of folders on the CD-ROM may vary compared to the hardcopy version (original) of the Operating Instructions included in the supply.

1.3 Organizational measures

Please contact the MAN TURBO After Sales Service directly if problems or situations arise on the machine unit which cannot be clarified by reference to the Operating Instructions or if there are any doubts about the handling of the Operating Instructions.

1.3.1 Location of Operating Instructions

The Operating Instructions can only be of assistance to you if you have them readily available at all times. Retain a copy of the Operating Instructions permanently at the place of use of the machine unit.

1.3.2 Manufacturer and contact addresses

Manufacturer

MAN TURBO AG Schweiz

Table 1-1 Headquarters of MAN TURBO *Group*

Country	**Address**
Germany	MAN TURBO AG Steinbrinkstrasse 1 46145 Oberhausen GERMANY Phone: ++49 / (0)2 08 / 6 92 - 01 Fax: ++49 / (0)2 08 / 66 90 21
	MAN TURBO AG Egellsstrasse 21 13507 Berlin GERMANY Phone: ++49 / (0) 30 / 43 01 03 Fax: ++49 / (0) 30 / 43 01 28 41

Country	Address
Switzerland	MAN TURBO AG Schweiz Hardstrasse 319 8005 Zurich SWITZERLAND Phone: ++41 / 44 / 278 - 22 11 Fax: ++41 / 44 / 278 - 3045
Italy	MAN TURBO S.r l. De Pretto Via Daniele Manin 16/18 36015 Schio (VI) ITALY Phone: ++39 / 04 45 / 69 15 11 Fax: ++39 / 04 45 / 51 11 38

MAN TURBO on the Internet

For all pertinent data about products and services of MAN TURBO AG Schweiz also visit our web site:

http://www.manturbo.com

1.3.2.1 After Sales Service

Our After Sales Service is your competent contact for all questions within the scope of customer service after the machine unit supplied by us has been handed over. If necessary, you will be given advice on the following questions:

- Troubleshooting during operation of the machine unit,
- Procurement and stock-keeping of spare parts,
- Inspections,
- Repair work.

Moreover, our After Sales Service also carry out examinations regarding modification possibilities and carry out the modification of machine units.

After Sales Service agencies

The worldwide After Sales Service network of MAN TURBO coordinated from our headquarters in Oberhausen, Berlin, Zurich, and Schio, is readily available to you for advice and assistance 24 hours a day every day of the year. The members of staff in our international marketing and sales agencies are competent contact partners for all technical questions and aspects of after sales service.

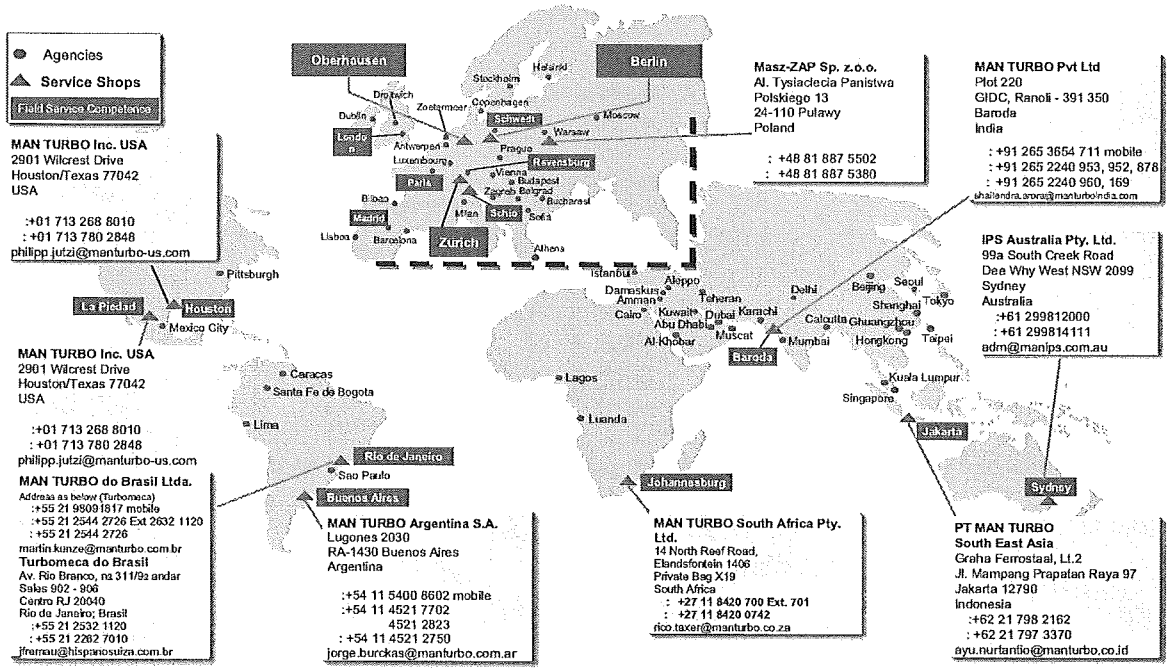


Figure 1-2 International agencies

Note: For our current After Sales Service network see http://www.manturbo.com.

24-hour hotline

Our After Sales Service is available to you 24 hours a day at the following phone, fax and mobile phone numbers:

	Turbomachinery			Screws	Gas Turbines	
	Oberhausen / ++49	Berlin / ++49	Zürich / ++41	Oberhausen / ++49	Oberhausen / ++49	Zürich / ++41
Technical Consultancy	Michael Siegmund (0)208 692 2450 (0)208 692 2096 (0)151 1250 2124	Dr. Hubert Schmidt (0)30 4301 2796 (0)30 4301 2806 (0)151 1250 2403	Jürg Schneider (0)1 278 3249 (0)1 278 3068 (0)79 349 1538	Heinrich Bär (0)208 692 2670 (0)208 692 2096 (0)151 1250 2175	Wolfgang Henser (0)208 692 2287 (0)208 692 9056 (0)151 1250 2259	Ernst Näf (0)1 278 3720 (0)1 278 3770 (0)79 346 5845
	Peter Klasen (0)208 692 2756 (0)208 692 2096 (0)151 1250 2366	Christian Kabisch (0)30 4301 2419 (0)30 4301 2806 (0)151 1250 2355		Dr. Ralf Gödde (0)208 692 2974 (0)208 692 2096 (0)151 1250 2409	Martin Dieudonné (0)208 692 2594 (0)208 692 9056 (0)151 1250 2121	Klemens Fisch (0)1 278 3730 (0)1 278 3770 (0)79 346 5847
	Manfred Manik (0)208 692 9535 (0)208 692 2096 (0)151 1250 2537			Lothar Schwalbe (0)208 692 9533 (0)208 692 2096 (0)151 1250 2418		Kurt Koster (0)1 278 3715 (0)1 278 3770 (0)79 219 9963
Field Service	Frank Haselmeyer (0)208 692 2159 (0)208 692 2982 (0)151 1250 2381	Thorsten Lehmann (0)30 4301 2716 (0)30 4301 2736 (0)151 1250 2085	Bastiaan Beckers (0)1 278 3156 (0)1 278 3045 (0)79 432 4303	Roland Böke (0)208 692 2235 (0)208 692 2096 (0)151 1250 2096	Ulrich Lehmann (0)208 692 2461 (0)208 692 9107 (0)171 351 0012	Alois Casutt (0)1 278 3760 (0)1 278 3770 (0)79 219 9964
	Reiner Witthaus (0)208 692 9412 (0)208 692 2982 (0)151 1250 2385		Javier Castilla (0)1 278 3065 (0)1 278 3045 (0)79 431 7190		Stefan Günther (0)208 692 2704 (0)208 692 9107 (0)151 1250 2330	Stefan Ehrler (0)1 278 3750 (0)1 278 3770 (0)79 346 5848

Figure 1-3 24-hour hotline

Note: For current phone numbers of our After Sales Service see http://www.manturbo.com.

Information in case of enquiries

In case of enquiries to our After Sales Service, please always provide the following data:

- Machine number
- Project code word
- Project number
- Designation of the relevant parts with Tag number or ID number in accordance with the drawings and spare parts lists

If it is necessary to call in our specialists to carry out work or consulting on site, please state an order number in writing or, in urgent cases, by telephone and then submit a written order later.

1.4 Presentation conventions

In the Operating Instructions signal words placed in the column for marginal notes serve to identify text passages of special importance. These presentation conventions are described in the Section below.

1.4.1 Warnings and references for use

Please observe the meaning of the following warnings and references for use:

NOTICE

A Notice indicates information that relates directly or indirectly to the safety of personnel or the protection of property.

- **Observe these Notices to ensure safe and economical operation of the machine unit.**

CAUTION

A warning of this hazard classification indicates a potentially hazardous situation which, if not avoided, may result in damage to property.

- **Follow the instructions in this warning to avoid physical damage to the machine unit.**

⚠CAUTION

A warning of this hazard classification indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

- **Follow the instructions in this warning to avoid personal injury.**

⚠WARNING

A warning of this hazard classification indicates a potentially hazardous situation which, if not avoided, could result in death or serious personal injury.

- **Follow the instructions in this warning to avoid possible danger to life or serious personal injury.**

⚠DANGER

A warning of this hazard classification indicates an immanently hazardous situation which, if not avoided, will inescapably result in death or serious injury.

- **Follow the instructions in this warning to avoid inescapable danger to life or serious personal injury.**

1.4.2 Text markings

Highlighting — Terms or text passages which are important but do not have any influence on safety are written in **bold** letters.

Quotes — Quoted terms, names or titles are written in *italics*.

Links — Links to documents such as e.g. drawings, schematic diagrams or Operating Instructions for Components are shown in red and underlined. Clicking text that is marked in this way opens the relevant document.

Hyperlinks — Hyperlinks (links to pages of the Internet) are written in blue and underlined. Clicking text that is marked in this way opens the corresponding Internet page in your local Internet browser.

Instructions 1, 1.1, ... — *Unconditional* instructions are marked numerically.

Instructions 1a, 1b, ...

Or instructions which may be followed alternatively are additionally marked alphanumerically. One of the work steps stated in this manner shall always be carried out.

Instructions marked with an asterisk (*)

Conditional instructions which shall be carried out under the specified conditions only are marked with an asterisk in addition to the numbering.

Procedures

The beginning of a procedure is marked with the word procedure and the associated number. A procedure is a sequence of actions that have to be performed.

1.4.3 Item numbers und cross-references

Item numbers

Parts in Figures are numbered in clockwise sequence.

References to item numbers

References in the text to item numbers are placed in brackets. They refer to the associated Figure above the text section.

Cross-references to text passages

Cross-references to Chapters, Sections, Figures, Tables, etc. are set in italics. They contain the number of the respective Chapter, Section, Figure, Table, etc.

Tag numbers

In addition to the designation, the components of the machine unit are identified by the Tag No. or PPI No. (power plant identification system number).

1.5 Further literature

In addition to the present Operating Instructions, the scope of documentation of machine unit KOSAIR 2004 includes

- the PMCS Documentation,
- the Quality Documentation,
- and the Installation Manual.

PMCS Documentation

In the separate PMCS Documentation you will find the engineering documents for the electrical, instrumentation, and control systems of the machine unit.

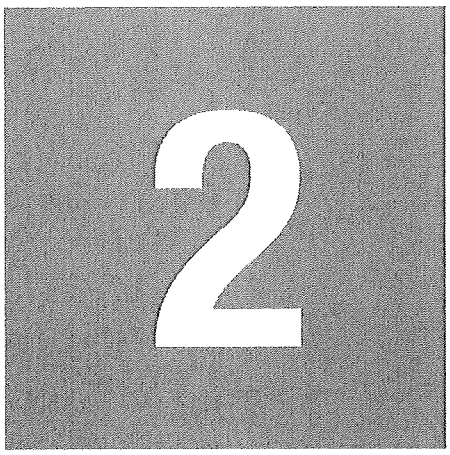
Quality Documentation

The separate Quality Documentation is the collection of material certificates and test records of the machine unit.

Installation Manual

In the separate Installation Manual you will find extensive information concerning the machine unit, on:

- transport, storage, preservation
- foundation preparation
- erection and alignment
- Safety, Health and Environment
- site mobilization,
- and cleaning of pipes.



Safety

This Chapter addresses all users of machine unit KOSAIR 2004. It contains information about the safety concept and the prerequisites for safe and economical use of the machine unit.

2.1 Overview

In *Section 2.2 Safety concept* you will find information on the following subjects:

- *Section 2.2.1 Purpose of machine unit*
- *Section 2.2.2 Operating modes*
- *Section 2.2.3 User roles*
- *Section 2.2.4 Hazard areas*
- *Section 2.2.5 Spheres of responsibility*
- *Section 2.2.6 General safety information*
- *Section 2.3 Residual hazards*
- *Section 2.3.1 Residual hazards to persons*
- *Section 2.3.2 Residual hazards to physical assets and property*

2.2 Safety concept

Machine unit KOSAIR 2004 has been designed and built by MAN TURBO according to the state of the art and the generally accepted safety rules. In spite of this, its use may cause danger to life and hazard of injury to users or third

parties, or may adversely affect the machine unit and other capital goods or assets.

The safety concept of MAN TURBO provides rules on the authorization for utilization and the responsibility of the individual users of the machine unit. The safety concept of the machine unit depends on the intended use of the machine unit and the existing residual hazards. The present Operating Instructions are an essential component part of the safety concept.

Conformity of the machine unit with the safety and health requirements of the EC Machinery Directive and the requirements of the referencing directives is confirmed by the EC conformity declaration or the declaration of the manufacturer. The declaration is included in the separate quality documentation.

2.2.1 Purpose of machine unit

Machine unit KOSAIR 2004 has been exclusively designed and built for the use as defined in *Section 2.2.1.1 Intended use*. For any injury to persons or damage to physical assets and property caused by improper use of the machine unit the Operator / User of the machine unit shall be liable, not the manufacturer.

2.2.1.1 Intended use

Machine unit KOSAIR 2004 is exclusively intended for the compression of air within the technical limits of application.

2.2.1.2 Improper use

Note: Improper use may cause design limits to be exceeded resulting in a risk of severe damage. Damaged machine parts may cause fatal injury.

The following is considered as improper use:

- Any use of the machine unit other than described in *Section 2.2.1.1 Intended use*, without written approval by the manufacturer.
- Any operation outside the technical limits of application.

2.2.2 Operating modes

The operating modes of machine unit KOSAIR 2004 are as follows:

Normal operation

Normal operation is the trouble-free operation of the machine unit according to the intended use.

Special operation

Special operation comprises all operating modes deviating from normal operation:

- Installation
- Commissioning
- Maintenance
- Troubleshooting
- Repair
- Decommissioning
- Dismantling
- Disposal

2.2.3 User roles

For ensuring safety, MAN TURBO specify certain requirements to the users of machine unit KOSAIR 2004. Only persons who satisfy these requirements are authorized to work with the machine unit.

User

All persons who work on the machine unit are designated by MAN TURBO as users. Since the requirements to be met by these users vary considerably depending on their activity, a distinction is made between the following user roles:

Engineering company

The engineering company is the contractual partner of the manufacturer MAN TURBO AG Schweiz. The engineering company designs the overall process plant or parts of it and supplies them to the Operator / User. When purchasing the machine unit, the engineering company may be legally bound by the manufacturer to comply with certain obligations.

Operator / User

The Operator / User is the contractual partner of the engineering company. When purchasing the machine unit, the Operator / User may be legally bound by the engineering company to comply with certain obligations.

Machine operator

The machine operator is a person authorized by the Operator / User, who operates the machine unit in normal operation. The machine operator must have professional training in the technical sector, e.g. as a mechanic, instrumentation technician, electrician, fitter, and been instructed in normal operation of the machine unit.

Service technician

The service technician is a person authorized by the Operator / User who carries out maintenance work and cleaning during special operation, and eliminates malfunctions. The service technician is a skilled person with professional training in the technical sector, e.g. as a mechanic, instrumentation technician, electrician, fitter, and has been instructed in special operation of the machine unit.

MAN TURBO After Sales Service technician

The MAN TURBO After Sales Service technician is an authorized skilled employee of MAN TURBO AG Schweiz. The MAN TURBO After Sales Service technician carries out maintenance work and corrects malfunctions on the machine

unit. The MAN TURBO After Sales Service technician reports to MAN TURBO AG Schweiz.

Technical expert Any person who has concerned himself in detail with the subject matter, who has been trained accordingly, and who - based on his experience - is capable of carrying out certain activities is regarded as a technical expert. This group of persons includes individual, specially trained MAN TURBO employees.

Authorized inspector An authorized inspector is a technical expert who has taken a relevant examination with a supervisory public institution. As a rule this person is a *third party* employee, in Germany e.g. an employee of the TÜV Technical Inspectorate.

Supervisor Specially trained MAN TURBO After Sales Service technician with profound knowledge of your machine unit.

2.2.4 Hazard areas

Overall process plant The Operator / User must define and mark the hazard areas within the overall process plant.

Machine unit The hazard areas of machine unit KOSAIR 2004 are marked in the Overview of Hazard Areas. This will be found in the separate folders *Drawings and Schematic Diagrams*. For an overview of the drawings and schematic diagrams please refer to *Section 8.4 Drawings and schematic diagrams*.

The safety signs on the machine unit have the following meaning:

Warning signs

Symbol	Significance
	Warning of high voltage
	Warning against risk of slipping
	Warning of pressure vessels

Mandatory signs

Symbol	Significance
	Use eye protection
	Wear a safety helmet
	Wear hearing protection
	Observe the Operating Instructions

2.2.5 Spheres of responsibility

Operator / User

After machine unit KOSAIR 2004 has been handed over, the Operator / User shall be responsible for the following aspects of utilization of the machine unit:

- Intended use of the machine unit
- Planning, implementation, and checking of the safety measures (which are required as defined for the intended use)
- Compliance with the requirements specified by MAN TURBO to the users
- Training, authorization, and checking of users of the machine unit
- Assessment of concrete danger to users under the specific working conditions on site
- Carrying out a hazard analysis, taking into consideration
  - concrete danger to users on site
  - generally valid statutory regulations
  - national laws and regulations on accident prevention, occupational safety, and environmental protection
  - regulations on the handling of hazardous substances
  - regulations on protective equipment for the protection of personnel
  - legal regulations on road traffic
- Preparation of service instructions (internal instructions by the Operator / User to the operating personnel), taking into consideration:
  - these Operating Instructions
  - the results of the hazard analysis

- Compliance with all laws, stipulations, regulations, and guidelines applicable on site
- Provision of equipment for the protection of personnel and checking the application of this

Machine operator

The machine operator employed by the Operator / User is responsible for normal operation of machine unit KOSAIR 2004. The work to be carried out by the machine operator is described in *Chapter 4 Normal operation*. Malfunctions which occur during normal operation have to be reported by the machine operator to the service technicians. The machine operator is responsible for using his personal protective equipment.

Service technician

The service technician employed by the Operator / User is responsible for the special operating modes of maintenance, cleaning, and troubleshooting of machine unit KOSAIR 2004. The service technician is responsible for using his personal protective equipment.

Engineering company

The engineering company is responsible for the correct interaction between machine unit and overall process plant.

MAN TURBO After Sales Service technician

The assigned MAN TURBO After Sales Service technician is responsible for the special operating modes of maintenance, troubleshooting, inspection, and service and maintenance. The MAN TURBO After Sales Service technician is authorized to carry out work beyond the scope described in *Chapter 6 Service, maintenance and troubleshooting*.

Technical expert

Based on his expert knowledge the technical expert carries out activities which require special training.

Authorized inspector

The authorized inspector inspects the work carried out by the technical expert and issues relevant certificates. He may, however, also carry out the technical expert's tasks and inspect them himself.

Supervisor

Installation and commissioning of the machine unit are managed by an MAN TURBO supervisor. The supervisor gives on-site directions for safe and cost-effective installation and commissioning.

2.2.6 General safety information

To avoid all hazards to persons and an impairment of machine unit KOSAIR 2004 when putting it to the intended use, the following safety regulations must be observed by the machine unit users:

- Start-up and/or keeping the machine unit in operation only if the machine unit is in technically unobjectionable and operative condition
- Sound protection and safety equipment of the machine unit (no bypassing, modification or disconnection of protection and safety equipment)
- Utilization of the machine unit only for the intended use
- Observance of these Operating Instructions, especially of the safety information

- Availability of these Operating Instructions and service instructions (the Operating Instructions are an essential component part of the machine unit)
- Sound (perfectly legible) safety and warning signs on the machine unit
- Immediate elimination of malfunctions
- Compliance with the maintenance schedule
- Use of original MAN TURBO spare parts for repairs
- Conversions or modifications on the machine unit shall only be made following consultation with and written approval by MAN TURBO
- Provision of workshop equipment for carrying out service and maintenance measures

2.3 Residual hazards

The machine unit ensures a maximum degree of safety. In spite of this, its use may cause danger to life of and hazard of injury to users or third parties, or may adversely affect the machine unit and other capital goods or assets. The remaining residual hazards and appropriate countermeasures are listed in the following Sections.

2.3.1 Residual hazards to persons

⚠ DANGER

Hazard of serious injury or death through sudden release of a large amount of energy in the event of damage!

- **Observe the safety regulations.**
- **Do not stay in the vicinity of the machine unit without necessity.**
- **Eliminate defects on the machine unit immediately.**

⚠ DANGER

Hazard of serious injury or death from coupling rupture due to inadmissibly high moments in the event of a sudden phase change of the main drive motor!

- **Provide a suitable protective function to ensure that the machine unit will be tripped without time lag in case of voltage failure.**
- **Do not stay in the vicinity of the machine unit without necessity.**
- **Only restart the main drive motor after a voltage failure if a rotor residual field no longer exists.**

⚠ DANGER

Hazard of serious injury or death in the event of leakage, resulting from burns by escaping hot process gas!

- **Observe the safety regulations.**
- **Do not stay in the vicinity of the machine unit without necessity.**
- **Eliminate defects on the machine unit immediately.**

⚠ DANGER

Hazard of serious injury or death through electric shock in case of faulty insulation of live parts!

- **Correct defects on the insulation of live parts immediately.**
- **Call in a skilled electrician to eliminate defects in the power supply.**
- **Make sure that live parts cannot get wet.**

⚠ DANGER

Hazard of serious injury or death through entanglement of parts of the body or clothing by unprotected rotating parts!

- **Keep away from rotating parts.**
- **On no account remove the safety covers as well as casings and housings on the machine unit during normal operation.**

⚠ DANGER

Hazard of serious injury or death through sudden release of a large amount of energy during start-up or by keeping the machine unit in operation while safety or monitoring facilities are defective!

- **Shut down the machine unit instantly if defects are detected in safety or monitoring facilities.**
- **Contact the MAN TURBO After Sales Service for repair.**

⚠ DANGER

Hazard of serious injury or death through sudden release of a large amount of energy arising from starting up the machine unit immediately after a trip!

- **Investigate the causes for the trip.**
- **Have an inspection carried out by MAN TURBO After Sales Service technicians if you are unable to determine the causes for the trip.**
- **Do not start up the machine unit again before the cause for the trip has been eliminated.**

⚠ WARNING

Hazard of serious injury or machine damage when safety facilities are disabled!

- **Never bypass any tripping facilities or alarms of the monitoring system.**
- **Reset alarms only after the cause of the alarm has been eliminated.**

⚠WARNING

Hazard of burns from contact with hot parts of the machine unit!

- **Observe the safety regulations.**
- **Keep protective equipment in good order.**
- **On no account remove the protective equipment during normal operation.**

⚠WARNING

Risk of hearing damage by exposure to noise without ear protectors!

- **Near the machine unit in the marked noise area always wear the specified hearing protection.**
- **On no account remove the noise control equipment during normal operation.**

⚠WARNING

Hazard of poisoning, acid burns or burns through improper handling of consumables!

- **Wear your personal protective equipment.**
- **Observe the safety regulations issued by the manufacturer for the respective consumable.**

⚠WARNING

Hazard of serious injury or machine damage in case of inadequate inspections or improper repair work on the machine unit!

- **Have inspections and repairs on the machine unit carried out by trained and skilled personnel only.**
- **Always contact the MAN TURBO After Sales Service.**
- **Use original MAN TURBO spare parts only.**

⚠WARNING

Hazard of injury from slipping or falling down from higher-level machine parts.

- **Be particularly careful when moving near the machine unit.**
- **Watch out for leakages.**

⚠WARNING

Hazard of serious injury or death in case of improper execution of maintenance work!

- **Have maintenance work carried out by trained and skilled personnel only.**
- **Use original MAN TURBO spare parts only.**

⚠WARNING

Hazard of burns from contact with hot plant unit components!

- **Always wait until the shut-down machine unit has cooled down sufficiently before carrying out the oil change.**

⚠WARNING

Hazard of injury to the respiratory system from inhalation of oil mist!

- **Follow the safety instructions for entering tanks.**
- **Prior to entering, verify that permission for entering the oil tank has been given.**
- **Put on the required protective clothing and protective equipment.**
- **Permit the oil mist to escape, and test the atmosphere in the oil tank before entering.**
- **Ensure adequate ventilation of the oil tank.**

⚠WARNING

Hazard of injury from falls by slipping on the oily tank bottom!

- **When working on the inclined bottom inside the oil tank take utmost care to avoid slipping.**

⚠WARNING

Hazard of injury from falls by slipping on oily ground!

- **Remove any oil leakage immediately.**

⚠WARNING

Hazard of serious injury or risk of machine damage in case of improper execution of inspection work!

- **Do not under any circumstances disable or dismantle the safety facilities of the machine unit during inspection stage 1.**

⚠WARNING

Hazard of serious injury or risk of machine damage in case of inspections carried out on the non-secured machine unit!

- **Before start of work, secure the machine against start-up, e.g. by fitting a lock to the main switch.**

⚠WARNING

Hazard of serious injury or death in case of improper elimination of malfunctions!

- **Have malfunctions which you cannot eliminate yourself corrected by MAN TURBO After Sales Service technicians.**

⚠ WARNING

Hazard of serious injury or death in case of improper repair work on the machine unit!

- Always contact the MAN TURBO After Sales Service to carry out repair work.
- Use original MAN TURBO spare parts only.

⚠ CAUTION

Hazard of injury or risk of environmental damage when handling substances hazardous to health and/or the environment!

- Ensure proper disposal of all substances.
- Observe the national regulations for disposal.

2.3.2 Residual hazards to physical assets and property

CAUTION

Risk of machine damage from lacking oil supply in the event of power failure!

- Back up power supply to the oil pumps by an emergency power supply system.

CAUTION

Risk of leakages resulting from damage.

- Never step on pipes, valves and fittings, instruments, piping or electric lines.

CAUTION

Risk of machine damage through impermissibly high forces and moments in case of misalignment!

- Make sure that alignment of the piping is correct.

CAUTION

Risk of damage to the oil pump drives through overload caused by viscous oil!

- Do not switch on the oil pumps before the oil has reached a temperature of at least 10°C.

CAUTION

Risk of machine damage through malfunctions of the oil system if the oil filters are clogged!

- Change or clean fouled oil filters.

CAUTION

Risk of damage to the oil cooler through fouling by sludge in case of inadequate water flow!

- Always keep the shut-off valves in the cooling water circuit fully open.

CAUTION

Risk of loads on the machine unit if the emergency-stop button is actuated without necessity!

- Do not shut down the machine unit by actuating the emergency-stop button except in case of emergency.

CAUTION

Risk of machine damage if the oil system is shut down prematurely!

- Do not shut down the oil system until the pressure inside the machines is equal to atmospheric pressure.

CAUTION

Risk of bearing or shaft damage if the oil system is shut down prematurely!

- Do not shut down the oil system until all the machine bearings have cooled off sufficiently.

CAUTION

Risk of contamination of process gas carrying spaces by oil if the oil mist separator is switched off prematurely!

- Keep the fan of the oil mist separator in operation until the oil mist has escaped from the oil system.

CAUTION

Risk of machine damage due to inadequate oil supply if there is sludge in the oil filter or if the oil filter is frozen!

- Always keep the shut-off valves in the cooling water circuit fully open.
- Ensure that the specified cooling water temperature is maintained also in winter.

CAUTION

Risk of machine damage through entry of oil if the seal air system is shut down prematurely!

- Continue seal air admission to the oil-side shaft seal until the oil pressure has decreased to atmospheric pressure after the oil system has been shut down.

CAUTION

Hazard of environmental pollution through condensed water containing oil and pollutants!

- **Collect the draining condensed water in a suitable collecting vessel.**
- **Dispose of the condensed water without hazard to the environment.**

CAUTION

Risk of machine damage through organometallic compounds in the oil!

- **Use only oil without organometallic compounds.**
- **Use oil which meets the quality requirements.**

CAUTION

Risk of machine damage through contaminants in the oil!

- **Ensure that the equipment used for filling and for transport is perfectly clean.**
- **Top up oil through a filter of the same mesh as that of the oil filter element only.**

CAUTION

Risk of machine damage if oil mixtures or other than the known oil brands are used!

- **Always use the same oil brand.**
- **Fill the oil system with one and the same brand of oil only.**
- **Clean the oil system before using a different oil brand.**

CAUTION

Risk of machine damage through malfunctioning of the oil supply if the oil level in the oil tank is too high!

- Never top up oil above the maximum level mark.

CAUTION

Hazard of environmental pollution through used oil getting into the sewage system!

- Collect the drained oil in suitable collecting vessels.
- Dispose of the used oil without hazard to the environment.

CAUTION

Risk of damage to the machine bearings through contaminated oil if the oil is filled in incorrectly!

- Ensure that the equipment used for filling and for transport is perfectly clean.
- Fill in the oil through a filter of the same mesh as that of the oil filter element in the oil system only.

CAUTION

Risk of damage to the machine bearings if another than the correct oil is used!

- For the oil change always use oil of the same quality as that used for the initial fill of the oil system.

CAUTION

Hazard of environmental pollution through drained oil getting into the sewage system!

- Collect the draining oil in a suitable collecting vessel.
- Dispose of the oil without hazard to the environment.

CAUTION

Risk of machine damage in case of improper execution of maintenance work!

- **Have cleaning of the oil coolers carried out by the MAN TURBO After Sales Service or by a specialist firm only.**

3

Design and function

This Chapter addresses the machine operator of machine unit KOSAIR 2004. It shows the design and describes the function of the machine unit.

3.1 Overview

In *Section 3.2 Design* you will find information on the following subjects:

- *Section 3.2.1 Machine unit*
- *Section 3.2.2 Components*
- *Section 3.2.3 Operator controls*

In *Section 3.3 Function* you will find information on the following subjects:

- *Section 3.3.1 Functional principle*
- *Section 3.3.2 Machine unit*
- *Section 3.3.3 Components*
- *Section 3.3.4 Operator controls*

3.2 Design

The following Sections describe the design of machine unit KOSAIR 2004 and of its components.

3.2.1 Machine unit

The following overview shows machine unit KOSAIR 2004 and the arrangement of its components. Components and auxiliary systems which are not mounted directly on the machine unit are not shown.

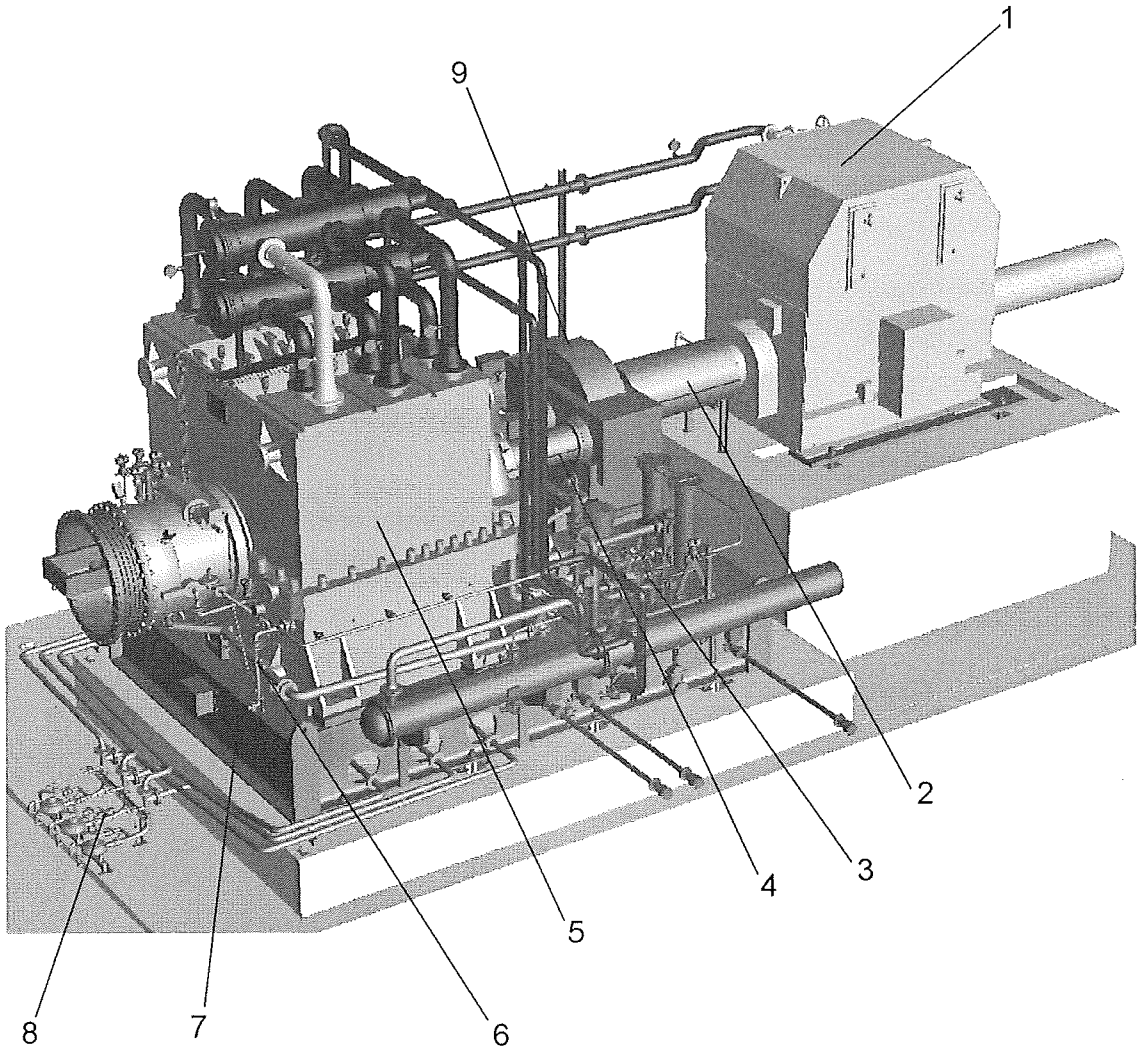


Figure 3-1 Overview of machine unit KOSAIR 2004

1	Main drive motor
2	Coupling 1 with coupling guard
3	Oil system
4	Coupling 2 with coupling guard
5	Compressor
6	Seal air system

7 Base frame of compressor

8 Draining system

9 Gear unit

Apart from the components shown in *Figure 3-1 Overview of machine unit KOSAIR 2004*, machine unit KOSAIR 2004 includes the following components and auxiliary systems:

- Process gas system
- Monitoring system
- Control system

For an overview of the machine unit also refer to the General Arrangement drawing; see *Section 8.4 Drawings and schematic diagrams*.

3.2.2 Components

You will find the overview of the Operating Instructions for Components in *Section 8.5 Operating Instructions for Components*.

Main drive motor (Item 1)

Main drive motor M 11001 is a water-cooled asynchronous motor. The main drive motor is mounted directly on the foundation.

A detailed description will be found in the manufacturer's operating instructions.

Coupling 1 (Item 2)

Coupling 1 is a flexible steel multiple disc clutch.

For a detailed description please refer to the Operating Instructions for Coupling 1.

Coupling 2 (Item 4)

Coupling 2 is a rigid coupling.

Gear unit (Item 9)

The gear unit is a single helical spur gear unit. The gear unit is mounted on the base frame of the compressor.

For a detailed description please refer to the Operating Instructions for Gear Unit.

Compressor (Item 5)

The compressor is a 4-stage single-shaft centrifugal compressor with horizontally split casing of RIK 80 type.

An inlet diffuser is located at the compressor suction end.

The compressor is mounted on a separate base frame.

A detailed description will be found in the Operating Instructions for Compressor.

Oil system (Item 3)

The oil system comprises the following main component parts:

- Oil tank B 11800
- Oil heater W 11810
- Oil mist separator, consisting of filter, vacuum pump, and drive motor M 11803
- Main oil pump, positively driven by the gear unit
- Auxiliary oil pump P 11820 with drive motor M 11820
- Oil cooler W 11839, water-cooled
- Double oil filter F 11852
- Oil pressure control valve PCV 11873
- Oil temperature control valve TCV 11845
- Oil pressure safety valve Z 11824
- Filler/Breather 20.035

The oil system is mounted on the base frame of the compressor.

For a detailed description please refer to the Operating Instructions for Oil System.

Seal air system (Item 6)

The seal air system consists of component parts and piping which are mounted on an instrument rack. The seal air system consists of the following main component parts:

- Seal air control valve PCV 11751 for seal air to the oil-side shaft seal
- Seal air control valve PCV 11753 for seal air to the oil-side shaft seal
- Non-return valve R 11751
- Non-return valve in the pipe between compressor and seal R 11752
- Pressure gauge in supply pipe PI 11752
- Pressure transmitter in return pipe PIT 11754

The seal air system is mounted on the compressor casing.

Process gas system

The process gas system is established by the Operator / User of plant unit KOSAIR 2004. The MAN TURBO scope of supply includes the following component parts of the process gas system:

- Non-return valve at discharge end

Monitoring system

The monitoring system consists of the following component parts:

- Measured value transmitter for monitoring the vibrations of the machine train shafts
- Measured value transmitter for axial displacement monitoring of the machine train shafts
- Measured value transmitter for temperature monitoring of the shaft bearings of the machine train

The VDUs of the monitoring system are located in the control room of the overall process plant.

Control system

The control system of machine unit KOSAIR 2004 is provided by the Operator / User of the overall process plant. Only the anti-surge control is supplied by MAN TURBO.

The control system is located in the control room of the overall process plant.

For a detailed description please refer to the manufacturer's operating instructions.

Draining system (Item 8)

The draining system consists of the following component parts:

- Drain piping
- Drain valves
- Level control
- Condensate traps

3.2.3 Operator controls

The operator controls of the machine unit are arranged as follows:

Emergency-stop button

The emergency-stop button is arranged on the machine unit.

Local instruments and valves/fittings

Local instruments and valves/fittings are arranged on the base frame and on the piping.

For further information about the location of the operator controls refer to the General Arrangement. For an overview of the drawings and schematic diagrams of the machine unit please refer to *Section 8.4 Drawings and schematic diagrams*.

For an overview of the Operating Instructions for Components please refer to *Section 8.5 Operating Instructions for Components*.

3.3 Function

The functional description enables you to understand the tasks of the machine unit and its components.

3.3.1 Functional principle

The functional principle of machine unit KOSAIR 2004 is based on energy being transmitted to the process gas by the conversion of electrical energy.

3.3.2 Machine unit

Air separation

The machine unit is used for the compression of atmospheric air in an air separation plant.

3.3.3 Components

You will find the overview of the Operating Instructions for Components in *Section 8.5 Operating Instructions for Components*.

Main drive motor (Item 1)

The electric motor converts electrical energy into mechanical energy. Main drive motor M 11001 drives the machine train.

A detailed description will be found in the manufacturer's operating instructions.

Coupling 1 (Item 2)

Equalizing shaft misalignment, coupling 1 transmits the torque via flexible steel multi-disc packages. Coupling 1 transmits speed and torque from the main drive motor to the gear unit.

For a detailed description please refer to the Operating Instructions for Coupling 1.

Coupling 2 (Item 4)

Coupling 2 transmits the torque entirely rigidly and at the same time transmits the shaft axial thrust. Coupling 2 transmits speed and torque from the gear unit to the compressor.

Gear unit (Item 9)

The gear unit converts and transmits movement and torque from the driver to the driven machine. The gear unit increases the drive speed to the operating speed of the driven machine.

For a detailed description please refer to the Operating Instructions for Gear Unit.

Compressor (Item 5)

The compressor operates as a fluid flow machine. It compresses process gas according to the dynamic principle. The mechanical energy supplied by the driver is transmitted to the process gas in the impellers of the compressor. After its discharge from the impellers the accelerated process gas is collected in the volutes where the acceleration is converted into pressure.

The compressor compresses the process gas in 4 stages and produces the specified discharge pressure of the process gas. Process gas coolers integrated in the compressor casing reduce the temperature of the process gas between the stages.

A detailed description will be found in the Operating Instructions for Compressor.

Oil system (Item 3)

The oil system is designed for closed oil circulation which is maintained by pumps. The oil system supplies oil to the following components of the machine unit:

- Lube oil system

For a detailed description please refer to the Operating Instructions for Oil System.

Seal air system (Item 6)

The seal air system controls the seal air flow by means of valves and monitors it by means of measuring instruments. The seal air system

- during standstill supplies the labyrinth seals of the compressor via a pressure control valve with instrument air
- monitors the pressure via a pressure gauge
- prevents oil from escaping from the shaft bearings
- during operation supplies the oil-side shaft seals of the compressor via a pressure control valve with seal air from the process
- routes the leakage gas escaping from the labyrinth seals to the atmospheric vent.

Process gas system

The components of the process gas system cool, control, and monitor the process gas flow. The components of the process gas system have the following functions:

- A non-return valve prevents process gas from flowing back into the discharge pipe during standstill of the machine train.

Monitoring system

The monitoring system of the machine unit ensures that machine malfunctions are detected at an early stage. During operation of the plant unit the monitoring system constantly monitors the operating values listed below.

- Bearing temperatures
  - Gear unit
  - Compressor
- Shaft vibrations
  - Gear unit
  - Compressor
- Axial shaft positions
  - Gear unit

Depending on the design, an audible or also a visual alarm is signalled when permissible limit values are exceeded; see *Section 6.4 Malfunctions*.

Critical operating values lead to tripping of the machine unit; see Alarm and Signal List.

Control system

During machine operation the control system performs the following monitoring and open- and closed-loop control functions:

- *Anti-surge control*

The compressor is protected by an anti-surge control. The anti-surge control prevents surging of the compressor by opening the blow-off valve, discharging process gas via the blow-off silencer to the atmosphere.

For a detailed description please refer to the manufacturer's operating instructions.

Draining system (Item 8)

The draining system automatically routes off condensate. The draining system removes condensate from the compressor and the connected piping in all operating modes of machine unit KOSAIR 2004.

3.3.4 Operator controls

Emergency-stop button

The emergency-stop button enables a trip. On actuation of one of the emergency-stop buttons, the machine unit is shut down non-controlled within a minimum period of time.

Local instruments and valves/fittings

The local instruments show measuring values or transmit measuring values to the monitoring and control systems. The local valves/fittings permit regulation of the flow media.

Normal operation

4

Normal operation

This Chapter addresses the machine operator. It provides all the information required for safe and trouble-free use of the machine unit during normal operation.

4.1 Overview

In *Section 4.2 Normal operation* you will find information on the following subjects:

- *Section 4.2.1 Prerequisites for start-up*
- *Section 4.2.2 Start-up*
- *Section 4.2.3 Checks of operation*
- *Section 4.2.4 Shut-down in an emergency*
- *Section 4.2.5 Shut-down from normal operation*

4.2 Normal operation

Before starting up the machine unit you have to make preparations and establish the preconditions for start-up as described in *Section 4.2.1 Prerequisites for start-up*.

Section 4.2.2 Start-up describes step by step how to put the machine unit into normal operation. The checks you have to perform are detailed in *Section 4.2.3 Checks of operation*.

In *Section 4.2.4 Shut-down in an emergency* and *Section 4.2.5 Shut-down from normal operation* you will find information about how to shut down the machine unit.

Note: After commissioning MAN TURBO supplement the following Sections by the data of the start-up procedure which is established during commissioning jointly by the Operator / User and the MAN TURBO After Sales Service technician.

4.2.1 Prerequisites for start-up

1 Carry out the following procedures:

- *Procedure 4-1 Preparation of machine unit*
- *Procedure 4-2 Supplying the machine unit with energy and operating media*
- *Procedure 4-3 Enabling the monitoring and control systems*
- *Procedure 4-4 Draining the machine unit*
- *Procedure 4-5 Starting up the seal air system*
- *Procedure 4-6 Starting up the oil system*
- *Procedure 4-7 Setting further components ready for operation*

Once you have successfully completed all the above procedures, the machine unit is prepared for start-up as described in *Section 4.2.2 Start-up*.

Procedure 4-1 Preparation of machine unit

Responsibility Machine operator

Prerequisites All items in the following list must be satisfied:

- Installation completed
- Commissioning completed
  - Initial operation carried out
  - Handover to Operator / User effected
  - Machine unit depressurized
  - Overall process plant ready for operation

1 Keep an operation log with the following data:

- Time, date, and person responsible for the following activities:
  - Start-ups
  - Shut-downs
  - Operating hours
  - Coast-down times
  - Measures initiated for standstill periods
  - Malfunctions

- Trips by the monitoring system and respective causes
- Leakages
- Manual interventions into the control system of the machine unit
- Maintenance work
- Inspections
- Repairs
- Modifications
- Spare parts used

2* If the standstill period of the machine unit exceeded 6 months: Have the machine unit started up by an MAN TURBO After Sales Service technician.

3 Check the machine unit for the following points:

- Leakages
- Damage
- Corrosion damage
- Damage to protective coating or coats of paint

4* If leakage or damage is detected: Have the leakage or damage eliminated by the service technician.

CAUTION

Risk of machine damage through impermissibly high forces and moments in case of misalignment!

- **Make sure that alignment of the piping is correct.**

5 Check that the following parts of the machine unit are securely mounted, correctly aligned and lubricated where necessary:

- Piping supports
- Springs
- Guides
- etc.

6* If parts are loose, misaligned or not lubricated: Have the defects eliminated by the service technician.

Procedure 4-1 Preparation of machine unit has been completed.

Procedure 4-2 Supplying the machine unit with energy and operating media

Responsibility Machine operator

Prerequisites *Procedure 4-1 Preparation of machine unit* has been carried out.

1 Provide the following required energies and operating media of the specified quality at the final consumers:

- High voltage
- Low voltage
- Control voltage
- Instrument air
- Cooling water
- Lube oil

2 Open all shut-off valves in the impulse lines to the instruments.

3 Open all shut-off valves on the instruments.

4 Close all vent valves on the instruments.

5 Close all compensating valves on the instruments.

Note: For details about the required energies and operating media please refer to the Consumer List.

Procedure 4-2 Supplying the machine unit with energy and operating media has been completed.

Procedure 4-3 Enabling the monitoring and control systems

Responsibility Machine operator

Prerequisites *Procedure 4-2 Supplying the machine unit with energy and operating media* has been carried out.

1 Start up the monitoring and control systems according to the manufacturer's instructions.

2 Select the desired operating mode:

- Automatic mode
- Manual mode

Procedure 4-3 Enabling the monitoring and control systems has been completed.

Procedure 4-4 Draining the machine unit

Responsibility Machine operator

Prerequisites *Procedure 4-3 Enabling the monitoring and control systems* has been carried out.

1 Open the shut-off valves in the drain pipes of the following component parts of the machine unit.

- Process piping (not included in the MAN TURBO scope of supply)
- Process gas cooler

2 Wait until liquid does not escape any longer.

3 Close the shut-off valves in the drain pipes.

Note: Instructions for draining these component parts will be found in the corresponding Operating Instructions for Components, see *Section 8.5 Operating Instructions for Components*.

Procedure 4-4 Draining the machine unit has been completed.

Procedure 4-5 Starting up the seal air system

Responsibility Machine operator

Prerequisites *Procedure 4-4 Draining the machine unit* has been carried out.

1 Set all valves of the seal air piping to operating position.

The correct operating positions are shown in the P&I Diagram.

2 Open the shut-off valves in the instrument air supply pipe to the seal air system.

Procedure 4-5 Starting up the seal air system has been completed.

Procedure 4-6 Starting up the oil system

Responsibility Machine operator

Prerequisites *Procedure 4-5 Starting up the seal air system* has been carried out.

NOTICE

When starting up the oil system also note the following in addition to the instructions given in this Section:

- **the Operating Instructions for Oil System in *Section 8.5 Operating Instructions for Components***
- **the Operating Instructions for Main Oil Pump in the Operating Instructions for Gear Unit in *Section 8.5 Operating Instructions for Components***
- **the Alarm and Signal List in *Section 8.4 Drawings and schematic diagrams***

1 Have *Procedure 6-2 Checking the oil level in the oil tank* (see *Section 6.2 Maintenance*) carried out by the service technician.

2* Oil level indicated by level indicator LG 11813 is too low: Have *Procedure 6-3 Topping up oil* carried out by the service technician.

3 Switch on oil heater W 11810.

4 Set all valves at operating position.

The correct operating positions are shown in the P&I Diagram.

5 Start up drive motor M 11803 of the oil mist separator.

6 Set the bypass flow valve on the suction pipe of the oil mist separator such that a negative pressure of 5-10 mbar is obtained in the oil tank.

Note: The oil mist separator has reached its optimum operating condition when the filter element is saturated with oil.

7 Open valve V 11871 in the bypass pipe of oil pressure control valve PCV 11873.

8 Check the oil temperature in oil tank B 11800 on the local thermometer.

CAUTION

Risk of damage to the oil pump drives through overload caused by viscous oil!

- **Do not switch on the oil pumps before the oil has reached a temperature of at least 10°C.**

9 Continue with the next work step when the oil temperature in the oil tank has reached at least 10°C.

CAUTION

Risk of machine damage through entry of oil if the auxiliary oil pump is switched on prematurely!

- **Switch on the auxiliary oil pump only after seal air supply to the oil-side shaft seals is ensured.**

10 Cut in auxiliary oil pump P 11820.

11 Check the oil temperature in oil tank B 11800 on the local thermometer.

12 Wait until the oil temperature in the oil tank has reached at least 20°C.

Note: The cold oil in the oil system has to be displaced slowly.

13 Slowly close valve V 11871 in the bypass line of oil pressure control valve PCV 11873.

14 Check the differential pressure on differential pressure gauge PDIS 11846 of the oil filter.

CAUTION

Risk of machine damage through malfunctions of the oil system if the oil filters are clogged!

- **Change or clean clogged oil filters before continuing with starting up the oil system.**

15* Differential pressure too high: Carry out *Procedure 6-6 Changing the oil filter element* in *Section 6.2.2 Maintenance work*.

16 Vent oil cooler W 11839 on the oil side as follows:

16.1 Open the oil-side vent valve.

16.2 Wait until air is no longer visible in the sight glass of the oil return pipe.

16.3 Close the oil-side vent valve.

17 Vent oil cooler W 11839 on the water side as follows:

CAUTION

Risk of damage to the oil cooler through fouling by sludge in case of inadequate water flow!

- **Always keep the shut-off valves in the cooling water circuit fully open.**

17.1 Open the shut-off valve in the cooling water supply pipe to the oil cooler.

17.2 Open the water-side vent valve.

17.3 Wait until water only escapes from the vent valve.

17.4 Close the water-side vent valve.

18 Vent oil filter F 11852 as follows:

18.1 Open the vent valve of the oil filter through which the oil flows.

18.2 Wait until air is no longer visible in the sight glass of the oil return pipe.

18.3 Listen for any noise which is indicative of air bubbles.

18.4 Close the vent valve.

18.5 Change operation over to the other oil filter.

18.6 Repeat *Step 18.1* to *Step 18.5* several times until air is no longer visible in the sight glass of the oil return pipe and there is no more noise to be heard which is indicative of air bubbles.

18.7 Re-open the vent valve of the oil filter through which the oil flows.

NOTICE

As long as the oil temperature is below the operating temperature, the differential pressure instrument will show a higher value than under operating conditions.

19 Vent the impulse line for oil pressure control valve PCV 11873.

20 Test the auxiliary oil pump for correct function.

21 Check the sight glasses in the oil drains for oil flow.

22* If there is no oil flow in the oil drains: Have the malfunction eliminated immediately.

23 Check the supply oil pressures in the supply lines to the bearings.

Note: For normal supply oil pressure values see Alarm and Signal List in *Section 8.4 Drawings and schematic diagrams*.

24* If the supply oil pressure is not in the normal range: Have the malfunction eliminated immediately.

25 Check the supply oil temperature in the supply lines to the bearings.

Note: For normal supply oil temperature values see Alarm and Signal List in *Section 8.4 Drawings and schematic diagrams*.

26* Oil feed temperature not in the normal range: Have the malfunction eliminated immediately.

27 Wait until at least the minimum oil temperature required for start-up of the machine unit has been reached.

Note: For the values required for starting up the machine unit see the Alarm and Signal List in *Section 8.4 Drawings and schematic diagrams*.

Procedure 4-6 Starting up the oil system has been completed.

Procedure 4-7 Setting further components ready for operation

Responsibility Machine operator

Prerequisites *Procedure 4-6 Starting up the oil system* has been carried out. The following components must be ready for operation:

- Main drive motor M 11001, see manufacturer's operating instructions.
- Coupling 1, see Operating Instructions for Coupling 1.
- Gear unit, see Operating Instructions for Gear Unit.
- Coupling 2.
- Compressor, see Operating Instructions for Compressor.

1 Open the discharge end shut-off valves in the process gas piping.

2 Establish the specified operating conditions for process gas operation of the machine unit.

3 Set all valves of the condensate traps to operating position according to the P&I Diagram. For further information refer to the Operating Instructions for Condensate Traps.

Procedure 4-7 Setting further components ready for operation has been completed.

When all procedures have been completed, the machine unit may be started up.

4.2.2 Start-up

Procedure 4-8 Starting up the machine train

Responsibility Machine operator

Prerequisites All procedures from *Section 4.2.1 Prerequisites for start-up* have been carried out. Further, the following applies:

- Inlet guide vanes are in start-up position
- Anti-surge valve is open

1 Make sure that the start-up interlocks have been released by the control system of the machine unit.

2 Check the indicators for alarm signals.

3* In the case of alarm signals which are not due to standstill of the machine unit: Eliminate the malfunction and then reset the alarms.

4* The start-up interlock is active. Check whether the following conditions are satisfied:

- Oil temperature ok TAL 11854
- Bearing seal air pressure ok PAL 11754
- Inlet guide vanes in start-up position GSL 11010
- Anti-surge valve open GSAH 11074
- Compressor at standstill
- Main drive motor is ready for operation -signal from main drive motor-
- Oil mist separator switched on -signal from MCC-
- None of the shut-down conditions satisfied

Note: Observe *Section 6.4.2 Troubleshooting*.

Display -Compressor Train ready for Start-up- on MCC

5 Switch on the main drive motor (Compressor Train Start).

Note: The start-up interlock prevents the machine train from being started up if the prerequisites for start-up are not satisfied.

When the main drive motor has been synchronised, message -Main Motor Synchronised- is displayed.

6 Check the following operating values as soon as the compressor train has reached its rated speed:

- Oil pressure on PIT 11854 and PT 11747
- Shaft vibrations on XT 11747, 11745, 11743, 11740
- Axial shaft positions on GT 11742
- Bearing temperatures on TE 11747, 11745, 11743, 11740, 11737, 11735, 11733, 11730
- Bearing seal air pressure on PIT 11754
- Air temperature at compressor discharge end on TE 11041

7 When all operating values are in the normal range: Switch the compressor train to -Normal Operation-.

With increasing speed of the main drive motor the blow-off valve closes

and the inlet guide vanes open.

8 Adjust the seal gas supply to the specified set-points; see Operating Instructions for Compressor.

Note: Once the machine unit has been started up, seal air supply is changed over to internal air supply.

9 Switch off oil heater W 11810.

10 Switch auxiliary oil pump P 11820 to automatic mode.

Note: The positively driven main oil pump has taken over oil supply.

Procedure 4-8 Starting up the machine train has been completed.

4.2.3 Checks of operation

The monitoring system and the control system check the major operating values of the machine unit. Alarms are signalled if inadmissible operating values occur.

Note: Eliminate malfunctions immediately; see *Section 6.4.2 Troubleshooting*.

Note: For information about alarm and limit values for operation of the machine unit please refer to the Alarm and Signal List; see *Section 8.4 Drawings and schematic diagrams*.

1 Carry out the following procedures at the specified time intervals:

- *Procedure 4-9 Hourly operation check*
- *Procedure 4-10 Daily operation check*

2 Have the maintenance work according to *Section 6.2 Maintenance* carried out by the service technician.

3 Have the inspections according to *Section 6.3 Inspection* carried out by the MAN TURBO After Sales Service technician.

Procedure 4-9 Hourly operation check

Responsibility Machine operator
Prerequisites Machine unit has been started up.

1 Regularly check the operating values of the monitoring system, the control system and the machine unit.

2* If automatic recording of operating values is not provided: Enter the operating values hourly into the operation log.

Note: This puts you in a position to quickly react to changes in the operating values and to identify trends.

Procedure 4-9 Hourly operation check has been completed.

Procedure 4-10 Daily operation check

Responsibility Machine operator
Prerequisites None

1 Inspect the machine unit for visible leakages.

2* If leakage is detected: Immediately inform the service technician and have the cause of the leakage eliminated.

3 Have *Procedure 6-2 Checking the oil level in the oil tank* in *Section 6.2.2 Maintenance work* carried out by the service technician.

4 Check the fastening bolts of the machine unit.

5* If fastening bolts are loose: Tighten the fastening bolts.

6 Carry out daily checks by reference to the following check list:

Note: The following indicators must be checked directly since they are not connected to the monitoring system or the control system of the machine unit. In case of deviations from the setpoint, instruct the service technician to carry out maintenance work according to *Section 6.2.2 Maintenance work*. The operator shall only carry out checks; for the performance of maintenance work and the elimination of malfunctions the service technician or the MAN TURBO After Sales Service technician shall be responsible.

a	Differential pressure across oil filter F 11852	Check
b*	Differential pressure too high	Carry out *Procedure 6-6 Changing the oil filter element*
c	Oil level on oil level indicator LG 11813	Check
d*	Oil level too low	Carry out *Procedure 6-3 Topping up oil*

Procedure 4-10 Daily operation check has been completed.

4.2.4 Shut-down in an emergency

In case of a technical malfunction the machine unit is tripped by the control system. The following malfunctions result in tripping of the machine unit:

- LUBE OIL PRESSURE LOW LOW
- COMPRESSOR SS VIBRATION HIGH HIGH
- COMPRESSOR DS VIBRATION HIGH HIGH
- GEAR HSS DE VIBRATION HIGH HIGH
- GEAR HSS NDE VIBRATION HIGH HIGH
- AXIAL DISPLACEMENT HIGH HIGH
- COMPRESSOR SS BEARING TEMP. HIGH HIGH
- COMPRESSOR DS BEARING TEMP. HIGH HIGH
- GEAR HSS DE BEARING TEMP. HIGH HIGH
- GEAR HSS NDE BEARING TEMP. HIGH HIGH
- THRUST BEARING O/B TEMPERATURE HIGH HIGH
- THRUST BEARING I/B TEMPERATURE HIGH HIGH
- GEAR LSS NDE BEARING TEMP. HIGH HIGH
- GEAR LSS DE BEARING TEMP. HIGH HIGH
- COMPR. DISCHARGE TEMPERATURE HIGH HIGH
- TRIP FROM MOTOR INSTRUMENTATION - (CLIENT'S SCOPE OF SUPPLY)
- DRIVING MOTOR TRIP

Note: If the set safety limit values are reached, this points to malfunctions on the machine unit. Keeping in operation or renewed start-up may cause a large amount of energy to be released as a result of machine damage, which may lead to serious injury or even death.

In the case of impending danger to people or in the case of malfunctions which do not result in tripping of the machine unit, the machine unit must be shut down by actuation of the EMERGENCY-STOP button.

Procedure 4-11 Shutting down the machine train in an emergency

Responsibility Machine operator

Prerequisites Risk of imminent danger! Machine train has been started up. Trip was not triggered.

1 Actuate the emergency-stop button.

Note: If danger is not imminent, shut down the machine unit in the normal way; see *Section 4.2.5 Shut-down from normal operation*.

After having actuated the emergency-stop button or in case of tripping through the monitoring system or the control system, the machine unit is shut down as quickly as possible. In this case the following steps are executed automatically:

- Energy supply to main drive motor M 11001 is interrupted.
- The blow-off valve opens.
- The inlet guide vanes move to start-up position.
- The machine train coasts down to complete standstill.
- The oil pumps of the oil system remain switched on.

⚠ DANGER

Hazard of serious injury or death through sudden release of a large amount of energy arising from starting up the machine unit immediately after a trip!

- **Investigate the causes for the trip.**
- **Have an inspection carried out by MAN TURBO After Sales Service technicians if you are unable to determine the causes for the trip.**
- **Do not start up the machine unit again before the cause for the trip has been eliminated.**

2 Carry out *Procedure 4-10 Daily operation check* in *Section 4.2.3 Checks of operation*.

3 Depending on operational requirements carry out the procedures described in *Section 4.2.5.1 Measures for standstill periods*.

Procedure 4-11 Shutting down the machine train in an emergency has been completed.

4.2.5 Shut-down from normal operation

For shut-down from normal operation you first have to carry out *Procedure 4-12 Shutting down the machine train*. Depending on operational requirements further processes follow as described in *Section 4.2.5.1 Measures for standstill periods*.

Procedure 4-12 Shutting down the machine train

Responsibility Machine operator

Prerequisites Machine train has been started up.

CAUTION

Risk of loads on the machine unit if the emergency-stop button is actuated without necessity!

- **Do not shut down the machine unit by actuating the emergency-stop button except in case of emergency.**
- **For shut-down of the machine unit follow the instructions in this Section.**

1 Switch off main drive motor M 11001. As a result, the following processes are executed:

- The motor speed decreases
- The compressor is set to blow-off operation so that the blow-off valve is fully open.
- The inlet guide vanes close.

2 Measure the coast-down time of the machine train and enter the value into the operation log.

3 Wait until the machine train has come to complete standstill.

4 Carry out *Procedure 4-10 Daily operation check* in *Section 4.2.3 Checks of operation*.

5 Depending on operational requirements carry out the procedures described in *Section 4.2.5.1 Measures for standstill periods*.

Procedure 4-12 Shutting down the machine train has been completed.

4.2.5.1 Measures for standstill periods

Depending on operational requirements different procedures described in this Section have to be carried out.

1 In the case of standstill periods of the machine unit of up to 4 weeks, protect the machine unit from:

- detrimental external influences
- mechanical damage
- corrosion
- condensate
- soiling
- dust
- entry of foreign matter
- current passage

2* In the case of standstill periods exceeding 4 weeks, carry out the following procedures:

- *Procedure 4-13 Isolating the process gas system from the overall process plant*
- *Procedure 4-14 Shutting down the oil system*
- *Procedure 4-15 Shutting down further components of the machine unit*
- *Procedure 4-16 Preservation of machine unit*

3* In the case of standstill periods exceeding 6 months:

3.1 Carry out the same procedures as for standstill periods exceeding 4 weeks.

3.2 Have the machine unit provided with long-term preservation by an MAN TURBO After Sales Service technician.

Note: Start-up after a standstill of more than 6 months may only be carried out by an MAN TURBO After Sales Service technician.

4* For maintenance work: Carry out the procedures specified as prerequisites in the respective procedures.

5* For repair work: Carry out the procedures specified as prerequisites in the respective procedures.

Procedure 4-13 Isolating the process gas system from the overall process plant

Responsibility Machine operator

Prerequisites *Procedure 4-12 Shutting down the machine train* has been carried out.

1 Depressurize the process gas carrying components of the machine unit to suction pressure.

Procedure 4-13 Isolating the process gas system from the overall process plant has been completed.

Procedure 4-14 Shutting down the oil system

Responsibility Machine operator

Prerequisites *Procedure 4-13 Isolating the process gas system from the overall process plant* has been carried out.

CAUTION

Risk of machine damage if the oil system is shut down prematurely!

- **Do not shut down the oil system until the pressure inside the machines is equal to atmospheric pressure.**

CAUTION

Risk of bearing or shaft damage if the oil system is shut down prematurely!

- **Do not shut down the oil system until all the machine bearings have cooled off sufficiently.**

1 Keep the oil system in operation until the machine bearings have cooled down and the pressure inside the machine is equal to atmospheric pressure.

CAUTION

Risk of damage to the auxiliary oil pump due to viscous oil if the auxiliary oil pump is switched on unintentionally!

- **Make sure that the auxiliary oil pump cannot cut in again automatically.**

2 Switch off auxiliary oil pump P 11820.

3 Switch off oil heater W 11810.

CAUTION

Risk of contamination of process gas carrying spaces by oil if the oil mist separator is switched off prematurely!

- **Keep the fan of the oil mist separator in operation until the oil mist has escaped from the oil system.**

4 Shut down motor M 11803 for the side channel blower of the oil mist separator.

5 Change oil filter element F 11852.

CAUTION

Risk of machine damage due to inadequate oil supply if there is sludge in the oil filter or if the oil filter is frozen!

- **Always keep the shut-off valves in the cooling water circuit fully open.**
- **Ensure that the specified cooling water temperature is maintained also in winter.**

6 Maintain the specified cooling water flow through oil cooler W 11839.

Procedure 4-14 Shutting down the oil system has been completed.

Procedure 4-15 Shutting down further components of the machine unit

Responsibility Machine operator

Prerequisites The following procedures must have been carried out:

- *Procedure 4-13 Isolating the process gas system from the overall process plant*
- *Procedure 4-14 Shutting down the oil system*

CAUTION

Risk of machine damage through entry of oil if the seal air system is shut down prematurely!

- **Continue seal air admission to the oil-side shaft seal until the oil pressure has decreased to atmospheric pressure after the oil system has been shut down.**

1 Shut down the seal air system.

2 Follow the instructions for shut-down and the instructions referring to the standstill periods in the operating instructions for the following components:

- Main drive motor M 11001, see manufacturer's operating instructions.
- Coupling 1, see Operating Instructions for Coupling 1.
- Gear unit, see Operating Instructions for Gear Unit.
- Coupling 2.
- Compressor, see Operating Instructions for Compressor.

Note: During standstill, condensate arises in the cooling-down process gas system.

3 Carry out *Procedure 4-4 Draining the machine unit* in accordance with the instructions in *Section 4.2.1 Prerequisites for start-up*.

4 Disable the monitoring system of the machine unit.

5 Switch off the control system with its protective and control functions.

6 Switch off the fan of the local control panel.

7 Stop the supply of energies and operating media to the machine unit:

- High voltage
- Low voltage
- Control voltage
- Instrument air
- Cooling water
- Lube oil

Procedure 4-15 Shutting down further components of the machine unit has been completed.

Procedure 4-16 Preservation of machine unit

Responsibility Machine operator

Prerequisites *Procedure 4-15 Shutting down further components of the machine unit* has been carried out.

1 Have the service technician carry out the preservation measures on the individual components of the machine unit as described in the manufacturers' operating instructions.

Note: The list of Operating Instructions for Components will be found in *Section 8.5 Operating Instructions for Components*.

The machine unit has now been preserved for a standstill period of up to 6 months.

Procedure 4-16 Preservation of machine unit has been completed.

Special operation

5

Installation and commissioning

This Chapter addresses the Operator / User of the machine unit. It provides an overview of the work to be carried out for installation and commissioning of machine unit KOSAIR 2004.

5.1 Overview

In *Section 5.2 Preparations* you will find information on the following subjects:

- *Section 5.2.1 Transport*
- *Section 5.2.2 Checking of scope of supply*
- *Section 5.2.3 Preparation of place of use*
- *Section 5.2.4 Energy supply*

In *Section 5.3 Installation and connections* you will find information on the following subjects:

- *Section 5.3.1 Erection and alignment*
- *Section 5.3.2 Interfaces and connections*

In *Section 5.4 Commissioning* you will find information on the following subjects:

- *Section 5.4.1 Checking of installation*
- *Section 5.4.2 Initial start-up*

5.2 Preparations

Efficient installation and commissioning include:

- Preparation of the jobsite
- Provision of means of transport
- Safe provision of traffic routes
- Safe custody and preparation of the scope of supply
- Provision of operating media

Installation and commissioning which has been prepared and carried out according to these points is the basis for taking up reliable operation and safe handling. For preparation of installation and commissioning refer to the *Installation Manual*.

Installation Manual

For the performance of installation and commissioning an *Installation Manual* will be provided by MAN TURBO. The *Installation Manual* covers, amongst other things, references to:

- Site mobilization
- Transport, packaging, preservation, painting
- Cleaning
- Machinery installation
- Piping installation
- Electrical connections
- Alignment and grouting of base frames/skids
- Commissioning
- Checks

Operating Instructions for Components

The job order specific installation of components of the machine unit must be carried out in accordance with the manufacturers' information in the Operating Instructions for Components. A list of the components will be found in *Section 8.5 Operating Instructions for Components*.

Note: MAN TURBO recommend having installation and commissioning carried out by an MAN TURBO After Sales Service technician.

5.2.1 Transport

All transport activities have to be carried out duly considering the information in the *Installation Manual*.

5.2.1.1 Transport to the jobsite

Responsibility

Transport to the jobsite is carried out according to the contractual agreements between MAN TURBO and Purchaser.

Transport procedures

On takeover of the scope of supply on the jobsite the transport procedures must be observed; they will be found in the *Installation Manual*.

5.2.1.1.1 Preparations for transport

The machines or machine units to be delivered are prepared by MAN TURBO for transport in accordance with the envisaged transport routes and means of transport. For preservation and packaging refer to the *Installation Manual*.

5.2.1.1.2 Modes of transport

The decision about break-up of the scope of supply into a larger or smaller number of separate consignments depends on the size of the machine unit and the number of components.

- Packaged transport
- Single transport
- Partial assembly
- Transport skid

Packaged transport

As a rule, MAN TURBO machine trains are delivered in assembled condition. In this case, all machines are mounted on a common base frame. Internal piping and power supply to the electrical consumers are connected up to as far as the base frame limits.

All couplings are removed and are delivered separately packaged.

Single transport

In the case of machine trains comprising very big individual machines it is often advisable - both for reasons of transport and from a design point of view - to mount and to deliver them individually on separate base frames.

Partial disassembly

Machines which exceed the usual transport dimensions or road dimensions on the jobsite are partly disassembled by MAN TURBO as required. Correspondingly, individual dismantled machine components may be dispatched separately. Additional partial disassembly of machine parts for transport on the jobsite may only be made after consultation with MAN TURBO.

Transport skid

Machines which will not be erected on base frames but on foundation bars will be placed on lower-weight transport skids for delivery.

5.2.1.2 Transport on the jobsite

Responsibility

Transport on site will be Purchaser's responsibility or the responsibility of the company put in charge of transport.

Transport procedures

For the transport procedures to be observed on the jobsite refer to the *Installation Manual*.

Note: It is imperative that the information in the Installation Manual is observed even during planning of the transport operations.

5.2.1.2.1 Transport means

The required means of transport for installation of the machine unit must be agreed between Purchaser and MAN TURBO AG Schweiz. They must be available on the day of installation.

5.2.2 Checking of scope of supply

Immediately after arrival of the consignment at site, consignee must check the scope of supply for completeness and proper condition. For checking the scope of supply see the *Installation Manual*.

Completeness

The scope of supply can be checked for completeness on arrival at site by reference to the enclosed *Packing list*.

Any discrepancies between the *Packing list* and the actual supply must be marked by consignee in the shipping papers, signed by consignee and forwarding agent, stamped, and notified to MAN TURBO within 24 hours.

MAN TURBO shall not accept any later claims, especially in the case of delays during installation originating from lacking machine parts and accessories.

Proper condition

Consignee must check the proper condition of

- packaging
- individual machine parts
- preservation and painting

immediately after arrival at site.

Damage and defects of any kind regarding the scope of supply must be marked by consignee in the shipping papers, signed by consignee and forwarding agent, stamped, and notified to MAN TURBO within 24 hours.

Any later claims e.g. regarding

- damage to machine parts caused by damaged packaging,
- damage during operation attributable to transport damage, and
- delays during installation resulting from damaged machine parts and accessories

shall not be accepted by MAN TURBO.

5.2.2.1 Marking

Label

Each consignment is identified by a label applied by MAN TURBO.

Repetition of the data stated on the labels in the packing list, see *Figure 5-3 Packing list (example)*, permits an easy check of the scope of supply for completeness.

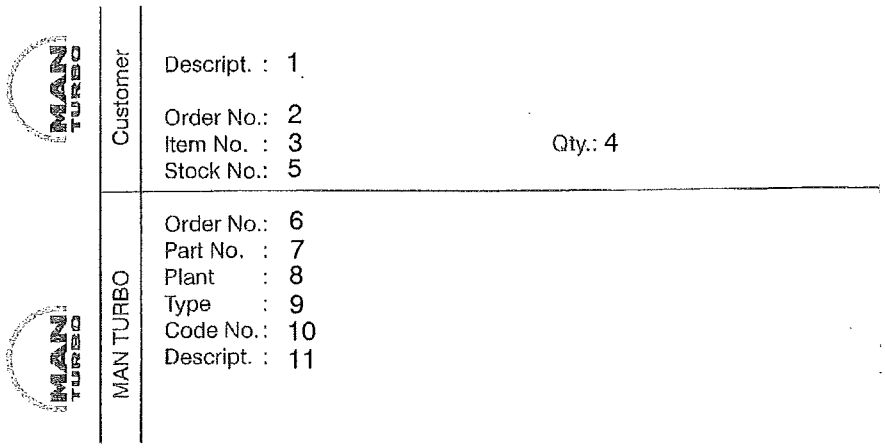


Figure 5-1 Label

1	Description
2	Customer's order number
3	Item number
4	Qty.
5	Stock number
6	MAN TURBO order number
7	Part number
8	Plant
9	Type
10	Code number
11	Description

Packing list

MAN TURBO enclose a packing list with every consignment of machines, components, other accessories, and spare parts.

Deliveries are identified by cross-referencing the stick-on label and the packing list.

Customs Invoice 822688

Datum/Date/Date 10.02.04

MAN TURBOMASCHINEN AG
Schweiz

An/A/To **Jinan Steel International Trade Co., Ltd.,**
21 Gongyebei Road
Jinan
China

Tel: 86-531-8868282
Fax: 86-531-8983798

Postfach
CH-8023 Zürich
Tel. (++41) 1-278 29 71
Fax (++41) 1-278 29 46

Ihre Ref./Votre ref./Your ref.:
Contract No. 2003CS-08QD

Von/De/From Central Station / Dragica Dostal
Tel. +41 1 278 29 71

Projektnr.:	N710 0120
Kennwort	Jinan
Dossier-Nr.:	822688/822700

Wir sandten/nous avons expédié/we have forwarded
CPT Jinan Airport

Zeichen und Nr. Marks and Nr. Marques et No	Inhalt/Contents/Contenu	Kilogramme(s) netto/net	 brutto/gross
	1 case 108x77x101 cm	372,180	443,00
	as per atlached packing List		
	(parts for compressor / HS Code 8414.90)		
	Markings: 2003CS-08QD ..... Jinan Airport China Package No.: 1 of 1 Gross weight: 443.000 kg Net weight: 372.180 kg Measurement:108x77x101 cm		
1	2	3	4
	The exporter of the products covered by this document (customs authorization no. 0035/1995) declares that, except where otherwise clearly indicated, these products are of swiss preferential origin.		

		Meissel	Häfligor	Grosjean	Rusterholz	Spühler	
		1	1	1	1	1	

Figure 5-2 Cover sheet packing list (example)

1 Marks and number
2 Contents
3 Net weight
4 Gross weight

Packing list 822688
Page 1 / 5. Feb 2004 (P 09:57:45)
SPUEHLEU/LF. N710 0120.

For: JINAN STEEL INTERNATIONAL TRADE CO., JINAN, China

Package No	: 1	Markings:
Package	: Plyw Case	
Dimension (cm)	: 108 X 77 X 101	2003CS-08QD
net weight (kg)	: 372.180	----------
gross weight (kg)	: 443.000	JINAN AIRPORT, P.R. CHINA
Volume (m3)	: 0.840	Case number : 1 of 1
		Measurement : 108x77x101 cm
		Gross weight: 443.000 kg
		Net weight : 372.180 kg

Item Sub	Quantity UN	Description of part Code-No = Item/Tag No / DRWG No	Part No	Weight total (kg)
328	1	Coupling complete D 568/330 X 850, FLEXIBOX	000 010 044 313	329,000
329	2	Rope (Green)	837 000 000 010	2,460
330	1	Shaft Lifting Device	837 000 000 010	24,600
331	1	tool for cooler drain	837 000 000 010	2,080
332	1	Connector D 125	837 000 000 010	6,320
333	1	Pin spanner D125	837 000 000 010	2,540
334	1	Spanner	837 000 000 010	2,800
335	1	Surplus material	837 000 000 010	2,080

1 2 3 4 5

Figure 5-3 Packing list (example)

1 Item number
2 Qty.
3 Description
4 Part number
5 Weight

5.2.3 Preparation of place of use

The place of use for the machine unit supplied by MAN TURBO must satisfy the requirements for safe installation of all components of the machine unit.

Site mobilization

Site preparations include, amongst other things, the furnishing of:

- traffic areas
- magazines for tools and other material

- working areas
- lighting
- energy supply
- emergency phone system
- safety facilities
- safeguarding of hazard areas

For mobilization and preparation of the jobsite refer to the *Installation Manual*.

Installation areas

The installation areas must be prepared in accordance with the information in the Foundation Drawing and the General Arrangement. See *Section 8.4 Drawings and schematic diagrams*. For preparation of the installation areas refer to the *Installation Manual*.

5.2.4 Energy supply

Energy supply to the machine unit is made from external energy sources. Provision of the various energy sources is the Operator's / User's responsibility.

This may include:

- Power supply
- Compressed air supply
- Coolant supply

For details on the consumers please refer to the Consumer List.

5.3 Installation and connections

Once the site has been prepared in accordance with the information in the *Installation Manual* the machine unit may be installed.

5.3.1 Erection and alignment

The scope of work for erection and alignment of the machine unit which has to be carried out by the Operator / User depends on the contractual agreements between MAN TURBO and Purchaser.

Erection and alignment include, amongst other things, the following activities:

- Taking the measurements of the foundation
- Mounting the machine train
- Rough alignment
- Piping
- Fine alignment

- Grouting of base frame

Note: The respective work may be carried out by trained and skilled personnel only.

For detailed instructions and data for erection and alignment refer to the *Installation Manual*.

MAN TURBO recommend having installation and alignment carried out by the MAN TURBO After Sales Service.

5.3.2 Interfaces and connections

5.3.2.1 Piping connections

The internal piping within the machine train is completely installed at the manufacturer's works up to the transition flanges at the base frame edges.

As for order-specific deviations refer to the *Site Manual*.

For the location of the transition flanges refer to the General Arrangement in *Section 8.4 Drawings and schematic diagrams*.

For laying the piping to other plant components see the *Installation Manual*.

5.3.2.2 Electrical connections

The wiring and all signal lines within the machine train required for power supply to the machine components are completely installed at the manufacturer's works up to the terminal boxes at the base frame edges.

For laying the cables to the local control panels observe the current national regulations for electrical installations and the *Installation Manual*.

5.3.2.3 Compressed air connections

The lines within the machine train required for compressed air supply to machine components are completely installed at the manufacturer's works up to the connection points at the base frame edges.

For the location of the connection points refer to the General Arrangement in *Section 8.4 Drawings and schematic diagrams*.

For laying the pipes to the local compressed air generators see the current national regulations for compressed air installations and the *Installation Manual*.

5.3.2.4 Connections for oil supply

The lines within the machine train required for oil supply to machine components are completely installed at the manufacturer's works up to the connection points at the base frame edges.

In the case of machine trains where the oil supply unit is integrated in the base frame all connecting pipes to the oil supply unit are completely installed.

For the location of the connection points refer to the General Arrangement in *Section 8.4 Drawings and schematic diagrams*.

For installation of the oil pressure piping refer to the *Installation Manual*.

5.4 Commissioning

Commissioning comprises a check of the completed installation, preparation for initial start-up, and a functional check of all technical safety facilities.

5.4.1 Checking of installation

After installation of the machine unit and prior to commissioning of the machine unit all the work carried out and also the safe condition of the machine unit have to be checked.

Note: MAN TURBO shall not accept any warranty claims which arise due to inadequate checking of the installation.

5.4.1.1 Scope

When checking the installation, the following points have to be inspected in particular:

a Piping according to General Arrangement..... fitted
b Wiring ..... carried out properly
c Safety equipment according to General Arrangement..... fitted
d Walkways and work rooms..... cleared

e All warning signs according to the overview of hazard areas.....fitted

For checking individual installation sections during installation refer to the *Installation Manual*.

5.4.1.2 Performance

The installation check may only be carried out by experienced operating personnel. MAN TURBO recommend having the installation check carried out by MAN TURBO After Sales Service personnel.

Initial oil fill

The installation check also includes taking an oil sample of approx. 2 kg from the oil tank, which must correspond to the oil specification 100%.

This serves as a reference in the further life cycle of the machine unit.

5.4.2 Initial start-up

For safety reasons, initial start-up must be carried out by experienced MAN TURBO After Sales Service technicians.

Initial operation

Before the machine unit may be handed over to the Operator / User for normal operation, intensive initial operation is carried out by the MAN TURBO After Sales Service.

Handover

Following successful initial operation the machine unit is handed over to the Operator / User by the MAN TURBO After Sales Service. This event is documented in the handover record.

Inspection plan

The inspection plan is prepared during handover by the Operator / User in cooperation with the service technician and has to be carried on appropriately during all inspections of machine unit KOSAIR 2004. It includes information about the day of preparation, date and scope of the next inspection, and all requirements from the national legislation.

Start-up procedure

Following initial start-up, MAN TURBO After Sales Service establish a specific start-up procedure for the machine unit.

6

Service, maintenance and troubleshooting

This Chapter addresses the service technician of the machine unit. It provides information about the type of work required for service, maintenance, and troubleshooting of the machine unit. It also explains which type of work you can carry out and which work may, for safety reasons, only be carried out by specially trained MAN TURBO After Sales Service technicians.

6.1 Overview

In *Section 6.2 Maintenance* you will find information on the following subjects:

- *Section 6.2.1 Maintenance schedule*
- *Section 6.2.2 Maintenance work*
- *Section 6.2.3 Cleaning*

In *Section 6.3 Inspection* you will find an inspection plan and a detailed explanation of the individual inspection stages.

In *Section 6.4 Malfunctions* you will find information on the following subjects:

- *Section 6.4.1 Detection of malfunctions*
- *Section 6.4.2 Troubleshooting*

In *Section 6.5 Repair* you will find the most important information for repair work on machine unit KOSAIR 2004.

6.2 Maintenance

Maintenance comprises all measures which are taken to maintain the desired condition of the machine unit.

6.2.1 Maintenance schedule

Correct maintenance of the machine unit depends on numerous factors. Maintenance is influenced, amongst other things, by:

- Ambient conditions
- Standards, directives/guidelines and laws
- Quality of process gas
- Quality of consumables
- Number of start-ups
- Standstill periods
- Required availability of the machine unit
- Operator's / User's maintenance philosophy

MAN TURBO recommend to establish an individual maintenance strategy jointly with the technicians of our After Sales Service. This is the only way to permanently ensure safe and economical operation. Moreover, MAN TURBO After Sales Service offer individual training courses for correct maintenance of the machine unit.

Periodic inspection of pressure equipment

Periodic inspection of pressure equipment shall be carried out according to the legal stipulations by the national authorities in the country of the Operator / User.

Maintenance work on the machine unit

The maintenance activities listed in *Table 6-1 Routine maintenance work at intervals in time* and *Table 6-2 Routine maintenance work depending on hours in operation* are described in *Section 6.2.2 Maintenance work*.

Table 6-1 Routine maintenance work at intervals in time

Interval	Maintenance activity
Daily	■ Carry out *Procedure 6-2 Checking the oil level in the oil tank.*
Monthly	■ Carry out *Procedure 6-8 Testing of automatic cut-in of auxiliary oil pump.* ■ Carry out *Procedure 6-1 Draining condensed water from the oil tank.*
Every three months	■ Compare the data of the recorded operating values from the operation log throughout this period to determine trends.

Interval	Maintenance activity
Annually	■ Perform inspection stages 1-3 in accordance with the inspection concept; see *Section 6.3 Inspection*.
In conformity with the legal stipulations by the national authorities in the country of the Operator / User.	■ Carry out *Procedure 6-9 Performing periodic inspections* and record the results in the inspection plan.

Table 6-2 Routine maintenance work depending on hours in operation

Interval	Maintenance activity
0 operating hours	■ Take an oil sample of approx. 2 kg from the oil tank and keep it available for the entire life cycle of the machine unit.
after 500 operating hours	■ Carry out *Procedure 6-5 Analysing the oil quality*.
every 4,000 operating hours, at least once a year	■ Carry out *Procedure 6-5 Analysing the oil quality*.

Note: Operational checks which the machine operator of the machine unit must carry out regularly are listed in *Section 4.2.3 Checks of operation*.

Maintenance work on components

In addition to the maintenance work listed here, the service technician must follow the maintenance procedures specified by the manufacturers of the individual machine unit components as described in the respective operating instructions. You will find an overview of the Operating Instructions for Components in the Annex; see *Section 8.5 Operating Instructions for Components*.

6.2.2 Maintenance work

⚠WARNING

Hazard of serious injury or death in case of improper execution of maintenance work!

- **Have maintenance work carried out by trained and skilled personnel only.**
- **Use original MAN TURBO spare parts only.**

This Section describes the maintenance work which the service technician may carry out without risk. For safety reasons work which requires special training and expertise may only be carried out by the MAN TURBO After Sales Service within the scope of inspections.

Note: For information about alarm and limit values for operation of the machine unit please refer to the Alarm and Signal List; see *Section 8.4 Drawings and schematic diagrams*.

The following maintenance work is described in this Section:

- *Procedure 6-1 Draining condensed water from the oil tank*
- *Procedure 6-2 Checking the oil level in the oil tank*
- *Procedure 6-3 Topping up oil*
- *Procedure 6-4 Carrying out the oil change*
- *Procedure 6-5 Analysing the oil quality*
- *Procedure 6-6 Changing the oil filter element*
- *Procedure 6-7 Cleaning oil cooler W 11839 on the oil side*
- *Procedure 6-8 Testing of automatic cut-in of auxiliary oil pump*
- *Procedure 6-9 Performing periodic inspections*

Procedure 6-1 Draining condensed water from the oil tank

Responsibility Service technician
Prerequisites None
Tools Collecting vessel

1 Open the drain valve on oil tank B 11800.

CAUTION

Hazard of environmental pollution through condensed water containing oil and pollutants!

- **Collect the draining condensed water in a suitable collecting vessel.**
- **Dispose of the condensed water without hazard to the environment.**

2 Drain the condensed water into the collecting vessel.

3 Close the drain valve on oil tank B 11800 as soon as oil is discharged.

4 Carry out *Procedure 6-2 Checking the oil level in the oil tank*.

Procedure 6-1 Draining condensed water from the oil tank has been completed.

Procedure 6-2 Checking the oil level in the oil tank

Responsibility Service technician
Prerequisites None

NOTICE

The control and monitoring systems automatically initiate a trip if the amount of oil in the oil system is inadequate.

1 Check the oil level in oil tank B 11800 at indicator LG 11813.

2* Oil level at the normal mark: Do not top up oil.

3* Oil level nearing the minimum mark: Carry out *Procedure 6-3 Topping up oil*.

Note: The minimum filling volume is specified in the Operating Instructions for Oil System. You will find an overview of the Operating Instructions for Components in *Section 8.5 Operating Instructions for Components*.

Procedure 6-2 Checking the oil level in the oil tank has been completed.

Procedure 6-3 Topping up oil

Responsibility Service technician
Prerequisites Fresh oil in the required amount is available
Tools Filling hose, filter with same filter mesh as the oil filter element

1 Remove the lid from the filling nozzle of oil tank B 11800.

2 Connect the filling hose to the filling nozzle. Ensure that the installed strainer remains in the filling nozzle.

CAUTION

Risk of machine damage through organometallic compounds in the oil!

- **Use only oil without organometallic compounds.**
- **Use oil which meets the quality requirements.**

Note: Organometallic compounds (e.g. zinc compounds) in the oil may lead to deposits in the bearings, toothed connections, and seals.

CAUTION

Risk of machine damage through contaminants in the oil!

- **Ensure that the equipment used for filling and for transport is perfectly clean.**
- **Top up oil through a filter of the same mesh as that of the oil filter element only.**

CAUTION

Risk of machine damage if oil mixtures or other than the known oil brands are used!

- **Always use the same oil brand.**
- **Fill the oil system with one and the same brand of oil only.**
- **Clean the oil system before using a different oil brand.**

Note: For the oil specifications please refer to *Section 8.2.2.3.1 Oil quality requirements*.

CAUTION

Risk of machine damage through malfunctioning of the oil supply if the oil level in the oil tank is too high!

- **Never top up oil above the maximum level mark.**

3 Top up oil using the filling hose and the filter until the oil level in the oil tank as indicated by LG 11813 is at the normal mark.

4 Remove the filling hose and the filter from the filling nozzle.

5 Put the lid back on the filling nozzle of oil tank B 11800.

Procedure 6-3 Topping up oil has been completed.

Procedure 6-4 Carrying out the oil change

Responsibility Service technician

Prerequisites The necessary amount of fresh oil is available and the following procedures have been carried out:

- *Procedure 4-12 Shutting down the machine train*
- *Procedure 4-14 Shutting down the oil system*

Tools

The following tools are required:

- Collecting vessel for used oil with a total capacity corresponding to the initial fill of the oil system; see Operating Instructions for Oil System.
- Filter with same filter mesh as the oil filter element

⚠WARNING

Hazard of burns from contact with hot plant unit components!

- **Always wait until the shut-down machine unit has cooled down sufficiently before carrying out the oil change.**

CAUTION

Risk of machine damage through organometallic compounds in the oil!

- **Use only oil without organometallic compounds.**
- **Use oil which meets the quality requirements.**

Note: Organometallic compounds (e.g. zinc compounds) in the oil may lead to deposits in the bearings, toothed connections, and seals.

CAUTION

Risk of machine damage if oil mixtures or other than the known oil brands are used!

- **Always use the same oil brand.**
- **Fill the oil system with one and the same brand of oil only.**
- **Clean the oil system before using another type of oil.**

Note: For the oil specifications please refer to *Section 8.2.2.3.1 Oil quality requirements*.

1 Unscrew the blind flange from the drain valve on oil tank B 11800.

CAUTION

Hazard of environmental pollution through used oil getting into the sewage system!

- **Collect the drained oil in suitable collecting vessels.**
- **Dispose of the used oil without hazard to the environment.**

2a Pump all the used oil from the oil tank into the collecting vessel.

2b Empty the oil tank by draining the used oil into the collecting vessel:

2.1 Connect the drain hose to the drain valve.

2.2 Open the drain valve and wait for the used oil to drain completely into the collecting vessel.

3 Remove the manhole cover from the top of oil tank B 11800.

⚠WARNING

Hazard of injury to the respiratory system from inhalation of oil mist!

- **Follow the safety instructions for entering tanks.**
- **Prior to entering, verify that permission for entering the oil tank has been given.**
- **Put on the required protective clothing and protective equipment.**
- **Permit the oil mist to escape, and test the atmosphere in the oil tank before entering.**
- **Ensure adequate ventilation of the oil tank.**

4 Remove the oil residues from the bottom of the oil tank.

5 Close the manhole cover.

6 Close the drain valve.

7 Mount the blind flange on the drain valve.

8 Clean oil coolers W 11839 of oil residues as described in *Procedure 6-7 Cleaning oil cooler W 11839 on the oil side.*

9 Change the elements of oil filters F 11852 as described in *Procedure 6-6 Changing the oil filter element*.

10 Clean or change the filter element of the oil mist separator according to the Operating Instructions for Oil System. For an overview of the Operating Instructions for Components please refer to *Section 8.5 Operating Instructions for Components*.

11 Remove the lid from the filling nozzle of oil tank B 11800.

12 Connect the filling hose to the filling nozzle. Ensure that the installed strainer remains in the filling nozzle.

CAUTION

Risk of damage to the machine bearings through contaminated oil if the oil is filled in incorrectly!

- **Ensure that the equipment used for filling and for transport is perfectly clean.**
- **Fill in the oil through a filter of the same mesh as that of the oil filter element in the oil system only.**

CAUTION

Risk of damage to the machine bearings if another than the correct oil is used!

- **For the oil change always use oil of the same quality as that used for the initial fill of the oil system.**

Note: For the oil specifications please refer to *Section 8.2.2.3.1 Oil quality requirements*.

13 Fill in oil through the filling hose and the filter until the level in the oil tank as indicated by LG 11813 is at the normal mark.

14 Keep an oil sample of the fresh oil for later oil analyses.

15 Remove the filling hose and the filter from the filling nozzle.

16 Put the lid back on the filling nozzle of oil tank B 11800.

Procedure 6-4 Carrying out the oil change has been completed.

Procedure 6-5 Analysing the oil quality

Responsibility Service technician
Prerequisites None
Tools Vessel for oil sample (approx. 1 litre)

1 Take an oil sample of about 1 litre from oil tank B 11800 through the valve provided for this purpose.

2 Have the oil sample examined by a chemical laboratory or by your oil supplier's technical service.

NOTICE

Always label each oil sample with manufacturer's name, oil brand, date, and sampling point, etc.

Note: For the oil specifications please refer to *Section 8.2.2.3.1 Oil quality requirements*.

3* The oil meets the quality requirements: Oil change not required.

4* The oil does not meet the quality requirements: Carry out *Procedure 6-4 Carrying out the oil change*.

5* Water content in oil exceeds 0.1%: Have the cause determined and eliminated immediately by an MAN TURBO After Sales Service technician. Contact the MAN TURBO After Sales Service; see *Section 1.3.2.1 After Sales Service*.

Procedure 6-5 Analysing the oil quality has been completed.

Procedure 6-6 Changing the oil filter element

Responsibility Service technician
Prerequisites A new filter element, sealing material and cleaning material are available.
Tools Collecting vessel for used oil

NOTICE

Carry out the work according to the instructions in the Operating Instructions for Oil System. For an overview of the Operating Instructions for Components please refer to *Section 8.5 Operating Instructions for Components*.

1 Open the vent valve of the second, clean oil filter F 11852.

2 Open the filling valve (in the bypass to the 3-way valve) of clean oil filter F 11852.

3 Wait until the non-fouled oil filter is filled with oil and oil flows back through the vent pipe to the oil tank.

4 Switch the 3-way valve on the double oil filter over to the second, clean oil filter.

5 Close the filling valve (in the bypass to the 3-way valve) of the fouled oil filter F 11852.

6 Open the vent valve of fouled oil filter F 11852.

CAUTION

Hazard of environmental pollution through drained oil getting into the sewage system!

- **Collect the draining oil in a suitable collecting vessel.**
- **Dispose of the oil without hazard to the environment.**

7 Place the collecting vessel underneath the drain valve of the fouled oil filter F 11852.

8 Open the drain valve of the fouled oil filter F 11852 and drain the oil completely from the filter housing into the collecting vessel.

9 Open the oil filter housing.

10 Change the filter element according to the instructions of the filter element manufacturer.

11 Remove the parts loosely fitted in the filter housing. Remember the sequence and direction of installation.

12 Clean the removed parts.

13 Remove oil sludge and impurities from the oil filter housing.

14 Clean the filter housing sump and all the interior of the filter housing.

15 Clean the sealing faces of filter housing lid and filter housing.

16 Replace the cleaned parts with new seals into the filter housing observing the correct sequence and direction.

NOTICE

Ensure that the filter element is not damaged during installation. If necessary, wet the sealing faces, O-rings, etc., with oil to ensure that they settle correctly during installation.

17 Fit the new filter element with new seals into the cleaned filter housing.

18 Fasten the filter element.

19 Check the sealing faces of filter housing lid and filter housing for impurities.

20* Sealing faces are fouled: Clean the sealing faces.

21 Mount the filter housing lid with new seal.

22 Screw down the filter housing lid.

23 Close the drain valve.

24 Open the vent valve.

25 Open the filling valve (in the bypass to the 3-way valve).

26 Wait until the cleaned oil filter housing has been filled with oil and oil returns through the vent line to the oil tank.

CAUTION

Risk of machine damage through inadequate oil supply if there is sludge in the oil filter!

- **Ensure that the oil filter is not in *standby* mode longer than necessary.**
- **Close the filling valve of the cleaned oil filter.**

27 Close the filling valve (in the bypass to the 3-way valve) of the cleaned oil filter housing.

Procedure 6-6 Changing the oil filter element has been completed.

Procedure 6-7 Cleaning oil cooler W 11839 on the oil side

Responsibility Service technician
Prerequisites Oil cooler has cooled down sufficiently
Tools Collecting vessel for oil and, if necessary, lifting gear of adequate carrying capacity for the cooler tube bundle

CAUTION

Risk of machine damage in case of improper execution of maintenance work!

- **Have cleaning of the oil coolers carried out by the MAN TURBO After Sales Service or by a specialist firm only.**

1 Call in the MAN TURBO After Sales Service or a specialist firm for cleaning.

Procedure 6-7 Cleaning oil cooler W 11839 on the oil side has been completed.

Procedure 6-8 Testing of automatic cut-in of auxiliary oil pump

Responsibility Service technician
Prerequisites The following prerequisites must be satisfied:

- Machine train has been started up
- Main oil pump is in operation
- Auxiliary oil pump P 11820 is set to *automatic cut-in*

1 Slowly close the shut-off valve upstream of pressure transmitter PIT 11854 and orifice plate FO 11894.

Note: The oil pressure on pressure transmitter PIT 11854 decreases to the value for automatic cut-in of the auxiliary oil pump.

2 Watch the reaction of the auxiliary oil pump

3* The switching value has been reached and the auxiliary oil pump delivers sufficient oil pressure: The test has been successful.

4* If the switching value has been reached and the oil pressure delivered by the auxiliary oil pump is insufficient: Have the cause determined and eliminated immediately by an MAN TURBO After Sales Service technician. Contact the MAN TURBO After Sales Service; see *Section 1.3.2.1 After Sales Service*.

CAUTION

Risk of machine damage if the machine unit is operated without the auxiliary oil pump being ready for operation!

- **Shut down the machine unit immediately.**
- **Have the cause of the malfunction determined and eliminated immediately by the MAN TURBO After Sales Service technician.**

NOTICE

You cannot start up the machine unit without the auxiliary oil pump being ready for operation.

5* If the switching value has been reached and the auxiliary oil pump has not started up automatically: Shut down the machine train immediately. Have the cause of malfunction immediately determined and eliminated by an MAN TURBO After Sales Service technician. Contact the MAN TURBO After Sales Service; see *Section 1.3.2.1 After Sales Service*.

6 Open the shut-off valve in the impulse line to pressure transmitter PIT 11854 upstream of orifice FO 11894.

7 Switch off the auxiliary oil pump and reset it to *automatic cut-in*.

Procedure 6-8 Testing of automatic cut-in of auxiliary oil pump has been completed.

Procedure 6-9 Performing periodic inspections

Responsibility After Sales Service technician or service technician

Prerequisites For this procedure the following measures and arrangements must already have been carried out.

- The initial acceptance test has been carried out, an inspection plan with due consideration of the specific national laws has been set up and is available.
- The Operator / User has made the preparations agreed with the service technician beforehand.
- A technical expert (MAN TURBO, customer, third party e.g. TÜV) is available for performance.
- An independent authorized inspector (e.g. TÜV) is available for reviewing safety regulations, controls, facilities, etc.

Periodic inspections are aimed at determining that the pressure equipment und process gas pipes of machine unit KOSAIR 2004 are in proper condition at the time of inspection.

1 Have items 2 to 4 carried out by a technical expert or by an independent authorized inspector and compare the results with the entries last made in the inspection plan.

2 Arrange for the internal inspection to be carried out:

2.1 Check the walls subjected to pressure for proper condition, thickness, etc., by visual inspection and with auxiliary means specially suited for this particular purpose.

2.2* If you suspect any changes which give cause for concern with regard to safety: Carry out a non-destructive examination of the wall parts.

2.3 Check that additional equipment parts are available and are in proper condition.

2.4 Have the existing safety facilities checked for proper functioning by an independent authorized expert.

3 Arrange for the external inspection to be carried out:

3.1 Check the external condition of pressure vessel and piping including all fastenings, supports, etc., for proper condition by visual inspection and/or suitable auxiliary means.

3.2 Check that the necessary safety facilities are present.

3.3 Check that the available safety facilities on pressure vessels and piping are operative.

3.4 Carry out a visual inspection of the equipment parts.

3.5 Compare the result with the latest entries in the inspection plan.

3.6 Check the measuring facilities for indicating accuracy and proper condition.

4 Have a pressure test carried out:

4.1 Test all pipes and pressure vessels in accordance with the applicable standards and directives in the country of the Operator / User.

4.2* If you suspect any changes which give cause for concern with regard to safety: Have a non-destructive examination of the wall parts carried out by an independent authorized inspector. The following methods are possible:

- Surface crack tests using the dye penetration method
- Radiographic inspections

- Ultrasonic tests

5 Enter the following data in the inspection plan:

- Scope of test
- Test result
- Current date
- Date of next inspection
- Further data result from the requirements stipulated by your national laws

6 Immediately eliminate any malfunctions which have occurred, to avoid that machine unit KOSAIR 2004 is closed down by the competent authority.

Procedure 6-9 Performing periodic inspections has been completed.

6.2.3 Cleaning

Procedure 6-10 Cleaning the machine unit

Responsibility Service technician
Prerequisites None

⚠WARNING

Risk of hearing damage by exposure to noise without ear protectors!

- **Near the machine unit in the marked noise area always wear the specified hearing protection.**
- **On no account remove the noise control equipment during normal operation.**

⚠WARNING

Hazard of burns from contact with hot parts of the machine unit!

- **Observe the safety regulations.**
- **Keep protective equipment in good order.**
- **On no account remove the protective equipment during normal operation.**

Note: Method and frequency of cleaning the machine unit depend on the ambient conditions (e. g. installation site, degree of pollution of the ambient air, climate).

1 Regularly clean the machine unit, especially all walkways, handles, steps, railings, pedestals, platforms, ladders, etc. from dust, soiling, ice, and snow.

2 Regularly clean all indicators and operator controls in order to ensure readability and operability at all times.

⚠WARNING

Hazard of injury from falls by slipping on oily ground!

- **Remove any oil leakage immediately.**

3 Clean the machine unit and the foundation immediately if operating media have escaped or have been spilled.

4 Do not leave any tools and replacement parts in the vicinity of the machine unit.

Procedure 6-10 Cleaning the machine unit has been completed.

6.3 Inspection

Note: If inspections during the warranty period are not carried out by MAN TURBO After Sales Service technicians, the warranty will become null and void. If work is carried out improperly by third parties, MAN TURBO shall not be liable for damage of any kind.

Inspection plan

The suitable intervals for inspection of the machine unit depend on numerous factors. Inspection intervals are influenced, amongst other things, by:

- Ambient conditions
- Quality of process gas
- Quality of consumables
- Number of start-ups
- Standstill periods
- Required availability of the machine unit
- Operator's / User's maintenance philosophy

MAN TURBO recommend establishing an individual inspection plan jointly with the technicians of our After Sales Service. This is the only way to permanently ensure safe and economical operation.

The dates fixed for inspections must be adhered to. The machine unit must be inspected even if there are no apparent defects. The objective of the inspection is to detect and eliminate any defects in advance thus preventing downtimes of the machine unit.

Table 6-3 Recommended inspection plan

Year	1	2	3	4	5	6	7	8	9	10
Stage 1	X	X		X	X	X	X		X	X
Stage 2			X					X		
Stage 3					X					X
After 5 years of operation, the inspection intervals are mainly dependent on the operating conditions and the inspection results.										

MAN TURBO distinguish between the following service and maintenance stages:

Stage 0 Routine maintenance work according to operational requirements carried out on-line by the service technician of the Operator / User, e.g. filter change. The maintenance schedule and the maintenance work are described in Section Maintenance.

Stage 1 Inspection for checking and determining the operating values and reviewing the safety systems during ongoing operation. The determined values are the basis for stage 3. The individual activities are described in the following *Procedure 6-11 Performance of inspection stage 1*.

Stage 2 Inspection for checking the main components and determining the condition of the machine unit during a short-term standstill. Includes the work of stage 1. The individual activities are described in the following *Procedure 6-12 Performance of inspection stage 2*.

Stage 3 General overhaul. A stage 3 inspection should be carried out 6 to 12 months after stage 1. The work operations for the general overhaul should be planned on the basis of the values determined during stage 1. The work steps are described in the following *Procedure 6-13 Performance of inspection stage 3*.

⚠WARNING

Hazard of serious injury or risk of machine damage in case of improper execution of inspection work!

- **For the performance of inspection work always contact the MAN TURBO After Sales Service; see *Section 1.3.2.1 After Sales Service*.**
- **Use original MAN TURBO spare parts only.**

Procedure 6-11 Performance of inspection stage 1

Responsibility MAN TURBO After Sales Service technician

Prerequisites The following prerequisites must be satisfied:

- 1 service technician of the Operator / User is available
- 1 MAN TURBO After Sales Service technician specialized in commissioning is available
- 1 MAN TURBO After Sales Service technician specialized in the field of instrumentation is available
- Consumables and replacement parts are available
- Operator / User has issued release for work

Time requirement 2-3 days for examinations and operating data analysis, 1-2 days for reporting

⚠WARNING

Hazard of serious injury or risk of machine damage in case of improper execution of inspection work!

- **Do not under any circumstances disable or dismantle the safety facilities of the machine unit during inspection stage 1.**

The MAN TURBO After Sales Service technicians carry out the following work:

- Analysis of operating values
- Analysis of operation log
- Analysis and assessment of findings
- Making recommendations
- Maintenance work jointly with the service technicians of the Operator / User, e.g.
  - Checking of automatic cut-in of the auxiliary oil pump
  - Checking fans
- Checking the monitoring system
- Checking the control system
- Checking the auxiliary systems
- Preparing report

Procedure 6-11 Performance of inspection stage 1 has been completed.

Procedure 6-12 Performance of inspection stage 2

Responsibility MAN TURBO After Sales Service technician

Prerequisites The following prerequisites must be satisfied:

- *Procedure 4-12 Shutting down the machine train* has been carried out
- *Procedure 4-13 Isolating the process gas system from the overall process plant* has been carried out
- *Procedure 4-14 Shutting down the oil system* has been carried out
- *Procedure 4-15 Shutting down further components of the machine unit* has been carried out
- Machine unit has cooled down

- 1 service technician of the Operator / User specialized in the field of instrumentation is available
- 1-2 service technicians of the Operator / User specialized in the field of mechanics are available
- 1 MAN TURBO After Sales Service technician specialized in commissioning is available
- 1 MAN TURBO After Sales Service technician specialized in the field of instrumentation is available
- Consumables and replacement parts are available
- The special tools supplied by MAN TURBO with the machine unit are available at the machine unit and are in operative condition
- Standard tools according to the MAN TURBO list of standard tools are available
- Lifting gear is available
- Operator / User has issued release for work

Time requirement 2 days for preparation, 5 days downtime of machine unit

⚠ WARNING

Hazard of serious injury or risk of machine damage in case of inspections carried out on the non-secured machine unit!

- **Before start of work, secure the machine against start-up, e.g. by fitting a lock to the main switch.**

The MAN TURBO After Sales Service technicians carry out the following work:

- Work as for stage 1
- Maintenance work jointly with the service technicians of the Operator / User, e.g.
  - Performance of borescopic inspections
  - Checking bearings
  - Checking alignment

Procedure 6-12 Performance of inspection stage 2 has been completed.

Procedure 6-13 Performance of inspection stage 3

Responsibility MAN TURBO After Sales Service technician

Prerequisites The following prerequisites must be satisfied:

- Inspection stage 1 must have been carried out 6-12 months earlier for planning the general overhaul.
- *Procedure 4-12 Shutting down the machine train* has been carried out
- *Procedure 4-13 Isolating the process gas system from the overall process plant* has been carried out
- *Procedure 4-14 Shutting down the oil system* has been carried out
- *Procedure 4-15 Shutting down further components of the machine unit* has been carried out
- Machine unit has cooled down

- 1-2 service technicians of the Operator / User specialized in the field of instrumentation are available
- 1-2 service technicians of the Operator / User specialized in the field of mechanics are available for each machine
- 1 MAN TURBO After Sales Service technician specialized in commissioning is available
- 1 MAN TURBO After Sales Service technician specialized in the field of instrumentation is available
- 1 MAN TURBO After Sales Service technician specialized in the field of mechanics is available
- Consumables and replacement parts are available
- The special tools supplied by MAN TURBO with the machine unit are available at the machine unit and are in operative condition
- Standard tools according to the MAN TURBO list of standard tools are available
- Lifting gear is available
- Operator / User has issued release for work

Time requirement Varies, depending on the configuration of the machine unit and the findings of inspection stage 1

⚠WARNING

Hazard of serious injury or risk of machine damage in case of inspections carried out on the non-secured machine unit!

- **Before start of work, secure the machine against start-up, e.g. by fitting a lock to the main switch.**

The MAN TURBO After Sales Service technicians carry out the following work:

- Maintenance work jointly with the service technicians of the Operator / User, e.g.
  - Uncovering the machines
  - Complete checking of safety facilities, instrumentation, and monitoring system.

Procedure 6-13 Performance of inspection stage 3 has been completed.

6.4 Malfunctions

This Section includes all the pertinent information for the detection of malfunctions and troubleshooting. It provides the service technician of the Operator / User with all the information required to carry out this work safely.

6.4.1 Detection of malfunctions

Malfunctions on the machine unit can be recognized by you from the following signs:

- *Trip*
- *Alarms*
- *Oil, gas or water leakages*
- *Change in operating values*
- *Malfunctions on components*

Trip

A trip of the machine train is accompanied by an alarm. It is initiated in all cases where any of the specified limit values is exceeded during operation.

The safety-relevant operating values which, if exceeded, result in tripping of the machine unit will be found in the Functional Diagram. For the switching and setting values please refer to the Alarm and Signal List. For an overview of the drawings and schematic diagrams please refer to *Section 8.4 Drawings and schematic diagrams*.

Alarms

The control system and the monitoring system signal an alarm whenever any of the predetermined limit values is exceeded during operation. Alarms can be seen on the relevant monitor of the control system, see Operating Instructions for Control System (not part of the MAN TURBO scope of supply).

The operating values which are monitored automatically and which trigger an alarm if the respective limit value is exceeded will be found in the Alarm and Signal List. For the switching and setting values please refer to the Alarm and Signal List. For an overview of the drawings and schematic diagrams please refer to *Section 8.4 Drawings and schematic diagrams*.

⚠WARNING

Hazard of injury from falls by slipping on oily ground!

- **Remove any oil leakage immediately.**

Oil, gas or water leakages

Oil, gas or water leakages are malfunctions which have to be corrected immediately in order to ensure safe operation of the machine unit.

Change in operating values

Any change in the operating values of the machine unit under constant operating conditions is indicative of a malfunction.

Malfunctions on components

The detection of malfunctions on machine unit components is described in the operating instructions for the individual components. For an overview of the Operating Instructions for Components please refer to *Section 8.5 Operating Instructions for Components*.

irds®

MAN TURBO recommend using the irds® intelligent remote diagnostic system. irds offers

- Transfer, reception and archiving of measuring data
- Automatic measuring data analysis with e-mail notification
- Detailed analyses of measuring data by MAN TURBO After Sales Service technicians

Continuous evaluation of the long-term behaviour of the machine unit provides for quick detection of irregularities. In case of a malfunction, irds® gives MAN TURBO After Sales Service technicians quick access to current and archived measuring data. The MAN TURBO After Sales Service technicians are thus able to quickly analyse the malfunction.

If you are interested in the use of irds®, please contact the MAN TURBO After Sales Service; see *Section 1.3.2.1 After Sales Service*.

6.4.2 Troubleshooting

⚠WARNING

Hazard of serious injury or death in case of improper elimination of malfunctions!

- **Have malfunctions which you cannot eliminate yourself corrected by MAN TURBO After Sales Service technicians.**

Note: During operation of the machine unit, malfunctions may occur which you cannot eliminate by means of the measures described in the following. In such cases always contact the MAN TURBO After Sales Service.

NOTICE

Malfunctions which occur on the components of the machine unit must be eliminated according to the operating instructions for the component concerned. For an overview of the Operating Instructions for Components please refer to *Section 8.5 Operating Instructions for Components*.

This Section describes how to eliminate the following malfunctions:

Symptom 1 Increase in shaft vibrations and bearing temperatures after shutdown 6-24

Symptom 2 Oil pressure too low 6-24

Symptom 3 Oil temperature too high 6-25

Symptom 4 Seal air pressure to oil-side shaft seal too low 6-26

Symptom 1 **Increase in shaft vibrations and bearing temperatures after shut-down**

Hypothesis 1-A Machine train rotates reversely due to gas expansion from the process gas discharge pipe

1 Check whether the shut-off valve in the process gas discharge pipe is open.

Yes/No question: Is the shut-off valve in the process gas discharge pipe open?

Yes . . . . . see *Diagnosis 1-A*
No . . . . . contact the MAN TURBO After Sales Service; see *Section 1.3.2.1 After Sales Service*

Diagnosis 1-A Machine train rotates reversely due to gas expansion from the process gas discharge pipe

1 Close the shut-off valve in the process gas discharge pipe.

Symptom 2 **Oil pressure too low**

Hypothesis 2-A Oil pressure control valve PCV 11873 set too low

1 Check the setting of oil pressure control valve PCV 11873.

Yes/No question: Is the setting of oil pressure control valve PCV 11873 below the specified range?

Yes . . . . . see *Diagnosis 2-A*
No . . . . . see *Hypothesis 2-B*

Diagnosis 2-A Oil pressure control valve PCV 11873 set too low

1 Set oil pressure control valve PCV 11873 at the specified value; see Alarm and Signal List. For an overview of the drawings and schematic diagrams please refer to *Section 8.4 Drawings and schematic diagrams*.

Hypothesis 2-B Air in the lube oil system

1 Vent the lube oil system through all vent valves.

Yes/No question: Is the oil pressure now in the normal range?

Yes . . . . . see *Diagnosis 2-B*
No . . . . . see *Hypothesis 2-C*

Diagnosis 2-B Air in the lube oil system

Hypothesis 2-C Oil filter F 11852 is fouled

1 Check whether the differential pressure across the oil filter exceeds the limit value.

Yes/No question: Does the differential pressure across the oil filter exceed the limit value?

Yes . . . . . see *Diagnosis 2-C*
No . . . . . see *Hypothesis 2-D*

Diagnosis 2-C Oil filter is fouled

1 Carry out *Procedure 6-6 Changing the oil filter element*; see *Section 6.2.2 Maintenance work*.

Hypothesis 2-D Oil cooler W 11839 is fouled.

1 Check the oil temperature downstream of oil cooler W 11839.

Yes/No question: Is the oil temperature downstream of the oil cooler too high?

Yes . . . . . see *Diagnosis 2-D*
No . . . . . contact the MAN TURBO After Sales Service; see *Section 1.3.2.1 After Sales Service*

Diagnosis 2-D Oil cooler is fouled

1 Carry out *Procedure 6-7 Cleaning oil cooler W 11839 on the oil side*; see *Section 6.2.2 Maintenance work*.

Symptom 3 Oil temperature too high

Hypothesis 3-A Oil temperature control valve TCV 11845 set too high

1 Check the setting of oil temperature control valve TCV 11845.

Yes/No question: Is the setting of oil temperature control valve TCV 11845 above the specified range?

Yes . . . . . see *Diagnosis 3-A*
No . . . . . see *Hypothesis 3-B*

Diagnosis 3-A Oil temperature control valve set too high

1 Set the oil temperature control valve at the specified value; see Alarm and Signal List. For an overview of the drawings and schematic diagrams please refer to *Section 8.4 Drawings and schematic diagrams*.

Hypothesis 3-B Setting of cooling water flow to oil cooler W 11839 is too low

1 Check the cooling water flow to the oil cooler.

Yes/No question: Is the cooling water flow below the specified flow rate?

Yes . . . . . see *Diagnosis 3-B*
No . . . . . see *Hypothesis 3-C*

Diagnosis 3-B Setting of cooling water flow to oil cooler W 11839 is too low

1 Set the cooling water flow to the oil cooler at the specified value; see Operating Instructions for Lube Oil System. For an overview of the Operating Instructions for Components please refer to *Section 8.5 Operating Instructions for Components*.

Hypothesis 3-C Oil cooler W 11839 fouled

1 Check the oil temperature downstream of oil cooler W 11839.

Yes/No question: Is the oil temperature downstream of the oil cooler higher than the setpoint?

Yes . . . . . see *Diagnosis 3-C*
No . . . . . contact the MAN TURBO After Sales Service; see *Section 1.3.2.1 After Sales Service*

Diagnosis 3-C Oil cooler is fouled

1 Carry out *Procedure 6-7 Cleaning oil cooler W 11839 on the oil side*; see *Section 6.2.2 Maintenance work*.

Symptom 4 Seal air pressure to oil-side shaft seal too low

Hypothesis 4-A Setting of seal air control valve too low

1 Check the setting of the seal air control valve.

Yes/No question: Is the setting of the seal air control valve below the specified range?

Yes . . . . . see *Diagnosis 4-A*

No . . . . . see *Hypothesis 4-B*

Diagnosis 4-A Setting of seal air control valve too low

1 Set the seal air control valve at the specified value; see Alarm and Signal List. For an overview of the drawings and schematic diagrams please refer to *Section 8.4 Drawings and schematic diagrams*.

Hypothesis 4-B Seal air pressure supplied by overall process plant insufficient

1 Check the pressure in the seal air supply to the machine unit.

Yes/No question: Is the pressure in the seal air supply to the machine unit too low?

Yes . . . . . see *Diagnosis 4-B*
No . . . . . contact the MAN TURBO After Sales Service; see *Section 1.3.2.1 After Sales Service*

Diagnosis 4-B Seal air pressure supplied by overall process plant insufficient

1 Adjust the specified pressure in the seal air supply to the machine unit.

6.5 Repair

⚠WARNING

Hazard of serious injury or death in case of improper repair work on the machine unit!

- **Always contact the MAN TURBO After Sales Service to carry out repair work.**
- **Use original MAN TURBO spare parts only.**

⚠WARNING

Hazard of serious injury or risk of machine damage in case of repair work being carried out on the non-secured machine unit!

- **Before start of work, secure the machine against start-up, e.g. by fitting a lock to the main switch.**

Note: If repair work during the warranty period is not carried out by MAN TURBO After Sales Service technicians, the warranty will become null and void. If work is carried out improperly by third parties, MAN TURBO shall not be liable for damage of any kind.

Repair will become necessary if the machine unit shows a defect which makes further safe use impossible. A faulty machine unit must not be used until the defect has been eliminated. For the performance of repair work on the machine unit please contact the MAN TURBO After Sales Service; see *Section 1.3.2.1 After Sales Service*.

7

Decommissioning, dismantling, and disposal

This Chapter addresses the Operator / User and the service technician. It provides you with all the information required for decommissioning, dismantling, storage, and disposal of machine unit KOSAIR 2004.

7.1 Overview

In *Section 7.2 Decommissioning* you will be acquainted with the major aspects of decommissioning the machine unit.

In *Section 7.3 Dismantling* you will find the steps required for dismantling the machine unit.

In *Section 7.4 Storage* you will find information on how to protect the dismantled machine unit from lasting damage resulting from storage.

In *Section 7.5 Disposal* you will find important information for possible scrapping of the machine unit.

7.2 Decommissioning

Procedure 7-1 Decommissioning the machine unit

Responsibility Service technician

Prerequisites All procedures from *Section 4.2.5.1 Measures for standstill periods* have been carried out.

1 Take measures to prevent further utilization of the machine unit.

2 Completely isolate the machine unit from the process gas system of the overall process plant.

3* If the machine unit is to be started up again at a later date: Have the machine unit provided with long-term preservation. Contact the MAN TURBO After Sales Service; see *Section 1.3.2.1 After Sales Service*.

Procedure 7-1 Decommissioning the machine unit has been completed.

7.3 Dismantling

Procedure 7-2 Dismantling the machine unit

Responsibility Operator / User

Prerequisites *Procedure 7-1 Decommissioning the machine unit* has been carried out

1* If dismantling is carried out for the purpose of re-using the machine unit: Have the machine unit dismantled by the MAN TURBO After Sales Service; see *Section 1.3.2.1 After Sales Service*.

2* If dismantling is carried out for disposal of the machine unit: Contact a competent firm to carry out the following work:

⚠CAUTION

Hazard of injury or risk of environmental damage when handling substances hazardous to health and/or the environment!

- **Ensure proper disposal of all substances.**
- **Observe the national regulations for disposal.**

Note: The Operator / User is obligated to place an order for dismantling of the machine unit only with specialist companies to whom the necessary devices and equipment items as well as the required skilled personnel are available for carrying out the work safely.

- Disconnecting the power supply
- Disconnecting the operating media connections
- Draining all consumables and operating media from the machine unit and ensuring disposal without hazard to the environment
- Removing wiring and piping connections to control panel and machine unit
- Dismantling individual components of the machine unit in accordance with the instructions in the Operating Instructions for Components. You will find the overview of the Operating Instructions for Components in *Section 8.5 Operating Instructions for Components*.
- Dismantling the remaining plant unit parts in the following sequence:
  - Piping
  - Valves, flaps, etc.
  - Pumps
  - Heaters
  - Thermostats, transmitters, pressure gauges, etc.
  - Terminal boxes and control panel
- Stripping down the machine unit observing the respective material groups

Procedure 7-2 Dismantling the machine unit has been completed.

7.4 Storage

Procedure 7-3 Storing the dismantled machine unit

Responsibility Service technician

Prerequisites *Procedure 7-2 Dismantling the machine unit* has been carried out

1 Have the machine unit provided with long-term preservation. Please contact the MAN TURBO After Sales Service; see *Section 1.3.2.1 After Sales Service*.

2 Store the preserved machine parts in a dry and sheltered location.

Procedure 7-3 Storing the dismantled machine unit has been completed.

7.5 Disposal

Procedure 7-4 Disposal of dismantled machine unit

Responsibility Operator / User

Prerequisites *Procedure 7-2 Dismantling the machine unit* has been carried out

⚠CAUTION

Hazard of injury or risk of environmental damage when handling substances hazardous to health and/or the environment!

- **Ensure proper disposal of all substances.**
- **Observe the national regulations for disposal.**

1 Call in a specialist firm or contact the MAN TURBO After Sales Service; see *Section 1.3.2.1 After Sales Service*.

Note: The Operator / User is obligated to place an order for disposal of the machine unit only with specialist companies to whom the necessary devices and equipment items as well as the required skilled personnel are available for carrying out the work safely.

Procedure 7-4 Disposal of dismantled machine unit has been completed.

Annex

8

Annex

This Chapter addresses all users of machine unit KOSAIR 2004. It provides you with general information about machine unit KOSAIR 2004 and with references to further component-specific sources of information.

8.1 Overview

Section 8.2 Technical details includes all the major data for machine unit KOSAIR 2004:

- *Section 8.2.1 Machine unit data*
- *Section 8.2.2 Operating data*
- *Section 8.2.3 Ambient conditions*

In *Section 8.3 Quality checks and tests* you will find information on activities prior to dispatch of machine unit KOSAIR 2004.

In *Section 8.4 Drawings and schematic diagrams* you will find a list of helpful information material for your machine unit KOSAIR 2004.

In *Section 8.5 Operating Instructions for Components* you will find a list with additional operating instructions for the individual components of machine unit KOSAIR 2004.

8.2 Technical details

In this Chapter you will find all data, values, substances, and conditions required for safe and reliable operation of machine unit KOSAIR 2004.

8.2.1 Machine unit data

Table 8-1 Technical data of machine unit

Designation	Value	Unit
Manufacturer	MAN TURBO AG Schweiz	
Year built	2005	
Height	5,111	mm
Width	5,000	mm
Length	11,000	mm
Total weight	76,000	kg

Further technical data for the individual components of the machine unit will be found in the Operating Instructions for Components, see *Section 8.5 Operating Instructions for Components*.

8.2.2 Operating data

The operating data of the machine unit components will be found in the respective operating instructions for the component concerned. See *Section 8.5 Operating Instructions for Components*.

8.2.2.1 Switching values

The switching values for

- start-up interlocks
- alarms
- tripping

are listed in the Alarm and Signal List. See *Section 8.4 Drawings and schematic diagrams*.

8.2.2.2 Noise emissions

The sound data have been determined according to DIN 45635 and DIN EN ISO 3744 and are valid for normal operation.

Table 8-2 Noise emissions

Designation	Type of measure-ment	Value	Unit
Machine unit without noise hood	L_{PA}	82.5	dB(A)

8.2.2.3 Operating media requirements

Operating media quantities

The required quantities of operating media are listed in the Consumer List. See *Section 8.4 Drawings and schematic diagrams*.

8.2.2.3.1 Oil quality requirements

Scope

The oil quality requirements apply to the complete oil system.

Properties

The lube oil must have the following basic properties:

- Partly synthetic mineral oil according to DIN 51515-1/-2
- High ageing stability
- High oxidation stability
- High wear-reducing effect under boundary and mixed-friction conditions
- Favourable air and water release property
- Low foaming tendency
- Good corrosion protection for ferrous and non-ferrous metals
- Free from organometallic compounds
- Low tendency to separation of oil-insoluble products under temperature load
- Suitable for high service temperatures
  - up to 120°C hot-spot temperature for turbine oils
  - up to 135°C specifically for gas turbines
- Suitable temperatures for continuous operation
  - up to approx. 105 ±5°C
- Suitable temperatures for permanent oil tank
  - up to max. 70°C
  - up to max. 80°C for gas turbines

Table 8-3 Oil requirements

Property	Requirement	Test method
Viscosity	ISO VG 46	DIN 51562-1 ASTM-D 445
Viscosity index	minimum 95	DIN ISO 2909 ASTM-D 2270
Density at 15°C	≤0.90 g/cm^3	DIN 51 757 ASTM-D 1298
Appearance	light and clear	
Colour	≤2	DIN ISO 2049 ASTM-D 1500
Flash point	≥ 180°C	DIN ISO 2592 ASTM-D 92
Flow point	≤-9°C	ISO 3016 ASTM-D 97
Neutralization index	≤0.15 mg KOH/g	DIN 51 558-1 ASTM-D 974
Ash	≤0.01% by mass	DIN EN ISO 6245 ASTM-D 482
Water content	≤150 mg/kg	DIN 51 777-1 ASTM-D 1744
Water release property	≤300 seconds	DIN 51 589-1 ASTM-D 1401
Air release property at 50°C	≤5 min.	DIN 51 381 ASTM-D 3427
Demulsification at 40°C	≤15 min.	DIN ISO 6614 ASTM D 1401
Corrosive effect on copper	≤2-100 A3	DIN EN ISO 2160 ASTM-D 130
Corrosion protection for steel	≤0-B (DIN) passive (ASTM)	DIN 51585 ASTM-D 665
Solid foreign matter	≤300 mg/kg	DIN ISO 5884
Fouling class	≤20/17/14	ISO 4406
Foaming characteristics Foam formation Foam stability (10 min.)	≤50/50/50 ml 0/0/0 ml	DIN 51 566 ASTM-D 892 (Sequence 1-3)
Load carrying ability (load stage)	7	FZG/GRC standard test DIN 51 354-02-A/8.3/90 ASTM-D 5182 ISO 14 635-1 IP 334

Table 8-4 Ageing behaviour requirements of oils

Property	Requirement	Test method
TOST ageing stability	≥ 4000 h (standard)	DIN 51 587 ASTM-D 943
RBOT ageing stability	≥ 350 min (standard)	ASTM-D 2272
Testing of low-viscosity oils for oxidation and corrosion preventing properties	Viscosity change: 20 to 5% TAN change: max. 2.0 mg KOH/g Sludge: to be indicated in mg/100 ml	DIN 51 394 FTM791B-5308.6

8.2.2.3.2 Seal air quality requirements

Filtered seal air only must be used as medium for buffering the dry gas seals and the secondary seals. The air must be dry and free from liquid constituents such as oil.

Table 8-5 Seal air requirements

Designation	Value	Unit
Type of gas	Air	-

8.2.2.3.3 Instrument air quality requirements

The instrument air must be free from dust and oil.

Table 8-6 Instrument air requirements

Designation	Value	Unit
Operating temperature	30	°C
Dew point	-30	°C
Residual moisture	0	%

8.2.2.3.4 Cooling water quality requirements

The cooling water must satisfy the following requirements:

Table 8-7 Cooling water requirements

Designation	Fresh water	
	Value	Unit
Fouling factor	0.00017	m^2K/W
pH value	6-8.7	
Chlorine content	53.2	Mg/l
TDS[a)]	10	Mg/l
Inlet pressure	10	bar g

a) Total Dissolved Solid

8.2.3 Ambient conditions

Table 8-8 Ambient conditions

Designation		Value	Unit
Mounting		indoors, frost protected	-
Elevation above mean sea level		208	m
Barometric pressure		0.99	bar
Ambient temperature	normal	20	°C
	min.	3	°C
	max.	45	°C
Outside temperature	normal	12	
	min.	-25	
	max.	35	
Relative humidity	normal	67	%

8.3 Quality checks and tests

The quality checks and tests carried out on the machine unit prior to dispatch are documented in the MAN TURBO Quality Documentation. This Quality Documentation is supplied separately.

8.4 Drawings and schematic diagrams

The following documents will be found in the separate folders *Drawings and Schematic Diagrams*.

Table 8-9 List of drawings and schematic diagrams

Title	Drawing No.
1 P&I Diagram	837016878_1 837016878_2 837016878_3 837016878_4
2 General Arrangement	837016420_1 837016420_2
3 Overview of Hazard Areas	837021159
4 Foundation Drawing	837016421
5 Instrument List	837017127
6 Alarm and Signal List	837017129
7 Consumer List	837016876
8 Start-up Diagram	837016287
9 Functional Diagram	837017130
10 Description of Anti-surge Control	837017435

Note: Drawings and schematic diagrams which refer directly to a component are filed in the respective operating instructions for the component concemed. You will find an overview of the Operating Instructions for Components in the following *Section 8.5 Operating Instructions for Components*.

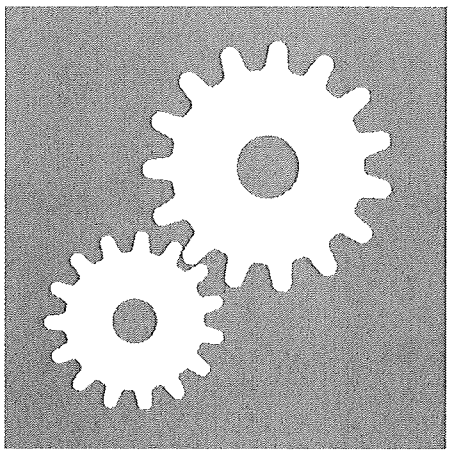
8.5 Operating Instructions for Components

The following operating instructions will be found in the separate folders *Operating Instructions for Components*.

Table 8-10 List of Operating Instructions for Components

Component	Manufacturer	Type	Tag No.
1 Gear unit	BHS Getriebe GmbH	HC 63-2	-
2 Compressor	MAN TURBO	RIK 80-4	-
3 Oil system	Lubisystem S.r.l.		-

Component	Manufacturer	Type	Tag No.
4 Anti-surge control	ABB	Protronic 550	FIC 11077
5 Coupling 1	Euroflex	10 GBH-330-S	-
6 Condensate traps	BEKO Kondensat Technik GmbH	BEKOMAT 16 CO	-



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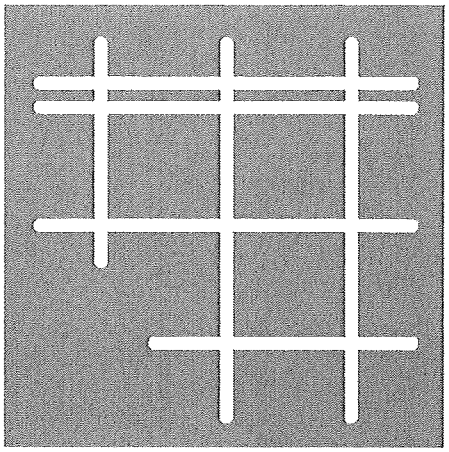

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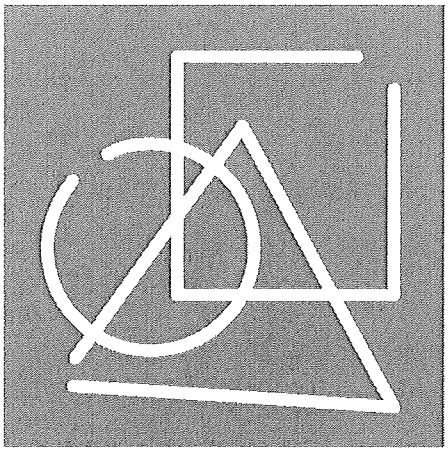

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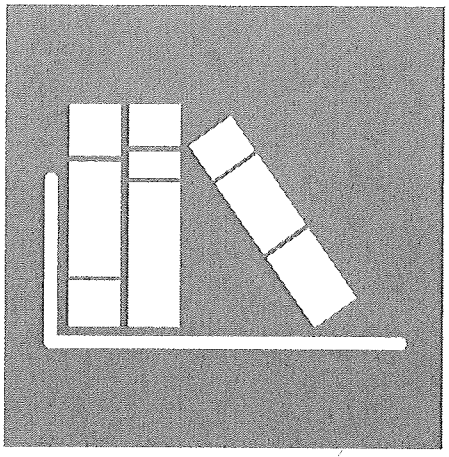


Glossary

This glossary provides an explanation of fundamental terms. The definition of terms will facilitate your understanding of the Operating Instructions.

Note: The definitions are primarily guided by the European directives and standards.

The following terms are included in the glossary:

- Decommissioning
- Subassembly
- Intended use
- Operation
- Initial start-up
- Skilled person
- Overall process plant
- Commissioning
- Start-up
- Inspection
- Service and maintenance
- Repair
- Component
- Machine
- Machine unit
- Machine train

- Normal operation
- Procedures
- Special operation
- Shut-down
- Malfunction
- Handover
- Maintenance

Decommissioning

The machine unit is not used any longer and finally decommissioned. With decommissioning the operation permit expires. The machine unit can only be used again after renewed commissioning, i.e. with new operation permit.

Subassembly

A component is made up of several subassemblies. Subassemblies consist of one or several component parts.

Intended use

The intended use defines the mode of utilization of the machine unit. This results from the design and construction of the machine unit.

Operation

Operation starts with handover of the operational machine unit to the Operator / User and ends with (final) decommissioning. Operation thus also includes any standstill periods. Standstills could be due to the following reasons:

- General interruption of utilization (normal operation)
- Malfunction (special operation)
- Service and maintenance (special operation)

Initial start-up

Initial start-up takes place during commissioning.

Skilled person

A skilled person is a person who, based on his/her special training and experience, is capable of recognizing risks and avoiding potential hazards which may arise from operation or service and maintenance of a product. (EN 62079) MAN TURBO differentiates between the following types of skilled persons (user roles):

- Machine operator
- Service technician
- MAN TURBO After Sales Service technician

Overall process plant

The overall process plant constitutes the primary production process to which the machine unit contributes a part. Within the overall process plant the MAN TURBO machine unit is only one of several functional units.

Commissioning

With commissioning the machine unit is made ready for use and handed over to the Operator / User. Following handover the machine unit is in operation.

Start-up

Start-up is the initiation of processes or movements. In the case of rotary machines this is, for instance, the controlled increase of speed from standstill up to operating speed, in the case of auxiliary systems the controlled increase of oil pressure, oil temperature, cooling water flow rate, etc. up to the operating value.

Inspection

An inspection is a check that is carried out regularly. At predetermined time intervals components of the machine unit have to be partly disassembled and

the subassemblies or parts subjected to a detailed review. The aim of an inspection is to determine potential sources of damage in good time, before failures and severe damage result.

Service and maintenance

Service and maintenance comprise all activities carried out to maintain or restore the functional integrity of the machine unit. This includes maintenance, inspection, and repair.

Repair

Repair includes all measures necessary to restore the required condition of the machine unit.

Repair is required

- if a technical defect has occurred.
- if it becomes apparent that a technical defect is about to occur (e.g. if wear is detected).

Component

A component is a self-contained functional unit which is part of the machine unit. A component may be a machine, an auxiliary system or an individual component part. A component is made up of individual subassemblies.

Machine

A machine is a functional technical unit (e.g. made up of rotor and stator) which by itself is not operational. Functionality is provided by the interaction with other machines and the auxiliary systems of the machine unit.

Machine unit

The machine unit is an operational entity which is made up of individual components. A component may be a machine, an auxiliary system or an individual component part.

Machine train

A machine train consists of machines with coupled shafts which co-rotate.

Normal operation

Operating condition in which the machine unit fulfils or is able to fulfil its envisaged function. Normal operation includes standstill periods which are due to other reasons than those arising from the machine unit itself. These include, for example, general interruptions of production.

Procedure

A procedure is a sequence of complex, interrelated work steps resulting in the fulfilment of a task (e.g. start-up of steam turbine). These may also be part of a complete process (e. g. start-up of machine train) or a higher-ranking procedure.

Special operation

Operating condition in which the machine unit is not in normal operation, i.e. is not able to perform its intended function. The reasons for this result from the machine unit itself. The term "special operation" is the opposite of the term "normal operation".

Shut-down

Shut-down is the termination of processes or movements. In the case of rotary machines, for instance, shut-down is the controlled reduction of speed up to standstill of the rotor(s) and in the case of auxiliary systems the controlled reduction of oil pressure, oil temperature, cooling water flow rate, etc.

Malfunction

A malfunction is a situation where the functionality of the machine unit is affected or will obviously be affected shortly. This is the case with:

- Tripping (e.g. EMERGENCY STOP)
- Alarm signals of the monitoring system
- Deterioration of performance of functions
- Impending deterioration of functionality

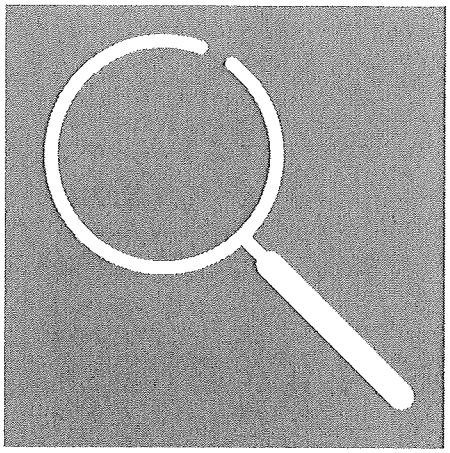
Standstill periods due to (production) disorders within the overall process plant are not malfunctions of the machine unit.

Handover

Handover is the point in time where commissioning is completed and the machine unit is taken over (for operation) by the Operator / User.

Maintenance

Maintenance comprises all measures which are taken to avoid foreseeable malfunctions or defects. The aim is to maintain the functional integrity of the machine unit. Example: Regular cleaning of oil filter.



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