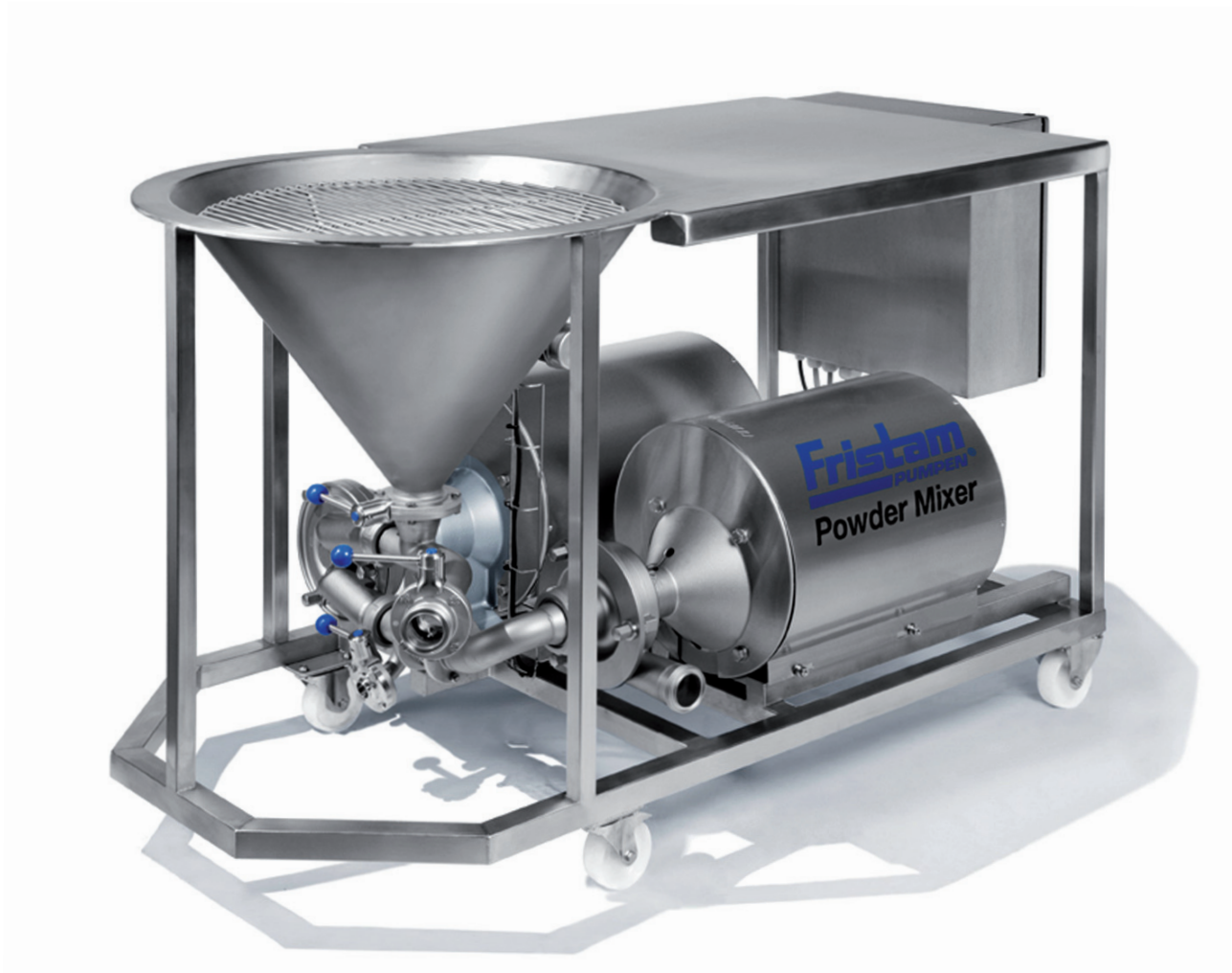


# Powder Mixer PM



Powder Mixer Size:

Powder Mixer No.:



## Table of contents

<b>1</b>	<b>Introduction</b> .....	5	<b>6</b>	<b>Installation</b> .....	20
1.1	Foreword.....	5	6.1	Safety Instructions .....	20
1.2	Manufacturer .....	5	6.2	Installation Location.....	20
1.3	Scope of Supply.....	5	6.3	Reduction of Noise and Vibration .....	20
1.4	Scope of Documentation .....	5	6.4	Powder Mixer Fixation.....	21
1.5	General Information.....	6	6.5	Installation of Pipes .....	21
1.6	Display Conventions.....	6	6.6	Supply System Connection.....	21
<b>2</b>	<b>Safety</b> .....	7	6.7	Hydraulic Connection.....	22
2.1	Intended Use .....	7	6.8	Connection of Power Supply .....	22
2.2	Predictable Misuse .....	7	6.9	Checking Direction of Rotation of Pumps....	22
2.3	System-Specific Safety Instructions .....	7	6.10	Cleaning.....	23
2.4	Labels .....	8	<b>7</b>	<b>Operation</b> .....	24
2.5	Noise Emissions .....	9	7.1	Turning On Powder Mixer .....	24
2.6	Disposal .....	10	7.2	Starting Powder Mixer .....	24
<b>3</b>	<b>Design and Function</b> .....	11	7.3	Monitoring Operation .....	25
3.1	Principles of Design.....	11	7.4	Stopping Powder Mixer .....	26
3.2	Funnel .....	11	7.5	Turning Off Powder Mixer .....	26
3.3	Pipes .....	12	<b>8</b>	<b>Faults</b> .....	27
3.4	Pumps .....	13	8.1	Safety Instructions .....	27
3.5	Control Cabinet .....	13	<b>9</b>	<b>Maintenance</b> .....	27
3.6	Vibratory Motor (Optional).....	14	9.1	Safety Instructions .....	27
3.7	Screen (Optional) .....	15	9.2	Replacement Parts .....	28
3.8	Protective Grating (Optional) .....	15	<b>10</b>	<b>Appendix</b> .....	28
3.9	Sizes and Standard Equipment.....	16	10.1	Specifications.....	28
3.10	Hydraulic Diagram.....	16	10.2	Performance Overview .....	29
3.11	Function .....	17	10.3	Lubricants.....	29
<b>4</b>	<b>Transportation</b> .....	18	10.4	Troubleshooting Table.....	30
4.1	Safety Instructions .....	18	10.5	Maintenance Intervals .....	32
4.2	Moving With Industrial Truck .....	18	10.6	Declaration of Conformity .....	33
4.3	Moving With Crane .....	18			
<b>5</b>	<b>Storage</b> .....	19			
5.1	Safety Instructions .....	19			
5.2	Storage Conditions.....	19			
5.3	Mothballing of the Powder Mixer .....	19			
5.4	Recommissioning .....	19			



## 1 Introduction

### 1.1 Foreword

This operator's manual describes all sizes, models, and versions of the PM powder mixer. Information on the model, size, version, and accessories applicable to your powder mixer can be found on the rating plate on your powder mixer and in the "Order-Related Documents" in the attached documents.

### 1.2 Manufacturer

FRISTAM Pumpen KG (GmbH & Co.)

Kurt-A.-Körber-Chaussee 55

21033 Hamburg

GERMANY

Tel.: +49-40-72556-0

Fax: +49-40-72556-166

E-mail: info@fristam.de

### 1.3 Scope of Supply

The package includes the following items:

- Table
  - Height-adjustable machine legs or wheels (partially pivot)
- Funnel with external electric vibrator (vibratory motor)
  - optional: protective grating, screen, guard or CIP cover, screw-in bushing for fill level sensor, filler adapter
- Centrifugal pump type *Fristam* FZ
  - optional: enclosure
- Shear pump type *Fristam* FSP
  - optional: enclosure
- Piping system with valves, inline sight glass, and connections
  - optional: adapter, pneumatic or electropneumatic valve drive, bypass
- Control cabinet with switches, buttons, and indicator lights
  - optional: frequency converter with control panel
- optional: connection cable and CEE three-phase plug in accordance with DIN EN 60309

### 1.4 Scope of Documentation

The documentation includes the following items:

- This operator's manual
- Powder mixer specifications
- FZ centrifugal pump operator's manual
- FSP shear pump operator's manual
- Vibratory motor operator's manual
- Brief instructions for frequency converter (optional)

- Circuit diagram for control cabinet
- Order-related documents

Please read this information before installing and operating the powder mixer.

## 1.5 General Information

Please read this operator's manual completely before using the powder mixer and keep it available at the mixer installation location.

Heed the applicable national regulations of the owner's country and the company's work and safety regulations.

All work described here may only be performed by qualified experts with caution.

Danger of contamination: Heed legal and operational safety regulations when pumping or filling dangerous media.

## 1.6 Display Conventions

List items are preceded by dashes:

- Part 1
- Part 2

Handling instructions that must be performed in a specified order are numbered:

1. Turn device on.
2. Turn device off.

Handling instructions that do not need to be performed in a specified order are preceded by triangular bullets:

- ▶ Action
- ▶ Action

### 1.6.1 Safety Instructions

#### **⚠ DANGER**

A safety instruction with the signal word "Danger" indicates personal hazards causing death or serious injury.

#### **⚠ WARNING**

A safety instruction with the signal word "Warning" indicates personal hazards that may lead to death or serious injury.

#### **⚠ CAUTION**

A safety instruction with the signal word "Caution" indicates personal hazards that may lead to mild to moderate injuries.

#### **NOTICE**

A safety instruction with the signal word "Note" warns of the possibility of material damage.

## 2 Safety

### 2.1 Intended Use

The standard PM powder mixer version is designed for use in the food, pharmaceutical, and biotechnology industries.

The PM powder mixer is designed for blending liquid base media with powder or liquid additive media. In its standard use, the powder mixer is designed for batch mode with individual powder bags. Continuous operation utilizing conveying equipment is possible with a special version.

Each PM powder mixer is designed according to customer requirements. The seal materials in the pumps have been selected for the respective media.

Supply and pumping of the base medium must be done in compliance with the maximum temperatures and pressures specified for the given powder mixer version and size. See the attached document entitled "Specifications."

The pump flow direction for the self-priming pump is fixed. The FZ pump can generate a vacuum in the suction line.

The PM powder mixer may only be used under the operating conditions specified in the customer's order. See the attached Order-Related Documents. For other operating conditions, please contact *Fristam*.

### 2.2 Predictable Misuse

- The standard PM powder mixer versions may not be used in explosive atmospheres.
- Introduction and pumping of foreign objects in the mix can block and destroy the pipes, the valves, or the shear pump.
- Pumping of base media or powders other than those specified can destroy pipes, valves, or pumps. The seal materials (elastomers) and the pumps have been selected for specific base media and mixtures. See Specifications and Order-Related Documents.
- Pumping of powders other than those specified or incorrect mixing ratios can clog the pipes, the valves, or the shear pump. For uninterrupted operations, the maximum allowable particle size of the powder must not be exceeded.

### 2.3 System-Specific Safety Instructions

#### Impermissible Pressure or Temperature Range

Personal injury and material damage from leakage or bursting of pumps or pipes and valves.

- ▶ Maintain the pump, pipe, and valve pressures within the specified pressure ranges. See the attached document entitled "*Specifications*" and the operator's manuals for the pumps.

Maintain the pump and pipe temperatures within the specified temperature ranges. See the attached document entitled "*Specifications*" and the operator's manuals for the pumps.

#### Hot Equipment Surface

Contact burns from touching the pipes.

- ▶ Check the temperature before touching the pipes.
- ▶ Only touch the pipes if you are wearing suitable gloves.

#### Noise Generated By Running Powder Mixer

Permanent hearing damage. The A-weighted sound pressure level of the powder mixer can be greater than 80 dBA.

- ▶ Always wear ear protectors in the vicinity of the running powder mixer.

- ▶ The local noise exposure regulations must be complied with.
- ▶ See the noise emission values for the pumps in the attached operator's manuals.

### Danger of Crushing When Moving Powder Mixer on Casters

Foot injuries from being run over by casters.

- ▶ Wear safety shoes.

### Cold Firefighting Water on Hot Pump

Material damage from bursting of pump.

- ▶ Do not cool the pump down excessively when extinguishing a fire.

### Unsuitable Working Height or Direction

Danger of injury when working on raised table.

- ▶ Lift the powder bag using a suitable aid.
- ▶ Place a working platform beside the table and use.
- ▶ Work on the side of the table designated for this purpose.

## 2.4 Labels

- ▶ Do not alter or remove the labels on the powder mixer.
- ▶ Immediately replace damaged or lost labels with ones that are true to the originals.

### 2.4.1 Safety Labels



Fig. 1 "Hot Surface"

The "Hot Surface" label indicates that parts can become hot during operation or, if applicable, that a hot base medium is being pumped. Check the temperature before touching the pipes. Only touch the pipes if you are wearing suitable gloves.



Fig. 2 "Do Not Reach Into Funnel"

The "Do Not Reach In" label indicates that the funnel must not be reached into during operation. There is a danger of injury in the region of the valve.



Fig. 3 "Do Not Bend Over Funnel"

The "Do Not Bend Over Funnel" label indicates that breathing in of dust or aerosols above the funnel must be avoided. Dust and aerosols can irritate the respiratory tract. Wear a dust mask if necessary.



Fig. 4 "Do Not Place Small Parts in Funnel"



The "Do Not Place Small Parts in the Funnel" label indicates that no hard objects such as rocks or metal parts should be allowed to get into the powder mixer. If they do, valves and pumps can be damaged or destroyed and the product will be contaminated. In an emergency, immediately press the emergency stop button and remove small parts.



Fig. 5 "Wear Ear Protectors"

The "Wear Ear Protectors" label indicate that damaging noise exposure may occur. Wear ear protectors when operating the powder mixer.

### 2.4.2 Rating Plate

The rating plate can be found on the lower part of the frame beside the shear pump.

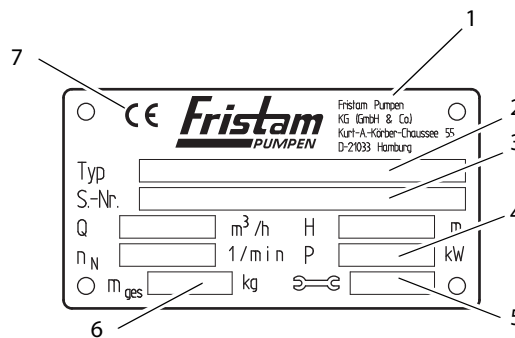


Fig. 6 Rating plate

1	Manufacturer
2	Typ: PM powder mixer
3	S.-Nr.: serial number of the PM powder mixer
4	P: motor output (total) [kW]
5	Year of manufacture
6	mttl: mass (total) [kg]
7	CE mark

### 2.5 Noise Emissions

The operating company must determine the respective sound pressure level for the base media used and instruct and protect personnel accordingly.

#### ⚠ CAUTION

##### Noise Generated by Running Pump

Hearing damage.

- ▶ The local noise exposure regulations must be complied with. For noise emission values for the pumps, please see the pump operator's manuals.

#### ⚠ CAUTION

##### Noise Generated by Running Vibratory Motor

Hearing damage.

- ▶ For powder mixers with two funnels or multiple vibratory motors, increased noise emissions must be taken into account.

Wear ear protectors when using the powder mixer with pumps or shakers with specified sound pressure levels of greater than 80 dBA. See *Chapter 10.1.2, "Noise Emissions," page 28* and the operator's manual for the vibratory motor.

---

## **2.6 Disposal**

- ▶ Follow the instructions in the operator's manuals for the powder mixer components.

### **2.6.1 Disposal of Transportation Package**

- ▶ Recycle the transportation package.

### **2.6.2 Disposal of Grease**

- ▶ Dispose of grease and objects saturated with grease in an environmentally friendly manner in accordance with applicable regulations.

### **2.6.3 Disposal of Lubricating Oil**

- ▶ Dispose of oil and objects saturated with oil in an environmentally friendly manner in accordance with applicable regulations.

### **2.6.4 Disposal of Powder Mixer**

1. Carefully clean the powder mixer. Dispose of residues in an environmentally friendly manner in accordance with applicable regulations.
2. Dismantle the powder mixer into its constituent parts.
3. Dispose of the components in an environmentally friendly manner in accordance with applicable regulations.

### **2.6.5 Disposal of Electrical and Electronic Scrap**

- ▶ Dispose of electrical and electronic scrap in accordance with applicable directives.

## 3 Design and Function

### 3.1 Principles of Design

A centrifugal pump (P1), a shear pump (P2), a control cabinet, and a funnel are connected to a pipe system in the PM powder mixer. The components are mounted to a table with a frame. The standard funnel is equipped with a vibratory motor. The entire system is mounted on casters or legs.

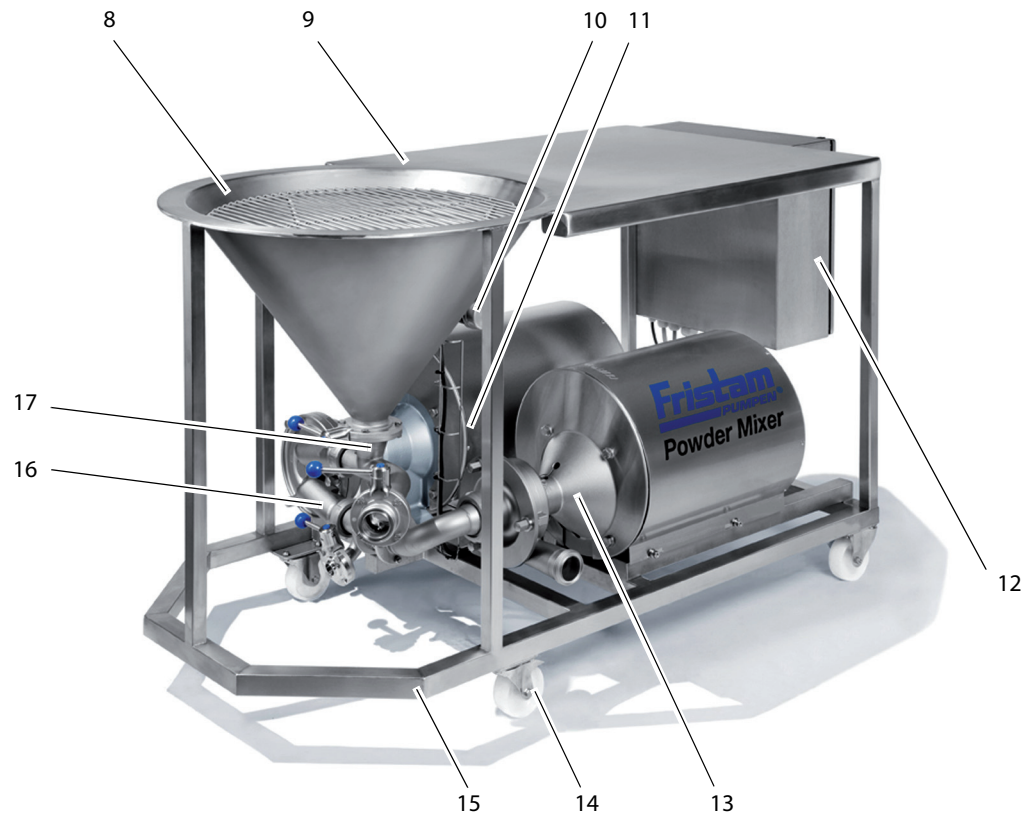


Fig. 7 Powder mixer layout

8	Funnel, grating optional
9	Table
10	Vibratory motor
11	Self-priming pump (FZ pump, P1)
12	Control cabinet
13	Shear pump (FSP pump, P2)
14	Caster (optional)
15	Frame
16	Pipes
17	Powder inlet

### 3.2 Funnel

Powder or liquid additive media is poured into the funnel, where it is then routed to the base medium in the pipe. The funnel is sealed in the lower region by metering valve V1. In the standard version, a vibratory motor is mounted on the side of the funnel. Other options such as protective grating, filter, CIP cover, screw-in bushing, and adapter are available. The funnel can be mounted on a vibration mount or welded on.

### 3.3 Pipes

The pipes include connections, manual and pneumatic valves, and the sight glass. Standard manual valves are equipped with hand levers that can be locked in the 0° and 90° positions. Other handles or attached drives can optionally be installed.

The premix, made up of the base medium and the powder or added liquid, is formed in the pipe region between throttle valve V2 and centrifugal pump P1.

The homogeneous end product is formed in shear pump P2 upstream of the discharge-side connection.

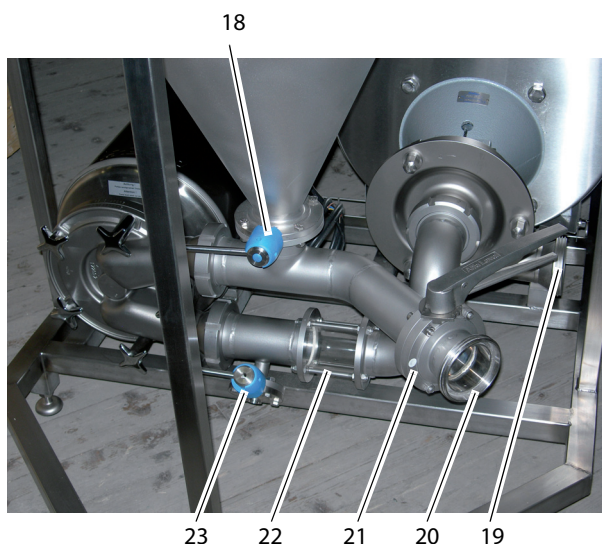


Fig. 8 Pipes, version with hand valves

18	Metering valve V1
19	Discharge-side connection
20	Suction-side connection
21	Throttle valve V2
22	Sight glass
23	Drain valve V3

#### 3.3.1 Valves

The manual valves in the standard version are set as follows:

1. Pull the handle out lengthwise.
2. Rotate the lever to the desired position.

All manual disk valves in the standard version only engage in the positions "On" or "Off."

#### 3.3.2 Variants of Metering Valve V1

##### Stepless Metering Valve V1

Valve V1 as a manual valve can be equipped with a continuously adjustable hand lever instead of a standard hand lever.

##### Valve Combination V1.1 + V1.2

Combination metering valve V1.1 stepless and V1.2 pneumatic (optional)

A V1.2 valve can be positioned below a V1.1 continuously adjustable manual valve. It has a pneumatic drive and can only be set to positions "On" and "Off."

### **Metering Valve V1 With Electropneumatic Drive**

This metering valve V1 features stepless control via an electropneumatic drive. An impressed current signal of 4-20 mA is required for this.

### **3.3.3 Variants of Throttle Valve V2**

#### **Stepless Throttle Valve V2**

The manual throttle valve V2 can be equipped with a continuously adjustable hand lever.

#### **Valve Combination V2.1 + V2.2**

A V2.2 valve can be installed beside a V2.1 continuously adjustable manual valve. It has a pneumatic drive and can only be set to positions "On" and "Off."

The disk of valve V2.2 is equipped with an appropriately sized drill hole and determines the degree of throttling at the inlet. The vacuum generated by the FZ pump cannot be varied in this case.

### **Metering Valve V2 With Electropneumatic Drive**

This throttle valve V2 features stepless control via an electropneumatic drive. An impressed current signal of 4-20 mA is required for this.

## **3.4 Pumps**

### **3.4.1 Centrifugal Pump**

The FZ series self-priming centrifugal pump draws in the supplied base medium and conveys the premix through a short pipe to the shear pump.

Please heed the information in the attached documentation on the FZ pump.

### **3.4.2 Shear Pump**

The FSP series shear pump acts as a rotary homogenizer. It whirls the premix, consisting of the base medium and the powder, and completely breaks down the remaining clumps with the help of high turbulence and high circumferential speeds.

Please heed the information in the attached documentation on the FSP pump.

## **3.5 Control Cabinet**

### **3.5.1 Control and Display Elements**

The powder mixer is controlled and monitored via the control and display elements on the control cabinet. Heed the information in the attached documentation on the frequency converter (FU, optional).

The circuit diagram can be found in the control cabinet.

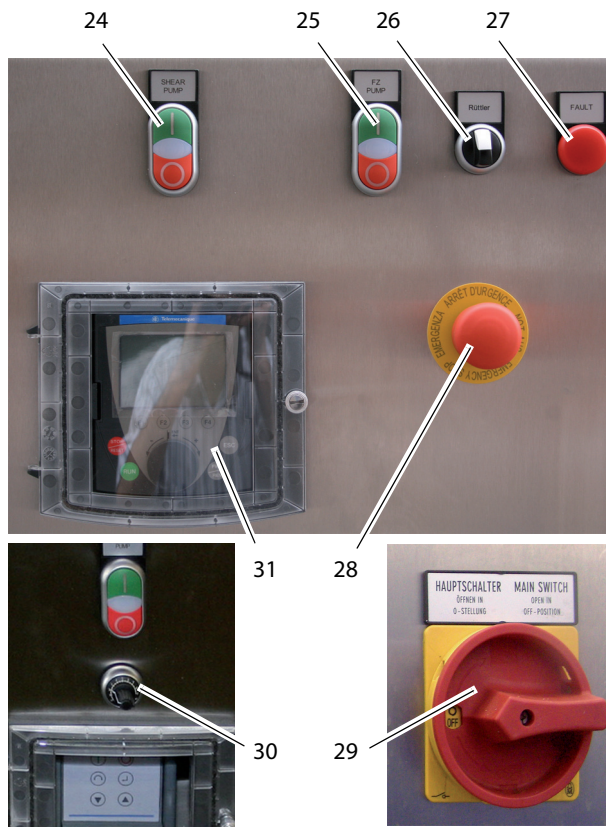


Fig. 9 Control cabinet

No.	Element	Design	Function
24	Switch for shear pump [S3]	Rocker switch with indicator light	Used to switch voltage supply for the shear pump frequency converter on and off
25	Switch for FZ pump [S2]	Rocker switch with indicator light	Used to switch FZ pump on and off
26	Vibratory motor switch "Vibrating" [S4]	Selector switch with set positions or selector dial	Used to switch external vibrator on and off
27	Fault indicator "Fault" [L1]	Indicator light	Lights up when faults occur (see "Faults")
28	Emergency stop button	Latching palm button	Used to turn off the powder mixer in an emergency
29	Main switch [S1]	Selector dial	Used to turn on powder mixer
30	Set point potentiometer (optional)	Control dial	Used to adjust the set point for shear pump speed
31	Graphics and control terminal for frequency converter (example)	Panel with LCD, buttons, and controls	Used to control the frequency converter or start the shear pump

Table 1 Control and display elements on control cabinet

### 3.6 Vibratory Motor (Optional)

The vibratory motor causes the funnel to vibrate and facilitates uniform powder flow to the bottom of the funnel.

If the vibratory motor is activated, it will run in specified switching cycles or switch off.

### 3.7 Screen (Optional)

Various screens are available for the funnel. For automated or semiautomated operation with a pneumatic metering valve, a screen improves powder flow and prevents clumping in the funnel.

Depending on the application, the screen can facilitate filling of the funnel.



Fig. 10 Funnel with grating

32	Funnel
33	Screen (optional)
34	Metering valve (here: disk valve)

### 3.8 Protective Grating (Optional)

The protective grating is mounted in the case of powder mixers with V1 automatic valves. It prevents access to the valve, the position of which cannot be changed by the operator. The protective grating is permanently mounted in the funnel at a distance of 10-15 cm above the valve.

### 3.9 Sizes and Standard Equipment

The following versions of the powder mixer are available:

Size	FZ Pump	Output in kW	Shear Pump	Output in kW	Approx. Dimensions W/H/D in mm	Connection Type DIN 11851	Approx. Weight in kg
PM01	FZ 15 PM	2.0–4.0	FSPE 712 D	4.0–5.5	800 990 1200	On DN40 OFF DN40	250
PM02	FZ 17 PM	4.0–5.5	FSPE 3522 D	4.0–11.0	800 990 1700	On DN50 OFF DN50	300
PM03	FZ 20 PM	5.5–11.0	FSPE 3532 D	7.5–18.5	800 990 1700	On DN50 OFF DN50	350
PM04	FZ 22 PM	11.0–15.0	FSPE 3542 D	15.0–30.0	1050 1000 2010	On DN65 OFF DN65	450
PM05	FZ 25 PM	15.0–18.5	FSPE 3552 D	22.0–45.0	1050 1000 2010	On DN80 OFF DN80	620

Table 2 Powder mixer sizes

Depending on the application, other combinations of pumps and connections can be used. The dimensions of the pipes and the connections may need to be adjusted for the viscosity of the end product.

Component	Equipment
Powder mixer	Permanent installation on height-adjustable machine legs or mobile installation on 4 casters (2 fixed and 2 pivot)
Control cabinet	With/without control cabinet, stainless steel, protection rating IP 54/IP 55 and others, current consumption up to 63 A, selectively with/without cable
Funnel	With diameter = 500 mm, H = 470 mm, approx. 35 l capacity; with diameter = 700 mm, H = 470 mm, approx. 66 l capacity; with/without vibratory motor, 400 VAC, 45–120 W; with/without screen
Pipes	Stainless steel 1.4404, 1.4571, and others
Connections	Thread: DIN 11851, DIN 11864, RJT, SMS, etc.; flange: DIN, ANSI, etc.; clamp connections: Tri-clamp, ISO clamp, and others
Pumps	With/without enclosure
Seals	Rotating seal ring, single/double flush elastomers: VMQ, NBR, FKM, PTFE/KALREZ, FEP, and others
Drives	PTC thermistor (motor), external fan, frequency converter

Table 3 Equipment variants for standard sizes

### 3.10 Hydraulic Diagram

The premix, made up of the base medium B1 and the powder, is formed in the pipe region between throttle valve V2 and centrifugal pump P1. The end product is formed from the base medium in container B1 and the powder.

#### 3.10.1 Interfaces

Via three-way valves, the operator can control the inflow of the base medium to the suction-side connection and the outflow of the end product from the discharge-side connection.



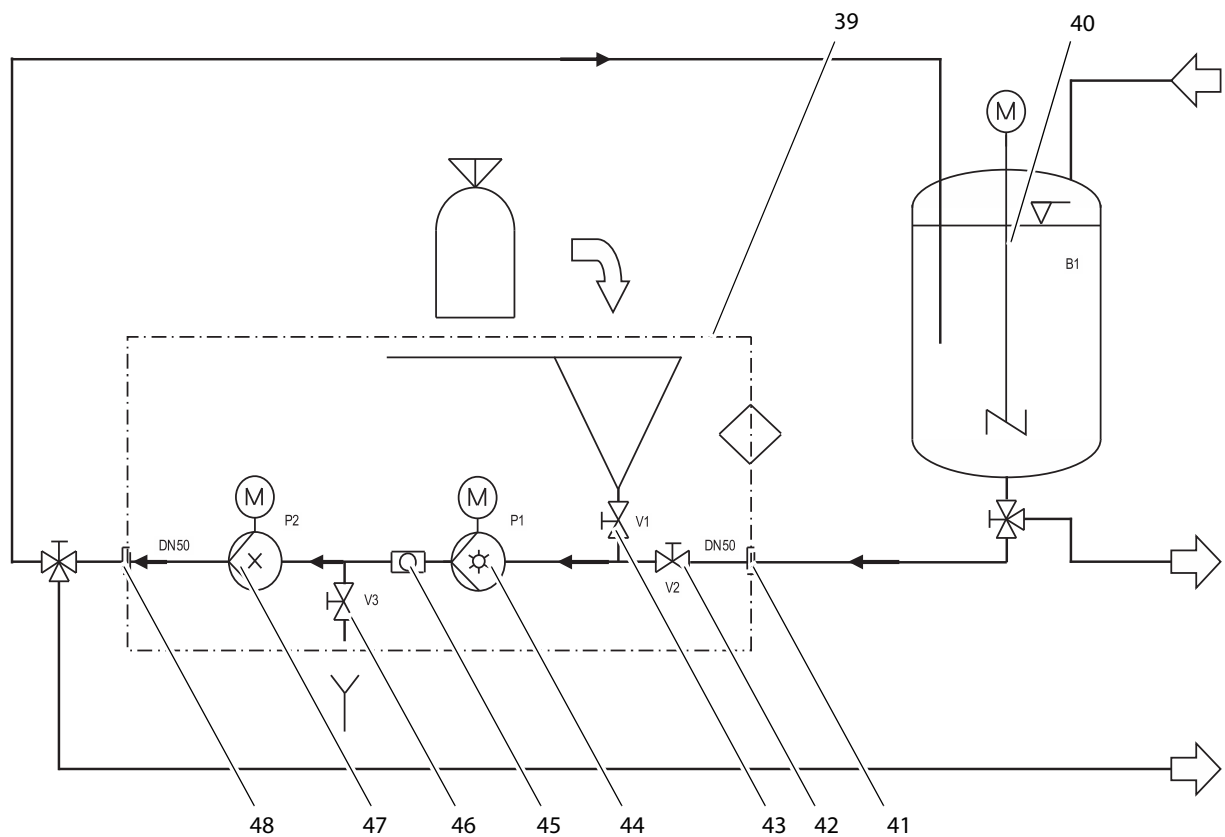


Fig. 11 Hydraulic diagram

39	Scope of supply for PM powder mixer
40	Container B1 with base medium
41	Suction-side connection
42	Throttle valve V2
43	Metering valve V1
44	Self-priming centrifugal pump (FZ pump) P1
45	Sight glass
46	Drain valve V3
47	Shear pump (FSP) P2
48	Discharge-side connection

### 3.11 Function

The PM powder mixer is a system in which powder or liquid ingredients (e.g., sugar, milk and cocoa powder, thickeners, oil, flavorings, etc.) are introduced into or dispersed in a base medium solution.

The self-priming centrifugal pump draws in the base liquid supplied in a tank and conveys it through a short pipe to the shear pump. If the self-priming centrifugal pump is throttled at the suction side via the throttle valve, a vacuum (of up to approx. 0.5 bar) is built up between the pump and the valve. This is where the funnel with the inlet for the additive medium is located.

The vacuum causes, for example, powder or liquid to be drawn directly into the liquid flow. First this still-inhomogeneous premix reaches the self-priming centrifugal pump, where it is premixed. The premix is then pumped by this pump to the shear pump, where the remaining clumps are completely broken up due to the high turbulence at circumferential speeds of up to 30 m/s.

## 4 Transportation

Transportation may only be performed by trained personnel.

The powder mixer can be moved using an industrial truck or a crane.

Always move the powder mixer in the installation condition.

### 4.1 Safety Instructions

#### Rolling on Sloping Site

Injuries from being crushed or run over, material damage.

- ▶ Ensure that the powder mixer is placed on a level surface.
- ▶ Lock the casters.
- ▶ Additionally secure the frame for operation.

#### Falling or Unsecured Parts

Danger of injury from impact or crushing.

- ▶ Only use suitable means of conveyance and hoists. Information on powder mixer weight can be found in the "Order-Related Documents" in the attached documents.
- ▶ Before moving the powder mixer secure it to prevent it from slipping.
- ▶ Secure pipes and attachment parts, and check screwed connections.

#### Contamination, Impact, and Moisture

Damage to pipes, valves, and pumps.

- Remove the protective film just prior to installation.
- Remove the pipe fitting covers just prior to connection to the pipes.

### 4.2 Moving With Industrial Truck

#### Preparation

- ▶ Ensure that the powder mixer is on the correct pallet and adequately secured.

#### Procedure

1. Pick up the pallet with the forks on the industrial truck.
2. Carefully move the pallet to the designated location and set down.

### 4.3 Moving With Crane

#### **⚠ WARNING**

---

#### Falling Parts

Death from crushing, pinching of extremities, material damage.

- ▶ Only use hoists that are designed for the total weight of the powder mixer.
- ▶ Ensure that the area below the powder mixer is clear of people.

#### **⚠ WARNING**

---

#### Swinging Parts

Crushing and serious injuries.

- ▶ Start and stop the crane with powder mixer smoothly.
- ▶ Ensure that the danger zone of the powder mixer is clear of people.

---

### **Auxiliary Equipment**

Hoists: round slings tested in accordance with DIN EN 1492-1 and 1492-2

### **Procedure**

1. Wrap the round sling twice around the frame of the powder mixer.
2. Guide both loops to the crane hook and rotate by 180° to ensure that the belt will not slip on the hook.
3. Position the center of gravity to ensure that the powder mixer is lifted horizontally.
4. Lift the powder mixer.

## **5 Storage**

### **5.1 Safety Instructions**

- ▶ Follow the instructions in the operator's manuals for the powder mixer components.

### **5.2 Storage Conditions**

- ▶ Store the powder mixer as follows:
  - Dry, in low humidity
  - Protected against frost and heat, optimally at a temperature of 20°C to 25°C
  - Ventilated
  - Dust-free
- ▶ All movable powder mixer parts must be rotated every three months.

### **5.3 Mothballing of the Powder Mixer**

If intended to be stored for longer than six months, the powder mixer must be mothballed. Heed the following:

- ▶ Before mothballing completely remove the shaft seals on the pumps and store separately.
- ▶ Open the valves.

### **5.4 Recommissioning**

- ▶ After mothballing and before recommissioning, check the pumps' connections, seals, bearings, and oil levels.

## 6 Installation

Remove the packaging materials and protective films (also on the casters). Inspect the powder mixer after unpacking. Remove any foreign objects in the funnel or the pipes.

Connect the power to the powder mixer. See *Chapter 6.8, "Connection of Power Supply," page 22.*

### 6.1 Safety Instructions

#### Unstable Installation

Severe crush injuries, material damage.

- ▶ Tighten screws to the specified tightening torque (see *Chapter 10.1.1, "Tightening Torques," page 28.*)
- ▶ Use a torque wrench or an impact driver with adjustable torque.

### 6.2 Installation Location

For standard powder mixers, the installation location must meet the following requirements:

- Nonexplosive atmosphere
- Dust-free environment and device for discharge of dust- or aerosol-containing air
- Ambient temperature:  $-20^{\circ}\text{C}$  to  $+40^{\circ}\text{C}$
- Moisture and salt contents in ambient air:  
The values are given in the operator's manuals for the pump motors; please see the attached documents.
- Foundation sized adequately for the system weight
- Horizontal and level installation surface
- Adequate installation surface strength for powder mixer mass
  - ▶ Consider the point loads created by the casters or legs on the powder mixer.
- Installation clearances given in the operator's manuals for the pumps
- Adequate clearance for maintenance work
- Adequate air supply for pump cooling

### 6.3 Reduction of Noise and Vibration

#### 6.3.1 Primary Measures

- Only operate the vibratory motor intermittently.
- Operate the powder mixer pumps in their optimum working ranges.
- Decouple the suction and discharge lines from vibrations.
  - ▶ Support lines.
  - ▶ Align lines.
  - ▶ Use vibration dampers.

#### 6.3.2 Secondary Measures

- ▶ Take structural measures such as the following:
  - Add acoustic panels.
  - Install housing.

## 6.4 Powder Mixer Fixation

1. Set up the powder mixer at the installation location. Lock the locks on the casters (if present), or secure the frame with chocks.
2. Ground the frame to dissipate electrostatic charge.
3. Position hose lines to ensure that they cannot be damaged.

## 6.5 Installation of Pipes

### ⚠ WARNING

#### Electrostatic Charge Buildup

Electric shock.

- ▶ Ground the pipes and the pump/Ground the powder mixer.

Lay and connect pipes as follows:

- ▶ Keep the pipe resistance as low as possible: Avoid unnecessary installation of valves, elbows, and abrupt pipe transitions.

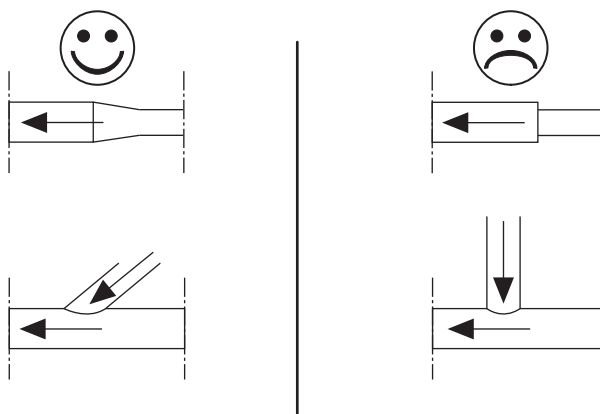


Fig. 12 Pipe transitions

- ▶ Design pipe cross section so that no unnecessary pressure losses or cavitation occurs in the suction and inlet areas.
- ▶ Install a shut-off valve in the discharge line.
- ▶ Design the suction lines to be as short as possible.
- ▶ Always lay the suction lines so that they are continuously rising toward the pump unit. Rule out the possibility of air pockets and dips in the pipes.
- ▶ Lay and connect the pipes to ensure that no stresses are applied to the connections.
- ▶ Secure pipes to ceilings, walls, or floor using pipe clamps.
- ▶ Align pipes flush with pump connections using a bracket.

## 6.6 Supply System Connection

The following connections are standardly provided on the suction and discharge sides in DIN 11851 (milk pipe):

Model	Centrifugal Pump	Shear Pump	Connection
PM 01:	FZ 15	FSPE 712	DN 40
PM 02:	FZ 17	FSPE 3522	DN 50

Table 4 Models and connections

Model	Centrifugal Pump	Shear Pump	Connection
PM 03:	FZ 20	FSPE 3532	DN 50
PM 04:	FZ 22	FSPE 3542	DN 65
PM 05:	FZ 25	FSPE 3552	DN 80

Table 4 Models and connections

## 6.7 Hydraulic Connection

The hydraulic connection is adapted to machine size, project specifications, or customer requirements (see order confirmation).

### 6.7.1 Suction-Side Connection

A slight pre-pressure is required on the suction side to ensure free inflow of the base medium into the powder mixer. The hydrostatic pressure from the supply tank at a pressure of approx. 0.05–0.5 bar (0.5–5.0 m suction head) is optimal here.

- ▶ If required, use only a controlled pump on the suction side. It will not affect the suction behavior of the powder mixer and will prevent fluid from being forced into the funnel.

### 6.7.2 Discharge-Side Connection

The back pressure from the powder mixer to the supply tank must be minimized. For this reason, the discharge line cross section must be as large and the line length as short as possible. The standard version of the powder mixer can generate a maximum back pressure of 0.5–0.6 bar for optimum powder draw-in.

- ▶ If additional components, e.g., heat exchangers or filters, that generate a significant pressure loss are added to the circuit, the operator should install an additional pump downstream of the discharge-side connection on the powder mixer.

## 6.8 Connection of Power Supply

Always heed the VDE regulations when connecting the powder mixer.

- Electrical connection: 1 x 400 V, 32 A or 63 A
- CEE plug in accordance with DIN 49 462 or DIN 49 463, VDE, and generally recognized rules of technology; backup fuse: 32–160 A, depending on customer-side installed capacity
- Interpoles are only approved for 32 A CEE plugs. Connection is usually made using a plug-in connection. A switched receptacle is required for this (63 A fuse).
- The pump motors are poled at the control cabinet connection in such a way that the pumps rotate correctly with a clockwise rotating field.

## 6.9 Checking Direction of Rotation of Pumps

### NOTICE

#### Damage to Pumps

Damage to seals.

- ▶ The pumps on the powder mixer may not be run dry.

1. Close throttle valve V2.
2. Close drain valve V3.
3. Open metering valve V1.
4. Fill the funnel with water until the pipes are filled.

- The mechanical seals will then be wetted with water, as required.
5. Turn on the shear pump briefly (for a few seconds), and then turn off again: check if the direction of rotation is correct. See the operator's manual for the pump.  
  
To perform the check, observe the impeller through the discharge port on the shear pump or the fan wheel on the motor (remove paneling). The pumps must rotate counterclockwise when viewed from the top, looking down on the pump casing.
  6. If the motors are running in the wrong direction, rotate the interpole in the connector (to 32 A).

## 6.10 Cleaning

Only use cleaning agents that comply with the hygiene guidelines for the respective base and additive media.

Thoroughly clean the pump and the pipe system before initial use.

### **⚠ CAUTION**

#### **Danger of crushing; irritation of the eyes, skin, and respiratory tract**

Contact with cleaning solutions or vapors from cleaning agents.

- ▶ Use caution when opening valve V1 and drain valve V3.
- ▶ Wear safety shoes.
- ▶ Wear safety glasses, gloves, and a rubber apron.

1. Connect the pipes.
2. Fill the connected cleaning tank with cleaning media.
3. Close drain valve V3.
4. Completely open throttle valve V2 and the valve at the cleaning tank outlet.
  - The cleaning medium can also be added through the funnel.
5. Wait until the cleaning medium has reached the pumps.
6. Check if valve V1 is closed.
7. Turn on both pumps.

The shear pump can also be turned on and off intermittently during the cleaning process.

Drain valve V3 can be opened briefly if necessary.

#### **6.10.1 Pump Cleaning With CIP System**

If a CIP system is available on-site, the powder mixer can be connected to it and cleaned.

**Throttle valve V2 must be fully opened and metering valve V1 and drain valve V3 must be closed during cleaning with a CIP system.**

1. Briefly open drain valve V3 if necessary.  
  
This will vent the system.

#### **6.10.2 Emptying of Cleaning Agents**

1. Close the valve at the supply system outlet.
2. Empty the hose line via throttle valve V2 (which is still open) and drain valve V3.
3. Open metering valve V1.

The table and the funnel must be cleaned manually according to operational guidelines. Completely dry the funnel after cleaning. After cleaning connect the powder mixer to the supply system.

## 7 Operation

### NOTICE

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#### Damage to Pumps

Damage to mechanical seals by product residues.

- ▶ Clean the powder mixer after each use.

### NOTICE

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#### Damage to Pumps

Damage to seals.

- ▶ The pumps on the powder mixer may not be run dry.

### ⚠ CAUTION

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#### Danger of Crushing; Irritation of the Eyes, Skin, and Respiratory Tract

Foot injuries.

Contact with dust or aerosol.

- ▶ Wear safety shoes and protective clothing.
  - ▶ Wear a dust mask if necessary.
- 

If the powder mixer shear pump is controlled by a frequency converter, heed the information in the operator's manual from the frequency converter manufacturer.

### 7.1 Turning On Powder Mixer

1. Turn on the main switch: position "ON."

The "Fault" fault indicator will light up.

2. Turn on the shear pump switch: position "I."

The supply voltage for the frequency converter (if supplied) will be turned on by this.

The "Fault" fault indicator will go out.

### 7.2 Starting Powder Mixer

#### 7.2.1 Preparation

### ⚠ CAUTION

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#### Danger of Crushing, Severing of Extremities

Wedging of fingers in metering valve.

- ▶ Do not reach into the funnel.
  - ▶ Install a grating for a pneumatic valve.
-



1. Clean the powder mixer when necessary.
2. Ensure that:
  - There is adequate base medium in the supply system.
  - There is no powder in the funnel.
  - The funnel is dry.
3. Close drain valve V3.
4. Close metering valve V1 on the funnel.
5. Open the supply system outlet valve.
6. Completely open throttle valve V2.  
Convey the medium from the supply tank to pump P1. Pump P1 requires a small amount of liquid at first for priming. Supply this through the funnel as required.
7. Turn on centrifugal pump P1 and begin conveying the supply medium through the circuit.
8. Turn on shear pump P2.

### 7.2.2 Mixing

#### **⚠ CAUTION**

##### **Respiratory Tract Irritation, Breathing Difficulties**

Inhalation of dust or aerosol.

- ▶ Do not bend over the funnel.
- ▶ Discharge dust- or aerosol-containing air.

1. Close control valve V2 to the extent where pump P2 is somewhat quieter.  
This corresponds to a closing angle of approximately 45%. (The exact value must be determined by the operator.) Through this, an adequate vacuum is generated below the funnel.
2. Completely open metering valve V1 below the funnel. Check the suction above the funnel and the flow through the sight glass.  
Close throttle valve V2 further if necessary to increase the suction.
3. Completely close metering valve V1.
4. Add powder or additional liquid to the funnel.
5. Slowly open metering valve V1.  
**With swelling products such as pectin or carrageen, proceed with caution to ensure that the pumps do not become clogged.**
6. Open metering valve V1 further as soon as the powder starts flowing well.
7. If necessary, turn on the vibratory motor (if supplied).

### 7.3 Monitoring Operation

Monitor the quality of the premix through the sight glass. Inspect the air content and the particle size of the homogenized product.

- ▶ Monitor operations: If homogenization is inadequate, close valve V2 further to lower the throughput and thereby increase the dwell time in the shear pump.
- ▶ A decrease in suction power with increasing product stream viscosity can be compensated for to a certain extent through further opening of throttle valve V2.

- ▶ As soon as the powder has been completely drawn out of the funnel and into the product, close metering valve V1 so that no air can get sucked into the product.
- ▶ If necessary, add new powder to the funnel. Perform the work steps described in 7.2.2, „Mixing,“ again.

#### **7.4 Stopping Powder Mixer**

- A For shear-sensitive powders, turn off shear pump P2 as soon as the powder has been completely drawn in.
- B For products that are not shear-sensitive, the product can continue to be conveyed through the circuit for rehomogenization.

#### **7.5 Turning Off Powder Mixer**

1. Close the supply system outlet valve.
2. Close throttle valve V2.
3. Open drain valve V3. Collect the draining medium.
4. Turn off the vibratory motor (if supplied).
5. Turn off centrifugal pump P1.
6. Turn off shear pump P2 via the frequency converter (if supplied).
7. Turn off the powder mixer via the shear pump switch.

<i>NOTICE</i>
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#### **Damage to Pumps**

Damage to mechanical seals by product residues.

- ▶ Always clean the powder mixer after turning off.
-

## 8 Faults

For information on faults, possible causes, and remedies, please see the appendix, *Chapter 10.4, "Troubleshooting Table," page 29.*

### 8.1 Safety Instructions

#### Hot Surfaces

Contact burns from touching the pumps or pipes. Pumping of hot media can cause the pumps and pipes to become very hot.

- ▶ Check the temperature before touching the pump.
- ▶ Only touch the pump if you are wearing suitable gloves.

#### Dust Generated by Clogged Funnel

Irritation of respiratory tract from inhalation of dust or aerosol.

- ▶ Do not allow the funnel to overflow.
- ▶ Do not bend over the funnel.
- ▶ Wear a dust mask.

## 9 Maintenance

For information on maintenance intervals, please see *Chapter 10.5, "Maintenance Intervals," page 32.*

### 9.1 Safety Instructions

#### Rotating Parts

Personal injury and material damage.

- ▶ Before removing the coupling guard and the guard plate, turn off the pump motor and prevent it from being able to be turned on accidentally.

#### Uncontrolled Outflow of Liquids

Personal injury and material damage from acid burns, poisoning, and contamination.

Before performing maintenance or cleaning work on the powder mixer:

- ▶ Close the suction and discharge lines.
- ▶ Completely empty the pipes before opening.
- ▶ Before opening the pump completely empty the pump casing.

#### Rapid Cooling of Pipes or Pumps

##### Tension cracks.

- ▶ Do not rapidly cool the pipes or pumps.

##### Use of Hard Driving Tools

Scratching of polished surfaces.

- ▶ For polished surfaces, use a copper socket wrench socket.

## 9.2 Replacement Parts

Use of replacement parts that are not approved by *Fristam* can lead to serious personal injury and material damage. If you have any questions regarding approved replacement parts, please contact *Fristam*.

*Fristam* registers all shipped powder mixers. For ordering *Fristam* replacement parts, you require the following information:

1. Order number
2. Serial number of powder mixer (see rating plate on powder mixer frame)
3. For pumps: pump serial number (see rating plate or number stamped into pump)
4. Replacement parts and materials designations (see Order-Related Documents in attached documents)

## 10 Appendix

### 10.1 Specifications

Detailed specifications for the powder mixer are given separately in the system documentation.

#### 10.1.1 Tightening Torques

Tightening Torques for Screws and Nuts

##### Material: Steel, Strength Class: 8.8

Thread	M8	M10	M12	M16
Tightening Torque [Nm]	25	49	85	210

##### Material: Steel, Strength Class: 70

Thread	M8	M10	M12	M16
Tightening Torque [Nm]	17.5	35	62	144

#### 10.1.2 Noise Emissions

The noise emissions are dependent on the pumps used, the shaker, and the size and fill level of the funnel.

The specified values apply to operation of the powder mixer at the best efficiency point (please also see pump characteristic curves and specifications in the attached operator's manuals).

The noise level can differ greatly at other operating points.

Size	Noise Level [dBA]
PM01	80
PM02	81
PM03	82
PM04	84
PM05	87

Table 5 Noise emissions without operation of a vibratory motor

## 10.2 Performance Overview

Sample data for granulated sugar

Size	FZ Pump (Applica- tion- Depen- dent)	Output at 1450 rpm and 50 Hz	Shear Pump	Output at 2950 rpm and 50 Hz	Max. Powder Feed Rate Via Funnel	Recom- mended Feed/Return Diameter	Recom- mended Fun- nel Outlet Diameter
		in kW		in kW			
PM01	FZ 15 PM	4.0–5.5	FSPE 712 D	3.5–5.5	500	40	50
PM02	FZ 17 PM	5.5–7.5	FSPE 3522 D	7.5–11.0	1,800	50	65
PM03	FZ 20 PM	7.5–11.0	FSPE 3532 D	11.0–22.0	3,500	50–65	65
PM04	FZ 22 PM	11.0–15.0	FSPE 3542 D	22.0–37.0	5,000	65–80	80
PM05	FZ 25 PM	15.0–18.5	FSPE 3552 D	37.0–45.0	10,000	100–125	100

Table 6 Performance overview illustrated for granulated sugar

### 10.2.1 Pump Combination

The specific combination of centrifugal pump (FZ pump) and shear pump is dependent on the application type. Other motor outputs may be required.

### 10.2.2 Shear Pump Output

The required output is dependent on the properties of the end product and the process parameters:

- Concentration of end product
- Temperature of base medium
- Dissolution properties of powder
- Viscosity of end product
- Cross section of pipe
- Length of pipe

### 10.2.3 Dissolution properties of powder

The viscosity of the premix below the funnel is higher than the viscosity of the end product. There is an overconcentration of powder in this pipe section. The reason for the high viscosity is the additional friction caused by the crystals that are not yet dissolved. In the example of granulated sugar, this results in higher motor output requirements for the shear pump.

## 10.3 Lubricants

Only use food-grade lubricants.

Lubrication points:

- Screwed connections on pump heads
- Screwed connections on connecting pipes

## 10.4 Troubleshooting Table

Problem	Possible Cause	Remedy
<b>Liquid coming out of funnel.</b>  See operator's manual for pump.	Centrifugal pump P1 not running; centrifugal pump P1 rotating in wrong direction.	Close metering valve as quickly as possible; eliminate pump fault; change direction of rotation for pumps. After restarting empty funnel via metering valve, close metering valve, and clean and dry funnel. Continue operations.
	Throttle valve opened too far; static head from container B1 too high.	Close throttle valve further. After cleaning empty funnel via metering valve, close metering valve, and clean and dry funnel. Continue operations.
	Product path clogged or still closed.	Clear product path; clean screens. After cleaning empty funnel via metering valve, close metering valve, and clean and dry funnel. Continue operations.
	Controlled supply pump has excessively high discharge head.	Reduce supply pump speed appropriately. After restarting allow funnel to be emptied by suctioning via metering valve, close metering valve, and clean and dry funnel. Continue operations.
<b>Pump either does not pump or pumps irregularly.</b>  See operator's manual for pump.	Pump interior not completely filled with liquid; pump interior not vented.	Fill pump interior with liquid.
	Suction line blocked or clogged.	Open or clean suction line.
	Pump with geodesic suction head <sup>3</sup> : liquid level falls at standstill and casing runs dry.	Install foot valve in suction line.
	Suction line leaky; seal on pump cover leaky and drawing in air.	Seal suction line; replace cover seal.
	Air pocket in suction line.	Lay suction line as straight as possible and at steady incline.
	Pump blocked; foreign objects in pump.	Clean pump interior; perform visual inspection; consult <i>Fristam</i> .
	Foot valve blocked or contaminated.	Clean foot valve; reestablish proper function.
	Viscosity of pumping medium too high; medium does not flow well because too viscous.	Consult <i>Fristam</i> .
<b>Flow rate too high.</b>  See operator's manual for pump.	Coupling punctured due to overloading.	Consult <i>Fristam</i> .
	Pump oversized.	Consult <i>Fristam</i> .
<b>Flow rate too low; discharge head too low.</b>  See operator's manual for pump.	Throttle valve opened too far.	Close throttle valve in supply further.
	Selected pump too small; motor speed too low due to incorrect voltage.	Consult <i>Fristam</i> ; connect according to motor rating plate.
	Suction line leaky and drawing in air.	Seal leaks.
	Viscosity of pumping medium too high (too viscous).	Possibly convert to heating; consult <i>Fristam</i> .
	Back pressure too high; relief valve (if supplied) regulates incorrectly.	Clear product path; clean screens in tank return line.
	Direction of rotation incorrect.	Correct pipe and electrical connections.

Table 7 Troubleshooting table

Problem	Possible Cause	Remedy
<b>Metal noise.</b>  <b>- Foreign objects in pipe.</b>  <i>See operator's manual for pump.</i>	Foreign objects in pump interior.	Disassemble, inspect, and (if necessary) repair.
	Mechanical catching.	Disassemble, rework, and set correct clearance.
	Excessive wear of bearings and gearwheels from overloading or inadequate lubrication.	Disassemble, inspect, and repair. Regular maintenance; lubricant service.
	Speed too high.	Use motor with frequency converter; consult <i>Fristam</i> .
	Pump running dry; shaft seal running dry.	Immediately supply pumping medium; immediately supply sealing water.
	Pumping medium temperature too high, clearance between impeller and cover or impeller and casing too small due to elevated temperature.	Check operating conditions; disassemble, rework, and set correct clearance; contact <i>Fristam</i> .
<b>Flow noise.</b>	Operation in overload or part-load range.	Adjust working point to design.
	Flow losses in suction line too high.	Increase nominal sizes; rule out the possibility of throttling.
	Cavitation.	Check condition for NPSH rating; see <i>Chapter 6.5, "Installation of Pipes," page 21.</i> Consult <i>Fristam</i> .
<b>Vibrations.</b>	Weight and hydraulic forces of pipes stressing the pump.	Support pipes so that pump is not stressed; install vibration dampers if necessary; keep water hammers away from pump.
<b>Excessive heating of pump shaft bearings and drive gear.</b>	Bearing damage.	Disassemble; replace bearings.
	Lubricating oil inadequate.	Change lubricating oil (see table); perform maintenance at regular intervals (see table).
<b>Motor power consumption too high.</b>	Resistance in discharge line too high; pump throttled too much; flow rate too low.	Increase nominal size of discharge line; open throttle valve; reduce speed using frequency converter on motor or control gear.
	Viscosity and/or density of pumping medium too high.	Consult <i>Fristam</i> .
	Massive damage to pump shaft bearings or gear motor.	Disassemble and inspect; consult <i>Fristam</i> .
<b>Leakage at shaft seal.</b>	Shaft seal mechanical damage or wear.	Replace mechanical seal and rotary shaft seal (including all secondary seals); possibly convert to different materials; consult <i>Fristam</i> .
	Shaft seal running dry; suction head too high; pumping medium temperature too high.	Decrease geodesic suction head; use double shaft seal; consult <i>Fristam</i> .
	Sealing or flushing water pressure too high.	Adjust using throttle valve and pressure gauge.
	Shaft seal materials not chemically resistant to pumping medium; medium temperature too high.	Consult <i>Fristam</i> ; convert to cooling or double shaft seal.
	Sealing or flushing water pressure too low; sealing water tubes clogged; shaft seal crusted or damaged.	Adjust sealing water inlet and outlet; clean sealing water tubes; replace shaft seal.
	Sealing water contaminated or too hot.	Use drinking water-quality water with temperature of max. 70°C.

Table 7 Troubleshooting table

a. The "geodesic suction head" is the vertical distance between the suction-side liquid level and the center of the pump pipe connections.

## **10.5 Maintenance Intervals**

Please refer to the operator's manuals for the pumps and the motors.

Maintenance to be performed when necessary:

- ▶ Replace mechanical seals.



## 10.6 Declaration of Conformity

The manufacturer hereby declares that the powder mixer complies with all applicable requirements of the Machinery Directive (2006/42/EC).

The machine also complies with all requirements of the Low Voltage Directive (2006/95/EC) and the EMC Directive (2004/108/EC).

The following harmonized standards have been applied:

- DIN EN 12100-1  
Safety of machinery - Basic concepts, general principles for design, Part 1: Basic terminology, methodology
- DIN EN 12100-2  
Safety of machinery - Basic concepts, general principles for design, Part 2: Technical principles

Authorized documentation representative:

Function: Quality Officer

Address: FRISTAM Pumpen KG (GmbH & Co.)  
Kurt-A.-Körber-Chaussee 55  
21033 Hamburg  
GERMANY





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FRISTAM Pumpen KG (GmbH & Co)  
Kurt-A.-Körber-Chaussee 55  
21033 Hamburg  
GERMANY

Tel.: +49-40-72556-0

Fax: +49-40-72556-166

E-mail: [info@fristam.de](mailto:info@fristam.de)