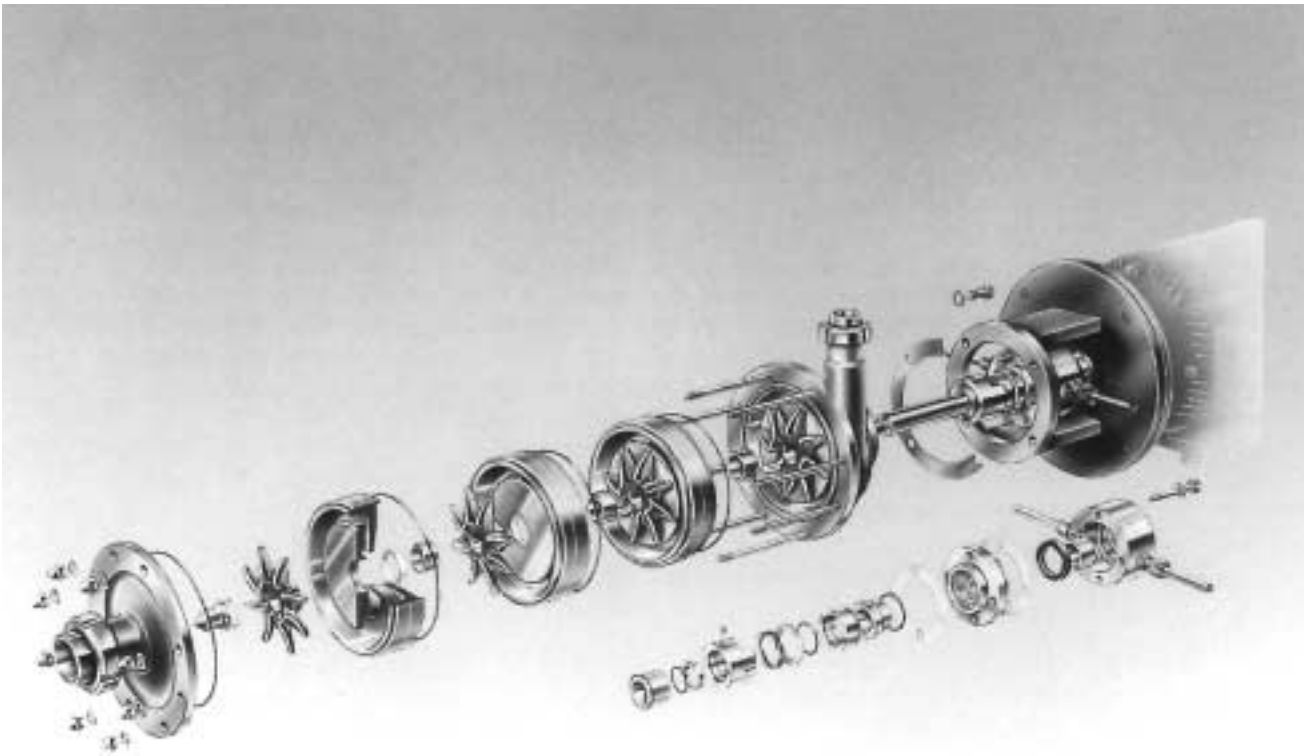


## MULTISTAGE CENTRIFUGAL PUMPS FM SERIES



**Pump type:**

**Pump no. :**

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## 1. General

This Operating Manual applies to all FM series pumps.

The Operating Manual must be read before installing or operating the pump. Please observe all safety directions.

### 1.1 Application

Depending on the order-related version, suitable for the following applications among others:



#### Dairy products

Raw milk, whey, skimmed milk, curdled milk



#### Foods

Tomato juice, vegetable juices, animal and vegetable oils and



#### Brewing

Hot and cold wort, waste beer, low-alcohol/alcohol-free beer



#### Nonalcoholic beverages

Mineral water, mixed drinks containing CO<sub>2</sub>, concentrates



#### Alcoholic industry

Distillates, alcoholic solutions



#### Pharmaceuticals/ Cosmetics

Superpure water, plant extracts, suspensions, enzymes, nutrient solutions



#### Chemicals

Slightly soiled liquids, waste water containing acid or lye, detergent solutions, chemically impure factory effluent

and, for example, in the industrial processes below:

Charging of filters, heaters and filling machines.

Feeding, circulation and pressure increase in ultrafiltration and reverse osmosis systems for water conditioning.

Dealcoholisation, separation of liquids containing pollutants and recovery of product residue.

Charging of evaporation and ultraheat treatment systems.

Acceleration and pressure build-up in carbonising, blending, metering and cleaning systems.

## 2. Safety

This Operating Manual contains directions of fundamental importance which must be observed during installation, operation and maintenance.

For this reason, it is imperative that the Operating Manual be read by the fitter as well as the responsible qualified staff/user before both installation and putting into operation and be kept constantly at hand at the place of use of the machine/system.

Apart from the general safety directions contained under the heading Safety, the special safety directions, e.g. for private use, included under the other headings must also be observed.

### 2.1 Identification of directions in the Operating Manual

The safety directions contained in this Operating Manual, which, if not observed, may endanger persons, are specially identified by the general danger symbol



safety symbol in compliance with  
DIN 4844 - W 9

or by the following to warn of electrical voltage



safety symbol in compliance with  
DIN 4844 - W 8

In the case of safety directions, whose nonobservance may endan-

ger the machine and its functioning, the word

**CAUTION**

is inserted.

It is vital that directions located directly on the machine such as

- rotation arrow
- fluid connection identifier

be observed and kept in a fully readable state.

### 2.2 Staff qualification and training

The staff entrusted with operation, maintenance, inspection and installation must be suitably qualified for these tasks.

The area of responsibility, accountability and supervision of staff must be precisely laid down by the user. Should staff not possess the knowledge required, they must receive training and instruction. If necessary, this can be carried out on behalf of the user of the machine by the manufacturer/supplier.

Furthermore, the user must ensure that the contents of this Operating Manual are fully understood by its staff.

### 2.3 Dangers connected with failure to observe the safety directions

Failure to observe the safety directions may endanger persons as well as the environment and machine. Failure to observe the safety directions can result in the loss of all claims for compensation.

The following are examples of individual dangers which may result from failure to observe the safety directions:

- Failure of important machine/system functions
- Failure of prescribed methods of maintenance and servicing
- Endangerment of persons by electrical, mechanical and chemical effects

- Endangerment of the environment due to the leakage of dangerous substances

### 2.4 Safety-conscious work

The safety directions contained in this Operating Manual, the current national accident prevention regulations as well as any internal working, operating and safety rules issued by the user must be observed.

### 2.5 Safety directions for the user/operator

- Should hot or cold machine parts pose dangers, the customer must ensure that they cannot be touched.
- The touch guards fitted to moving parts (e.g. coupling) must not be removed when the machine is in operation.
- Leakages (e.g. of the shaft seal) of dangerous pumped fluids (e.g. explosive, toxic, hot) must be dealt with in such a way that no danger is posed to persons or to the environment. Any statutory provisions must be observed.
- Dangers resulting from electrical power must be prevented (see, for example, the directions issued by the Association of German Electrical Engineers (VDE) and the local power supply companies for details).

### 2.6 Safety directions for maintenance, inspection and installation work

The user must ensure that all maintenance, inspection and installation work is carried out by authorised and qualified staff with adequate knowledge of the machine gained by an in-depth study of the Operating Manual.

Work on the machine must always be carried out only when it is at standstill. It is imperative that the procedure described in the Operating Manual for shutting down the

machine be observed.

Pumps or pumping sets conveying media of risk to health must be decontaminated.

All safety and protective devices must be refitted or returned to operation immediately after completing the work.

Before putting into or returning to operation, the points specified in the section entitled Putting into operation must be observed.

### 2.7 Unauthorised modification and manufacture of spare parts

Modifications or alterations to the machine are permissible only after consultation with the manufacturer. Original spare parts and accessories authorised by the manufacturer promote safety. The use of other parts may void liability for the consequences.

### 2.8 Unpermissible operating methods

The safety of operation of the machine supplied is ensured only when used properly. The limit values stated in the order-related documentation must never be exceeded.

## 3. Transport and storage

### 3.1 Safety measures



Before transportation the pump must be protected against falling over, e.g.:

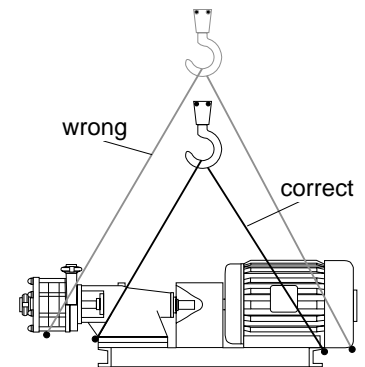
- by securing to the pallet with transport straps
- by screwing to the transport pallet.

### 3.2 Transportation

The choice of transport mode depends on the size and weight of the pump.

Pumps can be easily transported with a crane, low lift platform truck or fork lift truck, e.g.:

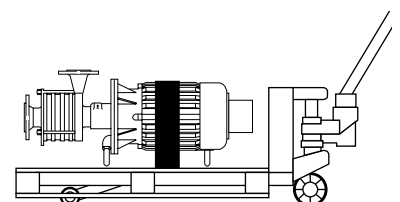
a) with a crane



#### CAUTION

The crane and strap must be of adequate capacity and strength. The lugs on the motor are not suitable for lifting or transporting the pump.

b) with a low lift platform truck or fork lift truck



### 3.3 Storing the pump

The place where the pump is stored should fulfil the following conditions:

it should be

- dry
- dust-free
- heated (approx. 20° - 25° C)
- ventilated.

**CAUTION** The pump must be cleaned before storing as there is otherwise a risk that pumping medium residue will harden, damaging the pump.

**CAUTION** The interior of the pump must be dry after cleaning and before sealing the suction and delivery connections.

### 3.4 Protection against ambient influences

With high air humidity (> 50%) it is recommended that the pump be packed with silica gel.

When covering the pump with a tarpaulin, take care to avoid the condensation of water.

When stored for extended periods (over 6 months), the seals, bearings and lubrication should be checked before putting into operation. In addition, moving parts should be rotated every 3 months.

## 4. Description of the pump and its accessories

### 4.1 General

FRISTAM type FM multistage centrifugal pumps are non-self-priming pumps for fed media.

Various types of impeller are used:

- FM 2 - half-closed impellers
- FM 3 - open impellers
- FMG 3 - closed impellers
- FMS 3 - closed impellers.

FRISTAM centrifugal pumps owe their reliability to the use of components made of solid, cast or forged stainless-steel material.

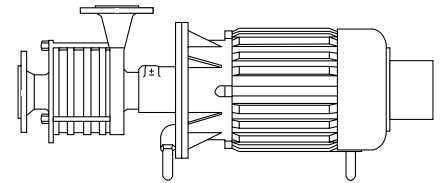
The FM pump series is designed for the following maximum pressure at the delivery end:

- FM 2 20 bar
- FM 3, FMG 3 and FMS 3 75 bar.

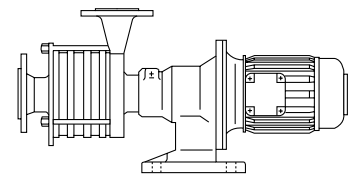
Depending on the operating conditions, Fristam type FM centrifugal pumps are equipped with single or double shaft seals.

### 4.2 Types

#### 4.2.1 FM 2

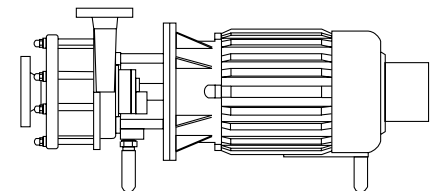


**A,B,C,D:** Special motor

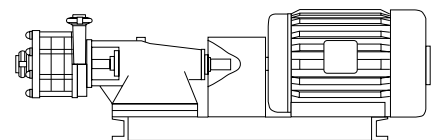


**KF:** Compact bearing bracket with base and IEC standard motor type B5

#### 4.2.2 FM 3, FMG 3 and FMS 3



**A, B, C, D:** Special motor



**L:** Bearing pedestal with coupling, coupling protector, IEC standard motor type B3, on joint base frame

Versions as standard or available with shroud and adjustable legs.

## 5. Installation and mounting

### 5.1 Information on the place of installation

Before installing the pump, it must be ensured

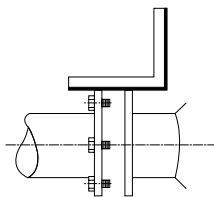
1. that the base is sufficiently dimensioned for the weight of the pump
2. that the installation surface is level
3. that there is sufficient space for maintenance work
4. that there is an adequate supply of air since the motor will not otherwise be sufficiently cooled
5. that the room characteristics conform with the legal provisions with regard to the max. permissible sound pressure
6. that the pump is suitable for the place of installation, e.g. operation of pumps in potentially explosive surroundings.

**CAUTION** If a pump is not equipped with an explosion-protected motor, it must not be operated in an explosive atmosphere.

During installation, care must be taken to ensure that the pump is not distorted by external forces.

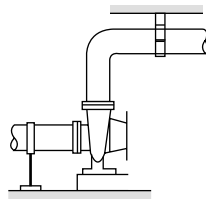
Distortion of the pump can be avoided by:

- alignment of the pump connections



Alignment with a try square

- supporting the piping in front of and behind the pump



Relieving the piping

### 5.2 Inspection before installation

The pump must be cleaned before operation. In addition, it must be ensured that no impurities are able to enter the pump through the system.

### 5.3 Electrical installation



Observe the electrical regulations. Heed the load ratings on the rating plate and do not exceed the performance data. The pump must be connected up to the power supply only by qualified staff.

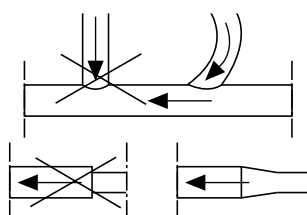
- Connect up according to the circuit diagram in the terminal box.
- Protect the terminal box and cable bushing against moisture.

### 5.4 Piping

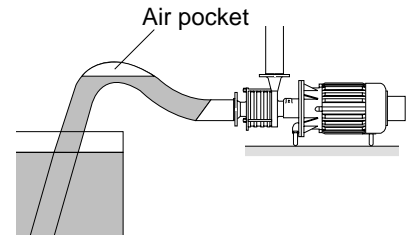
#### 5.4.1 General

To ensure trouble-free operation, the following installation directions must be observed:

- Avoid abrupt pipe transition pieces.

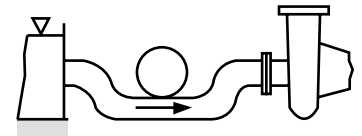


- Avoid the formation of air pockets in the piping



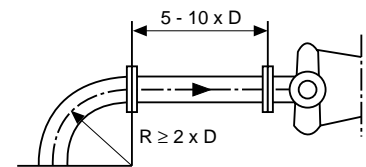
Danger due to air pockets

- Avoid deposits



#### 5.4.2 Suction pipe

- Keep as short as possible.
- Do not locate any pipe bends directly in front of the suction connection.



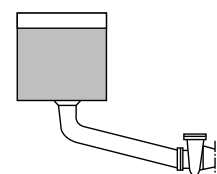
Suction-side pipe bend

- Never allow the pump to become drained when at standstill, e.g. by installing a foot valve.
- If a shutoff valve is required, it must be installed as near to the pump as possible.

**CAUTION** Do not regulate the pump with the shutoff valve.

#### 5.4.3 Supply pipe

- Dimension sufficiently so that the  $NPSH_{System} > NPSH_{Pump}$ .
- Install with constant downward slope without reverse gradients.



Optimum supply

- Keep pipe resistance low. Avoid installing valves, elbows, transition pieces etc.

#### 5.4.4 Liquid level

Before operating, fill the pump and suction pipe with the pumping medium at least up to the delivery connection.

#### 5.4.5 Delivery pipe

- Install a shutoff valve in the delivery pipe.

**CAUTION** Abruptly shutting off the delivery pipe during operation of the pump may cause hammering:

- Risk of damaging the pumping medium and the pump

#### 5.4.6 Sealing liquid pipe

- Install a throttle valve in the supply pipe.
- Fit the outlet pipe with a flow meter.

### 6. Putting into operation

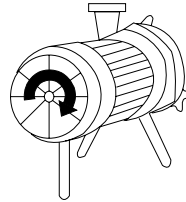
#### 6.1 General

- Clean the pump.
- Clean the pipe system.
- Fill and vent the pump and suction pipe.
- Always start up the pump with the valve closed.

**CAUTION** Check the direction of rotation:  
(see identifying marking on the pump).

1. Fill the pump with pumped fluid and start the sealing liquid system, if fitted, at the specified pressure (Tab. 1).

2. Allow the pump to run for 1 second max.
3. If the fan rotates clockwise, the motor is connected correctly.



Checking the direction of rotation

**CAUTION** Running the pump dry may damage the shaft seal. With a **double shaft seal** the flow of sealing liquid to the shaft seal must be ensured **before putting into operation**. An incorrect direction of rotation may damage unidirectional shaft seals.

**CAUTION** Shutting off the delivery pipe for extended periods will damage the pumped fluid and possibly the pumping set.

**CAUTION** The max. speed may not exceed 3600 rpm

#### 6.2 Special directions

##### 6.2.1 Double shaft seal

- Make sure the flushing pressure is correct (see Tab. 1).
- The sealing medium must be clean and have no abrasive constituents.
- The temperature of the sealing medium must not exceed 70°C.

##### 6.2.2 Bearing pedestal version

- Check the oil level.
- Fit the coupling protector.

##### 6.2.3 Controlling and monitoring devices

(If fitted.) See order-related documentation for a detailed description.

### 7. Taking out of operation

- If fitted, close the shutoff valves in the suction and delivery pipes.
- Empty the pump.
- Clean the pump.
- Dry the pump.
- Protect the pump against ambient influences (dust, moisture, heat etc.).

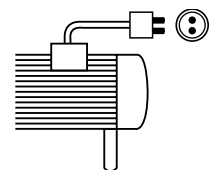
### 8. Maintenance

#### 8.1 General

It is imperative that the maintenance directions be followed since the efficiency and service life of the pump may otherwise be impaired.



The pump must be disconnected from the power supply before all maintenance work.



Disconnecting the power supply

#### 8.2 Maintenance directions

##### 8.2.1 Special motor

The pump-side motor bearing must be dismantled, cleaned and regreased every 2,000 operating hours. The fan-side motor bearing cannot be regreased (see section 8.3 Lubrication table).

If the end float of the shaft increases to 0.3 mm, the bearings must be replaced.

### 8.2.2 IEC standard motor with flange

The motor has a locating bearing on the drive side. The motor bearings cannot be regreased. If the end float of the shaft increases to 0.3 mm, the bearings must be replaced.

### 8.2.3 Motor for bearing pedestal

The motor bearings cannot be regreased. If worn, the bearings must be replaced.

### 8.2.4 KF bearing bracket

The bearings must be greased every 3,000 operating hours (see 8.3 Lubrication table). With new bearings, increased temperatures may arise during the run-in phase, which subsequently drop. If the end float of the shaft increases to 0.3 mm, the bearings must be replaced.

### 8.2.5 Bearing pedestal 3V

- Check the oil level regularly.
- Oil change (see 8.3 Lubrication table).
- Drain off the oil at operating temperature.
- Clean the drain plug and seal before resealing.

If the end float of the shaft increases to 0.3 mm, the bearings must be replaced.

### 8.2.6 Double shaft seal

Check the sealing liquid pressure in accordance with the information in Tab. 1.

Type of mech. shaft seal	max. flushing pressure P (bar)
Face to Face	P=0.2 bar
Back to Back	P=P <sub>System</sub> +0.5 bar

Tab. 1 Flushing Pressure

See order-related documentation for special versions.

### 8.3 Lubrication table

	Lubricant	Change interval	Quantity of lubricant
<b>Versions A, B, C, D with special motor</b>			
Angular contact ball bearing	GBU-Y 132 Klüber Lubrication München KG	2,000 hours	approx. 70 g
Deepgroove ball bearing	Bearing with lifetime lubrication. If necessary, replacement of the entire bearing		
<b>Compact bearing bracket</b>			
Deepgroove ball bearing Cylindrical-roller bearing	Darina Grease 2 (Deutsche Shell AG)	3,000 hours	approx. 130 g
Shaft end IEC standard motor	COPASLIP (Slip-Ölprodukte GMBH Dudenhofen)	Apply before each assembly	approx. 5 g
<b>Bearing pedestal version</b>			
3V	Essolube HDX Plus 30 (ESSO AG)	3,000 hours	approx. 3 litres
<b>IEC standard motor</b>	See motor manufacturer's lubrication instructions		

Tab. 2 Lubrication table

Another brand lubricant of equal quality and viscosity may also be used.

Lubricant							
Type	ARAL	BP	DEA/ Texaco	ELF	ESSO	Mobil	Shell
<b>Compact bearing bracket</b> Cylindrical-roller bearing	Aralub HTR 2	Energrease HTG	Paragon EP 2	GRX 500	HT Grease 275	Mobiltemp SHC 100	Darina Grease 2
<b>Bearing pedestal 3V</b>	Turboral 30 W	Energol HD-S 30	Cronos Super SAE 30	ELF Performance XR 30	Essolube HDX plus 30	Delvac 1300	Rotella MX



### 8.4 Disassembly



- Disconnect the pump from the power supply so that it is de-energised (see 8.1).
- If fitted, close the shutoff valves in the suction pipe and delivery pipe.
- Undo the suction/delivery connections and remove the pump from the system.



In the case of dangerous pumping media, legal and works safety directions must be observed.

#### 8.4.1 FM 2 pump casing and shaft seal

- Unscrew the cover and empty the pump, cleaning it if necessary.
- Undo the impeller nut.
- Pull off the impellers and stage casing from the pump shaft.
- Remove the feather key.
- Dismantle the front part of the shaft seal.
- With double shaft seal: Remove the sealing liquid pipe.
- Undo the screw of the clamped joint/pump casing.
- Carefully remove the pump casing and shim.
- See order-related documentation for further disassembly of the shaft seal.

#### 8.4.2 Pump casing and shaft seal of the FM 3, FMG 3 and FMS 3

- Unscrew the cover and empty the pump, cleaning it if necessary.
- Undo the impeller nut.
- Pull off the impellers, spacer sleeves and stage casing from the pump shaft.

- Remove the feather key.
- Dismantle the front part of the shaft seal.
- With double shaft seal: Remove the sealing liquid pipe.
- Undo the flanged joint of the pump bell housing/pump casing.
- Carefully remove the pump casing.
- See order-related documentation for further disassembly of the shaft seal.

#### 8.4.3 More extensive disassembly

##### 8.4.3.1 Versions A, B, C and D (special motor)

Undo the screwed joint of the motor flange/pump skirt and pull off the pump skirt.

##### 8.4.3.2 Version KF

- Undo the screwed joint of the motor/bearing bracket.
- Pull off the motor.

##### 8.4.3.3 Bearing pedestal version

- Remove the coupling protector.
- Dismount the coupling in accordance with the order-related documentation.
- Undo the base fastening screws on the motor and bearing pedestal.

### 8.5 Assembly

#### 8.5.1 General

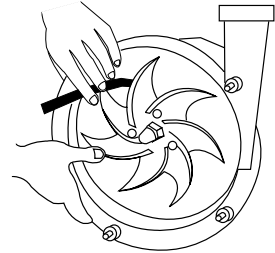
Before assembling the pump, the following must be carried out:

- the parts cleaned
- the sealing areas cleaned
- all parts checked for precision of fit and, if necessary, reworked, with the exception of the sliding surfaces of the shaft seal
- worn parts replaced

- seals generally replaced before assembly.

#### 8.5.1.1 Setting the clearances

The clearance size of the pump must be reset in accordance with Tab. 3.



**CAUTION** Even in the worst instance, the clearance size must be no less than **0.3 mm**.

Pump type	Axial clearance between rear impeller/pump casing
FM 2	0.9 to 1.1 mm
FM 3	0.9 to 1.1 mm
FMG 3	1.4 to 1.6 mm
FMS 3	1.9 to 2.1 mm

Tab. 3 Gap sizes

#### 8.5.1.2 Screw tightening torque

The tightening torque in the tables below must be complied with.

	M 6	M 8	M 10	M 12	M 16
Nm	10	25	49	85	210

Tab. 4 Class 8.8 steel screws

	M 6	M 8	M 10	M 12	M 16
Nm	7,3	17,5	35	60	144

Tab. 5 Stainless-steel screws A2-70 and A4-70

## 8.5.2 FM 2

### 8.5.2.1 Preparing the FM 2 - setting the gap -

The gap size between the impeller and casing must be checked before assembly and, if necessary, reset.

- Push the pump casing with shim into the clamped joint.
- Push the front shaft seal set (see order-related documentation) onto the pump shaft.
- Insert the feather key and push all impellers onto the pump shaft and tighten the impeller nut.
- Measure the gap size and compare with the table:
  - pull the pump casing towards the impeller nut
  - measure the gap between the pump casing and clamping element
- Change the gap size:
  - too small: replace the shim
  - too large: adapt the shim by reduction.

The other impellers need not be set.

### 8.5.2.2 Assembling the FM 2

After checking the gap size, actual assembly is carried out. For this the pump must again be dismounted. In assembly a distinction is made between:

- versions A,B,C,D and KF as well as
  - single and double shaft seals (see order-related documentation).
1. Fit the pump bell housing to the special motor.
  2. Assembling the shaft seal step I:
    - 2.1 With single shaft seal:
      - fit the mating ring with seal ring into the pump casing.
    - 2.2 With double shaft seal:
      - fix the shaft sleeve with seal ring in position on the pump shaft

- press the radial seal ring into the pump casing (drive side)
  - fit the mating ring with seal ring into the pump casing (product side).
3. Push the pump casing with shim into the clamped joint and tighten the clamping screw (M 10) with 36 Nm.
  4. Assembling the shaft seal step II:
    - push the front movable shaft seal set onto the pump shaft.
  5. Insert the feather key.
  6. Fit the impellers and stage casing according to the numbered sequence.
  7. Push the split retaining ring onto the pump shaft and tighten the impeller nut with 100 Nm.
  8. Place the cover with seal onto the casing and screw down.
  9. With version KF only: Motor installation
    - Insert the plastic feather key supplied into the motor shaft extension.
    - Coat the motor shaft extension and feather key with a lubricating paste containing copper (see 8.3 Lubrication table).
    - Screw together the motor and compact bearing bracket.

## 8.5.3 FM 3, FMG 3 and FMS 3

### 8.5.3.1 Preparing the FM 3, FMG 3 and FMS 3 - setting the gap -

- Screw the casing without shaft seal to the pump bell housing or to the bearing pedestal.
- Push the fixed bushing and shaft sleeve of the shaft seal (see order-related documentation) onto the pump shaft.
- Push all impellers with spacer sleeves onto the pump shaft and tighten the impeller nut.

- Measure the gap size and compare with the table:
  - a. FM3:
    - measure the impeller/pump casing gap with a feeler gauge.
  - b. FMS 3 and FMG 3:
    - loosen the screwed joint between the pump casing and pump skirt or bearing pedestal a little
    - pull the pump casing towards the impeller nut
    - measure the gap in the flanged joint between the pump casing and pump bell housing.
- Change the gap size
  - too small: replace the fixed bushing
  - too large: adapt the fixed bushing by reduction.

The other impellers need not generally be set. Should one of the front impellers rub, the fixed bushing must be replaced or its height correspondingly adapted by reduction.

### 8.5.3.2 Replacing the wear ring pressed into the stage casing

Replacement is necessary only if worn or damaged.

- Carefully press the wear ring out of the stage casing.

#### CAUTION

Do not knock the wear ring out with a hammer.

- Degrease the recess of the stage casing.
- Degrease the wear ring.
- Coat the wear ring and recess of the stage casing with Loctite adhesive type 648.
- Press the wear ring into the stage casing so that the large chamfer points outwards.

### 8.5.3.3 Assembling the FM 3, FMG 3 and FMS 3

After checking the gap size, actual assembly is carried out. For this the pump must again be dismantled. In assembly a distinction is made between:

- versions A,B,C,D and the bearing pedestal version as well as
- single and double shaft seals (see order-related documentation).

#### 1. Assembling the shaft seal step I:

##### 1.1 With single shaft seal:

- fit the mating ring with seal ring in the seal cover
- screw the seal cover with new gasket to the pump casing. Tightening torque of the screws is 36 Nm.

##### 1.2 With double shaft seal:

- fix the shaft sleeve with seal ring in position on the pump shaft
- press the radial seal ring into the rear seal cover (drive side)
- fit the mating ring with seal ring in the front seal cover (product side)
- screw both seal covers with new gaskets to the pump casing. Tightening torque of the screws is 36 Nm.

#### 2. Screw together the pump casing and flanged joint.

#### 3. Assembling the shaft seal step II:

- push the front movable shaft seal set with shaft sleeve and fixed bushing onto the pump shaft.

#### 4. Insert the feather key into the shaft extension.

#### 5. Fit the impellers, bushes and stage casing with seal according to the numbered sequence.

#### 6. Place the cover with seal onto the casing and screw down.

#### 7. Push the split retaining ring onto the pump shaft and tighten the impeller nut with 100 Nm.

- #### 8. With bearing pedestal version only:
- screw the bearing pedestal to the base frame
  - insert and align the coupling between the bearing pedestal and motor (as per order-related documentation)
  - screw the motor to the base frame
  - attach the coupling protector
  - check the oil level and, if necessary, top up.

#### CAUTION

Each time the impeller is assembled a check must be made to ensure that it does not touch at any point.

## 9. Spare parts

Only use original Fristam spare parts. The use of other manufacturers parts renders the warranty void.

In order to ensure the prompt supply of spare parts, we require the following information:

1. Pump type and pump no.
2. Components list no.
3. Part no. of the spare part concerned
4. Material required
5. Number of the respective spare part

10. Faults	Causes	Remedy
<b>Delivery head too small</b>	a. Motor rotating in wrong direction	Motor connected to the terminals incorrectly. Compare connection with the circuit diagram and correct
	b. Motor speed too low (incorrect voltage)	Compare voltage applied with the rating plate
	c. Impeller diameter too small	Replace impeller after consulting the Fristam Application Advice Service
<b>Flow rate too low</b>	a. Motor rotating in wrong direction	Motor connected to the terminals incorrectly. Compare connection with the circuit diagram and correct.
	b. Resistance too great in suction pipe and/or delivery pipe	Increase pipe diameter and/or reduce number of pipe bends and valves
	c. Pumped fluid too viscous	Call Fristam Application Advice Service
<b>Power consumption of the drive motor is too high</b>	a. Pumped fluid too viscous	Call Fristam Application Advice Service
	b. Impeller not set correctly	Check the impeller clearance and reset
	c. Resistance in the delivery pipe too low (flow rate too high)	Regulate speed, e.g. with a frequency converter, or install a control valve in the delivery pipe
	d. Impeller diameter too large	Reduce the Impeller after consulting Fristam Application Advice Service
<b>Excessive noise</b>	a. Resistance in the suction pipe is too high	Increase the diameter of the suction pipe and/or reduce the length of the suction pipe
	b. Liquid level in the suction pipe is too low	Increase NPSH <sub>level</sub>
	c. Impeller hits against casing	Check the impeller clearance and reset
	d. Bearing damage	Replace bearing

If you are not able to pinpoint and eliminate a fault by referring to the table above, the Fristam Application Advice Service is available to help you at any time. We require the following information:

1. Operating conditions
2. Precise description of the fault
3. Pump type and serial number
4. If possible, drawing of pump installation