

# **General operating instructions Twin-screw extruder**

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# 1 General

### 1.1 Introduction



Irrespective of legal and colloquial designations, the designation **machine** is used with general validity in the following text for the entire Coperion scope of supply, e.g. component, apparatus, device etc. Individual machine sections are referred to as a **unit**.

Specific assignment to suit legal requirements will be made as these installation and operating instructions continue.

These operating instructions contain important remarks to help you use the machine in accordance with its designated purpose. The operating instructions are aimed at qualified, instructed and trained personnel responsible for installing the machine in an existing plant.

The operating instructions must always be kept at the place of use of the machine and must be read, understood and applied by any person responsible for work on or with the machine. This applies in particular to safety instructions, which are specially identified in these operating instructions. Taking account of the instructions will help prevent accidents, faults and malfunctions.

These operating instructions are intended to make it easier for the customer/user/operator to get to know the machine and to use its designated potential applications.

The operating instructions contain important remarks which will help operate the machine safely, properly and economically.

Compliance with the operating instructions

- helps avoid hazards,
- · increases reliability in use,
- increases the service life of the machine,
- reduces maintenance costs and downtimes.

If you receive further information from us for the machine (e.g. additional technical information), this must also be observed and enclosed with the operating instructions.

If you do not understand the operating instructions or individual chapters, you should ask your dealer and/or Coperion GmbH before starting the relevant activity.

To ensure safe operation of this machine, it is important to comprehend, understand and follow the instructions, recommendations and comments in these operating instructions. If the instructions, recommendations and comments are not followed, any potential claim made with respect to this machine may be limited or rejected. This applies both to claims under warranty and liability and to damage to the machine resulting from non-compliance with these operating instructions.

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Examples of use not in accordance with designated use:

- · installation faults.
- inadequate maintenance.
- other uses not specified in the operating instructions or the contract documentation.

### 1.2 Amendments/limitations

We make every effort to ensure that these operating instructions are accurate and up to date. In order to maintain our technical advantage, it may be necessary to make amendments to the product and its operation without prior notice. We accept no liability for malfunctions, failures and resulting damage.

You should also refer to any additional information provided.

# 1.3 Warranty and liability

Our "General Terms and Conditions of Sale and Delivery" essentially apply. These are available to the end customer at the latest when concluding the contract and can be accessed on our website.

Coperion GmbH refuses to accept claims under warranty and liability for personal injury and material damage if these are attributable to one or more of the following causes:

- use not in accordance with the designated purpose.
- installation and/or start-up not correct.
- operation with safety equipment not correctly fitted or not in functioning condition.
- non-compliance with the safety instructions and remarks in the operating instructions.
- repairs or manipulations made by persons who are neither authorized nor trained for this purpose.
- autonomous structural adaptations and modifications.
- service and maintenance work not carried out properly and in good time.
- auxiliary equipment, accessories, spare parts and extra materials which cause damage and have not been approved by the manufacturer. The manufacturer accepts no liability for any resulting consequential damage.
- disasters as a result of the effects of foreign bodies and force majeure.
- product contamination as a result of malfunctions (e.g. abrasive wear). The manufacturer accepts no liability appropriate measures (e.g. magnetic separators) must be taken by the owner.

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Please refrain from any interventions or modifications to the machine not authorized by us, especially to drives and to mechanical and pneumatic components, as this might void declarations issued in relation to the EU Directive!

# 1.4 Scope of supply

- 1. On receipt of the delivery, use the shipping documents to check that the machine and/or individual subassemblies have been delivered complete.
- 2. In the event of transport damage, make the delivering carrier liable in writing.
- 3. Immediately notify the manufacturer/supplier in writing about any missing parts.

### 1.5 Documentation

The operating instructions are a constituent part of the product and of the scope of supply.

A copy of these instructions must be accessible to authorized personnel at all times throughout the entire service life of the machine. Make sure that the instructions are also passed on if the machine is sold.

We reserve the right to make changes to the data and images in these operating instructions as a result of technical development.

Regardless of these instructions, the laws, ordinances, directives, regulations and standards applicable in the country of use and in the location of use must be observed.

Text and images correspond to the state of the art at the time of printing - subject to change. We would be grateful if you would pass on any suggestions for improvement and point out any errors in the operating instructions.

# 1.5.1 Language and copyright

Translations are carried out to the best of our knowledge. No liability can be accepted for translation errors and any resulting consequences, even if the translation was carried out by us or on our behalf.

The German text has and retains priority for any claim under warranty and liability. All legal rights under copyright law are expressly reserved.

# 1.6 Characters and symbols in these instructions

The characters and symbols in these instructions are intended to help you use the instructions and the machine quickly and safely.

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### 1.6.1 Information



Information informs you of the most effective and practical use of the machine and these instructions.

### 1.6.2 Actions

The defined sequence of actions makes it easier for you to use the machine correctly and safely. Actions are sequentially numbered in these instructions.

### 1.6.3 Item numbers

Item numbers in graphics are identified in the text by round brackets ().

# 1.6.4 Safety marking

The safety marking symbolizes the source of a hazard. Safety markings throughout the technical documentation comply with EN ISO 7010.

The following symbols are used in this manual:

Pictogram	Description
<b>A</b>	Warning of hand injuries
	This warning sign precedes the description of activities which involve hazards related to the crushing and severing of limbs, possibly with fatal consequences.
4	Warning of dangerous electrical voltage  This warning sign precedes the description of activities which involve electric
	shock hazards, possibly with fatal consequences.
<b>A</b>	Warning of hot surface
<u>5555</u>	This warning sign precedes the description of activities which involve hazards due to hot surfaces.

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Pictogram	Description
A	Warning of risk of slipping
	This warning sign precedes the description of activities which involve hazards due to slipping, possibly with fatal consequences.
<b>A</b>	Warning of suspended loads
	This warning sign precedes the description of activities which involve hazards due to falling objects, possibly with fatal consequences.
	Warning of potentially explosive substances
	This warning sign precedes the description of activities which involve hazards due to explosive substances, possibly with fatal consequences.
<b>A</b>	Warning of risk of crushing
-E TR-	This warning sign precedes the description of activities which involve hazards due to crushing.
	Warning of pressurized parts and media
	This warning sign precedes the description of activities which involve hazards from pressurized parts and media.
<b>A</b>	Warning of risk of suffocation
	This warning sign precedes the description of activities which involve hazards due to suffocation.

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Pictogram	Description
	Warning of injuries  This warning sign precedes the description of activities which involve hazards related to limbs becoming trapped, possibly with fatal consequences.
N2	Warning of nitrogen  This warning sign precedes the description of activities which involve a hazard due to the escape of nitrogen.

#### Safety instructions - classification of signal words 1.7



# **DANGER**

### **Description**

Indicates a hazardous situation which, if not avoided, will result in death or serious, irreversible injuries.

Possible ways of avoiding this situation are described here.



# **WARNING**

### **Description**

Indicates a hazardous situation which, if not avoided, might result in death or serious, irreversible injuries.

Possible ways of avoiding this situation are described here.



# ♠ CAUTION

### **Description**

Indicates a hazardous situation which, if not avoided, might result in mild or moderate injuries.

Possible ways of avoiding this situation are described here.

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# **NOTICE**

### **Description**

Indicates a situation which, if not avoided, may lead to material or environmental damage.

Possible ways of avoiding this situation are described here.

# SICHERHEITSROUTINE

Describes operating sequences which must be followed consistently, e.g. switch-off processes in the event of malfunction or emergency.

# 1.8 Structure of safety instructions

Warning notes in these operating instructions are structured as follows:

### **HAZARD LEVEL**

### Consequences of non-compliance!

Type and source of hazard

► Action to eliminate risk

# 1.9 Performance label

The performance label serves for labelling the twin screw extruder. The performance label clearly identifies the extruder so that the machine can be assigned to a certain Coperion project. The performance label is in two languages, English and the country of installation.

The performance label is permanently attached to the extruder, e.g. on the support or on the machine base frame. It can be read at all times under normal operating conditions.

All questions about a delivered extruder must always be accompanied by the data on the performance label.

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Figure 1: Example of a performance label

# 1.10 Numbering system

Coperion uses a company-specific numbering system for consistent identification of plant sections, units and built-in components. The plant is subdivided into plant sections and, to each plant section, the corresponding units and components are assigned.

### 1.10.1 Plant sections

The plant comprises nine plant sections.

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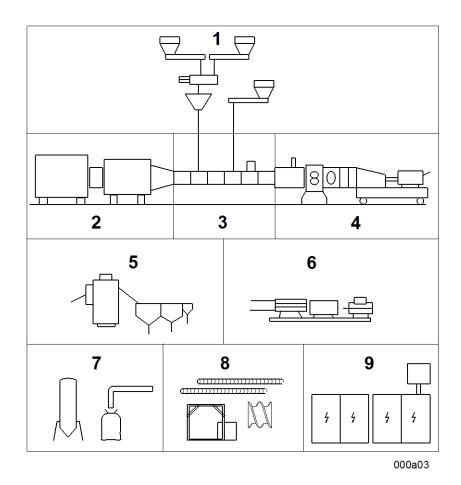


Figure 2: Plant sections

Item	Designation
1	Feed section
2	Drive
3	Processing section
4	Discharge
5	Extrudate handling
6	Accessory units
7	Product handling
8	Miscellaneous
9	Electrical equipment

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### 1.10.2 Unit number

Each unit within a plant section has a unit number, e.g. A110 or A110/01.

Unit number	Meaning
<b>A</b> 0 00 / 01	Letter for identification of units
A <b>0</b> 00 / 01	Fixed number of the plant section
A 0 <b>00</b> / 01	Fixed number of the unit type
A 0 00 / <b>01</b>	Counter number

### 1.10.3 TAG number

Within the units, the individual sub-assemblies, components and pipe connections have a TAG number, e.g. M302-11/01, which is related to the unit number. An identification is therefore always possible.

TAG number	Meaning
<b>X</b> 0 00 - 00 / 01	M= Motor; P= Pump; E= Heat exchanger; C= Clutch; V= Safety valve; TE, PE, LI= Instruments; N= Pipe connections
X <b>0</b> 00 - 00 / 01	Fixed number of the plant section
X 0 <b>00</b> - 00 / 01	Fixed number of the unit type
X 0 00 - <b>00</b> / 01	Counter number for sub-assemblies, individual components, pipe connections
X 0 00 - 00 / <b>01</b>	Counter number

### 1.10.4 Document number

Some documents such as lists, data sheets, drawings and circuit diagrams are created new for every project. To ensure a clear assignment of such documents to the project, each of these documents is given a project-specific document number, e.g. 64012345.609.0001.0.01.

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Document number	Meaning
<b>6400000</b> .000.0000.0.00	Project number
64000000. <b>000</b> .0000.0.00	Code
64000000.000. <b>0000</b> .0.00	Counting number
64000000.000.0000. <b>0</b> .00	Page size DIN format A0 to A4
64000000.000.0000.0. <b>00</b>	Revision index 00 to 99

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Chapter 2: Transport, packing, storage

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# 2 Transport, packing, storage

## 2.1 Introduction

The units and any individual subassemblies that belong to the scope of supply are delivered to the installation site packed in crates or assembled on transport devices. The cases and transport devices are to protect the unit and sub-assemblies against damage during transport.



Means of transport, lifting gear and any other equipment must be selected according to local conditions and the weights to be manoeuvred. Local safety regulations and supplementary specifications from the local standards authorities must be observed.

# 2.2 Transport damage

The purchaser or his representative is required to inspect the goods for transport damage immediately upon receipt.

The following action must be taken if transport damage is found:

- Any damage must be immediately reported in writing to Coperion.
- All damage should be recorded and logged by an independent inspector for accidents and insurance.
- The damage protocol and report are to be sent to Coperion without delay.

Otherwise, no claims under warranty or insurance will be accepted.

# 2.3 Transport with packing

The unit and individually packed sub-assemblies can be transported with or without packing. The transport specifications and instructions should be followed.

To ensure proper transport and handling, the following symbols are provided on the cases.

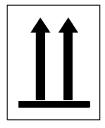


Figure 3: This side up

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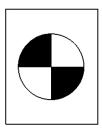


Figure 4: Centre of gravity

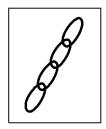


Figure 5: Sling here



Figure 6: Protect from moisture

# 2.4 Storage

If the machine is not installed and put into operation immediately after unpacking, it must be protected against moisture and dirt. Plugs are supplied for all openings on the machine. These must be attached as soon as the machine is stored. If no more plugs are available, the openings must be sealed tight with film.

In order to maintain top quality and functionality, the following actions must be taken for a storage period of up to 3 months:

- cover the machine in its original packaging or with UV-resistant film and store it under cover with its openings tightly sealed.
- store machine at -20 °C to +60 °C.
- prevent condensation from forming.

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In order to maintain top quality and functionality, the following actions must be taken for a storage period of 3 months or more:

- pack the machine with drying agent (e.g. composite aluminium foil) rendering it airtight and evacuate it. Store it under cover. Store machine at -20 °C to +60 °C.
- · check the packaging every month for damage and loss of vacuum.

### **ALTERNATIVELY**

 Store the machine in its original packaging or covered with film and store in a dry building with its openings tightly sealed (relative humidity < 50 %).</li>

In order to maintain top quality and functionality, the following actions must be taken for a storage period of 24 months or more:

• Before start-up, maintenance must be carried out in line with the maintenance and lubrication schedule for the 2-year maintenance interval.

# 2.5 Packing

The machine has been packed carefully to ensure sufficient protection during shipping.

Upon receipt of the goods, the packaging and the goods should be checked for damage. Damaged cables and connectors are also a safety risk and must not be used.

In the event of damage, the machine must not be started up.

In this case, please contact Coperion GmbH.

# 2.6 Transport

Depending on project scope, the machine will be supplied complete or in individual parts. In the latter case, the subassemblies are listed separately in the shipping documents. Depending on size and design, satellite machines will be supplied assembled or separately.

# 2.6.1 Safety and personnel

To avoid fatal injury and material damage during transport, it is essential to observe the following points:

- ensure that transport work is carried out only by qualified persons in compliance with the safety instructions.
- be aware that protruding sharp edges may lead to injuries.
- do not stand under suspended loads.
- ensure that the transport route is barricaded and secured so that no unauthorized persons can enter the danger area.
- ensure that the means of transport (hall crane, crane trolley, low-lift truck) complies with local accident prevention regulations.

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- observe applicable national and regional directives and accident prevention regulations. This applies especially to directives with regard to hazards during transport and moving.
- When selecting the means of transport, take account of the weight and dimensions of individual plant parts.
- Suspend chains or cables at all the suspension points provided for the suitable load handling device.
- Chains or cables must adopt a shallow angle to the perpendicular.

# 2.6.2 Transporting the twin-screw extruder

Shocks and condensation due to high temperature fluctuations must be avoided during transport.

Detailed transport instructions can be found in the installation manual. If you have any further questions, please contact Coperion.



When selecting lifting gear, lashing and lashing equipment, take account of the total weight of the machine and the add-on parts. The values can be found in the installation plan.

# DANGER

### Hazard due to incorrect transport!

Persons may be caught by machine parts. The machine may slip away or tip over. Risk of serious injury with fatal consequences.

- ▶ Only pick up the machine by the transport eyes provided. If there are no transport eyes on the machine, it must always be lashed by the flanges.
- Transport the machine to its place of use using a suitable means of transport!
- Appropriate transport locks must be used for transport.
- Do not enter or stand in the danger area.
- Do not stand under suspended loads.

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# **CAUTION**

# Risk of injury from the satellite machine tipping over if moved on uneven or dirty ground!

- ► The ground in the area where the satellite machine is being moved must be clean, flat and free of obstacles.
- ▶ Move the satellite machine slowly and without jerks.
- ▶ The transport lock (optional) must be secured.
- ► The satellite machine must be relocated only a short distance. The base frame is not a means of transport.
- Wear safety boots.

# **↑** CAUTION

# Risk of crushing parts of the body if the twin-screw side feeder is transported incorrectly!

▶ Attach transport cables securely as shown in the drawing.

# 2.6.2.1 Transporting the twin-screw extruder with the suspension device Sling points and maximum permitted values

Different sling points are possible depending on the size of the machine. All the sling points can be found in the set-up manual. Example sling points are shown below.

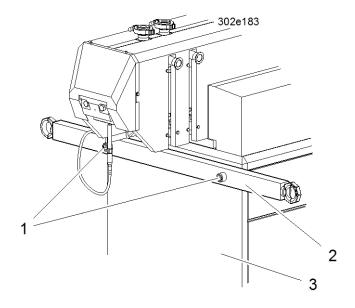


Figure 7: Example of the suspension device on small machines

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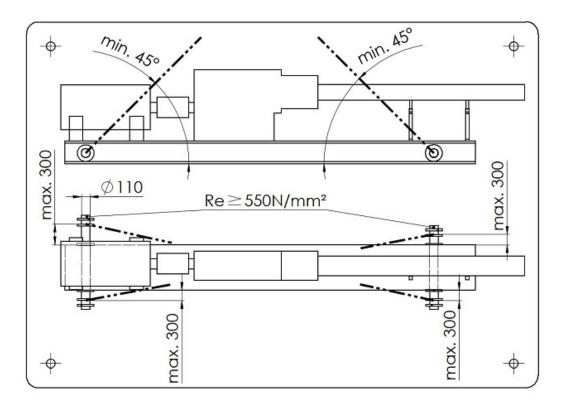


Figure 8: Example of the suspension device on large machines

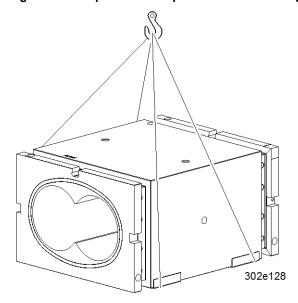


Figure 9: Transporting the screw barrel

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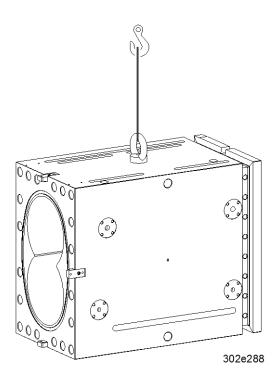


Figure 10: Transporting the screw barrel using an attachment swivel

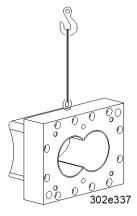


Figure 11: Transporting the insert

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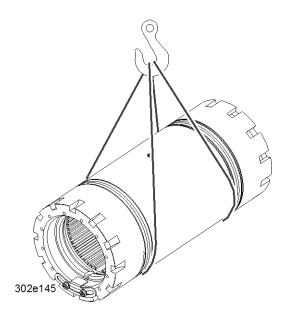


Figure 12: Screw shaft coupling

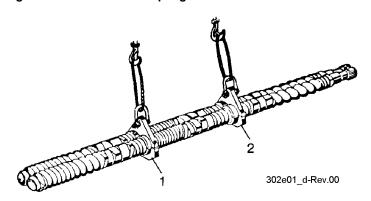


Figure 13: Transporting screw shafts up to a length of 12 screw barrels

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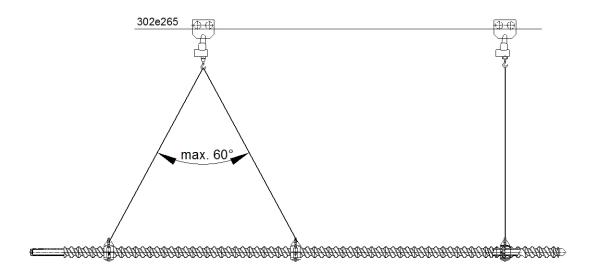


Figure 14: Transporting screw shafts from a length of 13 - 16 screw barrels

### 2.6.2.2 Satellite machine

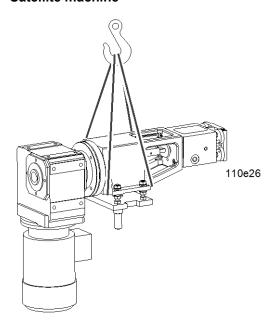


Figure 15: Transporting the satellite machine

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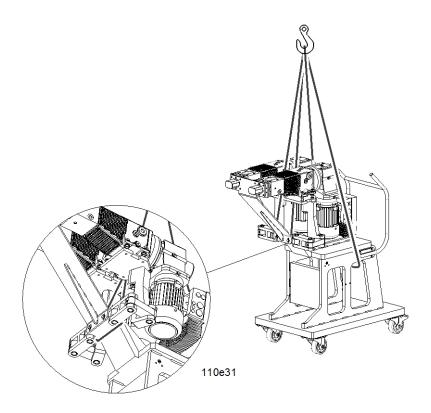


Figure 16: Transporting the satellite machine with base frame

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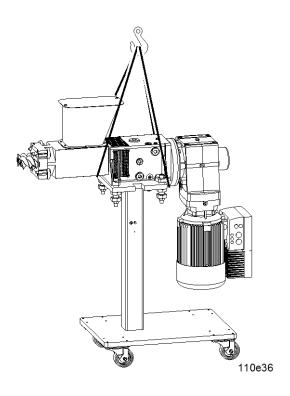


Figure 17: Transporting the satellite machine with wheeled base frame.

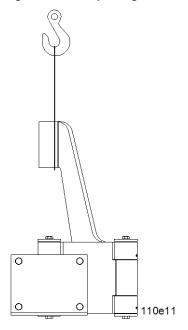


Figure 18: Transporting the swivel arm (satellite machine)

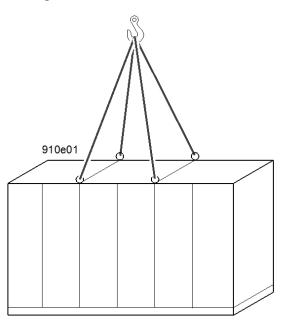
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### 2.6.2.3 Switchgear unit



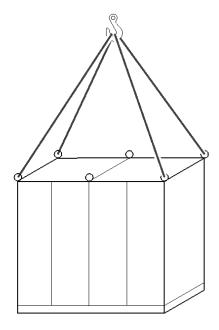


Figure 19: Transporting the switchgear unit

# 2.7 Preservation of plant parts

# 2.7.1 Introduction

Plant components and units manufactured by Coperion are preserved inside and/or outside before delivery. The preservation measures depend on the storage period and the climatic conditions at the place of storage. The following table shows the possible types of preservation at the factory.

Table 1: Types of preservation at the factory

Short-time preserva- tion	Preserva- tion period	Preserva- tive
Short-time preservation	up to 3 months	Ensis Flu- id G
Standard preservation	up to 6 months	Tectyl 506
Long-term preservation	up to 2 years	Tectyl 506 multicoat

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The preservation regulations of the various unit manufacturers must be observed; see the operating instructions for the particular unit in the chapter "Operating instructions for plant components".

A follow-up preservation or long-time preservation is necessary, if the duration of preservation at the factory is exceeded or if the plant is not started up after installation over a longer period of time.

To keep the plant in the condition as delivered, additional preservation measures inside and outside of the units are required. For determining suitable measures, please confer with Coperion. Removal of the preservative

#### 2.7.2 Preservatives in food machines

There are no preservatives on food machines.

#### 2.7.3 Removal of the preservative

Coperion recommends a cold cleaner for removing the preservative.

A cold cleaner is a solvent suitable for cleaning cold metal parts contaminated with grease, oil, tar or wax.

The cold cleaner should be non-polluting. It must form a stable emulsion with water and allow quick separation in accordance with the requirements of DIN 1999 (Light Liquid Separators).

This is how the preservative is removed:



### WARNING

### Risk of injury to skin and eyes!

- Avoid direct contact with the cold cleaner.
- Wear protective clothing and goggles.

# WARNING

### Risk of fire when heating!

- Make sure that the working rooms are well ventilated.
- 1. Apply the cold cleaner to the preservative-coated surfaces by means of a brush or by spraying.

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2. Clean the surfaces with cleaning wool or cleaning rags.

# 2.7.4 Preservatives

See the "Table of lubricants" for preservatives for short-term, long-term and standard preservation.

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# 3 Safety

## 3.1 Introduction

Read the following safety instructions and information for safe operation carefully before starting work. Familiarize yourself with all functions. Keep this manual carefully and pass it on to others if necessary.

It is very important for your safety that you have understood and follow all chapters relating to safety.

On the topic of safety, read and follow

- chapter 3 "Safety",
- the special warning notes relating to dangerous actions,
- the safety data sheets at the workstation,
- the working instructions at the workstation.

Ignoring this information may lead to a hazard to the life and health of persons, to environmental harm and/or to extensive material damage.

Observing the safety instructions helps avoid hazards.

# 3.1.1 General safety instructions

- General statutory regulations or directives on occupational safety, accident prevention regulations and environmental protection laws must be observed, e.g. the German health and safety at work regulations [Betriebssicherheitsverordnung - BetrSichV] or nationally applicable regulations.
- If it has to be assumed that safe operation is no longer possible, the machine must be switched off immediately.
- Safe operation is no longer possible in the following situations, among others:
  - faults in the control system lead to uncontrolled movements
  - the machine is blocked by a workpiece or a component
  - damage to parts of the machine can be seen
- When explosion-protected electrical systems are set up or operated, standards IEC/EN 60079- 14 (NEC for the USA) and the relevant installation and operating regulations must be observed.

# 3.1.2 Safety signs on the machine

The safety marking symbolizes the source of a hazard. Safety markings on the machine comply with EN ISO 7010.

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Pictogram	Description
<b>A</b>	Warning of hand injuries
	This warning sign precedes the description of activities which involve hazards related to the crushing and severing of limbs, possibly with fatal consequences.
	Warning of dangerous electrical voltage
14	This warning sign precedes the description of activities which involve electric shock hazards, possibly with fatal consequences.
<b>A</b>	Warning of hot surface
<u>5555</u>	This warning sign precedes the description of activities which involve hazards due to hot surfaces.
A	Warning of potentially explosive substances
	This warning sign precedes the description of activities which involve hazards due to explosive substances, possibly with fatal consequences.
<b>A</b>	Warning of risk of crushing
	This warning sign precedes the description of activities which involve hazards due to crushing.
A	Warning of pressurized parts and media
	This warning sign precedes the description of activities which involve hazards from pressurized parts and media.

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Pictogram	Description
	Warning of risk of suffocation  This warning sign precedes the description of activities which involve hazards due to suffocation.
	Warning of injuries  This warning sign precedes the description of activities which involve hazards related to limbs becoming trapped, possibly with fatal consequences.
N2	Warning of nitrogen  This warning sign precedes the description of activities which involve a hazard due to the escape of nitrogen.

# 3.2 Use in accordance with the designated purpose

Within the framework of use in accordance with the designated purpose, the machine complies with the state of the art and the applicable safety regulations at the time of market launch.

In terms of design, neither foreseeable misuse nor remaining hazards could be avoided without limiting intended functionality.

Depending on the process, the machine is designed for:

- filling
- plasticizing
- compounding
- mixing
- devolatilizing
- extruding
- conveying
- dispensing

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## 3.2.1 Areas of application

The machine is designed for various products, such as foods, pharmaceuticals, plastics etc. depending on the order specification.

Depending on the scope of supply or the project specification, this is partly completed machinery or machinery within the meaning of Machinery Directive 2006/42/EC.

Depending on the order specification, the machine may be installed and operated both indoors and under cover outdoors.

Any use not in accordance with the designated purpose or any activity on the machine not described in these instructions represent prohibited misuse outside the legal limits of the manufacturer's liability.

# 3.2.2 Directive 2014/34/EU (ATEX)

The owner is responsible for explosion protection when using materials which may form explosive mixtures. The twin-screw extruder is not designed with explosion protection.

# 3.3 Reasonably foreseeable misuse

The manufacturer accepts no responsibility for any misuse of the machine. Any kind of misuse also voids any claim under warranty the manufacturer grants with the machine.

Reasonably foreseeable misuses are:

- operating the machine with guards and/or warning notes removed, disassembled or manipulated.
- operating the machine using any technical data other than those agreed in writing/ contractually.
- operating the machine with products which are chemically unstable or classified as explosives.
- maintenance or repair work that has been carried out incorrectly or not at all.
- operating the machine with products classified as toxic.
- operating the machine with formulations for which it was not contractually specified.

# 3.4 Remaining hazards

Any remaining hazards are indicated in the documentation.

Any remaining hazards can be avoided by observing and implementing these specifications in a practical form:

- special warning notes on the machine
- · safety instructions and warning notes in these instructions
- owner's operating instructions

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The machine may present a danger to life/risk of injury to persons as a result of:

- misuse
- incorrect handling
- transport
- missing or manipulated guards
- defective or damaged component parts
- handling/use by untrained personnel who have received no instruction

Material damage to the machine may be caused by:

- incorrect handling
- operating and maintenance specifications not being observed
- unsuitable consumables
- unsuitable installation sites

Material damage may be caused to other material assets in the operating range of the machine as a result of:

· incorrect handling

The machine may suffer impaired performance/functionality as a result of:

- incorrect handling
- incorrect maintenance or repair
- unsuitable consumables

#### 3.4.1 Thermal hazards

# **CAUTION**

#### Hazard from hot surfaces, hot product and/or hot air flows!

Hazard from burns or shock as a result of hot media!

- Allow the machine to cool down (if technically possible). (Screw shafts can only be dismantled as long as the product remains capable of processing.)
- Wear personal safety equipment.
- ▶ Do not remove the heat insulating hood during operation.

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#### 3.4.2 Mechanical hazard

- Crushing or impacts can result from carelessness or careless use of personal protective clothing.
- There is a risk of unexpected malfunctions on the machine as a consequence of damage to its component parts, failure or malfunction of the control system.

# 🛕 DANGER

#### Hazard due to moving and/or rotating/swivelling parts!

When the machine is running, there is a risk of injury with fatal consequences as a result of limbs becoming trapped, drawn in, crushed or severed.

- Guards must not be removed.
- Do not reach into moving and/or rotating/swivelling parts during operation.
- Ensure that moving parts are not accessible during operation.
- Do not wear loose clothing or jewellery or leave long hair loose.
- Before carrying out any work on moving component parts, switch off the machine and secure it against being switched back on. Wait until all component parts have come to a standstill.

# DANGER

### Hazard from machine standing on casters!

If the machine and/or its accessories are not fixed in position, there is a risk of injury with fatal consequences as a result of lower limbs being crushed or severed.

- Fix the machine in position.
- ▶ Ensure that moving parts are not accessible during operation.
- Before carrying out any work on moving component parts, switch off the machine and secure it against being switched back on. Wait until all component parts have come to a standstill.

# **CAUTION**

#### **Risk of cuts!**

Sharp surfaces, edges and corners of the machine may lead to cuts!

- Wear personal safety equipment.
- Wear cut-resistant gloves.
- Consult a doctor immediately in the event of injury.

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It is imperative that the actions below are taken.

- The unprotected drive mechanisms present a risk of limbs being severed, crushed and trapped during installation and start-up, as well as when making settings.
- No second person may stand in the danger area during these activities.
- Covers may only be opened/removed for the duration of maintenance and repair work and must be properly fitted or closed during operation.
- Keep hands, hair, clothing and tools away from moving parts such as: chain drive, shafts etc.
- Do not reach into a section with moving parts or into rotating drive parts.

#### 3.4.3 Electrical hazard



### **DANGER**

#### Hazard due to electrical voltage!

There is a danger to life from electric shock when working on live component parts!

- Any work on the electrical fittings of the machine must only be performed by qualified electrical specialists or by instructed persons under the direction and supervision of a qualified electrical specialist in compliance with electrical engineering regulations.
- Observe the 5 safety rules for working on electrical systems: switch off; secure against switching back on; ensure parts not live; earth and short-circuit; cover or block off adjacent live parts.



#### **WARNING**

#### Risk of explosion due to naked ignition sources!

Arcing resulting in a flame may lead to fires or explosions!

Disconnect electrical connectors in areas at risk of dust explosion only when the equipment is switched off.



### **DANGER**

#### Risk of explosion!

Formation of sparks as a result of electrostatic charge in areas at risk of fire and explosion.

▶ All machines are equipped with earthing screws/clips which must be connected.

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It is imperative that the actions below are taken.

- Check electrical equipment regularly: retighten loose connections and replace damaged wires or cables immediately.
- When working on the machine, there is an electrical hazard from direct contact with live parts or parts which have become live due to faulty conditions.
- When work is being performed on live parts, wires or cables, a second person must always be present to switch off the main switch in the event of an emergency.
- Never clean electrical equipment with water or similar liquids.
- All insulation must be checked for damage before work is started.
- Before working on the system, switch off the system at the main switch, check that the system is de-energized and secure it against being switched back on.
- · Use only insulated tools!

### 3.4.4 Hazard due to gas, dust, fumes, smoke

# **A** DANGER

#### Risk of explosion from dust deposits and/or gas escape!

Dust deposits with a layer thickness > 5 mm and/or gas escapes may ignite on hot surfaces, for example, leading to fires or explosions!

- ▶ Clean the machine regularly so that no dust is stirred up.
- Ensure that the maximum surface temperatures of operating equipment and components in areas at risk of dust explosion and the permissible temperature class in the area at risk of gas explosion are not exceeded.
- ► Check the machine regularly for escape of dust or gas. Pay special attention to sections with shaft bearings.
- ► Ensure that no dust or gas escapes when opening or dismantling the machine.



### Risk of suffocation due to gases, dusts, fumes and smoke!

There is a risk of suffocation when using machines indoors in an environment of air-displacement gases, dusts, fumes and smoke!

Ensure an adequate supply of fresh air.

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# **MARNING**

#### Risk of lung damage and/or eye injury from dust!

Dust turbulence can occur during any work on and with the machines; this may lead to eye injuries and/or to lung damage if inhaled.

- ▶ Wear personal safety equipment (suitable respirator, goggles etc.).
- Extract, absorb dust ...

### 3.4.5 Pneumatics, steam, hydraulics

# **⚠** CAUTION

#### Hazard from pressurized parts and media!

When working on pressurized lines or component parts, pressurized media may suddenly escape. Escaping media can lead to injuries or uncontrolled movements of component parts! Product moisture or added moisture can cause pressure as a result of evaporation in the machine.

- ▶ Before starting repair work, depressurize any system sections and pressurized lines (compressed air) which have to be opened!
- ▶ Work on pressurized lines is permitted only by specialist personnel!
- Repair damage to lines, hoses and screw fittings immediately!
- ▶ Wear personal safety equipment (suitable safety goggles, protective gloves).

### 3.4.6 Oils, greases and other chemical substances

When handling oils, greases and other chemical substances, comply with the safety regulations applicable to the product!

• For details, see the safety data sheet for the hazardous goods.

# **CAUTION**

#### Health hazard!

Oils, greases and other chemical substances may harm health in the event of skin contact or swallowing.

- Wear personal safety equipment (suitable safety goggles, protective gloves).
- Take immediate measures in line with the safety data sheet in the event of skin contact or swallowing.

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# **MARNING**

#### **Health hazard!**

Do not come into contact with the fumes which result during the production of battery compound.

- Wear personal safety equipment.
- Ensure adequate ventilation and/or extract fumes.

# **⚠ WARNING**

#### Health hazard!

Preservatives and oils become volatile when heated up.

- Wear personal safety equipment.
- Ensure adequate ventilation and/or extract fumes.

### **NOTICE**

#### Environmental pollution from oils, greases and other chemical substances!

Substances hazardous to water (e.g. oil) may pollute the soil or groundwater!

- ▶ Retain, contain and dispose properly of substances hazardous to water.
- Leaking points on machine parts where substances hazardous to water (oil, grease etc.) escape must be repaired and resealed immediately.
- Keep spaces for collecting substances hazardous to water clear of parts which reduce collecting volume. These collecting spaces must not have any drains.
- It is imperative to maintain test intervals for monitoring and maintaining components hazardous to water (e.g. oil tanks) in line with the maintenance schedule.
- Record maintenance measures or changes of components of equipment hazardous to water in a plant register.

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#### 3.5 Noise information

# **⚠** CAUTION

#### Risk of hearing damage!

Product-related running noise may occur during operation. Sound pressure levels LpA of 95 dB(A) or more may occur and cause hearing damage.

- Wear personal safety equipment.
- Do not use the machine without the heat insulating hood.

### 3.6 Personnel - qualifications and obligations

Only authorized personnel may perform any activities on the machine.

The authorized personnel must:

- have reached the age of 18,
- be familiar with and be able to apply the accident prevention regulations and safety instructions for the machine,
- have been trained and instructed in how to behave in the event of a malfunction,
- have the physical and intellectual skills to carry out their responsibilities, tasks and activities on the machine,
- have been trained and instructed with regard to their responsibilities, tasks and activities on the machine,
- have understood the technical documentation with regard to their responsibilities, tasks and activities on the machine and be able to implement these in practice.

Comply with the remarks below:

- familiarize yourself with the machine and your area of work.
- use the machine only for the contractually agreed purpose.
- use suitable lifting gear to transport and attach heavy accessories.
- wear your safety equipment, such as suitable protective shoes and hearing protection.
- if defects on safety equipment or other defects are found, inform the responsible personnel immediately.
- Pay attention to the following information attached to the machine:
  - safety markings,
  - · health and safety markings,
  - safety instructions.

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### 3.6.1 Personal safety equipment

All parts of personal safety equipment must be worn on and in the area of the machine during all the activities described in these instructions.

This includes, for example, suitable:

- safety boots
- cut-resistant protective gloves
- · hearing protection
- work clothing (inflammable and providing cover)
- suitable safety goggles

Respective national and local regulations for personal safety equipment (e.g. safety helmet) must be observed.

### 3.7 Switching on the twin-screw extruder

### SICHERHEITSROUTINE

- Ensure that there is no-one in areas of the machine which involve a risk of injury.
- Check that the machine is in a perfect, undamaged, complete condition. Never start up the machine if it is damaged or defective.
- Check whether all wearing parts are in operational condition. Have worn or otherwise defective component parts replaced immediately.
- Check that the machine is correctly installed and secured.
- Never attempt to operate the machine with moving parts accessible: risk of severe injury or fatal injury as a result of crushing, severing, being drawn in etc.!
- Never attempt to operate the machine with pressurized parts unsecured. Risk of severe injury from product being flung out, depressurization etc.!
- Only operate the machine with guards and safety equipment fitted!

# 3.8 Guidelines for servicing and maintenance work, as well as malfunctions

# SICHERHEITSROUTINE

- Carry out the specified installation, maintenance and inspection work according to schedule.
- Work on the electrical components must only be carried out by an electrical specialist.
- Switch off the main switch and secure it against being switched back on.

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- Secure supply media such as power and compressed air against being started up unintentionally.
- All screws loosened for maintenance or inspection work must be tightened again to the specified torque and checked before the machine is restarted.
- The function of the safety device must be checked at the end of maintenance or inspection work.

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Chapter 4: Technical data

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### 4 Technical data

### 4.1 Characteristic data

The characteristic data for the machine can be found on the performance label.

Technical data are project-specific and agreed during the project planning phase.

### 4.2 Ambient conditions

The operating temperature without add-on parts is between 18 °C and 40 °C. As designs may have specific features, actual threshold values will be found on the performance label.

Room temperature for twin-screw extruder: standard: 18  $^{\circ}$ C - 40  $^{\circ}$ C; with gearbox heating 5  $^{\circ}$ C - 40  $^{\circ}$ C; special approval from the unit manufacturer is required for temperatures below 5  $^{\circ}$ C and above 40  $^{\circ}$ C.

Room temperature for control cabinet: standard: 0 - 35 °C. Heating in the control cabinet prevents condensation from forming. Up to a room temperature of 35 °C, the machine can be operated with a fan; at temperatures above 40 °C, an air conditioning unit is required.

# 4.3 Dimensions, mass, centre of gravity

#### 4.3.1 Dimensions and mass

Dimensions and weights can be found in the customer-specific installation plan from the project phase.

#### 4.3.2 Centre of gravity

On all types and sizes, the centre of gravity is in the area of the gearbox connection piece.

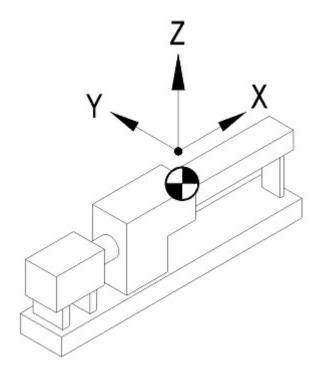
The centres of gravity for the satellite machine and other units can be found in the installation manual.

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# 5 Product description

### 5.1 Introduction

The machine consists of individual units or subassemblies. The twin-screw extruder is the heart of the machine. It consists of these higher-order subassemblies: motor, clutch, gearbox, processing section and base frame. There are different sizes and designs depending on the order specification. Satellite machines which can be used for feeding or devolatilization, for example, can be mounted on the processing section. The end of the twin-screw extruder forms the discharge. There the product is transported out of the twin-screw extruder and has a different shape depending on the order specification. The twin-screw extruder is equipped with heating and/or cooling.

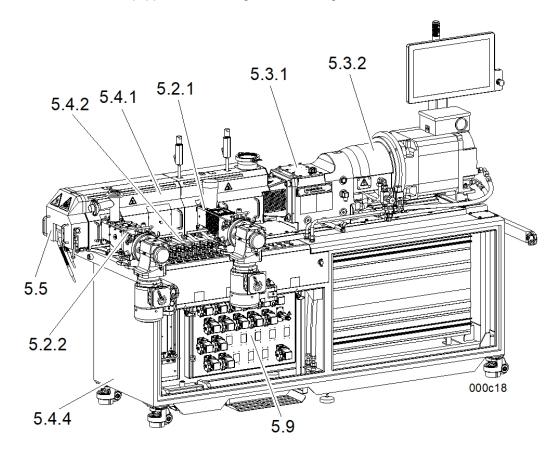


Figure 20: Laboratory machine (item numbers in accordance with the following chapters)

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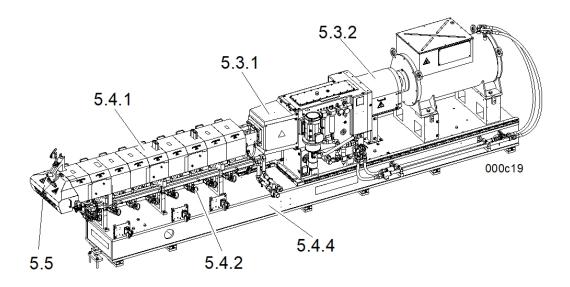


Figure 21: Central machine (item numbers in accordance with the following chapters)

### 5.2 Feed section

### 5.2.1 A110 Twin-screw side feeder (ZS-B)

The ZS-B allows fillers and additives or chopped glass fibres to be fed in from the side in powder and/or pellet form. The co-rotating screw shafts are largely self-wiping and promote active conveying. The feeder can be attached to the twin-screw extruder in conjunction with a connection housing at any point in the processing section where feeding of the above-mentioned materials makes sense. The ZS-B can be quickly installed or removed using quick-change devices on the screw barrel. The ZS-B is designed with a wheeled base frame; a flat and smooth installation surface is required for this. Sufficient space must also be provided for installation and removal, as well as for cleaning.

The twin-screw side feeder consists of the following component parts:

- screw barrel
- 2 screw shafts with positive engagement
- frequency-controlled motor
- · distributing gear with integrated reduction gear
- base frame
- feed hopper
- water cooling of the ZS-B barrel (optional)
- FET insert (optional)

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### 5.3 Drive

### 5.3.1 A202 Mechanical drive parts

The clutch is a component of the mechanical drive parts. The clutch is a mechanical or pneumatic disengaging clutch and serves to separate or limit the flow of force between the motor and the main gearbox if there is an impermissible increase in torque. The clutch has been adjusted to a maximum torque. The clutch and the motor must be aligned according to Coperion specifications.

The clutch consists of the following component parts:

- clutch
- · clutch guard
- sensor for monitoring switching state

### 5.3.2 A203 Main gearbox

The main gearbox reduces motor speed to screw shaft speed and distributes the torque to two output shafts.

The main gearbox consists of the following component parts:

- case-hardened and machined gear tooth systems
- involute gear couplings between output shafts and screw shafts
- · gearbox connection piece for mounting the first barrel
- integrated thrust bearing assembly
- pressurized oil lubrication for bearings and tooth meshes, designed for an ambient temperature of at least 18 °C
- housing in torsion-resistant, vibration-free design
- · lower section of housing as oil reservoir

# 5.4 Processing section

### 5.4.1 A302 Processing section

The processing section is installed between the main gearbox and the discharge. It is composed of several temper-capable screw barrels in which two closely intermeshing corotating screw shafts are arranged. The screws consist of one-piece screw shafts onto which differently acting screw elements are fitted.

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The modular system of screw elements and screw barrels allows different zones to be set up to match the individual process task:

- conveying zone
- plasticizing zone
- mixing and shearing zone
- homogenizing zone
- devolatilization zone
- pressure build-up zone

#### **Screw barrel**

The flexible modular design, based on various different screw barrels, allows the processing section to be configured on an individual basis. Heater cartridges are used for heating.

Intensive, even cooling of the barrels is provided by an internal bore system wrapped tightly around the figure-of-eight-shaped bore of the process technology. Water is used as the cooling medium.

Barrel designs are available as:

- sealed barrels
- barrels with openings for the addition of material or for devolatilization of volatile components
- barrels with an opening on both top and side for connecting a feed screw (screw shafts/elements)

#### **Screw elements**

The screw shaft system is characterized by

- one-piece solid shafts
- screw elements of differing pitch and length
- mixing blocks with different angles of stagger, as well as different numbers and thicknesses of disk
- kneading blocks with different angles of stagger as well as different numbers and thicknesses of disk
- screw tips for fixing the screw set in the axial direction
- involute gear teeth for an optimum flow of force between screw shaft and screw elements

The screw elements can also be combined in a wide variety of designs. Due to the intermeshing, co-rotating profile of the screws, they clean one another in the event of little clearance. This means that no residue can form in the screw flights, reducing cleaning effort during product changes.

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### 5.4.2 A306 Water manifold for processing section

The manifold is used for intensive cooling of the screw shaft barrels. The cooling water (to Coperion specification) is distributed to the individual cooling zones by the pump of a water tempering unit via the header pipe (feed). The integrated 2/2-way solenoid valves are controlled automatically and ensure that the cooling water reaches the individual control zones. The steam produced in the barrels flows into the header pipe (return line). This is flushed with water by a bypass so that the steam can condense there. The hot water is then fed back into the water tempering unit for return cooling.

The manifold consists of the following component parts:

- 1 feed header pipe
- 1 return header pipe
- 1 feed pressure gauge
- 1 return line pressure gauge (optional)
- 1 manual control zone with manually adjustable needle valve for the feed barrel (optional)
- automatic control zones according to specification
- hose connection between header pipes and barrels
- 1 bypass
- shut-off valves (ball valves) upstream and/or downstream of solenoid valves

### 5.4.3 A309 Twin-screw side devolatilization machine (ZS-EG)

The ZS-EG facilitates extremely effective devolatilization of volatiles from the extrusion compound. The screw shafts co-rotate and thus prevent product escaping from the twinscrew extruder into the ZS-EG. A special screw barrel with side connection option allows the ZS-EG to be mounted at any point on the twin-screw extruder where devolatilization is useful. The modular design with quick-change devices enables rapid attachment/ removal. If the ZS-EG is designed with a wheeled base frame, a flat, smooth installation surface is required.

The twin-screw side devolatilization machine consists of the following component parts:

- connecting flange for connecting the ZS-EG to a vacuum unit
- devolatilization barrel
- distributing gear
- base frame
- variable frequency gear motor
- frequency converter
- 2 screw shafts with positive engagement

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#### 5.4.4 A341 Machine base frame

The machine base frame is a welded/sheet metal frame construction and is used to hold the machine components.

Installation is carried out on

- levelling shoes
- rails
- ball bearings

# 5.5 Discharge section

#### 5.5.1 Introduction

There are different discharge variants. The design varies by customer specification and product.

The discharge gives the product its shape, which may vary according to customer specification. The product is conveyed evenly out of the twin-screw extruder to produce an evenly-shaped product.

### 5.5.2 A402 Oblique die head

The newly-developed oblique die head, with optimized flow geometry and low dead space, facilitates reliable extrusion even with highly filled products. It is mounted directly on the last barrel and can be swivelled using a boom. The reduction in weight and the quick-change devices ensure efficient, easy handling.

#### Design:

- · Quick-change design
- Nitride steel material
- Heater cartridges (IP 65)
- 2 or more heating zones
- 1 interchangeable die strip
- 4 or more measuring points, each including measuring sensor:
  - 1x for melt temperature (1/2" UNF bore)
  - 1x for melt pressure (1/2" UNF bore)
  - 2x for barrel temperature
- · heat insulating hood
- screen pack with breaker plate (optional)

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### 5.6 Extrudate handling

The compound conveyed out of the twin-screw extruder is referred to as the product. Depending on customer specification and order, all the properties of the product may differ. The design of the extrudate handling system depends on the product and the order specification. The product may be crushed in the underwater pelletizer or cooled in the water bath and then treated.

See the customer specification to find out whether extrudate handling is part of the scope of supply and, if so, what design is involved. Extrudate handling may include, for example: strand pelletizer, pellet drier, extrudate cooler etc.

# 5.7 Accessory units

#### 5.7.1 Introduction

Scope and design may vary depending on the order specification. The accessory units include the cooling units, the vacuum unit and the compressor. Filters, blowers and pipework may also be included in the accessory units.

See the customer specification to find out whether accessory units are part of the scope of supply and which may be involved. Examples of accessory units may be: oil tempering unit, compressor, exhaust fan, blower etc.

#### 5.7.2 A601 Water cooler

The water cooler is used to cool the screw barrels of the extruder (processing section). The device is supplied ready for connection.

The water cooler consists of the following component parts:

- heat exchanger
- circulating pump: centrifugal pump with slide ring packing
- · expansion vessel: stainless steel tank
- electrical equipment: unit complete with control cabinet for control and power part, degree of protection IP 54
- installation and safety equipment: the unit is supplied ready for connection with fittings, pipes and instruments,10-m cable with plug for power supply and 10-m cable with plug for signal exchange.
- hose pipe between twin-screw extruder and cooling unit
- automatic refilling (optional)

# 5.8 Product handling

Depending on the order specification, product handling includes conveying the material from receipt of the raw materials through to packing the finished product. Discharge devi-

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ces, bag emptying devices, containers and tanks, dryers, scales and filters may be part of product handling. The scope of the plant and the presence of individual units and subassemblies depend on the order specification.

See the customer specification to find out whether units are part of the scope of supply and which may be involved. Product handling may be composed of the following subassemblies, for example: discharge device, bag emptying device, silo, tank, hopper, etc.

### 5.9 Electrical equipment

#### 5.9.1 Introduction

The scope of the electrical equipment depends on the order specification and may contain different assemblies, for example: switchgear units, controls, computers and user interfaces, converters, transformers and exciters.

#### 5.9.2 Control cabinet

All electrical components for controlling and monitoring the machine are installed in a control cabinet intended for installation close to the machine under normal ambient conditions in an area not at risk of explosion.

The control cabinet contains:

- power part
- control and regulation unit
- guards for personal safety and machine safety
- telemaintenance via the Coperion ServiceBox (optional)

The machine is installed electrically in terminal boxes and in enclosed cable ducts mounted on the machine base frame. The system includes continuous segregation of power circuits as well as control and measurement signals.

Central control elements are an industrial PC and an S7-1500 PLC which is connected to the decentralized peripherals on the machine via Profinet.

In sizes ZSK 18, 26 and 27, the control cabinet is located in the machine base frame.

### 5.9.3 Frequency converter

The frequency converter is designed in accordance with IEC and DIN VDE.

Depending on the design, the frequency converter consists of the following component parts:

- line commutating choke
- control transformer
- convenience control panel

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- standardized Coperion interface (Profinet)
- microprocessor control based on field-oriented vector control
- non-condensation heater (for humidity > 80 %)
- motor cut-out via winding temperature PT 100/PT 1000
- radio interference suppression for second environment (industry), Category C3

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Chapter 6: Installation

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#### Installation 6

#### 6.1 General conditions

- Ensure that the substrate is suitable for bearing the weight, including accessories. The permissible floor load must be checked.
- Ensure that the specified tightening torques are adhered to.
- Note the spheres of application and use in accordance with the designated purpose.
- The units must be installed stress-free.
- Special regulations apply to areas at risk of fire and explosion comply with the relevant national and international regulations.
- The installation position must have sufficient space on all sides of the machine for start-up, maintenance, cleaning and repair.
- The installation location must be prepared in accordance with the conditions contractually agreed in advance.
- For separate delivery of the screw shafts, refer to the chapter entitled "Operation".
- All screws must be provided with fitting paste. Fitting paste should be selected to suit application.
- i

Information

The earthing screws/clips are attached to the barrel and marked \( \begin{aligned} \end{aligned} \).





Information

Coperion GmbH should perform installation and start-up.

#### 6.2 **Preparatory measures**

Check machine for:

- completeness
- corrosion
- contamination
- damage

#### 6.3 Transport lock on the processing section

A red painted transport lock (2) is fitted to the screw barrel (1) and the screw barrel support (3) for transport of the processing section. This transport lock should prevent the pro-

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cessing section from moving during transport. The transport lock must be fitted every time the processing section is transported.

The transport lock must be removed before aligning the processing section.

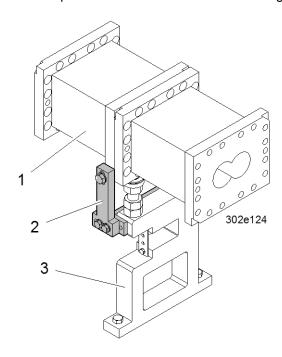


Figure 22: Processing section transport lock

Item	Designation
1	Screw barrel
2	Processing section transport lock
3	Screw barrel support

### 6.4 Lock

The twin-screw side feeder is positioned at the level of the machine base frame in three hinges to enable it to move. If the connection to the processing section of the twin-screw extruder is released, the twin-screw side feeder is easy to swivel. To prevent this happening in an uncontrolled manner, there is a lock which is able to fix the swivel arm in a variety of positions.

When the twin-screw side feeder is released from the processing section, swivel it away to the desired position for servicing and close the lock bolt (2). Ensure that all lock bolts snap into their lower (closed) position.

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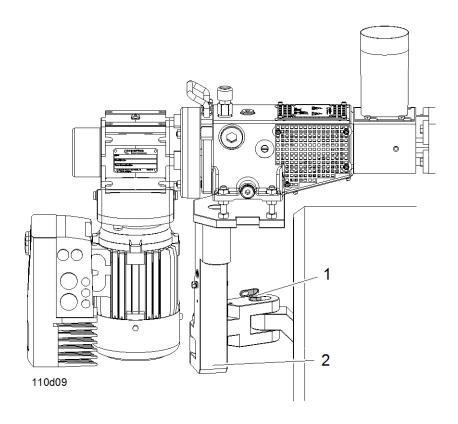


Figure 23: Lock

Item	Designation
1	Lock bolt
2	Swivelling arm

# 6.5 Installation plan

The installation plan agreed in the project phase has priority here and must be used.

# 6.6 Preparations for installation

The installation site must be clean and the floor level.

The screw tip height from the installation plan must be observed when aligning the extruder.

The levelling shoes must be positioned in the same way as specified in the installation plan. The levelling shoes are precisely aligned by a Coperion employee.

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#### 6.7 Connection

# **MARNING**

#### Hazard due to incorrect connection!

- ► Ensure that all connections cables, hoses and lines are laid in such a way that they do not cause a trip hazard!
- ► Ensure that the specified bending radii are complied with when laying cables, hoses and lines!
- ► Ensure that the specified arrangement from the connection diagram is complied with when connecting the cables, hoses and lines!
- Make sure all connections are complete and tight when connecting cables, hoses and lines!
- Bear in mind that cables, hoses and lines which are not connected or connected incorrectly may lead to malfunctions which jeopardize the safety of operating personnel!

#### 6.7.1 Electrical connections

# **A** DANGER

#### Hazard due to electrical voltage!

There is a danger to life from electric shock when working on live component parts!

- Any work on the electrical fittings of the machine must only be performed by qualified electrical specialists or by instructed persons under the direction and supervision of a qualified electrical specialist in compliance with electrical engineering regulations.
- Observe the 5 safety rules for working on electrical systems: switch off; secure against switching back on; ensure parts not live; earth and short-circuit; cover or block off adjacent live parts.
- Inspect proper electrical installation in accordance with the customer's and local regulations.
- A lockable separating device must be installed close to the machine so that the machine can be secured against accidental switching on during maintenance and service work.
- Connect all earth terminals as shown in the wiring diagrams.
- Inspection and start-up of motors to be performed by Coperion in accordance with the motor manufacturer's specifications.

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- Monitoring devices are required to protect the motor from impermissible heating as a result of overload, non-starting, short-circuit or 2-phase running.
- Before electrical connection of motors, the available supply voltage and frequency must be compared with the values quoted on the gear motor performance label.

### 6.7.2 Connection diagram/table

The P+I diagram and wiring diagrams agreed in the project phase have priority here and must be used.

#### 6.7.3 Non-electrical connections

Water, compressed air, vacuum, steam and inert gas are provided by the customer.

The connections and the quality of the media must meet Coperion specifications.

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Chapter 7: Start-up

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# 7 Start-up

#### 7.1 Introduction

We strongly recommend having start-up performed by Coperion GmbH due to a wide range of influences and for warranty reasons.

The following operations are to be performed as part of start-up:

- check the machine and accessories (installation errors etc.).
- check the entire plant and determine the optimum settings to suit the contractual agreement.
- instruct operating personnel.
- provide additional advice on operation of the machine, maintenance and service work.

### 7.2 Safety and personnel

To avoid fatal injury or material damage during start-up, the following points must be observed:

- before start-up, after installation, it is essential to subject the machine and add-on parts to a visual inspection for damage. Have trained service personnel repair any damage prior to start-up.
- ensure that permission to perform start-up is given only to qualified persons in compliance with the safety instructions.
- ensure that only authorized persons are in the working area and that no other persons are put at risk by the start-up.
- observe and check the applicable German trade association rules on occupational health and safety and/or occupational health and safety regulations in the respective country.
- prior to initial start-up, check that all tools and foreign parts have been removed from the machine.
- prior to start-up, check all connections, cables, hoses and lines for completeness and tight fit.
- for all checks which require the machine to be at a standstill for safety reasons, secure it against being switched back on unexpectedly.

# 7.3 Preparatory measures

- All media must be provided by the customer.
- Wiring and pipes must be connected and the pipes checked for leaks.

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- Wiring and pipes must have been designed in accordance with Coperion specifications.
- Pressure tests must be recorded.

### 7.4 Start-up

# **MARNING**

#### **Health hazard!**

Preservatives and oils become volatile when heated up.

- Wear personal safety equipment.
- Ensure adequate ventilation and/or extract fumes.

Initial start-up by Coperion includes the following steps, among others:

- 1. check the direction of rotation of the motors.
- 2. check P+I diagram to see whether it matches the configuration of the plant.
- 3. add oil according to specification. If no specification is available, consult Coperion.
- 4. check screwed connections and tighten if necessary (crosswise).
- 5. tighten the die head screw fitting to the correct torque.
- 6. check that seals are present and undamaged.
- 7. check that the screw shafts move freely.
- 8. check screw speed (also twin-screw side feeder and twin-screw side devolatilization machine).
- 9. check the assignment of heaters to barrels.
- 10. check the assignment of the temperature sensors and their spring tension.
- 11. check the function of the pressure sensors.
- 12. check the emergency OFF circuit.
- 13. check the function of the clutch sensor.
- 14. fill the cooling unit with water to specification.

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# 8 Operation

### 8.1 Safety and personnel

# **MARNING**

#### Hazard due to incorrect operation!

The machine can present hazards if it is operated incorrectly or in poor condition.

- Before switching on the machine, ensure that no-one can be put at risk by the machine running.
- ▶ Do not operate the machine in any way that appears unsafe!
- ▶ Only operate the machine if all guards and safety-related features, e.g. detachable guards, emergency stop devices, are fitted.

# SICHERHEITSROUTINE

- Ensure that there is no-one in areas of the machine which involve a risk of injury.
- Check that the machine is in perfect, undamaged, complete condition. Never start up the machine if it is damaged or defective.
- Check whether all wearing parts are in operational condition. Have worn or otherwise defective component parts replaced immediately.
- Check that the machine is correctly installed and secured.
- Never attempt to operate the machine with moving parts accessible. Risk of severe injury or fatal injury as a result of crushing, severing, being drawn in etc.!
- Never attempt to operate the machine with pressurized parts unsecured.
   Risk of severe injury from product being flung out, depressurization etc.!
- Only operate the machine with guards and safety equipment fitted!
- Ensure the correct direction of rotation of the motors.

# 8.2 Normal operation

The machine must be operated in accordance with the information transmitted during start-up. The logic diagram for operation is stored in the control system/software. Machine safety is controlled by the software.

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### 8.3 Cleaning

# **⚠** CAUTION

#### Hazard from pressurized parts and media!

When working on pressurized lines or component parts, pressurized media may suddenly escape. Escaping media can lead to injuries or uncontrolled movements of component parts! Product moisture or added moisture can cause pressure as a result of evaporation in the machine.

- ▶ Before starting repair work, depressurize any system sections and pressurized lines (compressed air) which have to be opened!
- Work on pressurized lines is permitted only by specialist personnel!
- Repair damage to lines, hoses and screw fittings immediately!
- Wear personal safety equipment (suitable safety goggles, protective gloves).

# **!** CAUTION

#### Risk of cuts!

Sharp surfaces, edges and corners of the machine may lead to cuts!

- Wear personal safety equipment.
- Wear cut-resistant gloves.
- Consult a doctor immediately in the event of injury.

# **A** DANGER

#### Risk of crushing!

Rotating shafts in the machine can lead to crushing and to loss of limbs!

- Do not reach into the shafts.
- Consult a doctor immediately in the event of injury.

# **!** CAUTION

#### Risk of burns!

Hot surfaces of the machine can cause burns!

- Wear personal safety equipment.
- Wear cut-resistant gloves.
- Consult a doctor immediately in the event of injury.

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### 8.3.1 Cleaning the screw shaft

Removing the screw shafts

- Remove the discharge
- Open screw shaft coupling
- · Pull the screw shafts using pull-off aid if required

Installing screw shafts

- Perform a roll test
- When inserting the shafts, pay attention to their positioning
- Lubricate screw shafts with grease (to specification)
- Fit screw shafts into screw shaft coupling
- · Close the screw shaft coupling
- Check that the screws move freely (e.g. by turning the coupling)
- Install the discharge

Exact handling is explained by Coperion during start-up. Additional training from Coperion is possible (digitally as an option).

After wet cleaning, dry all parts before installing them.

#### 8.4 How to behave in the event of a fault

Regardless of the instructions below, local safety regulations apply in any event.

# SICHERHEITSROUTINE

- Switch off the main switch and secure it against being switched back on.
- Secure supply media such as power and compressed air against being started up unintentionally.
- Disconnect the machine from the product flow.
- Ensure that there is no-one in areas of the machine which involve a risk of injury.
- After troubleshooting, check the function of the safety device.
- Remedy cause of fault

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# 8.5 Troubleshooting table



The faults listed below are just examples. The options for remedy shown are not exclusive.

In the event of faults which cannot be rectified using this table, please request our customer service.

<b>8</b> Fault	Cause	<b>Orrection</b>
Twin-screw side feeder jud- ders	Insufficient product flowing from the feed section into the twin-screw side feeder	Increase product feed
	Speed too high	Reduce speed to the lowest possible setting
	Twin-screw side feeder not aligned perfectly with the processing section of the twinscrew extruder	Line up the units accurately in relation to one another
	Product blockage ahead of the opening to the processing section	In the processing section, do not use screw elements which obstruct the opening to the twin-screw side feeder (e.g. kneading elements)
		Vent the combination block barrel of the processing section
	Screw shaft vibrating	Glue set screw in the screw shaft with Loctite, remove old adhesive residues with a screw tap first
Product escaping at the screw shaft seal	Gland packing leaking	Retighten nuts on the screw shaft seal
	Gland packing leaking	Replace gland packing
	Screw shaft vibrating	Glue set screw in the screw shaft with Loctite, remove old adhesive residues with a screw tap first
Product escaping between the screw barrels	Pre-tension of the tie rods is too low or has dropped due to long-term effect of tempera- ture and load cycle	Remove any product adhering to the barrel end faces
		Set the pre-tension on the tie rods correctly

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<b>&amp;</b> Fault	<b>②</b> Cause	<b>⊘</b> Correction
	Screw barrel end faces are damaged, uneven or dirty	Grind end faces on a grinding machine
Product escaping from the sealing surfaces	Tightening torque of fastening screws incorrect	Tighten the screws to the specified torque
	Dirty or damaged sealing sur- faces	Remove die head, clean and repair damage
Screw shafts at a standstill	Overload due to excessive throughput rate	Reduce throughput rate
Problems feeding components	Bulk density is too low	Increase bulk density
	Speed of screw shafts too low	Increase speed
	Throughput rate too high	Reduce throughput rate
	Backstreaming of gases	Adjust screw set
	Fluidization in the feed zone	Reduce gas filling
	Components sticking in the first screw barrel	Cool first screw barrel
	Bridge building in the hopper	Mount vibrator on the hopper
Powerful deflagration in the processing section	Moist powder being pro- cessed	Use dry powder
Processing section distorted	Uneven tempering	Check tempering
Vibration on the processing section	Speed range not ideal	Alter speed slightly
	Throughput rate too low	Increase throughput rate
Loud noises in the processing section, e.g. knocking, rat-tling, squeaking	Twin-screw extruder running without product (no lubrication/running dry)	Add product
		Switch off twin-screw extruder in good time
	Excessive proportion of pellets with a powder screw configuration	Reduce pellet ratio
		Increase temperature upstream of and in the plasticizing zone by means of external heating
		Increase block pressure/back pressure of the kneading block in the plasticizing zone

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& Fault	<b>②</b> Cause	Correction
	Screw elements installed incorrectly	Check and correct the screw element arrangement
	Screw shaft coupling not tightened, the screw shafts are not correctly aligned	Tighten union nuts until the screw shafts abut the gearbox output shafts
Major fluctuations in power consumption	Feed section varies within short time cycles	Check feed section; optimize precision if necessary
	Product is moist	Measure moisture
		Reduce moisture of the prod- uct
	Product fluidized	If necessary reduce nitrogen blanketing and pressure
		Optimize venting of the prod- uct feed line
		Cool first screw barrel more intensively
		In special cases, optimize screw set or devolatilization
	Bridge building in the feed section	Take appropriate action to stop bridge building
Wear/metal abrasion on screw barrels	Wear during start-up	Normal phenomenon
		Check magnetic screen residue. During start-up, the level of wear and the quantity of metal drops steadily
	Distortion of the processing section due to uneven tempering	Check contact of heater car- tridges with screw barrels
		Check function of the heating elements
		Check flow through the cooling circuit of the screw barrels
		If necessary, increase or reduce cooling pulses
	Insufficient plasticizing output	Increase temperature of processing section
		Reinforce screw set in the plasticizing zone

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8 Fault	<b>②</b> Cause	<b>⊘</b> Correction
		Ask Coperion Process Engineering if necessary
	Higher pellet content for pow- der screw configuration	Reinforce plasticizing zone back-pressure in screw set
		Change arrangement of kneading blocks to suit conditions
		Increase temperature of processing section
	Abrasive additives/components in product	Use suitable wear-resistant screw elements and screw barrels
		Optimize screw set
		Ask Coperion Process Engineering if necessary
	Essentially the wrong screw set for the respective production process or product	Ask Coperion Process Engineering
	Screw elements installed incorrectly	Ask Coperion Process Engineering
Wear/metal abrasion on screw shafts	Wear during start-up	Normal phenomenon
		Check magnetic screen residue. During start-up, the level of wear and the quantity of metal drops steadily
	Distortion of the processing section due to uneven tempering	Check contact of heater car- tridges with screw barrels
		Check function of the heating elements
		Check flow through the cooling circuit of the screw barrels
		If necessary, increase or reduce cooling pulses
	Insufficient plasticizing output	Increase temperature of processing section
		Reinforce screw set in the plasticizing zone

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S Fault	<b>②</b> Cause	<b>⊘</b> Correction
		Ask Coperion Process Engineering if necessary
	Higher pellet content for pow- der screw configuration	Reinforce plasticizing zone back-pressure in screw set
		Change arrangement of kneading blocks to suit conditions
		Increase temperature of processing section
	Abrasive additives or components in the product	Use suitable wear-resistant screw elements and screw barrels
		Optimize screw set
		Ask Coperion Process Engineering if necessary
	Essentially the wrong screw set for the respective production process or product	Ask Coperion Process Engineering
	Screw elements installed in- correctly	Ask Coperion Process Engineering
Temperature of the screw bar- rels fluctuates significantly around the set-point	Time setting for heating/cooling pulses not ideal	Increase or reduce cooling pulses as necessary (max. 500 ms)
		Check product moisture and reduce, if necessary
		In special cases, check or change the screw set
	Devolatilization not fully functional	Check the devolatilization opening
	Bulk density of the product varies considerably	Reduce bulk density difference
	Too much air in the powder	Check the venting system in the product feed line (vent pipes or filter equipment)
		Adjust the screw set. Ask Coperion Process Engineering
Screw barrel temperature is not reached	Faulty heater cartridges or fuses	Check function of the heater cartridges; check fuses

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& Fault	② Cause	<b>⊘</b> Correction
Screw barrel temperature is too high	Water supply interrupted	Check the water supply and water pressure in the feed (4 to 10 bar)
	2/2-way valve not opening	Check valve or valve dia- phragm, replace valve if nec- essary or renew valve sealing set
Temperature in screw barrels too low	2/2-way valve not closing	Check valve or valve dia- phragm, replace valve if nec- essary or renew valve sealing set
	Nonreturn valve not closing	Check the nonreturn valve, replace valve if necessary
Screw barrel temperature drops having maintained temperature level perfectly at first	Defective heater plates or fuses	Check function of the heater plates/check fuses
	Poor contact between the heater plates and the screw barrel	Check the heater plates for correct contact with the screw barrel
Operating temperature not reached	Heater cartridges not connected or incorrectly connected	Check electrical connection
	Faulty heater cartridges	Check function of the heater cartridges and replace as necessary
	Heater cartridges with insufficient output installed	Install heater cartridges with sufficient output
	Heating control faulty or not adjusted	Check heating control
Screw barrel temperature dis- played drops having main- tained temperature level per- fectly at first	Faulty heater cartridges or fuses	Check heater cartridge function
		Check heater cartridges for correct installation
		Replace faulty heater cartridges
		Check fuses
	Defective controller	Check controller and replace or readjust it, as necessary

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<b>⊗</b> Fault	<b>②</b> Cause	<b>V</b> Correction
	Poor contact between the thermocouple and the screw barrel	Check thermocouple for good contact
	Valve of the barrel cooling system not closing	Check valve and clean or replace it, as necessary
	Dirty valve or faulty dia- phragm	Also check the valves on adjacent screw barrels if necessary
	Faulty valve triggering	Check triggering
	Throughput rate too high, resulting in insufficient mechanical energy input	Reduce throughput rate or increase energy input
	Screw set is too weak for this throughput rate, especially in the plasticizing zone	Reinforce the screw set
The screw shafts "scrape" the screw barrels	Processing section not per- fectly aligned	Align the processing section when cold
Product quality and/or throughput rate no longer meet requirements	Wear on screw elements	Remove screw shafts, then disassemble and clean screw elements
		Check all parts for signs of wear, corrosion and damage
		Replace damaged parts
Screwed connections leaking	Screwed connections have worked loose	Tighten or replace screwed connections
Steam hammer	Control valve closing too quickly	Reduce air escaping at the sound absorber
	Excessive pressure difference between water tempering unit and return line	Adjust pressure on the suction side of the pump of the water tempering unit so that it does not exceed 1 bar
	Water flow rate in the return line too high or too low	Check flow rate and, if necessary, adjust it at the manually actuated valve on the bypass (use a portable flowmeter)
	Steam injector (if available) in the return line not installed in flow direction	Install steam injector (if available) in flow direction

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8 Fault	<b>②</b> Cause	<b>⊘</b> Correction
Inadequate devolatilization of volatile components in the product	No vacuum pump connected	Connect vacuum pump
	Leakage in the vacuum system	Find leak with the leak detector and repair
	Blocked suction pipe	Clean suction pipe
	Defective vacuum pump	Check the suction power of the vacuum pump and repair any damage
High build-up of pressure up- stream of die head	Operating temperature has not yet been reached and product is therefore not yet plasticized	Wait until operating tempera- ture has been reached
	Breaker plate screen clogged	Switch off the machine and change screen

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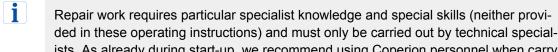
Chapter 9: Maintenance

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#### 9 Maintenance

#### 9.1 Introduction

- Operating faults caused by insufficient or incorrect maintenance can cause very high repair costs and long machine downtimes. Regular maintenance is therefore essential.
- The operational reliability and service life of the machine depend on proper maintenance in addition to several other factors.
- When dismantling the machine, pay particular attention to reinstalling matching component parts back in their original position in relation to one another.



ists. As already during start-up, we recommend using Coperion personnel when carrying out repairs on the machine for the first time. This gives your maintenance personnel an opportunity for intensive induction. These operating instructions only describe the repair work which comes up during maintenance.

### 9.2 Safety and personnel

Only trained, authorized and instructed maintenance personnel must carry out the work.

# **A** DANGER

#### Hazard due to moving and/or rotating parts!

When the machine is running, there is a risk of injury with fatal consequences as a result of limbs becoming trapped, drawn in, crushed or severed.

- ▶ Do not reach into moving or rotating parts during operation.
- Ensure that moving parts are not accessible during operation.
- Do not wear loose clothing or jewellery or leave long hair loose.
- Before carrying out any work on moving component parts, switch off the machine and secure it against being switched back on. Wait until all component parts have come to a standstill.

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#### Chapter 9: Maintenance

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## **MARNING**

#### Risk of lung damage and/or eye injury from dust!

Dust turbulence can occur during any work on and with the machines; this may lead to eye injuries and/or to lung damage if inhaled.

- Wear personal safety equipment (suitable respirator, goggles etc.).
- Extract, absorb dust.

## **CAUTION**

#### Risk of cuts!

Sharp surfaces, edges and corners of the machine may lead to cuts!

- Wear personal safety equipment.
- Consult a doctor immediately in the event of injury.

### 9.3 Inspection and maintenance work

The following inspection and maintenance work must be carried out at regular intervals depending on operating conditions:

- check the machine for visible defects and damage, e.g. check unusual running noise.
- · check that all screwed connections are tight.
- · check connecting flange connections for leaks and tight fit.

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#### 10 Maintenance

### 10.1 Maintenance and lubrication schedule



#### Hazard due to depressurization in the machine/in the processing section

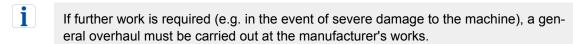
The product, temperature and pressure can cause pressure to build up in the machine.

► The entire machine must be depressurized before any maintenance work is performed.

# **SICHERHEITSROUTINE**

- Carry out the specified installation, maintenance and inspection work according to schedule.
- Work on the electrical components must only be carried out by an electrical specialist.
- Switch off the main switch and secure it against being switched back on.
- Secure supply media such as power and compressed air against being started up unintentionally.
- All screws loosened for maintenance or inspection work must be tightened again to the specified torque and checked before the machine is restarted.
- The function of the safety device must be checked at the end of maintenance or inspection work.
- Earthing cables must be re-connected following maintenance or service work.

The manufacturer's maintenance and lubrication intervals must be respected.



The specifications of third-party manufacturers, e.g. motor, gearbox etc., must also be observed.

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#### 10.2 Table of lubricants



Coperion does not assume any liability with regard to the quality terms used by the above-mentioned companies for their standard lubricants and expressly excludes any liability. The composition and names of the lubricants of the individual producers are subject to modification. The lubricants listed (Rev. 5) are those recommended by Coperion. Further information can be found in the operating instructions for the "documentation" of plant components.

Table 2: Lubricating oils

Manufacturer	Lubricating oil CLP to DIN 51502	Lubricating oil CLP to DIN 51502	Lubricating oil CLP to DIN 51502
ISI viscosity class designation	ISO VG to DIN 51519	ISO VG to DIN 51519	ISO VG to DIN 51519
	Average visc	osities mm²/s	
40 °C	100	220	320
100 °C	11	19	24
Addinol	Eco Gear 100 M [1,2,4]	Eco Gear 220 M [1,2,4.5]	Eco Gear 320 M [1,2,4]
		Gear Oil 220 F [2]	Gear Oil 320 F [2]
		Gear Oil CLP 220 [3]	Gear Oil CLP 320 [3]
Aegean		VALESCO EP ISO VG 220 <sup>[2]</sup>	VALESCO EP ISO VG 320 <sup>[2]</sup>
Avia Bantleon		AVIA GEAR RSX- F 220 <sup>[2]</sup>	AVIA GEAR RSX- F 320 <sup>[2.4]</sup>
Balmer Lawrie		Balmerol Protogear AM 220 [2]	Balmerol Protogear AM 320 [2]
BayWa AG		TECTROL GEAR CLP PLUS 220 <sup>[2]</sup>	TECTROL GEAR CLP PLUS 320 <sup>[2]</sup>
Bechem		Staroil G 220 [5]	
Bharat Petroleum		MAK Amocam Plus 220 [2]	MAK Amocam Plus 320 [2]
BP	Energol GR XP 100 [4]	Energol GR XP 220 [4]	Energol GR XP 320 [4]
Brugarolas	Beslux Gear XPM 100 [2]	Beslux Gear XPM 220 [2]	Beslux Gear XPM 320 [2]

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Manufacturer	Lubricating oil CLP to DIN 51502	Lubricating oil CLP to DIN 51502	Lubricating oil CLP to DIN 51502
ISI viscosity class designation	ISO VG to DIN 51519	ISO VG to DIN 51519	ISO VG to DIN 51519
	Average visc	osities mm²/s	
40 °C	100	220	320
100 °C	11	19	24
Castrol	Alpha SP 100 [4]	Alpha SP 220 [1,2,3,4]	Alpha SP 320 [1,2,3,4]
	Optigear BM 100 [1,4]	Alpha EP 220 [5]	Optigear BM 320 [1, 2,3,4]
	Tribol 1100/100 [4]	Optigear BM 220 [1, 2,3,4]	Tribol 1100/320 [3.4]
		Tribol 1100/220 [3.4]	
Cepsa		ENGRANAJES XMP 220 <sup>[2]</sup>	ENGRANAJES XMP 320 <sup>[2]</sup>
			AEROGEAR 320 [2]
Caltex, Chevron Texaco		Meropa XL 220 [2]	Meropa XL 320 [3.4]
		Meropa MG 220 [2]	Gearlube F 320 [2]
Cogelsa		Ultragear EP 220 [2]	Ultragear EP 320 [2]
Engen Petroleum Ltd		Gengear XEP 220 [2]	Gengear XEP 320 [2]
Eni		Eni Blasia FMP 220 [2]	Eni Blasia FMP 320 [2]
Fuchs	Renolin CLP 100 [1]	Renolin CLP 220 [1,2,5]	Renolin CLP 320 [1.2]
		Renolin HighGear 220 <sup>[2]</sup>	Renolin HighGear 320 [2]
		Renolin CLP 220 PLUS <sup>[2,4]</sup>	Renolin CLP 320 PLUS <sup>[2,4]</sup>
		Renolin CLP VCI 220 [2]	
Fuchs Lubritech		Gearmaster CLP 220 [2,3]	Gearmaster CLP 320 [2,3]
GMERI (Guangyan)		CH Gear Oil 220 [2]	CH Gear Oil 320 [2]
Gulf Oil International		Gulf Gear WT 220 [2]	Gulf Gear WT 320 [2]
Hindustan Petroleum		Parthan ML 220 [2]	Parthan ML 320 [2]
		Parthan EP 220 MA [2]	Parthan EP 320 MA [2]

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Manufacturer	Lubricating oil CLP to DIN 51502	Lubricating oil CLP to DIN 51502	Lubricating oil CLP to DIN 51502
ISI viscosity class designation	ISO VG to DIN 51519	ISO VG to DIN 51519	ISO VG to DIN 51519
	Average visc	osities mm²/s	
40 °C	100	220	320
100 °C	11	19	24
Indian Oil		Servomesh Gold 220 [2]	Servomesh Gold 320 [2]
Klüber Lubrication	Klüberoil GEM 1-100 [4]	Klüberoil GEM 1-220 [4]	Klüberoil GEM 1-320 [4]
		Klüberoil GEM 1-220 N <sup>[1,2]</sup>	Klüberoil GEM 1-320 N <sup>[1,2]</sup>
Lukoil		Lukoil Steelo 220 [2]	Lukoil Steelo 320 [2]
		Lukoil Steelo HST 220 [2]	Lukoil Steelo HST 320 <sup>[2]</sup>
Lotos Oil		Transmil EXTRA XSP 220 [2]	Transmil EXTRA XSP 320 [2]
Mobil	Mobilgear 600 XP 100 <sup>[1,2,4]</sup>	Mobilgear 600 XP 220 [1,2,4.5]	Mobilgear 600 XP 320 [1,2,3.4]
MOL-LUB Ltd.		MOL Ultrans EP 220 [2]	MOL Ultrans EP 320 [2]
Mosil Lubricants		Gearlube SP-e220 [2]	Gearlube SP-e320 [2]
Motorex		GEAR COMPOUND PLUS ISO 220 [2]	GEAR COMPOUND PLUS ISO 320 [2]
OMV		OMV gear HST 220 [2]	OMV gear HST 320 [1.2]
Olma d.o.o.		OLMAREDOL FL 220 [2]	OLMAREDOL FL 320 [2]
PANOLIN		GEAR CLP FL 220 [2]	
Pertamina		MASRI SUPER FLG 220 <sup>[2]</sup>	MASRI SUPER FLG 320 <sup>[2]</sup>
		MASRI FLG 220 [2]	MASRI FLG 320 [2]
PETROGAL		GALP TRANSGEAR FA 220 <sup>[2]</sup>	GALP TRANSGEAR FA 320 <sup>[2]</sup>
Petrol Ofisi		PO Gravis MP 220 [2]	PO Gravis MP 320 [2]

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Manufacturer	Lubricating oil CLP to DIN 51502	Lubricating oil CLP to DIN 51502	Lubricating oil CLP to DIN 51502
ISI viscosity class designation	ISO VG to DIN 51519	ISO VG to DIN 51519	ISO VG to DIN 51519
	Average visc	osities mm²/s	
40 °C	100	220	320
100 °C	11	19	24
Petromin Corporation		Petromin Gear Lube EPF 220 [2]	Petromin Gear Lube EPF 320 [2]
Petronas		Petronas Gear FL 220 [2]	Petronas Gear FL 320 [2]
Prista Oil	PRISTA ROLON F 100 <sup>[4]</sup>	PRISTA ROLON F 220 <sup>[4]</sup>	PRISTA ROLON F 320 <sup>[4]</sup>
PTT Oil and Retail (PTTOR)		Drivera SF 220 [2]	Drivera SF 320 [2]
Raloy Lubricantes		Raloy Wind Turbines 220 [2]	Raloy Wind Turbines 320 [2]
Shell	Omala S2 GX 100 [1,2]	Omala S2 GX 220 [2]	Omala S2 GX 320 [2]
		Omala S2 G 320 [3,5]	Omala S2 G 320 [3,5]
			Omala S5 Wind 320 [2]
Sinopec		Great Wall 4407 Heavy- Duty Industrial Gear Oil 220 [2]	Great Wall 4407 Heavy- Duty Industrial Gear Oil 320 [2]
		Great Wall AP 220 [2]	Great Wall AP 320 [2]
Monarch Tongyi Petrole- um		Micropitting Resistant Industrial Gear Oil 220 [2]	Micropitting Resistant Industrial Gear Oil 320 [2]
Statoil	LoadWay EP 100 [4]	LoadWay EP 220 [4]	LoadWay EP 320 [4]
Sunoco			Sunep 1090 ISO 320 [4]
Total	Carter EP 100 [4]	Carter XEP 220 [2,5]	Carter XEP 320 [2]
		Carter EP 220 [2,3,4]	Carter EP 320 [2,3,4]
Valvoline			Valvoline WA 20 [4]

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Manufacturer	Lubricating oil CLP to DIN 51502	Lubricating oil CLP to DIN 51502	Lubricating oil CLP to DIN 51502	
ISI viscosity class designation	ISO VG to DIN 51519	ISO VG to DIN 51519	ISO VG to DIN 51519	
	Average viscosities mm²/s			
40 °C	100	220	320	
100 °C	11	19	24	
Verkol Lubricantes		Gearoil CKC 220 [2]	Gearoil CKC 320 [2]	
Wisura			Wisura Kineta 320 [4]	

- [1] Approved by Eisenbeiss GmbH
- [2] Approved by Siemens AG (Flender): https://www.flender.com/de/GearOilsHBPM
- [3] Approved by PIV Drives GmbH
- [4] Approved by Renk AG
- [5] Approved by Knödler-Getriebe GmbH & Co. KG

Table 3: Hydraulic oils and compressor oils

Manufacturer	Hydraulic oil HLP to DIN 51502	Compressor oil VDL to DIN 51502 recommen- ded values to DIN 51506	Low flammability hy- draulic fluid to HFDU 7 <sup>[1]</sup>	
ISI viscosity class designation	ISO VG to DIN 51519	ISO VG to DIN 51519	ISO VG to DIN 51519 or ASTM D-445	
	Average viscosities mm²/s			
40 °C	46	100	46	
100 °C	6.5	11	10	
Addinol	HLP 46	VDL 100		
Agip	Oso 46	Dicrea 100		
Aral	Vitam GF 46	Motanol HE 100		
BP	Energol HLP-HM 46	Energol RC 100		
Castrol Performance	Tribol 772	Tribol 890 Tribol ET 1555/100	Anvol SWX FM 46 (FM approval)	

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Manufacturer	Hydraulic oil HLP to DIN 51502	Compressor oil VDL to DIN 51502 recommen- ded values to DIN 51506	Low flammability hy- draulic fluid to HFDU 7 <sup>[1]</sup>
ISI viscosity class designation	ISO VG to DIN 51519	ISO VG to DIN 51519	ISO VG to DIN 51519 or ASTM D-445
	Average visc	osities mm²/s	
40 °C	46	100	46
100 °C	6.5	11	10
Caltex, Chevron, Texa- co	Rando oil HD 46	Compressor oil EP VDL 100	
Caltex, Chevron, Texa- co	EP Hydraulic oil 46	EP Industrial oil 100	
Fuchs	Renolin B 15	Renolin 504	Renosafe DU 46 [1] Plantoflux-AT-S 46 (FM approval) [1]
Fuchs Lubritech	Renolin B 15	Renolin 504 VDL 100	
Klüber Lubrication	Lamora HLP 46		
ExxonMobil	Mobil DTE 25	Mobil Rarus 427	
Optimol	Hydo 46	Copo 100	
Pennzoil			Pennzsafe SL 200 [1]
Sentinel			S-FRH-46 <sup>[1]</sup>
Shell	Tellus oil 46	Corena P 100	Irus DU 46 [1]
SRS	Wintershall Wio- lan HS 46	Wintershall Wio- lan CD 100	
Texaco	Rando oil HD 46	Compressor oil EP VDL 100	
Total	Azolla ZS 46	Dacnis P 100	

<sup>[1]</sup> For hydraulic central unit of the underwater pelletizer and hydraulic unit for screen pack changer and throttle start-up valve

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Table 4: Lubricating greases

Fluid gear grease EP 0/00 DIN 51502 and DIN 51825 / 51826	Li-base grease 3 to DIN 51502 perform- ance to DIN 51825	Li-base grease 2 to DIN 51502 perform- ance to DIN 51825
Consistency class DIN 51818	Consistency class DIN 51818	Consistency class DIN 51818
Consistency class 0/00	Consistency class 3	Consistency class 2
Low-viscosity grease SGA 600 SGR 4 -00-9 P	Multi-grade grease LM 3 EP	Multi-grade grease LM 2 EP Longlife-Grease HP 2
GR-LF 0	GR-MU 3	GR-SM
GR-SLL	GR-MU EP 3	GR-MU EP 2
Aralub FDP 00	Aralub HL 3	Multi-purpose grease F
		Energrease L 21 M
Energrease PR-EP 00	Energrease LS 3	Energrease MM-EP 2 [1]
		Energrease SY 2202 [1]
M	Multifak Premium 3	Molylex EP 2
Mariak 0/00	Starplex EP 3	Multifak EP 2
CD graces 00	Duralith graces ED 2	Moly grease EP 2
CP grease 00	Duraniii grease EP 3	Duralith grease
Renolit SO GFB	Renolit FWA 220	Renolit FLM 2
Coormontor II 400	Ctobul L 100	Lagermeister BF 2
Gearmaster Li 400	Stabyi L 120	Urethyn MP 2 [1]
Microlube GB 00	Centoplex 3	Unimoly GL 402
		Mobilgrease Spezial
Mobilux EP 004	Mobilux EP 3	Mobil Unirex EP 2 [1]
		Mobil Unirex S 2 [1]
	Olit 3 EP	Olislamoly 2
Onagel		Optitemp HT 2 [1]
	Olisia Longlime 3	Olista Longtime 2 [1]
	0/00 DIN 51502 and DIN 51825 / 51826  Consistency class DIN 51818  Consistency class 0/00  Low-viscosity grease SGA 600  SGR 4 -00-9 P  GR-LF 0  GR-SLL  Aralub FDP 00  Energrease PR-EP 00  Marfak 0/00  CP grease 00  Renolit SO GFB  Gearmaster LI 400  Microlube GB 00  Mobilux EP 004	DIN 51502 and DIN 51802 performance to DIN 51825  Consistency class DIN 51818  Consistency class O/00  Low-viscosity grease SGA 600 SGR 4 -00-9 P GR-LF 0 GR-SLL GR-MU EP 3  Aralub FDP 00  Multi-grade grease LS 3  Energrease PR-EP 00  Energrease LS 3  Consistency class 3  Multi-grade grease LM 3 EP  GR-MU 3 GR-MU EP 3  Aralub HL 3  Energrease PR-EP 00  Duralith grease LS 3  Renolit SO GFB Renolit FWA 220  Gearmaster LI 400  Microlube GB 00  Centoplex 3  Olit 3 EP

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Lubricant	Fluid gear grease EP 0/00 DIN 51502 and DIN 51825 / 51826	Li-base grease 3 to DIN 51502 perform- ance to DIN 51825	Li-base grease 2 to DIN 51502 perform- ance to DIN 51825
ISI viscosity class designation	Consistency class DIN 51818	Consistency class DIN 51818	Consistency class DIN 51818
Average viscosi- ties mm²/s	Consistency class 0/00	Consistency class 3	Consistency class 2
			Retinax EPX 2
Shell	Alvania GL 00	Alvania RL 3	Albida HD 2 [1]
			Albida EP 2 [1]
Toyoo	Morfolx 0/00	Multifak Premium 3	Molylex EP 2
Texaco	Marfak 0/00	Starplex EP 3	Multifak EP 2
			Multis MS 2
Total	Multis EP 00	Multis 3	Ceran WR 2 [1]
			Multis Complex EP 2 [1]
[1] For underwater pelletizer knife shaft bearing assembly			

#### Table 5: Solid lubricants

Manufacturer	MoS2, Graphite	Air-hardening dry lubricant
ISI viscosity class designation	DIN/specification LLV 134	Viscosity to DIN 53211/3
DOW Corning		Molykote D321 R
Fuchs Lubritech	Gleitmo 900S	

## 10.3 Table of lubricants for the food and pharmaceutical sectors



Coperion does not assume any liability with regard to the quality terms used by the companies mentioned here for their standard lubricants and expressly excludes any liability. The composition and names of the lubricants of the individual manufacturers are subject to modification. The lubricants listed (Rev. 4) are those recommended by Coperion. Further information can be found in the operating instructions for the "Documentation of plant parts".

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The plant must only be operated with lubricants permitted for the food or pharmaceutical sectors.

A search function for all lubricants approved for contact with foodstuffs from the NSF (National Sanitation Foundation) can be found at www.nsfwhitebook.org.

Table 6: Table of lubricating oils for gearboxes in the food and pharmaceutical sectors

Lubricant	Lubricating oil CLP to DIN 51517		NSF H1
ISO viscosity class designation	Consistency class according to DIN 51519		
Average viscosities mm²/s			
40 °C	220 320		
Bremer & Leguil	Cassida Fluid WG 220	Cassida Fluid WG 320	X
Klüber Lubrication	4 UH1 220N	4 UH1 320N	X

Table 7: Roller bearing greases for gearboxes in the food and pharmaceutical sectors

Lubricant	NLGI consistency class 2 to DIN 51818	NSF H1
Bremer & Leguil	TUNAP TUNGREASE CSH 2 <sup>[1]</sup>	X
Klüber Lubrication	Klübersynth UH1 14-222 [2]	X
Castrol	Optileb GR UF 2 [3]	X
<sup>[1]</sup> Approved by Knödler GmbH		
<sup>[2]</sup> Approved by PIV GmbH		
[3]Approved by Siemens AG (Flender)		

#### Table 8: Lubricating greases for the food and pharmaceutical sectors

Lubricant	Lubricating grease class according to DIN 51502	NSF H1
ISO viscosity class designation	Consistency class according to DIN 51818	
Average viscosities mm²/s	Consistency class 3	
MOLYDUVAL	Soraja MP	X

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# 10.4 Table of maintenance and inspection work processing section

Maintenance intervals	Inspection point/maintenance instruction
Daily	Check function of temperature and pressure monitoring equipment and heating during operation
	Correct all faults observed during operation, e.g. leakages and mechanical defects
	Check screw shaft seal for leakage and seal if necessary
Every 2,000 operating hours	Check all heating and cooling connections, extractions, flanges and valves for leakage and seal if necessary
Every 8,000 operating hours	Recondition screw shaft seal and check for wear. If there are problems with sealing, the slide bushing on the screw shaft must be replaced

# 10.5 Maintenance and inspection list twin-screw side feeder

Maintenance intervals	Check point / maintenance instruction
Daily	Correct all defects observed during operation, e.g. leaks.
	Check the screw shaft seal for leaks; slightly tighten nuts if necessary
After 200 operating hours	Re-tighten all bolt and screw connections.
Every 8,000 operating hours or annually	Renew the gland packing of the screw shaft seal.

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## 10.6 Maintenance and inspection list screw shaft coupling

Maintenance intervals	Check point / maintenance instruction
Every 2000 operating hours	Grease the screw shaft couplings through the grease nipple until grease emerges from the side of the screw shaft couplings
	<b>Grease type:</b> Li grease 2 according to DIN 51502, performance according to DIN 51825, consistency class 2 DIN 51818
Every 8,000 operating hours	Disassemble, clean and reassemble the screw shaft couplings. Grease the screw shaft couplings through the grease nipple until grease emerges from the side of the screw shaft couplings
	<b>Grease type:</b> Li grease 2 according to DIN 51502, performance according to DIN 51825, consistency class 2 DIN 51818

# 10.7 Maintenance and inspection list screw shaft seal

Maintenance intervals	Check point / maintenance instruction
Daily	Check the screw shaft seal for leaks, tighten if necessary or insert new gland packing
As required	Renew the gland packing of the screw shaft seal.

# 10.8 Maintenance and inspection list water manifold to processing section

Maintenance intervals	Check point / maintenance instruction
Monthly	If water pressure between the water tempering unit and the manifold drops by 1 bar, change the filter in the dirt trap of the pressure control valve.  Tighten screw connections

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# 10.9 Maintenance and inspection list twin-screw side devolatilization machine

Maintenance intervals	Check point / maintenance instruction
Daily	Correct all defects observed during operation, e.g. leaks.
	Check the integrity of the screw shaft seal; gently retighten the nuts on the gland packing if required.
After 200 operating hours	Re-tighten all bolt and screw connections.
Every 1,000 operating hours	Check torque M $_{\rm A}$ on the screw tips, and retighten the screw tips if required.
Every 8,000 operating hours or annually	Renew the gland packing of the screw shaft seal.

# 10.10 Maintenance and inspection list heater cartridge

Maintenance intervals	Check point / maintenance instruction
Every 2,000 operating hours	Check the heater cartridges for close fit and functioning
Every 8,000 operating hours	Dismantle the heater cartridges and clean the contact surfaces. Reinstall the heater cartridges and check them for functioning. Pay attention to close fit.

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Chapter 11: Spare parts

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# 11 Spare parts

### 11.1 Spare parts inventory

In order to ensure smooth and trouble-free operation of the plant and/or individual units, necessary spare parts should be kept in stock by the operator. Therefore, you should request Coperion to submit a spare parts offer.

Coperion will only warrant original spare parts. If spare parts from other suppliers are installed or mounted, no warranty of the plant and/or individual units will be given by Coperion

#### 11.2 Spare part order

Coperion provides its customers with an electronic spare parts catalogue through the "MyCoperion" online portal. This enables each customer to easily identify the spare parts for their complete Coperion scope of supply and select them directly using a shopping cart function.



The spare parts catalogue includes the parts lists for mechanical and electrical spare parts with corresponding drawings of all units and component parts that form part of the Coperion scope of supply. This includes the spare parts information for machines, units and subassemblies that Coperion purchases from its suppliers.

In order to be able to deal quickly with your spare parts order **without online access** we need the following information from you:

- 1. Machine type (e.g. ZSK 92, ZS-B 18)
- 2. Year unit was built
- 3. Project number
- 4. Part name
- 5. Part number
- 6. Drawing number

The data for items 1 and 2 can be found on the performance label of the respective unit.

The data for item 3 can be found on the title pages of the technical documentation and the operating instructions.

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The data for items 4 to 6 can be found on the parts lists of the respective unit in the technical documentation.

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Chapter 12: Disposal

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# 12 Disposal

#### 12.1 Disassembly

If the machine is shut down - for whatever reason - it must be completely drained, cleaned and dried.

### 12.2 Recycling

The plant operator is responsible for disposing of the machine. The former must ensure compliance with the applicable legal regulations at the time of disposal.

#### 12.2.1 Environmental protection

The plant operator is responsible for disposing of the machine. The former must ensure compliance with the applicable legal regulations at the time of disposal.

#### 12.2.2 Consumables and materials

Dispose of consumables and materials in accordance with the corresponding specifications and respective national regulations.

#### 12.2.3 Electrical/electronic components

Dispose of electrical/electronic component parts in accordance with relevant national regulations.

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Chapter 13: Appendix

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# 13 Appendix

#### 13.1 Tightening torques for screwed connections

The specified tightening torque levels are applicable only to units manufactured by Coperion itself. The specifications relate to screwed connections with standard metric threads at an application temperature of max. 300 °C. The screwed connections are tightened at room temperature (approx. 20 °C). It is not intended for the screwed connections to be retightened while the units are in a heated state. If there are any exceptions, these will be explicitly specified.

The screwed connections must be tightened using a torque wrench or a hydraulic wrench. When tightening with a hydraulic wrench, the specified pre-clamping force and/or the hydraulic pressure must be observed.

Further information can be found in chapter "Documentation of plant components" in the manufacturer's operating instructions.

This specification is not applicable to the following application cases:

- 1. Flanges on pipework
- 2. Pre-tensioning of fixators



Before installation, "Molykote P37" fitting paste is to be applied to the fitting surfaces and thread surfaces of all bolts.

Table 9: Tightening torque for bolts made of steel

Bolt size	Quality class 5.6	Quality class 6.8	Quality class 8.8	Quality class 10.9	Quality class 12.9
M 4	1 Nm	1.5 Nm	2.1 Nm	3.2 Nm	3.6 Nm
M 5	1.9 Nm	3 Nm	4.1 Nm	6 Nm	7 Nm
M 6	3.3 Nm	5.3 Nm	7.1 Nm	10 Nm	12 Nm
M 8	8 Nm	13 Nm	17 Nm	25 Nm	30 Nm
M 10	16 Nm	26 Nm	34 Nm	50 Nm	60 Nm
M 12	25 Nm	45 Nm	60 Nm	85 Nm	100 Nm
M 14	45 Nm	70 Nm	95 Nm	135 Nm	160 Nm
M 16	65 Nm	105 Nm	145 Nm	210 Nm	250 Nm
M 20	120 Nm	210 Nm	290 Nm	410 Nm	480 Nm

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Bolt size	Quality class 5.6	Quality class 6.8	Quality class 8.8	Quality class 10.9	Quality class 12.9
M 24	230 Nm	360 Nm	500 Nm	710 Nm	830 Nm
M 27	330 Nm	530 Nm	740 Nm	1050 Nm	1230 Nm
M 30	450 Nm	720 Nm	1000 Nm	1400 Nm	1650 Nm
M 33	610 Nm	980 Nm	1350 Nm	1900 Nm	2250 Nm
M 36	780 Nm	1250 Nm	1750 Nm	2450 Nm	2900 Nm
M 39	1000 Nm	1600 Nm	2250 Nm	3200 Nm	3700 Nm
M 42	-	-	2600 Nm	3800 Nm	4400 Nm
M 48	-	-	4000 Nm	5700 Nm	6600 Nm
M 52	-	-	5100 Nm	7300 Nm	8500 Nm
M 56	-	-	6300 Nm	9000 Nm	10500 Nm
M 60	-	-	7900 Nm	11200 Nm	13100 Nm

Table 10: Tightening torque for bolts made of stainless steel

Bolt size	Quality class	Quality class	Quality class
	A2-70; A4-70	A2-80; A4-80	2.4952
M 4	1.4 Nm	1.9 Nm	1.9 Nm
M 5	2.5 Nm	3.3 Nm	3.3 Nm
M 6	4.2 Nm	5.6 Nm	5.6 Nm
M 8	11 Nm	15 Nm	15 Nm
M 10	22 Nm	30 Nm	30 Nm
M 12	39 Nm	55 Nm	55 Nm
M 14	65 Nm	85 Nm	85 Nm
M 16	95 Nm	125 Nm	125 Nm
M 20	200 Nm	260 Nm	260 Nm
M 24	320 Nm	420 Nm	420 Nm
M 30	740 Nm	980 Nm	980 Nm

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Chapter 14: Certificate

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# 14 Certificate

## 14.1 EU Declaration of Conformity

Reproduction of the content of the EU declaration of conformity follows depending on the scope of supply or the project specification. The originals are not a constituent part of these operating instructions.

# 14.2 EC DECLARATION OF CONFORMITY (reproduction of content)

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The EU declaration of conformity always contains the company's name and the full address of the manufacturer. Also included are the name and address of the person authorised to compile the technical documents, and details of the person authorised to issue this declaration on behalf of the manufacturer as well as this person's signature.

# Rendition of content **EU DECLARATION OF CONFORMITY**

in keeping with the EU Machinery Directive 2006/42/EG, Appendix II A

We hereby declare that the machinery listed below

Designation: XXX Machine type: XXX Project number:

Is compliant with the following pertinent conditions:

EU machinery directive 2006/42/EC

EU directive on electromagnetic compatibility 2014/30/EU

Applied harmonised standards the citations of which were published in the EU Gazette:

XXX

EN ISO 12100: 2010 Safety of Machinery: General principles for design - Risk assessment and

risk reduction

EN ISO 13857: 2008 Safety of Machinery: Safety distances against accessing hazardous areas

with the upper and lower limbs

Safety of Machinery: Emergency Stop Design Guidelines EN ISO 13850: 2015

EN 60204-1: 2007 Safety of Machinery: Electrical Equipment of Machinery - General

Requirements

EN 1114-1: 2012 Extruders and Extrusion Systems - Safety Requirements for Extruders