



English

Original Instructions

# Installation, Operation and Maintenance Instructions

## E Range

Sizes OX2 and below

# Spares & Service Contact Details

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# Special Tools

<u>Pump Size</u>	<u>Tool Set</u>	<u>Extractor Bolt (Shaft)</u>	<u>Extractor Screw (Rotor Adaptor)</u>	<u>Extractor Tool</u>
E0X2	21101	MS E041 9700	N/A	MS E041 9710
E034				

*Other models require no special tools*

# ATEX Warning Statements

## PUMPS AND PUMP UNITS

Where a pump or pump unit is to be installed in a potentially explosive atmosphere ensure that this has been specified at the time of purchase and that the equipment has been supplied accordingly and displays an ATEX nameplate or is supplied with a certificate of conformity. If there is any doubt as to the suitability of the equipment please contact Mono Pumps Limited before commencing with installation and commissioning.

Process liquids or fluids should be kept within specified temperature limits otherwise the surface of pump or system components may become an ignition source due to temperature rises. Where the process liquid temperature is less than 90°C the maximum surface temperature will not exceed 90°C provided the pump is installed, operated and maintained in accordance with this manual. Where the process fluid temperature exceeds 90°C the maximum surface temperature will be equal to the maximum process fluid temperature.

Cavities that could allow the accumulation of explosive gases, such as under guards, should where possible, be designed out of the system. Where this is not possible they should be fully purged before any work is carried out on the pump or system.

Electrical installation and maintenance work should only be carried out by suitably qualified and competent persons and must be in accordance with relevant electrical regulations.

All electrical equipment, including control and safety devices, should be suitably rated for the environment in to which they are installed.

Where there may be a risk of an accumulation of explosive gases or dust non-sparking tools should be used for installation and maintenance.

In addition to causing permanent damage to the stator, dry running of the pump could generate a rapid rise in the temperature of the stator tube or barrel, which could become an ignition source. It is therefore essential that a dry run protection device be fitted. This must shut the pump down immediately should a dry run situation occur. Details of suitable devices are available from Mono Pumps Limited.

To minimise the risk of sparking or temperature rises due to mechanical or electrical overload the following control and safety devices should be fitted in addition to a dry run protection system. A pressure relief system whereby the pump can not generate pressures in excess of the maximum rated pressure or an over pressure device which should shut the pump down when the maximum discharge pressure is exceeded. A control system that will shut the pump down if the motor current or temperature exceed specified limits. An isolator switch that will disconnect all electrical supply to the motor and ancillary electrical equipment and be capable of being locked in the off position. All control and safety devices should be fitted, operated and maintained in accordance with the manufacturer's instructions. All valves on the system should be open when the pump is started otherwise serious mechanical overload and failure may result.

It is important that the pump rotates in the direction indicated on the nameplate. This must be checked on installation and commissioning and after any maintenance has been carried out. Failure to observe this may lead to dry running or mechanical or electrical overload.

# ATEX Warning Statements

When fitting drives, couplings, belts, pulleys and guards to a pump or pump unit it is essential that these are correctly fitted, aligned and adjusted in accordance with the manufacturer's instructions. Failure to do so may result in sparking due to unintended mechanical contact or temperature rises due to mechanical or electrical overload or slipping of drive belts. Regular inspection of these parts must be carried out to ensure they are in good condition and replacement of any suspect part must be carried out immediately.

Mechanical seals should be suitably rated for the environment. The seal and any associated equipment, such as a flushing system, must be installed, operated and maintained in accordance with the manufacturer's instructions.

Where a packed gland seal is fitted this must be correctly fitted and adjusted. This type of seal relies on the process liquid to cool the shaft and packing rings so a constant drip of liquid from the gland section is required. Where this is undesirable an alternative seal type should be fitted.

Failure to operate or maintain the pump and ancillary equipment in line with the manufacturer's instructions may lead to premature and potentially dangerous failure of components. Regular inspection, and where necessary replacement, of bearings and lubrication is essential.

The pump and its components have been designed to ensure safe operation within the guidelines covered by legislation. Accordingly Mono Pumps Limited have declared the machine safe to use for the duty specified as defined by the Declaration of Incorporation or Conformity that is issued with this instruction manual.

The use of replacement parts that are not manufactured by or approved by Mono Pumps Limited may affect the safe operation of the pump and it may therefore become a safety hazard to both operators and other equipment. In these circumstances the Declaration provided will become invalid. The guarantee referenced on the Terms and Conditions of Sale will also be invalidated.

# Index

<b>SECTION 1</b>	<b>INSTALLATION</b>
	<b>START-UP PROCEDURE</b>
	<b>ASSEMBLY AND DISMANTLING ADVICE</b>
<b>SECTION 2</b>	<b>FAULT FINDING</b>
<b>SECTION 3</b>	<b>DRAWING REFERENCE NUMBERS</b>
	<b>PUMP CODING SHEET</b>
<b>SECTION 4</b>	<b>DISMANTLING AND ASSEMBLY DIAGRAMS</b>
	<b>EXPLODED VIEWS</b>
<b>SECTION 5</b>	<b>TORQUE TIGHTENING FIGURES</b>

## EC Declaration as defined by Machinery Directive 2006/42/EC.

The following harmonised standards are applicable: BS EN 809, BS EN ISO 12100 Parts 1 & 2

### EC Declaration of Incorporation

This declaration is only valid when partly completed machinery has been supplied.

In this case, the machinery meets the requirements of the said directive and is intended for incorporation into other machinery or for assembly with other machinery in order to constitute relevant machinery as defined by the said directive including any amendments, which are valid at the time of supply.

#### **IMPORTANT**

This machinery must not be put into service until the relevant machinery into which it is to be incorporated has been declared in conformity to the said directive.

This declaration is only valid when the machinery has been installed, operated and maintained in accordance with these instructions and safety guidelines contained within as well as instructions supplied for equipment assembled with or intended for use with this equipment.

### EC Declaration of Conformity

This declaration is not valid for partly completed machinery has been supplied.

In this case the machinery meets the requirements of the said directive including any amendments which are valid at the time of supply.

We further declare that, where applicable, said machinery also meets the requirements of:

The EMC Directive 2004/108/EC  
The Low Voltage Directive 2006 /95/E  
The Pressure Equipment Directive 97/23/EC  
The Outdoor Noise Directive 2005/88/EC  
The Drinking Water Directive 99/83/EC

#### **IMPORTANT**

This declaration is only valid when the machinery has been installed, operated and maintained in accordance with these instructions and safety guidelines contained within as well as instructions supplied for equipment assembled with or intended for use with this equipment.



**Mr C. Q. Griffiths - Engineering Services Manager.**  
**for Mono Pumps Limited, Martin Street, Audenshaw,**  
**Manchester England, M34 5JA**

# Installation, Operation & Maintenance Instructions

## INSTALLATION

### 1.1 INSTALLATION AND SAFETY RECOMMENDATIONS

In common with other items of process plant a pump must be installed correctly to ensure satisfactory and safe operation. The pump must also be maintained to a suitable standard. Following these recommendations will ensure that the safety of personnel and satisfactory operation of the pump is achieved.

#### 1.2.1. GENERAL

When handling harmful or objectionable materials, adequate ventilation must be provided in order to disperse dangerous concentrations of vapours. It is recommended that wherever possible, Mono pumps should be installed with provision for adequate lighting, thus ensuring that effective maintenance can be carried out in satisfactory conditions. With certain product materials, a hosing down facility with adequate draining will simplify maintenance and prolong the life of pump components.

Pumps operating on high temperature duties should be allowed to cool sufficiently before any maintenance is carried out.

#### 1.2.2. SYSTEM DESIGN & INSTALLATION

At the system design stage, consideration must be given to provision of filler plugs, and the installation of non-return and/or isolating valves. Pumps cannot be reliably used as non-return valves. Pumps in parallel and those with high static discharge head must be fitted with non-return valves.

The pumps must also be protected by suitable devices against over pressure and dry running.

##### i. HORIZONTAL MOUNTING

All ranges excluding P Range Mono pumps are normally installed in a horizontal position with baseplates mounted on a flat surface, grouted in and bolted, thus ensuring firm fixing and a reduction in noise and vibration.

The unit should be checked after bolting down to ensure that the alignment of the pump to its prime mover is correct.

##### ii. VERTICAL MOUNTING

P Range Pumps Only

The P range pumps are intended for vertical installation. Care must be taken when lifting the pump into the vertical position.

Normally 'P' range pumps will be designed with a sole plate that will be bolted to the customers framework.

If the pump is to be mounted in any way other than described above, confirmation of the installation must be agreed with Mono Pumps Limited. All the pipework should be independently supported.

#### 1.3.1 HANDLING



During installation and maintenance, attention must be paid to the safe handling of all items. Where a pump or its components weigh in excess of 20 kg (45lb) it is recommended that suitable lifting tackle should be used to ensure that personal injury or damage to components does not occur.

For safe handling of both bareshaft pumps and pump units (pump/ gearbox/motor etc.) slings should be used. The position of the slings will depend upon the specific pump/unit construction and should be carried out by personnel with the relevant experience to ensure that the pump is not damaged and injury to personnel does not occur.

If eyebolts do exist then these should only be used for lifting the individual components for which they are supplied.

#### 1.3.2 STORAGE AND INFREQUENT OPERATION

The situation where a pump is used infrequently is also covered by the instructions in this section.

##### SHORT TERM STORAGE

**Where a pump has to be stored for 6 months or less then the following steps are advised:-**

1. Store pump inside wherever possible or if this is not feasible then provide protective covering. Do not allow moisture to collect around the pump.
2. Remove the drain plug, if fitted. Any inspection plates fitted should also be removed to ensure that the suction housing can drain and dry completely.
3. Loosen the packed gland and inject sufficient grease into the stuffing box. Tighten the gland nut hand tight. If a water flush system is to be used do not grease, a small amount of light oil is recommended for these.
4. See Manufacturers Instructions for motor/gearbox/drive instructions for storage procedures.

# Installation, Operation & Maintenance Instructions

## LONG TERM STORAGE

**If the pump is to be kept in storage for more than six months then in addition to the above the following procedures should be carried out regularly (every 2 - 3 weeks if possible):**

1. If practicable rotate the pump at least three quarters of one revolution to avoid the rotor setting in the stator.
2. Note, however, that the pump is not to be rotated for more than two revolutions each time because damage could be caused to the rotor/ stator elements.

## IMMEDIATELY PRIOR TO INSTALLATION AND STARTING



**Before installing the pump please ensure that all plugs and inspection plates are replaced and that excess grease/oil is removed from the stuffing box.**

### 1.4 ELECTRICAL



Electrical connection should only be made using equipment suitable for both rating and environment. Where any doubts exist regarding the suitability of equipment, Mono Pumps Limited, should be consulted before proceeding. Normally the Mono pump should be installed with starting equipment arranged to give direct on line starting.

Earthing points will be provided on electric drives (if supplied) and it is essential that these are correctly connected. When the motor is being wired and checked for rotation, the start/stop sequence must be instantaneous to prevent dry running (see 2) or pressurising upstream equipment. (Check direction arrow on pump nameplate). The electrical installation should include appropriate isolating equipment to ensure that the pump unit is safe to work on.

### 1.5 PRESSURE RELIEF VALVES AND NON-RETURN VALVES

1. It is recommended that a suitable safety device is installed on the discharge side of the pump to prevent over-pressurisation of the system.
2. It is also recommended that a non-return valve is installed on the discharge side of the pump to prevent reverse flow through the system.

When both are installed it is advised that the relief valve is positioned closer to the pump than the non-return valve.

## IMPORTANT



**The pump must never run against a closed inlet or outlet valve, as this could result in mechanical failure.**

### 1.6 GENERAL SAFETY



**GREAT CARE MUST BE TAKEN TO PROTECT ALL ELECTRICAL EQUIPMENT FROM SPLASHING WHEN HOSING DOWN. WHERE MONO PUMPS LIMITED HAVE SUPPLIED A BARESHAFT PUMP THE ONUS IS ON THE USER TO FIT ADEQUATE GUARDS IN COMPLIANCE WITH THE REQUIREMENTS OF THE RELEVANT REGULATIONS.**

All nuts and bolts, securing flanges and base mounting fixtures must be checked for tightness before operation. To eliminate vibration, the pump must be correctly aligned with the drive unit, and all guards must be securely fixed in position. When commissioning the plant, all joints in the system must be checked thoroughly for leakage.

If, when starting, the pump does not appear to operate correctly (see 2), the plant must be shut down immediately and the cause of the malfunction established before operations are recommenced. It is recommended that depending upon plant system operation, either a combined vacuum and pressure gauge, or a vacuum gauge only be fitted to the pump inlet port, and a pressure gauge fitted to the outlet port, these will then continuously monitor the pump operating conditions. May contain substances from the ECHA SVHC Candidates List (REACH - Regulation (EC) No. 1907/2006)

### 1.7 DUTY CONDITIONS

Pumps should only be installed on duties for which Mono Pumps Limited have specified the materials of construction, flow rates, pressure, temperature, speed etc. Where dangerous materials are to be pumped, consideration must be given to the safe discharge from relief valves, gland drains etc.

**IF THE DUTY SHOULD BE CHANGED, MONO PUMPS LIMITED SHOULD BE CONTACTED AND THEIR RECOMMENDATIONS SOUGHT IN THE INTEREST OF APPLICATION, SAFETY OF PLANT, EFFICIENCY AND PUMP LIFE.**



# Installation, Operation & Maintenance Instructions

## 2. START-UP PROCEDURE

Pumps must be filled with liquid before starting. The initial filling is not for priming purposes, but to provide the necessary lubrication of the stator until the pump primes itself. When the pump is stopped, sufficient liquid will normally be trapped in the rotor/stator assembly to provide lubrication upon re-starting.

If, however, the pump has been left standing for an appreciable time, moved to a new location, or has been dismantled and re-assembled, it must be refilled with liquid and given a few turns before starting. The pump is normally somewhat stiff to turn by hand owing to the close rotor/stator fit. However, this stiffness disappears when the pump is running normally against pressure.

### 2.1 DRY RUNNING



**NEVER RUN THE PUMP IN A DRY CONDITION EVEN FOR A FEW REVOLUTIONS OR THE STATOR WILL BE DAMAGED IMMEDIATELY. CONTINUAL DRY RUNNING COULD PRODUCE SOME HARMFUL OR DAMAGING EFFECTS.**

### 2.2 PUMP ROTATION DETAILS

<u>PUMP RANGE</u>	<u>BI-DIRECTIONAL</u>	<u>COMMENT</u>
E	Yes	†
Monobloc B	Yes	†
Merlin Industrial	Yes	†
S, SL	Yes	†
LF	Yes	†
W	No	**
Merlin Widethroat	No	**
MM ML	No	*
MS	No	**
G	No	*
CB/SB	No	*
Placer	No	**
Grout Injection	No	**
P	No	*
CP0011	No	**
CP0025,CP0800,CP1600	No	*

- \* Clockwise when viewed from drive end.  
\*\* Anti-clockwise when viewed from drive end.  
† Anti-clockwise gives inlet at drive end.

### DIRECTIONS OF ROTATION



**BEFORE THE DIRECTION OF ROTATION IS CHANGED, MONO PUMPS LIMITED MUST BE CONSULTED SO THAT THE SUITABILITY OF THE PUMP CAN BE CONFIRMED WHEN OPERATING ON THE NEW DUTY.**

### 2.3.1. GLAND PACKING

Where a pump is supplied fitted with gland packing (manufactured from a non-asbestos material), the gland will require adjustment during the initial running in period. Newly packed glands must be allowed to run-in with only finger tight compression on the gland follower nuts. This should continue for about 3 days. The gland follower should be gradually tightened over the next week to achieve a leakage rate as shown in the table below. Gland followers should be adjusted at regular intervals to maintain the recommended leakage flow rate. Under normal working conditions a slight drip from the gland under pressure assists in cooling and lubricating the packing. **A correctly adjusted gland will always have small leakage of fluid.**

#### Typical Leakage Rates from Packed Glands

<u>Up to 50mm shaft diameter</u>	<u>2 drops per minute</u>
<u>50 ... 75mm shaft diameter</u>	<u>3 drops per minute</u>
<u>75 ... 100mm shaft diameter</u>	<u>4 drops per minute</u>
<u>100 ... 125mm shaft diameter</u>	<u>5 drops per minute</u>
<u>125 ... 160mm shaft diameter</u>	<u>6 drops per minute</u>

A gland drip is, however, undesirable when handling corrosive, degreasing, or abrasive materials. Under these conditions the gland must be tightened the minimum amount whilst the pump is running to ensure satisfactory sealing when under pressure, or to stop entry of air when under suction conditions.

The gland leakage of toxic, corrosive or hazardous liquids can cause problems of compatibility with the pumps materials of construction.

Provision of a gland drain should be considered, especially for the leakage of hazardous products.



**CARE IS REQUIRED WHEN ADJUSTING THE GLAND WHILST PUMP IS RUNNING.**

### 2.3.2 MECHANICAL SEALS - ALL PUMPS

When a mechanical seal is fitted to the pump it may be necessary to provide a barrier fluid to some part of the seal. This should be provided in line with the seal manufacturers instructions.

### 2.4. GUARDS



In the interests of safety, and in accordance with the U.K. Health and Safety at Work Act 1974, all guards must be replaced after necessary adjustments have been made to the pump.

# Installation, Operation & Maintenance Instructions

## 2.5 WARNING/CONTROL DEVICE

Prior to operating the pump, if any warning or control devices are fitted these must be set in accordance with their specific instructions.

## 2.6 PUMP OPERATING TEMPERATURE

The range of temperatures the pump surfaces will develop is dependent upon factors such as product temperature and ambient temperature of the installation. There may be instances where the external pump surface can exceed 50°C.

In these instances, personnel must be made aware of this and suitable warnings/guarding used.

## 2.7 NOISE LEVELS

1. The sound pressure level should not exceed 85dB at one metre distance from the pump.
2. This is based on a typical installation and does not necessarily include noise from other sources or any contribution from building reverberation or installation pipework
3. It is recommended the actual pump unit noise levels are ascertained once the unit is installed and running at duty conditions

## 2.8 LUBRICATION

Pumps fitted with bearings should be inspected periodically to see if grease replenishment is necessary, and if so, grease should be added until the chambers at the ends of the bearing spacer are approximately one third full.

Periodic bearing inspection is necessary to maintain optimum bearing performance. The most expedient time to inspect is during periods of regular scheduled equipment downtime - for routine maintenance or for any other reason.

Under tropical or other arduous conditions, however, a more frequent examination may be necessary. It is therefore advisable to establish a correct maintenance schedule or periodic inspection.

BP LC2 / Mobilgrease XHP 222 or their equivalent must be used for replenishment.

## 2.9 PUMP UNITS

Where a pump unit is dismantled and re-assembled, consideration must be given to ensure that where appropriate the following steps are covered.

1. Correct alignment of pump/gearbox
2. Use of appropriate couplings & bushes
3. Use of appropriate belts & pulleys correctly tensioned.

## 2.10 CLEANING PRIOR TO OPERATION

### i. Non Food Use

During the commissioning of a new pump or recommissioning of an overhauled pump, it is advisable to clean the pump prior to the initial operation of the pump in the process.

### ii. Food Use

When a pump has been supplied for a food application, it is important to ensure that the pump is clean prior to initial operation of the pump.

Therefore, it is important that a clean-in-place treatment is executed on the pump at the following times:-

1. When the pump is first commissioned for use.
2. When any spare components are fitted into the wetted area of the pump.

A recommended CIP procedure is as follows:

**This procedure should not be used on the CP Pump Range. Please consult our application engineers for a suitable procedure.**

### Caustic Wash

LQ94 ex Lever Diversey or equivalent  
2% concentration

### Acid Wash

P3 Horolith 617 ex Henkel  
Ecolab or equivalent 1% concentration

### Procedure

1. Caustic wash @ 75°C for 20 mins
2. Water rinse @ 80°C for 20 mins

# Installation, Operation & Maintenance Instructions

3. Acid wash @ 50°C for 20 mins
4. Water rinse @ 80°C for 20 mins

- CIP flow rates (hence pump speeds) should be maximised to achieve highest level of cleanability.

A C.I.P. liquid velocity of 1.5 to 2.0 m/s is required for removal of solids and soiling.

Pumps fitted with CIP by pass ports will permit higher flow rates without the need to increase pump speed.

- The use of neat active caustic and acid chemicals is not recommended. Proprietary cleaning agents should be used in line with manufacturers instructions.
- All seals and gaskets should be replaced with new if disturbed during maintenance.
- Pump internals should be regularly inspected to ensure hygienic integrity is maintained, especially with respect to elastomeric components and seals, and replaced if necessary.

The four stages constitute one cycle and we recommend that this cycle is used to clean the pump before use on food.

Once the pump has been commissioned, the cleaning process will depend upon the application. The user must therefore ensure that their cleaning procedures are suitable for the duty for which the pump has been purchased.

## 2.11 WIDETHROAT PUMPS

Specific pumps may have auger feed screws, with or without a bridge breaker system to feed the pumping element. If the pump installation requires that these cannot be enclosed, care must be taken to ensure personnel cannot gain access whilst the pump is operating. If this is not possible an emergency stop device must be fitted nearby.

## 2.12 EXPLOSIVE PRODUCTS/ HAZARDOUS ATMOSPHERES

In certain instances the product being pumped may well be of a hazardous nature.

In these installations consideration must be given to provide suitable protection and appropriate warnings to safeguard personnel and plant.

## 2.13 ACCESS PORTS



Where access ports are fitted then the following steps must be followed prior to removal:

1. Pump must be shut down and the electrical supply isolated.
2. Protective clothing should be worn, especially if the pumped product is obnoxious.
3. Remove access plate with care utilising where possible drip trays to collect product leakage.

Access ports are included to assist in removing blockages and to allow a visual check on the components within the suction chamber.

It is not to be considered as an additional method in dismantling the pump.

Re-assembly of the plate should be completed using new gaskets prior to the pump being switched on.

## 2.14 ADJUSTABLE STATORS

If adjustable stators are fitted then the following steps must be followed for adjusting the clamping devices.

The adjustable stator assembly is designed to give an even compression around the stator circumference. It is designed to be used when pump performance reduces through wear to an unacceptable level, to restore the required flow rate.

The stator compression is increased using the following steps:-

1. Release the six locking screws half a turn.
2. Tighten the eight clamp screws until adjustment allowed by releasing the lock screws has been taken up.
3. Repeat steps 1 and 2 until the pump performance has been restored to its former level.

## NOTE

It is imperative that when adjusting the stator that only sufficient pressure is placed on the stator to enable the capacity of the pump to be reinstated.

Over tightening of the stator could easily result in damage to the driver by overload and so extreme care must be taken when carrying out these adjustments.

# Installation, Operation & Maintenance Instructions

It is therefore advisable to make the adjustment while the pump is running and power readings can be monitored.

## REMOVAL OF ADJUSTABLE STATOR

The procedure for removal of an adjustable stator is the same as that of a standard one, except it is necessary to remove the clamp plates before the stator can be twisted off the rotor.

This can be done by undoing the clamp screws; then releasing the clamp plate by using the locking screws as jacking screws to remove the clamp plates.

Re-assembly will be done using the reverse procedure.

## 2.15 MAINTENANCE OF WEARING COMPONENTS

### 2.15.1 ROTOR AND STATOR

The wear rate on these components is dependent on many factors, such as product abrasivity, speed, pressure etc.

When pump performance has reduced to an unacceptable level one or possibly both items will need replacing.

### 2.15.2 DRIVE SHAFT - PACKED GLAND

The wear rate of the gland area is dependent on many factors such as product abrasivity and speed. Regular gland maintenance will maximise the life of the shaft. Replacement of both the gland packing and shaft will be necessary when shaft sealing becomes difficult to achieve.

### 2.15.3 COUPLING ROD JOINTS

Regular maintenance and lubrication will maximise life of the joints.

Replacement of one or both joint assemblies and possibly the coupling rod may be necessary when wear is apparent.

It is essential to replace all the joint items with genuine Mono parts to ensure maximum life.

## 2.15.4 FLEXISHAFT DRIVE PUMPS

With this design there are no wearing items to replace in the drive train, however, if during routine inspection the shaft is visibly damaged / distorted or the protective coating is damaged, then this item should be replaced to avoid unexpected breakdowns.

## 2.16 MECHANICAL SPEED VARIATORS

Refer to the manufacturers instructions.

These machines require regular maintenance, which typically includes weekly adjustment through the full speed range.

## 3.0 ASSEMBLY AND DISMANTLING

Section 4 contains the steps to dismantle and re-assemble the pump. All fastenings must be tightened securely and when identified the appropriate torque figures should be used.

## 3.1 USE OF ITEMS NOT APPROVED OR MANUFACTURED BY MONO PUMPS LIMITED

The pump and its components have been designed to ensure that the pump will operate safely within the guidelines covered by the legislation.

As a consequence Mono Pumps Limited have declared the machine safe to use for the duty specified as defined by the Declaration of Incorporation or Conformity that is issued with this Instruction Manual.

The use of replacement items that are not approved by or manufactured by Mono Pumps Limited may affect the safe operation of the pump and it may therefore become a safety hazard to both operators and other equipment. In these instances the Declaration provided will therefore become invalid. The guarantee referenced in the Terms and Conditions of Sale will also be invalidated if replacement items are used that are not approved or manufactured by Mono Pumps Limited.

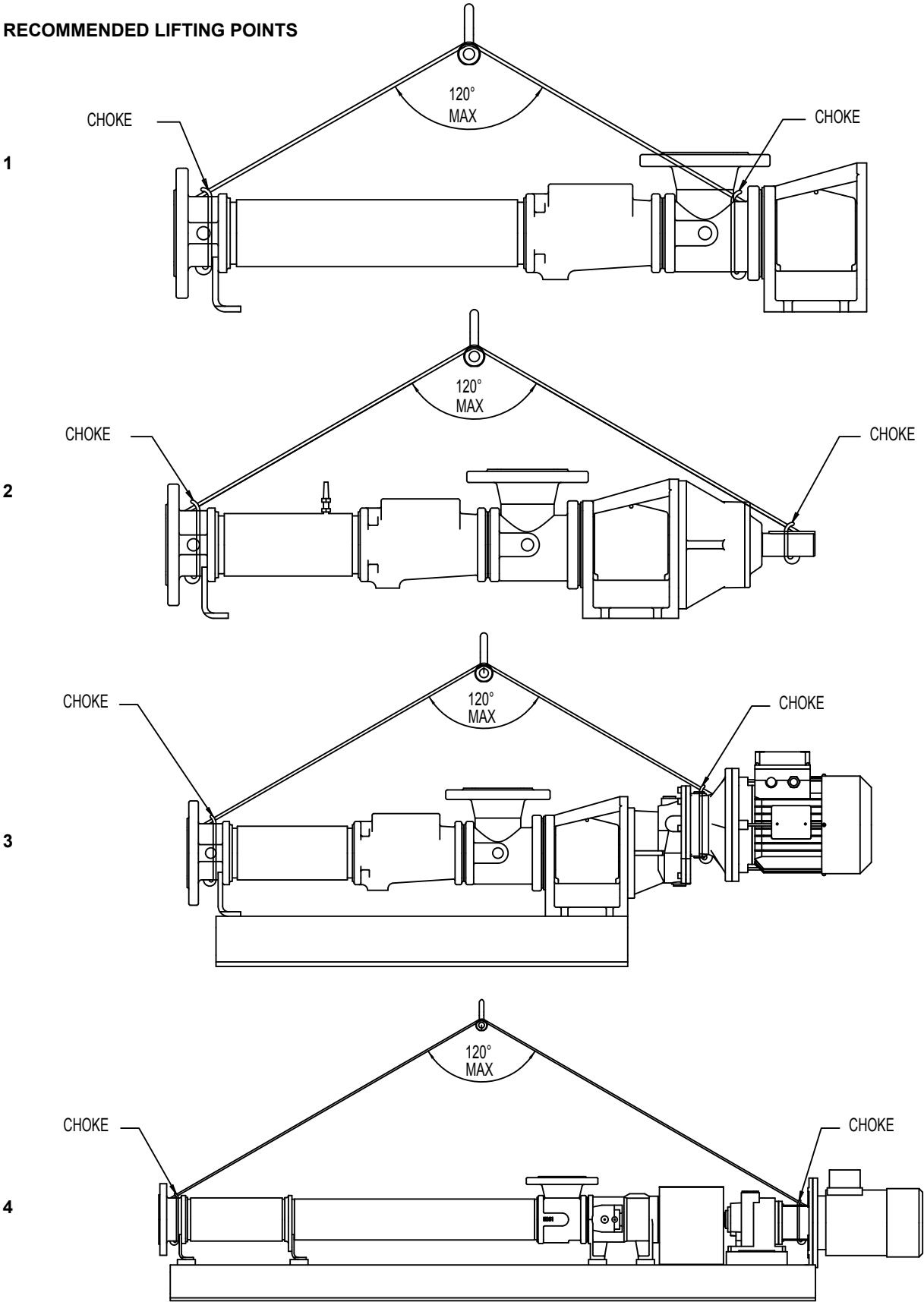


## DISPOSAL OF WORN COMPONENTS

*When replacing wearing parts, please ensure disposal of used parts is carried out in compliance with local environmental legislation. Particular care should be taken when disposing of lubricants.*

# Installation, Operation & Maintenance Instructions

## 3.2 RECOMMENDED LIFTING POINTS



# Diagnostic Chart

SYMPTOMS		POSSIBLE CAUSES	
1.	NO DISCHARGE	1.	2. 3. 7. 26. 28. 29.
2.	LOSS OF CAPACITY	3.	4. 5. 6. 7. 8. 9. 10. 22. 13. 16. 17. 21. 22. 23. 29
3.	IRREGULAR DISCHARGE	3.	4. 5. 6. 7. 8. 13. 15. 29.
4.	PRIMING LOST AFTER START	3.	4. 5. 6. 7. 8. 13. 15
5.	PUMP STALLS AT START UP	8.	11. 24.
6.	PUMP OVERHEATS	8.	9. 11. 12. 18. 20
7.	MOTOR OVERHEATS	8.	11. 12. 15. 18. 20.
8.	EXCESSIVE POWER ABSORBED BY PUMP	8.	11. 12. 15. 18. 20
9.	NOISE AND VIBRATION	3.	4. 5. 6. 7. 8. 9. 11. 13. 15. 18. 19. 20. 22. 23. 27. 31
10.	PUMP ELEMENT WEAR	9.	11.
11.	EXCESSIVE GLAND OR SEAL WEAR	12.	14. 25. 30.
12.	GLAND LEAKAGE	13.	14.
13.	SEIZURE	9.	11. 12. 20.
LIST OF CAUSES		REMEDIAL ACTIONS	
1.	INCORRECT DIRECTION OF ROTATION	1.	REVERSE MOTOR
2.	PUMP UNPRIMED	2.	BLEED SYSTEM OF AIR/GAS
3.	INSUFFICIENT N.P.S.H. AVAILABLE	3.	INCREASE SUCTION HEAD OR REDUCE SPEED/TEMP.
4.	PRODUCT VAPORISING IN SUPPLY LINE	4.	INCREASE N.P.S.H. AVAILABLE (SEE 3 ABOVE)
5.	AIR ENTERING SUPPLY LINE	5.	CHECK PIPE JOINTS/GLAND ADJUSTMENT
6.	INSUFFICIENT HEAD ABOVE SUPPLY VESSEL OUTLET	6.	RAISE VESSEL/INCREASE PIPE SIZE
7.	FOOTVALVE/STRAINER OBSTRUCTED OR BLOCKED	7.	CLEAN OUT SUCTION LINE/VALVES
8.	PRODUCT VISCOSITY ABOVE RATED FIGURE	8.	DECREASE PUMP SPEED/INCREASE TEMP.
9.	PRODUCT TEMP. ABOVE RATED FIGURE	9.	COOL THE PRODUCT
10.	PRODUCT VISCOSITY BELOW RATED FIGURE	10.	INCREASE PUMP SPEED/REDUCE TEMP.
11.	DELIVERY PRESSURE ABOVE RATED FIGURE	11.	CHECK FOR BLOCKAGES IN DELIVERY LINE
12.	GLAND OVERTIGHT	12.	ADJUST GLAND SEE O&M INSTRUCTIONS
13.	GLAND UNDERTIGHT	13.	ADJUST GLAND SEE O&M INSTRUCTIONS
14.	GLAND FLUSHING INADEQUATE	14.	CHECK FLUID FLOWS FREELY INTO GLAND
15.	PUMP SPEED ABOVE RATED FIGURE	15.	DECREASE PUMP SPEED
16.	PUMP SPEED BELOW RATED FIGURE	16.	INCREASE PUMP SPEED
17.	BELT DRIVE SLIPPING	17.	RE-TENSION BELTS
18.	COUPLING MISALIGNED	18.	CHECK AND ADJUST ALIGNMENT
19.	INSECURE PUMP/DRIVE MOUNTING	19.	CHECK AND TIGHTEN ALL PUMP MOUNTINGS
20.	SHAFT BEARING WEAR/FAILURE	20.	REPLACE BEARINGS
21.	WORN PUMP ELEMENT	21.	FIT NEW PARTS
22.	RELIEF VALVE CHATTER	22.	CHECK CONDITION OF VALVE/RENEW
23.	R.V. INCORRECTLY SET	23.	RE-ADJUST SPRING COMPRESSION
24.	LOW VOLTAGE	24.	CHECK VOLTAGE/WIRING SIZES
25.	PRODUCT ENTERING PACKING AREA	25.	CHECK PACKING CONDITION AND TYPE
26.	DRIVE TRAIN BREAKAGE	26.	CHECK AND REPLACE BROKEN COMPONENTS
27.	NEGATIVE OR VERY LOW DELIVERY HEAD	27.	CLOSE DELIVERY VALVE SLIGHTLY
28.	DISCHARGE BLOCKED/VALVE CLOSED	28.	REVERSE PUMP/RELIEVE PRESSURE/CLEAR BLOCKAGES
29.	STATOR TURNING	29.	REPLACE WORN PARTS/TIGHTEN UP STATOR BOLTS
30.	STUFFING BOX 'EATS' PACKING	30.	CHECK FOR WORN SHAFT AND REPLACE
31.	VEE BELTS	31.	CHECK AND ADJUST TENSION OR REPLACE

# Drawing Reference Numbers

<u>DRG. REF</u>	<u>DESCRIPTION</u>	<u>DRG. REF</u>	<u>DESCRIPTION</u>
01A	BODY	P101	BEARING
01B	BEARING HOUSING	P102	BEARING
06A	NAMEPLATE (SOG)	P104	CIRCLIP/SEAL
06B	NAMEPLATE (DOG)	P105	HEXAGON HEAD BOLT
08A	GLAND	P106	HEX NUT
10A	GLAND PACKING OR MECHANICAL SEAL	P107	WASHER (PLAIN)
10B	ROTARY SHAFT LIPSEAL (OPTIONAL)	P108	WASHER (SPRING)
11A	BEARING COVER	P109	HEX HEAD SCREW
15A	THROWER GUARD	P110	HEX NUT
20A	GASKET ..GLAND	P111	WASHER (PLAIN)
20B	GASKET ..STATOR SUPPORT RING	P112	WASHER (SPRING)
20C	GASKET ..STATOR SUPPORT RING	P113	HEXAGON HEAD BOLT
22A	STATOR	P114	HEX NUT
22B	STATOR	P115	WASHER (PLAIN)
23A	SUCTION CHAMBER	P116	WASHER (SPRING)
23B	SUCTION CHAMBER EXTENSION	P117	DRIVE SCREW
24A	END COVER		
25A	ROTOR	P201	HEX HEAD BOLT
26A	FLEXISHAFT	P202	HEX NUT
27A	ADAPTOR ..ROTOR	P203	WASHER
30A	ROTOR CAP	P401	KEY
31A	LOCKING WASHER	P402	SEAL
31B	WASHER ..ADAPTOR	P403	SEAL
32A	SHAFT	P404	SEAL
32B	DRIVE SHAFT ..BEARING HOUSING	P409	WASHER
35A	BEARING SPACER	P410	HEXAGON NUT
35B	SHAFT SLEEVE		
36A	LOCKING COLLAR ..SHAFT	P501	TAPER PLUG
40A	LANTERN RING	P503	TAPER PLUG
42A	THROWER	P504	HEX NUT
47A	STATOR SUPPORT RING	P505	SGL. COIL SPRING WASHER
47B	STATOR SUPPORT RING	P506	PLAIN WASHER
59A	COVER PLATE	P507	HEX NUT
59B	INSPECTION COVER PLATE	P508	SGL. COIL SPRING WASHER
62A	SUPPORT FOOT	P509	PLAIN WASHER
62B	SUPPORT FOOT	P510	HEX HD BOLT
62C	SUPPORT FOOT	P511	HEX NUT
65A	GLAND SECTION	P512	SGL. COIL SPRING WASHER
66A	ABUTMENT RING	P513	PLAIN WASHER
75A	SLEEVE ... ROTOR	P514	TOROIDAL SEAL RING
76A	ADAPTOR FLANGE	P515	TOROIDAL SEAL RING
76B	ADAPTOR FLANGE - STATORS	P516	HEX NUT
95A	TIE BAR ..STATOR	P517	SGL. COIL SPRING WASHER
95B	TIE ROD	P518	PLAIN WASHER
95C	TIE BAR - STATOR	P527	SGL. COIL SPRING WASHER
97A	SUPPORT CHANNEL	P528	PLAIN WASHER
97B	SUPPORT CHANNEL	P530	HEX NUT
		P531	HEX HD BOLT
		P532	HEX NUT
		P533	SGL. COIL SPRING WASHER
		P534	PLAIN WASHER
		P535	HEX NUT
		P536	SGL. COIL SPRING WASHER
		P537	PLAIN WASHER

## IMPORTANT NOTE

THE DRAWING REFERENCES SHOWN GIVE THE DESCRIPTION OF ALL THE PARTS DETAILED ON THE SECTIONAL DRAWINGS IN THIS SECTION OF THE BOOK. THEREFORE SOME OF THE REFERENCES MAY NOT BE SHOWN ON ANY ONE.

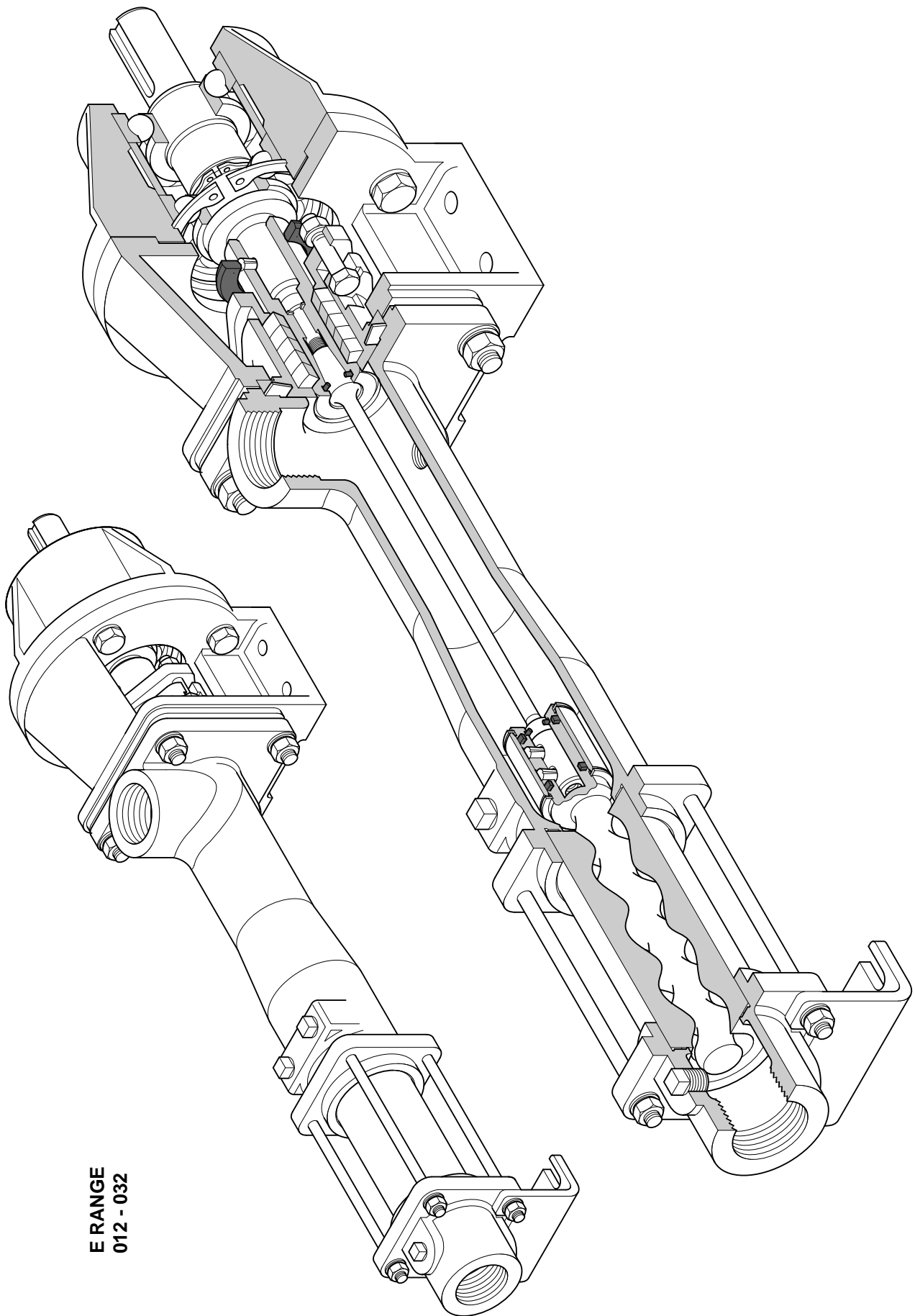


# Pump Coding

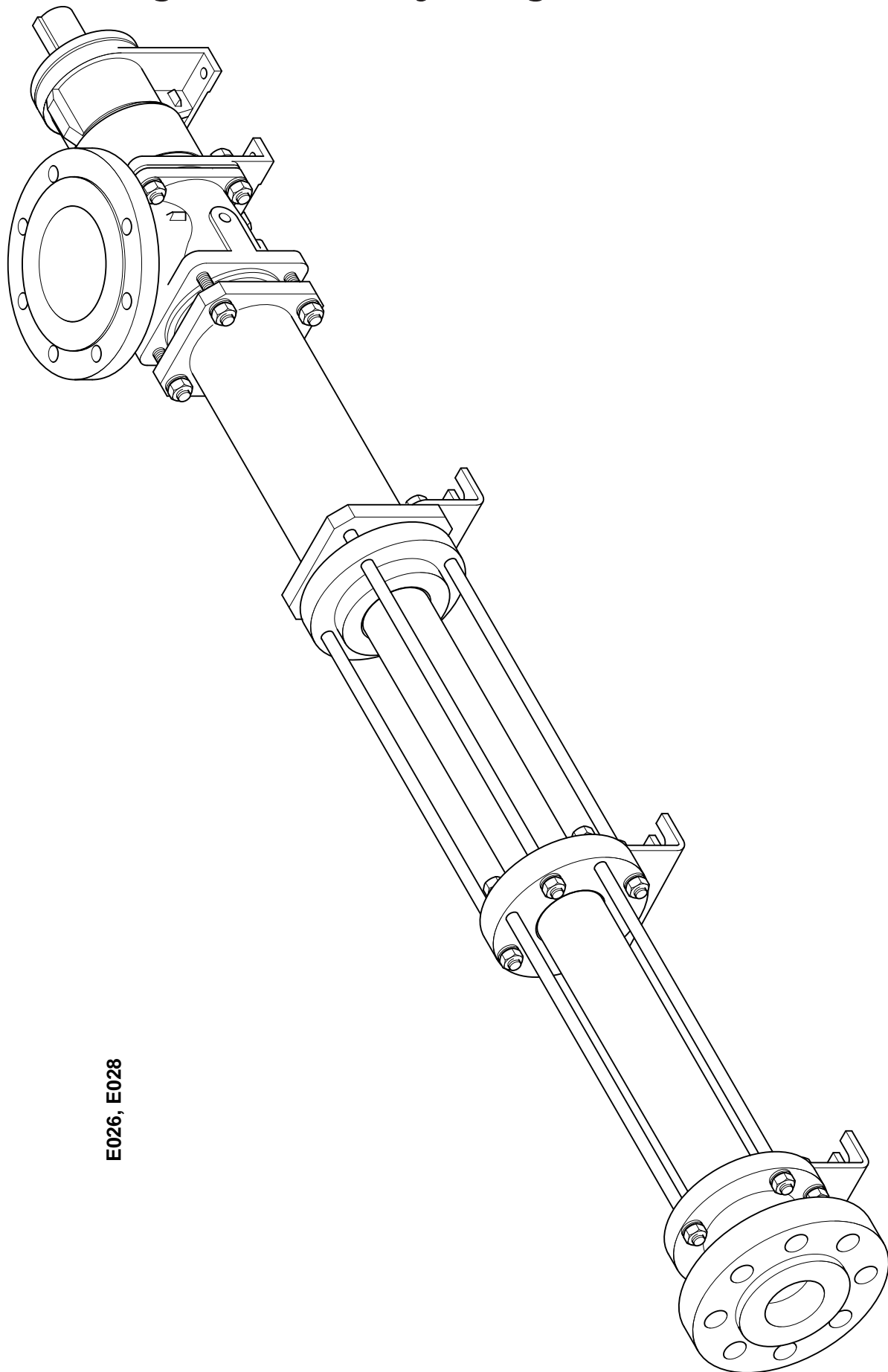
FEATURES	DESCRIPTION	BASIC PUMP CODE										STANDARD VARIATION				
		1	2	3	4	5	6	7	8	9	10	/	12	13	14	15
BODY MATERIALS	Cast Iron	C														
	Stainless Steel	S														
	Duplex	F														
	Rubber Lined	R														
PUMP DESIGN	Flexishaft - Industrial		E													
MAXIMUM PUMP CAPACITY AT MAXIMUM SPEED AND ZERO PRESSURE	1.3m³/h			0	1											
	3.3m³/h			0	2											
	10m³/h			0	3											
	13m³/h			0	X											
	22m³/h			0	4											
	37m³/h			0	5											
	57m³/h			0	6											
	79m³/h			0	7											
	97m³/h			0	8											
	125m³/h			0	9											
	165m³/h			1	0											
	225m³/h			1	2											
	210m³/h			1	5											
	290m³/h			1	6											
	420m³/h			2	0											
PUMP STAGES	Low Pressure					K										
	One					1										
	Two					2										
	Three					3										
	Four					4										
	Six					6										
	Eight					8										
	Twelve					C										
END COVER AND DRIVE DESIGN	Str thro E/C, Std Flexishaft						M									
	90° E/C, Std Flexishaft						G									
	Str thro E/C, Special Flexishaft						S									
	90° E/C, Special Flexishaft						T									
MECHANICAL SEAL DUTY CONDITIONS	Light duty with Mk 1 rotor							H								
	Standard duty with Mk 1 rotor							J								
	Standard duty with Mk 0 rotor							K								
	Light duty with Mk 0 rotor							N								
PACKED GLAND DUTY CONDITIONS	Light duty with Mk 1 rotor							L								
	Standard duty with Mk 1 rotor							S								
	Standard duty with Mk 0 rotor							X								
	Light duty with Mk 0 rotor							Z								
DESIGN MARK NUMBER	1989 (1994 Sizes 01-0X) (1996 Low Pressure)									1						
	1995									2						
	1996									3						
STATOR MAT'L	RA, RR etc.										A					
ROTATING PARTS	1, 3, 4, 5, 8											3				
TYPICAL BASIC PUMP CODING	Cast Iron Flexishaft pump size 05 single stage. Mechanical seal, str thro E/C, Std F/shaft, Std duty conditions, Mk 0 rotor, Design 1, Natural rubber stator, Code 3 rotating parts	C	E	0	5	1	M	K	1	A	3					
MARKET VARIATIONS	'A' - America															
	'E' - Europe															
	'H' - Home															
	'C' - Bareshaft - Mono Australia only															
	'J' - Japan															
FULL PUMP CODING TO BE STAMPED ON PUMP NAMEPLATE																



# Dismantling & Assembly Diagrams

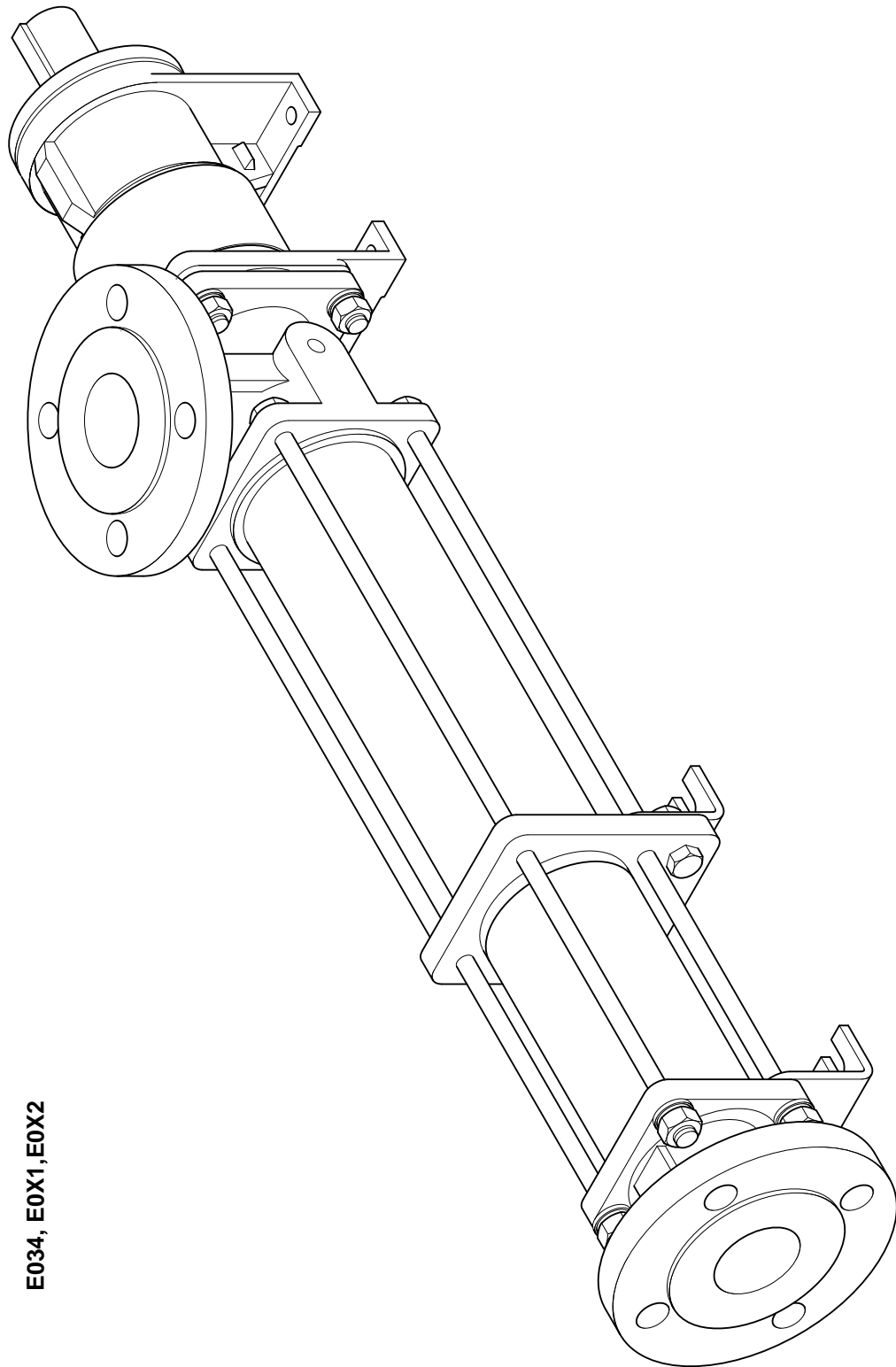


# Dismantling & Assembly Diagrams



E026, E028

# Dismantling & Assembly Diagrams

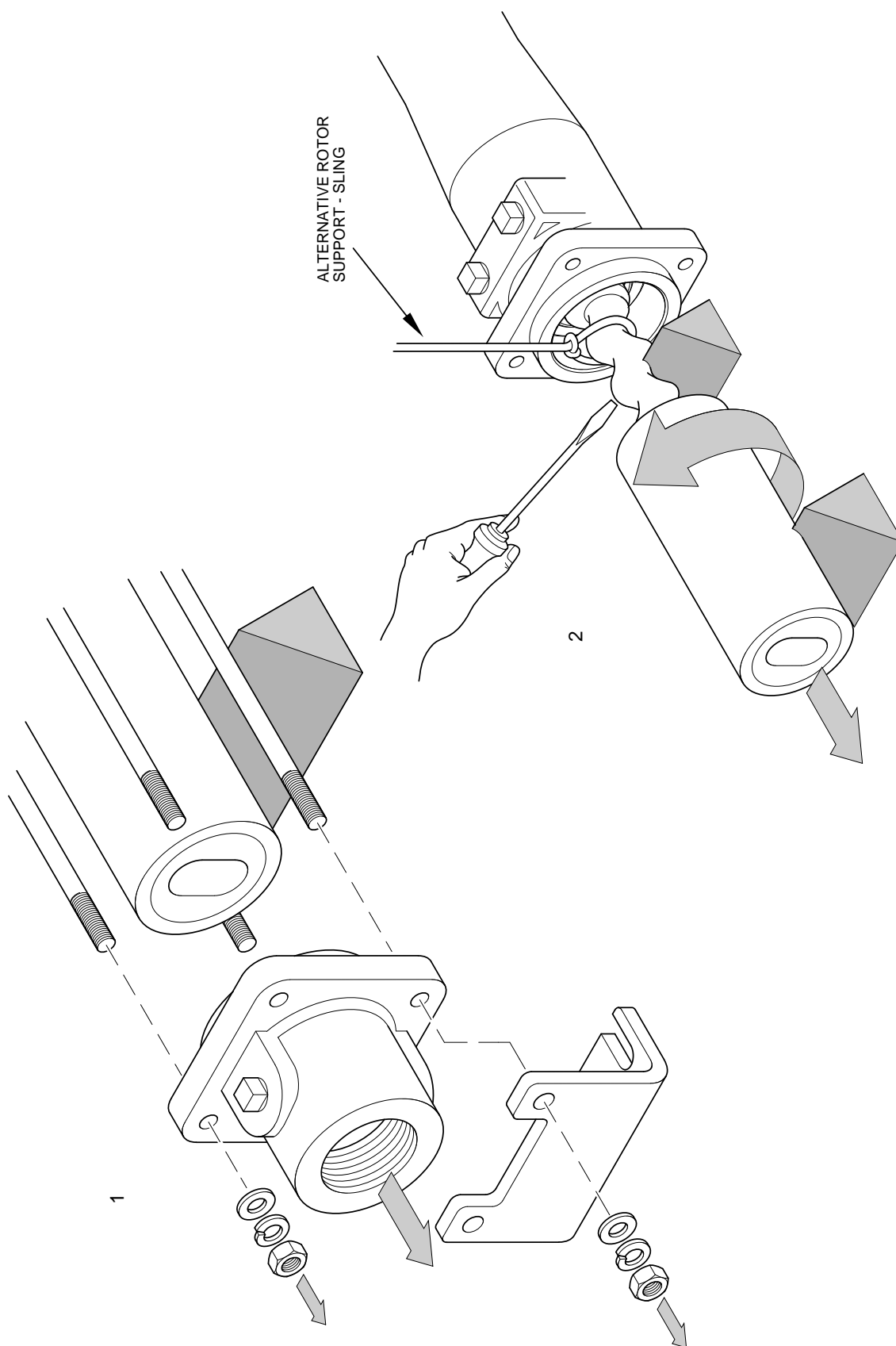


E034, E0X1, E0X2

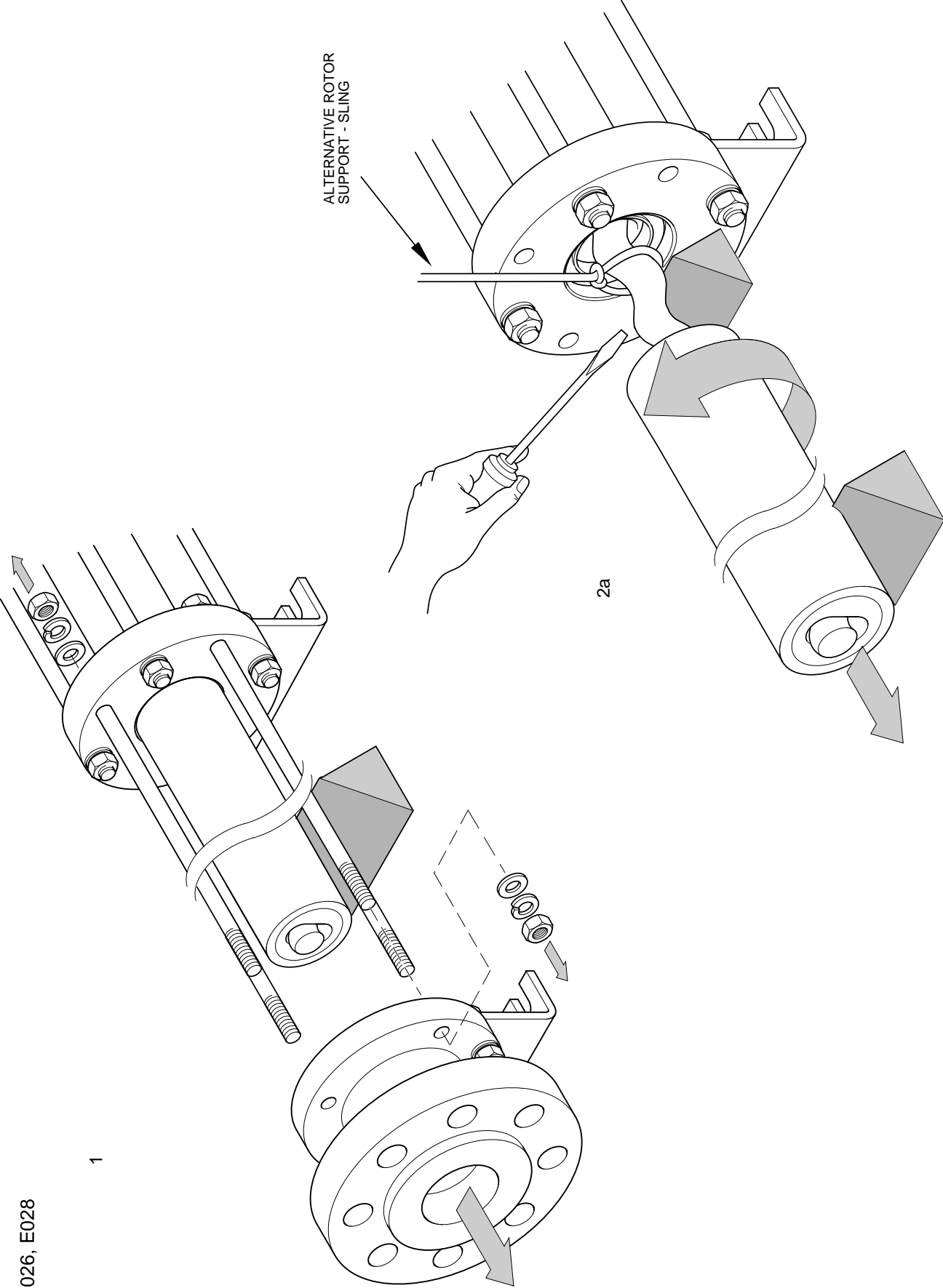
# Dismantling & Assembly Diagrams

## DISMANTLING PROCEDURE

FOR PUMP SIZES: E012, E014, E021, E022, E024, E031, E03K, E032, E034, E0X1, E0X2

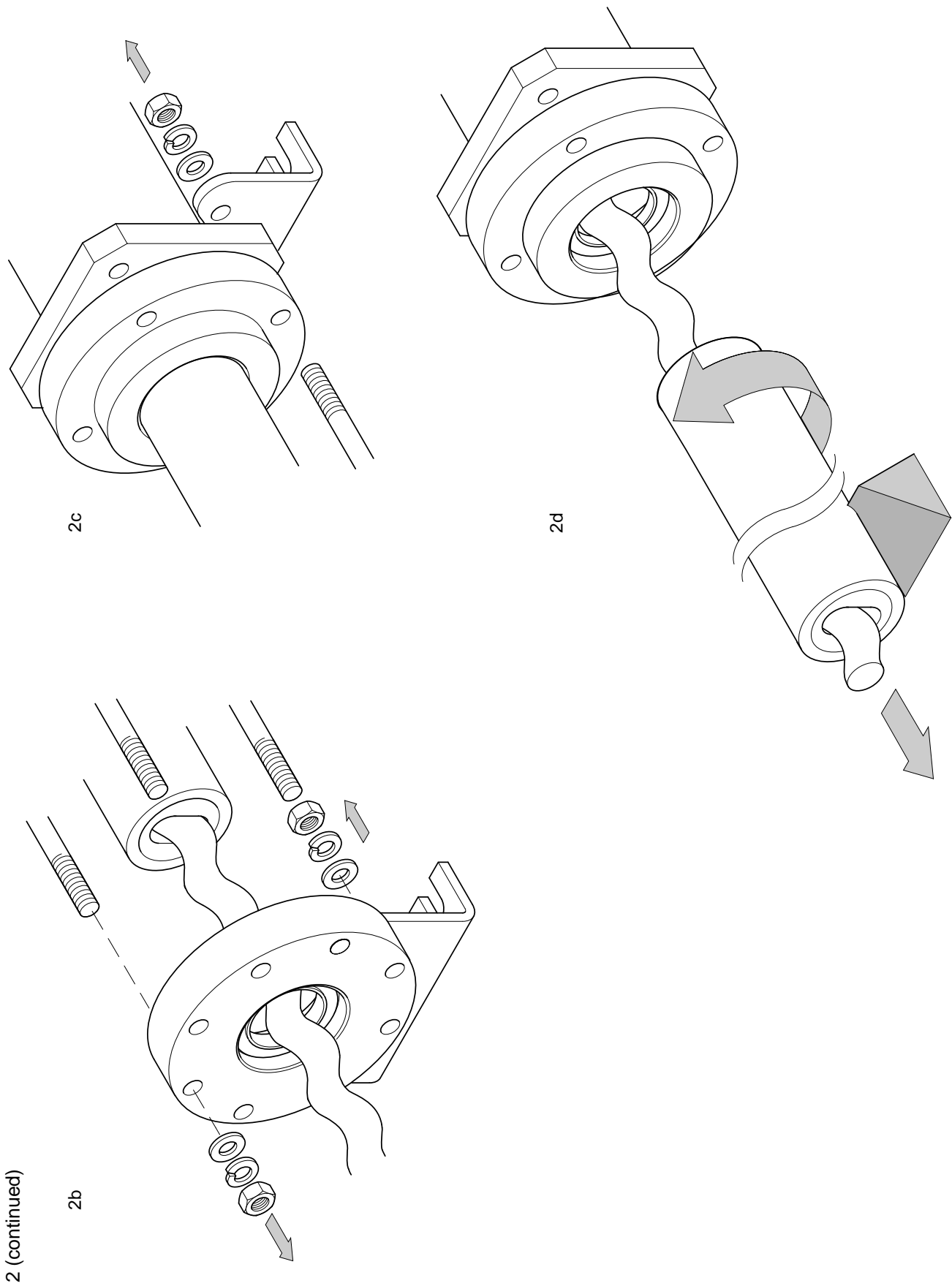


# Dismantling & Assembly Diagrams



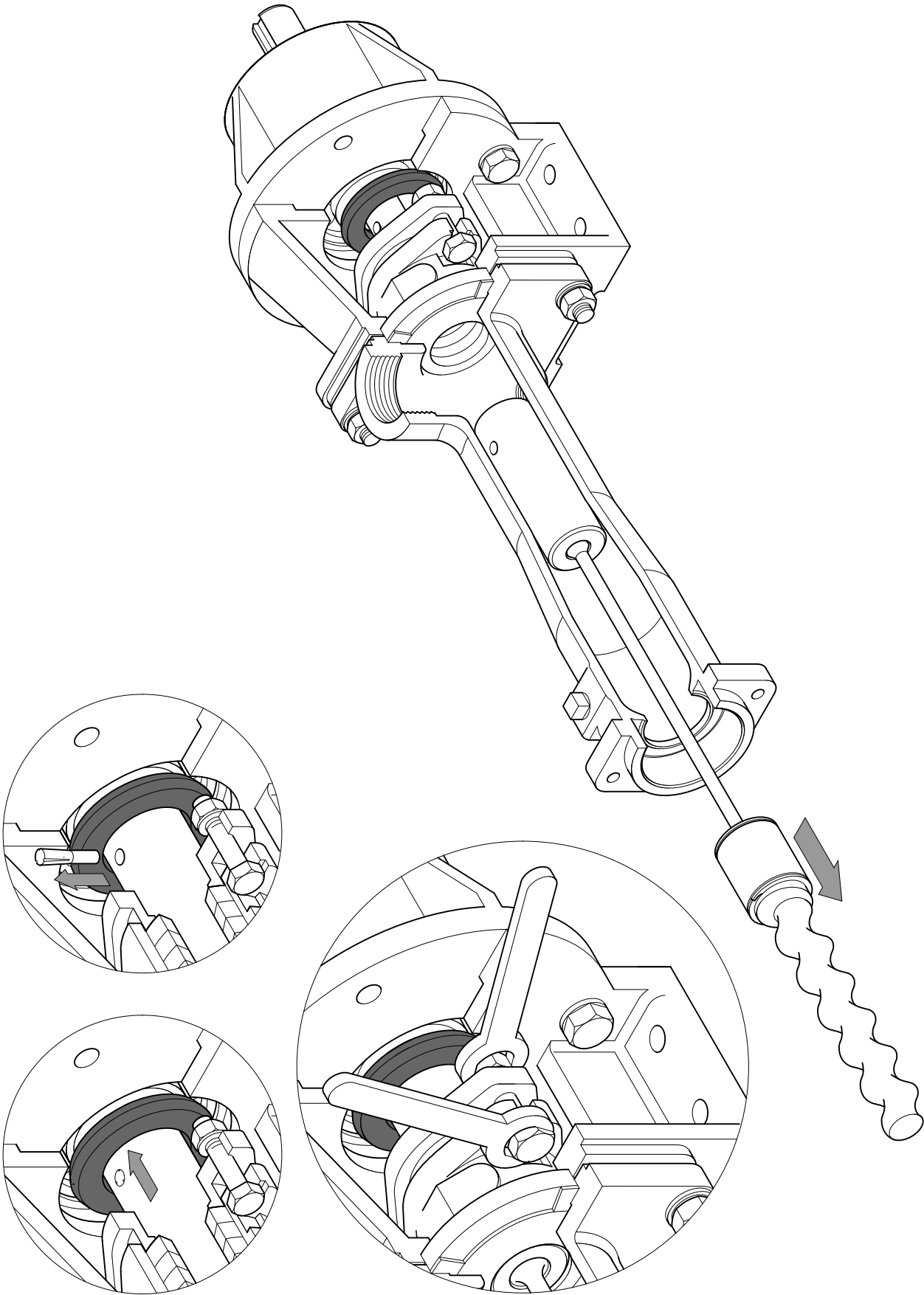
E026, E028

# Dismantling & Assembly Diagrams



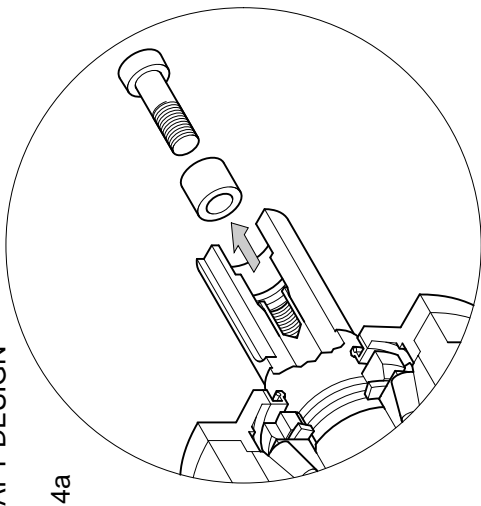
# Dismantling & Assembly Diagrams

FOR PUMP SIZES: E012, E014, E021, E022, E024, E031, E03K, E032, E0X1 - TWO PIECE SHAFT DESIGN

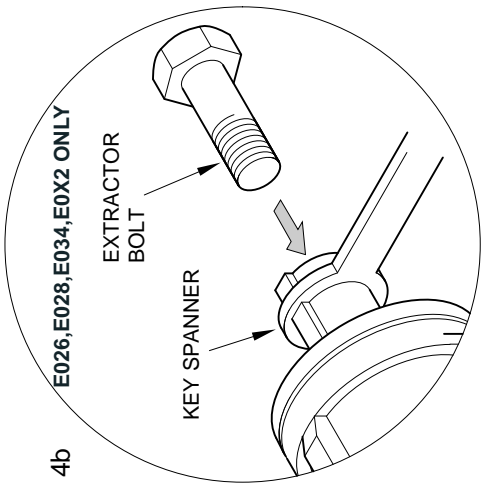


# Dismantling & Assembly Diagrams

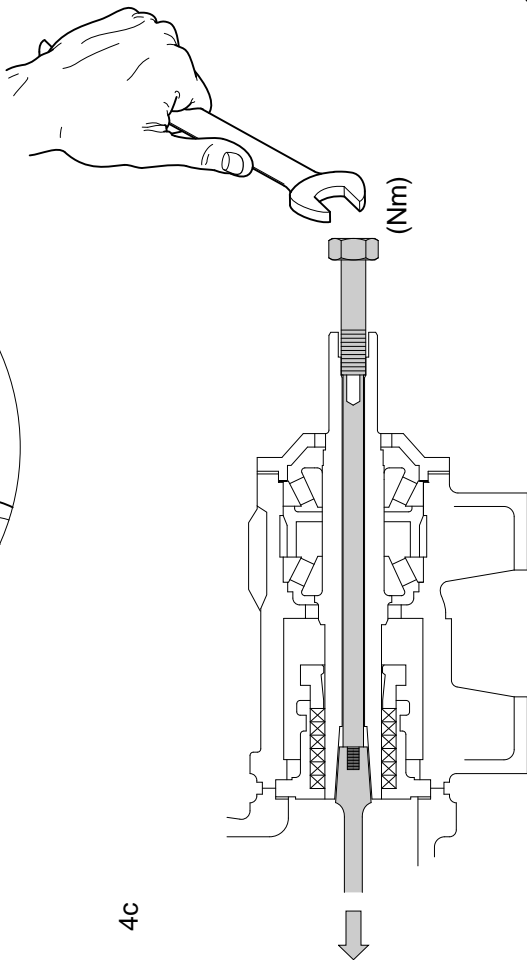
FOR PUMP SIZES: E026, E028, E034, E0X2 and sizes E012, E024, E021, E022, E024, E031, E03K, E032, E0X1  
- SINGLE PIECE SHAFT DESIGN



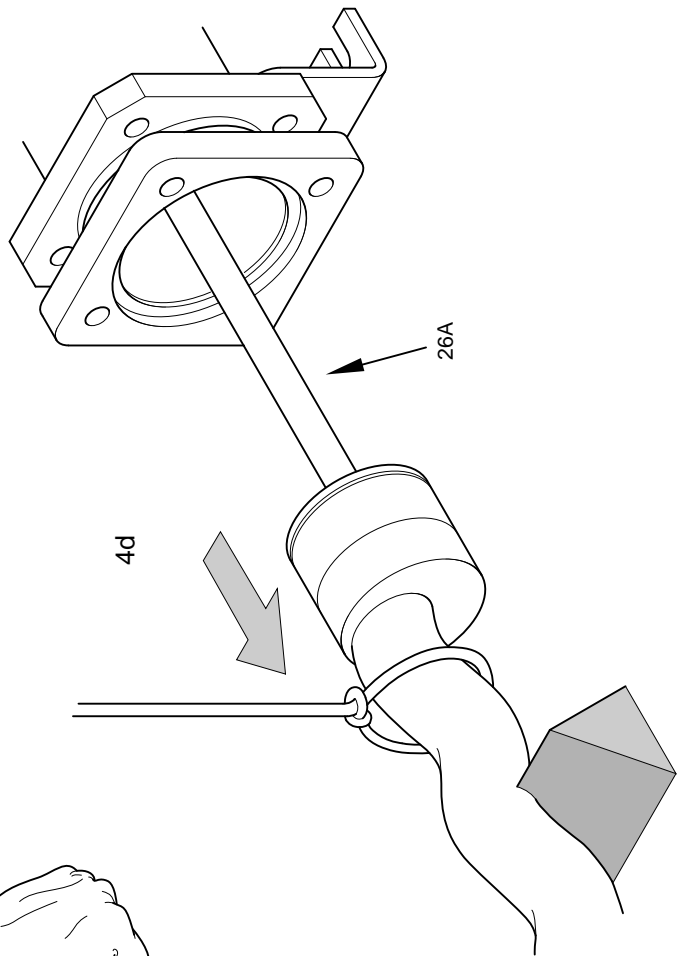
4a



4b



4c



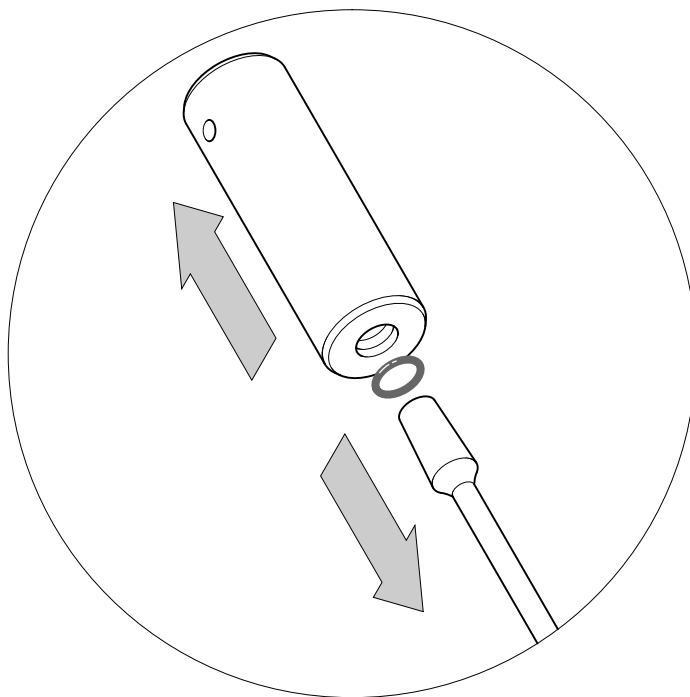
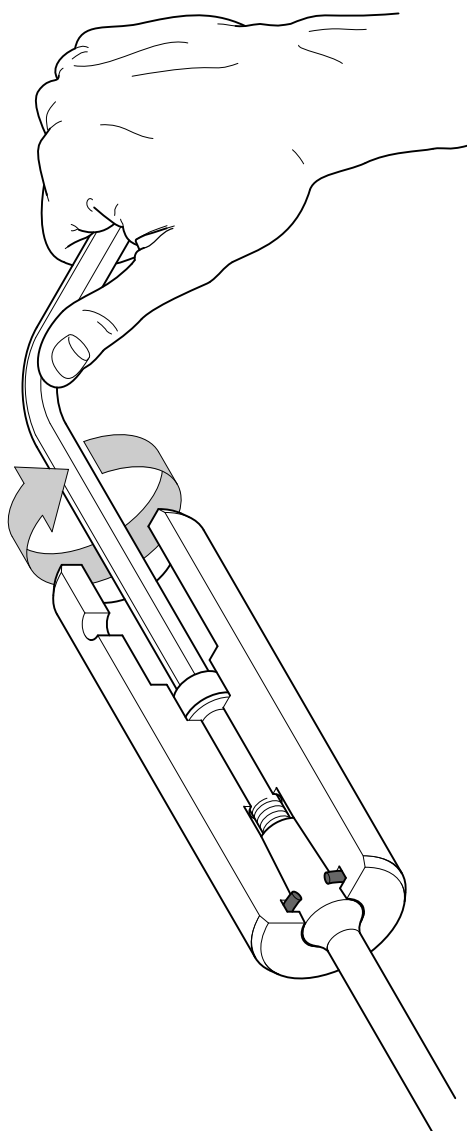
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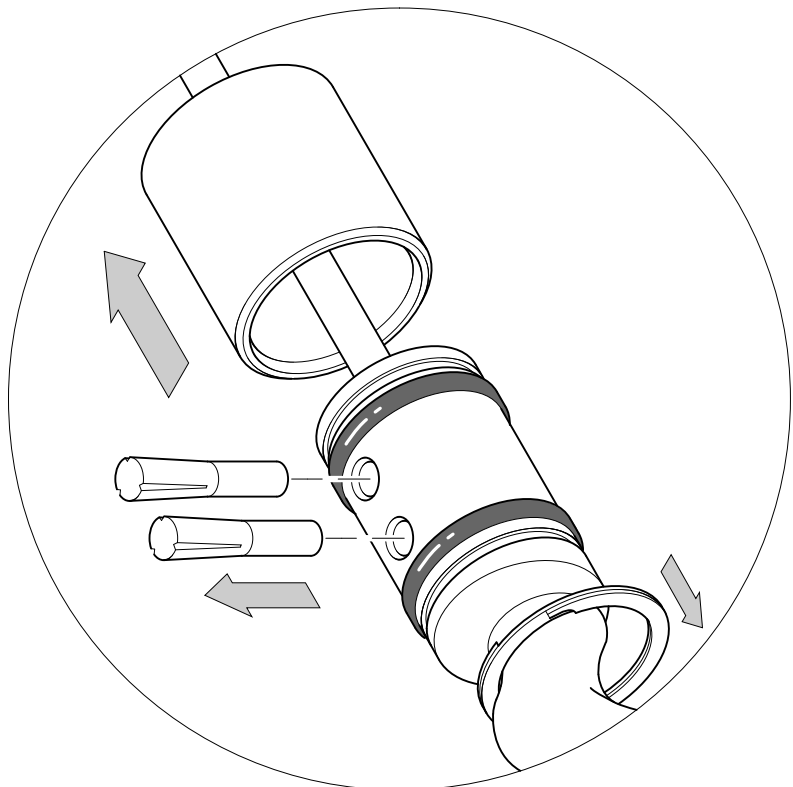
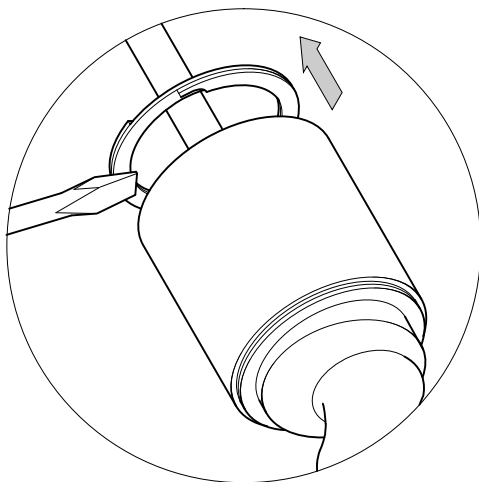
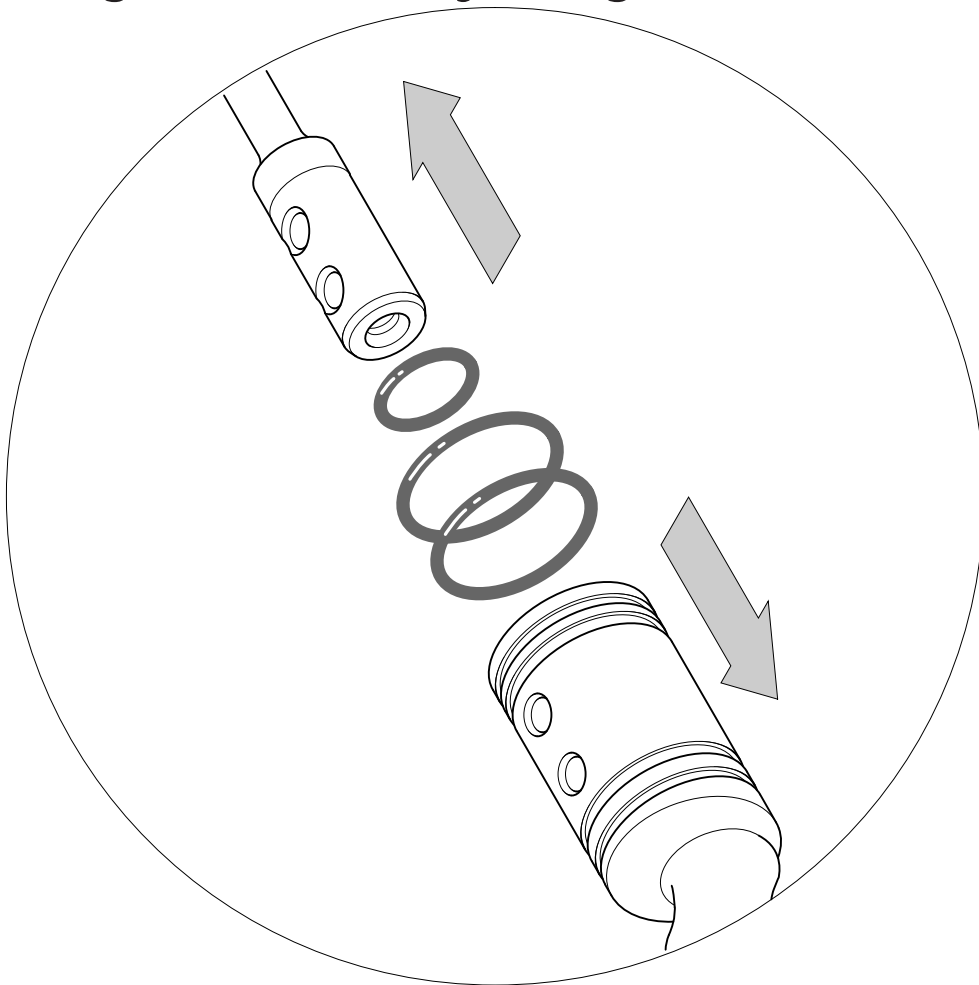
# Dismantling & Assembly Diagrams

FOR PUMP SIZES: E012, E014, E021, E022, E024, E031, E03K, E032, E0X1 - TWO PIECE SHAFT DESIGN

5

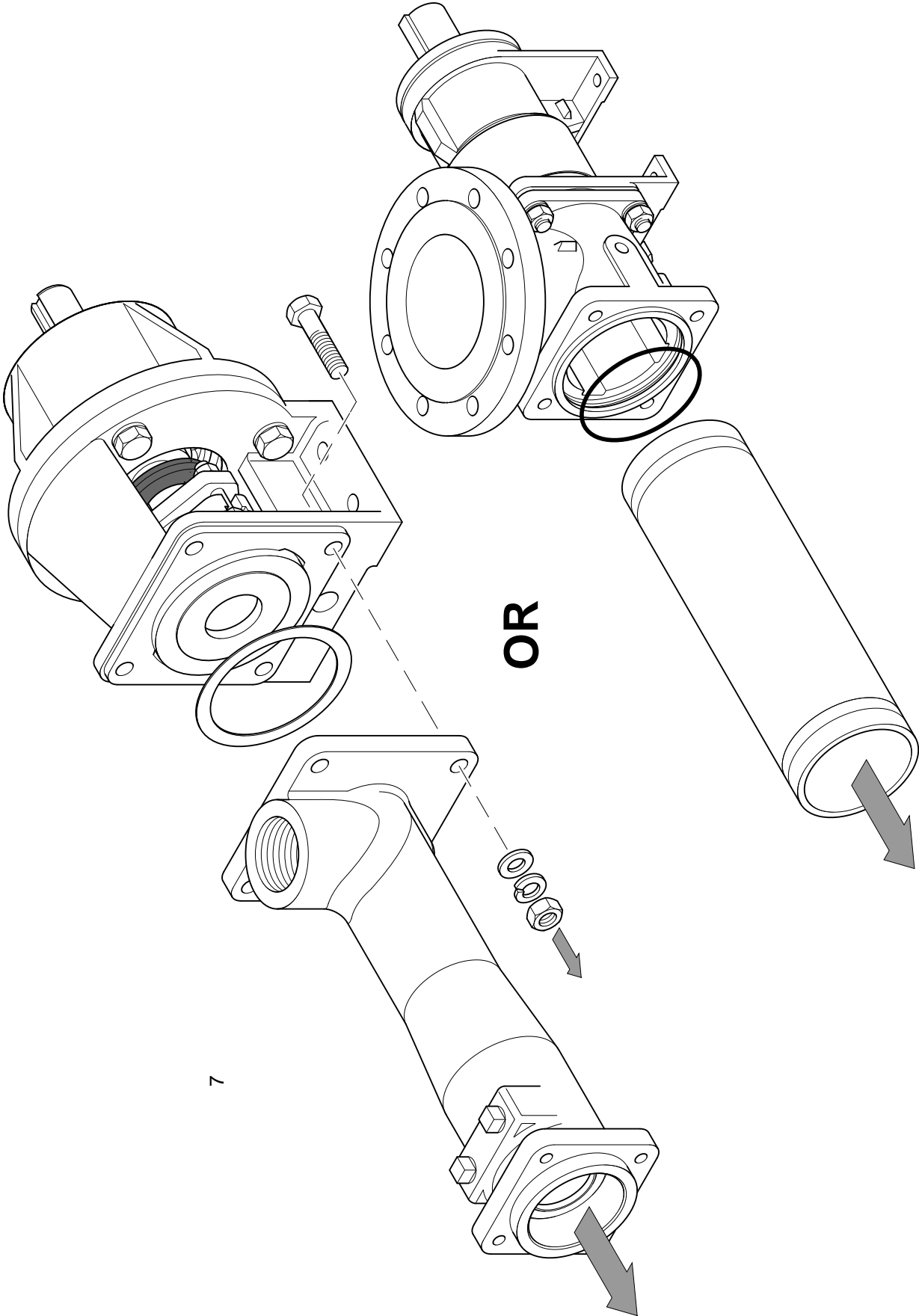


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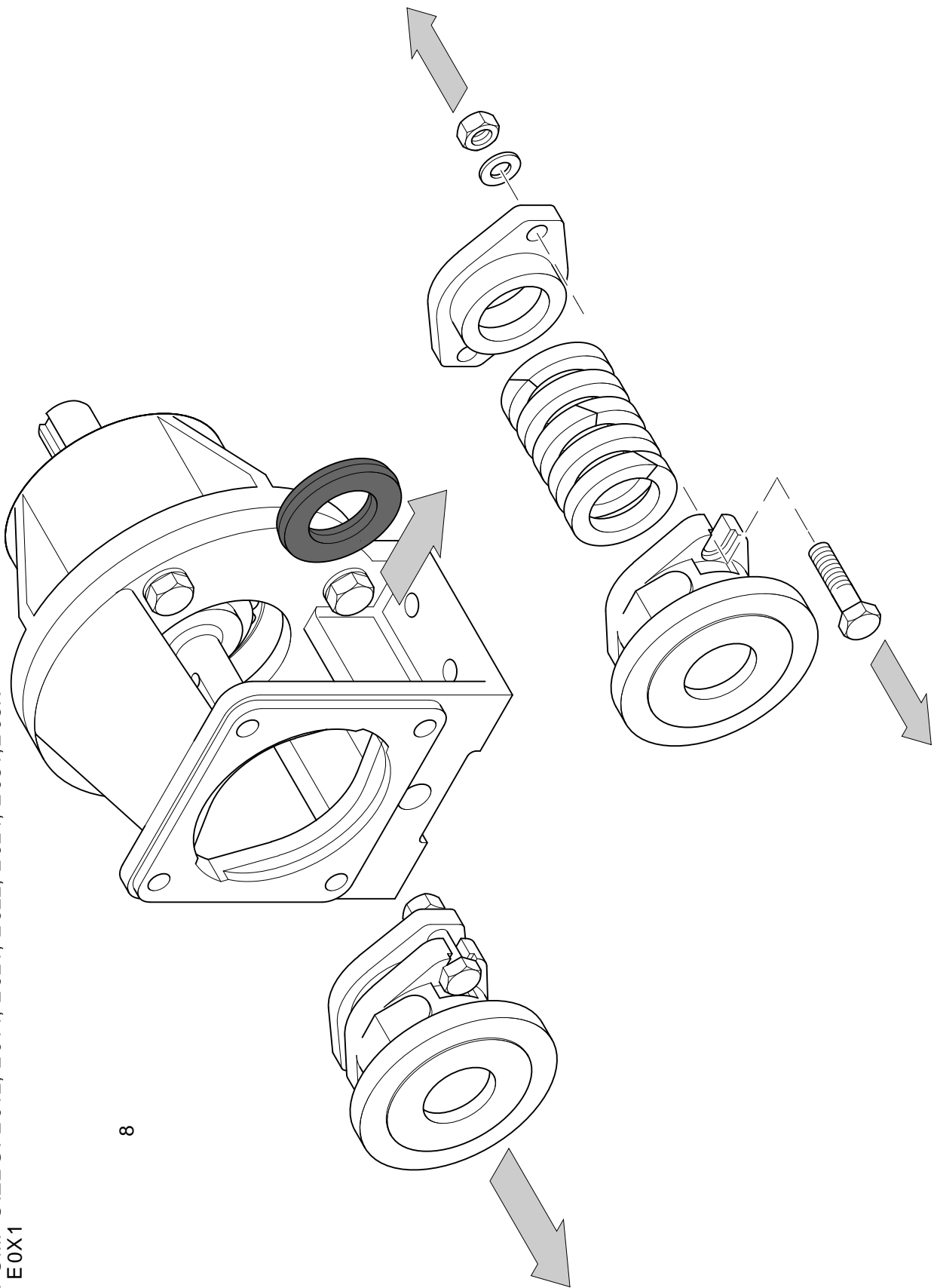


6

# Dismantling & Assembly Diagrams



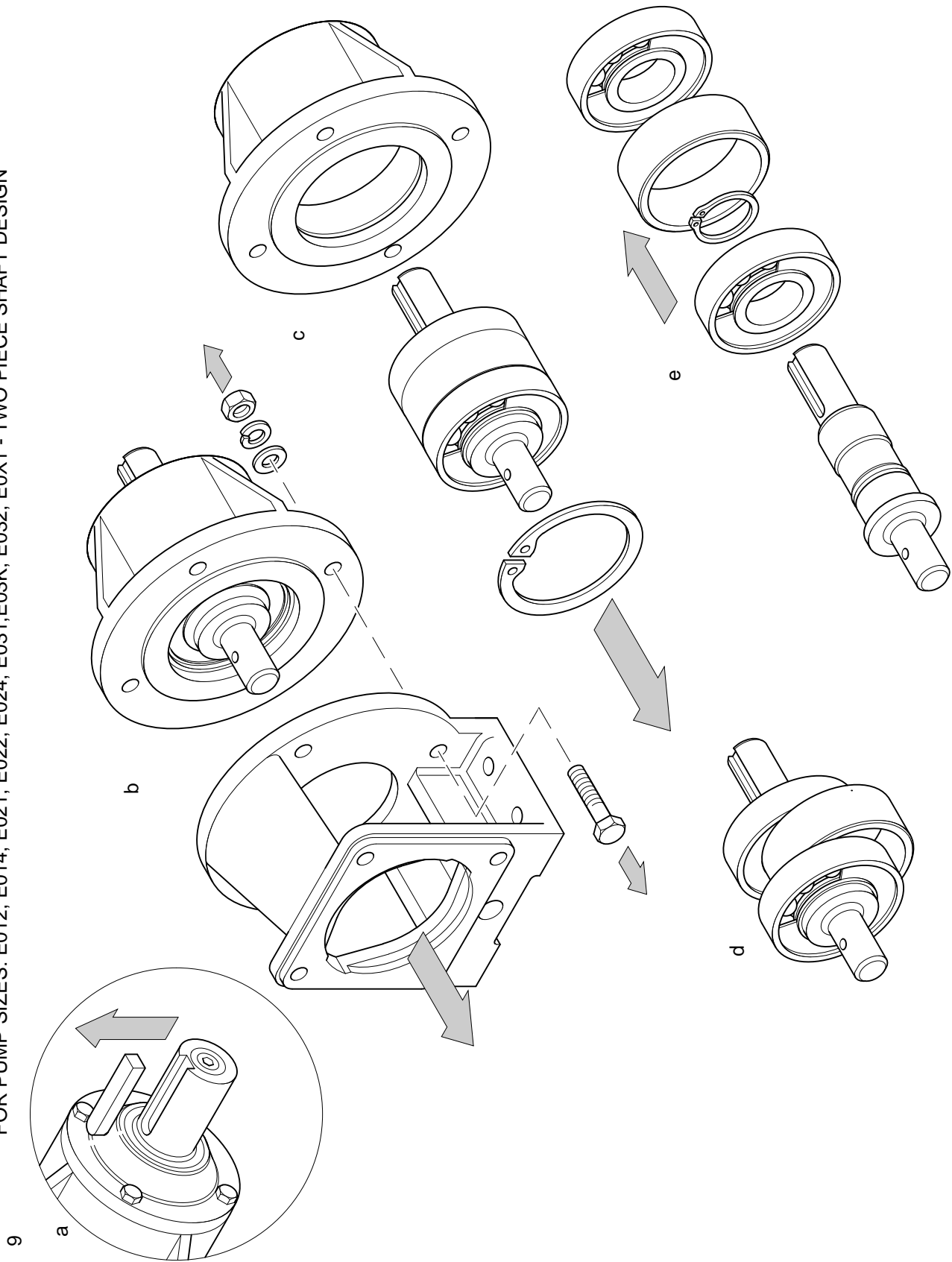
# Dismantling & Assembly Diagrams



FOR PUMP SIZES: E012, E014, E021, E022, E024, E031, E03K  
E032, E0X1

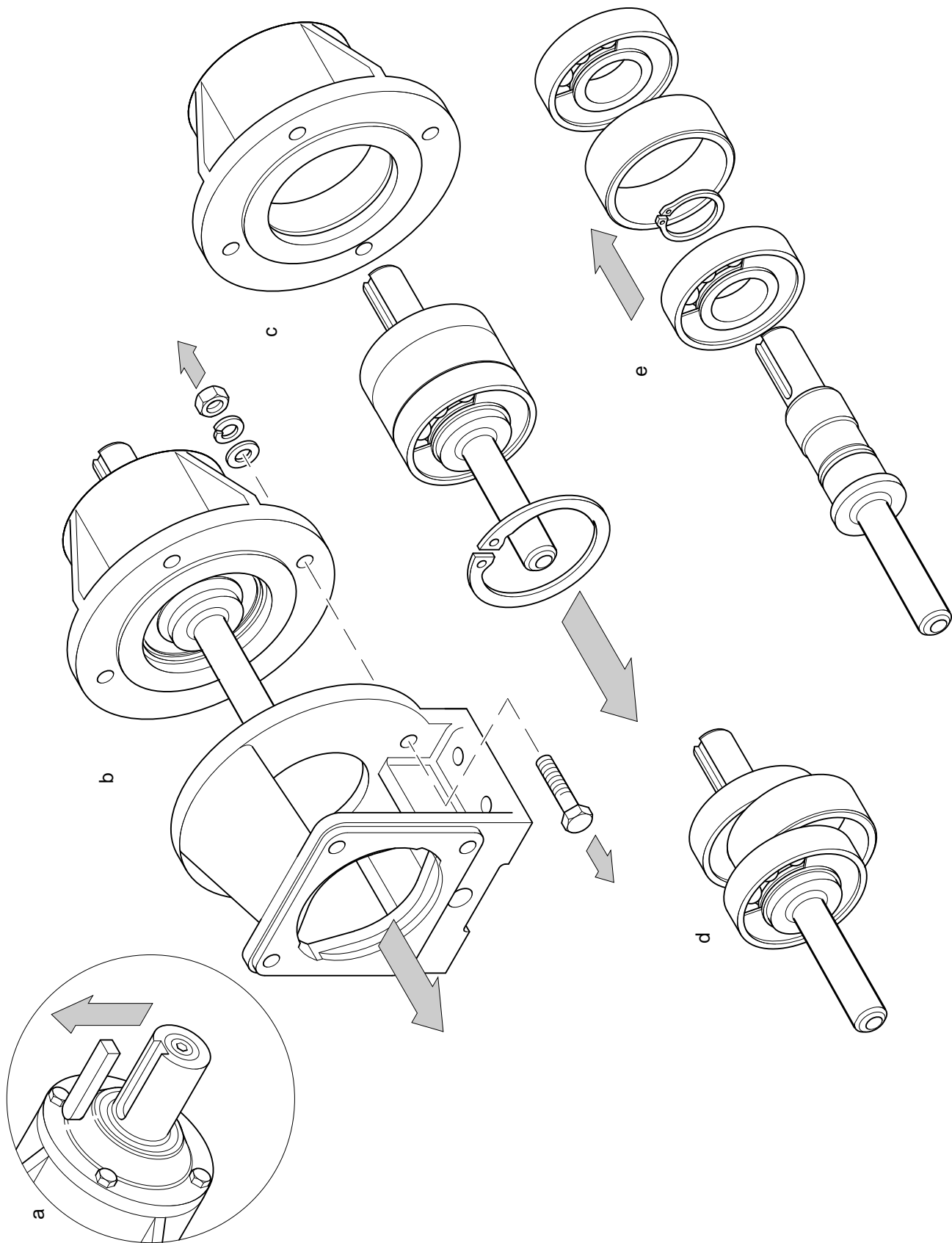
# Dismantling & Assembly Diagrams

FOR PUMP SIZES: E012, E014, E021, E022, E024, E031, E03K, E032, E0X1 - TWO PIECE SHAFT DESIGN

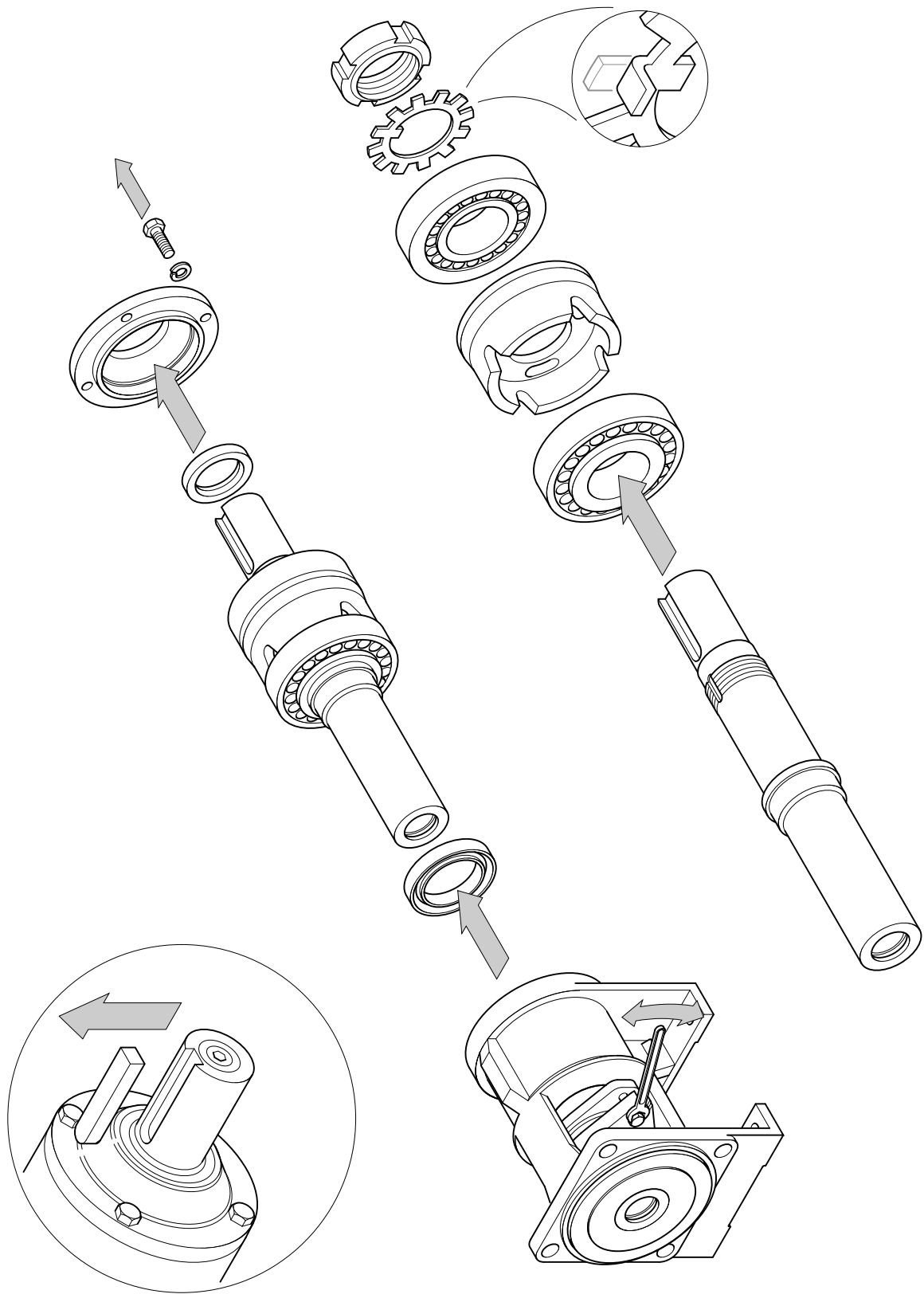


# Dismantling & Assembly Diagrams

FOR PUMP SIZES: E012, E014, E021, E022, E024, E031, E03K, E032, E0X1 - SINGLE PIECE SHAFT DESIGN

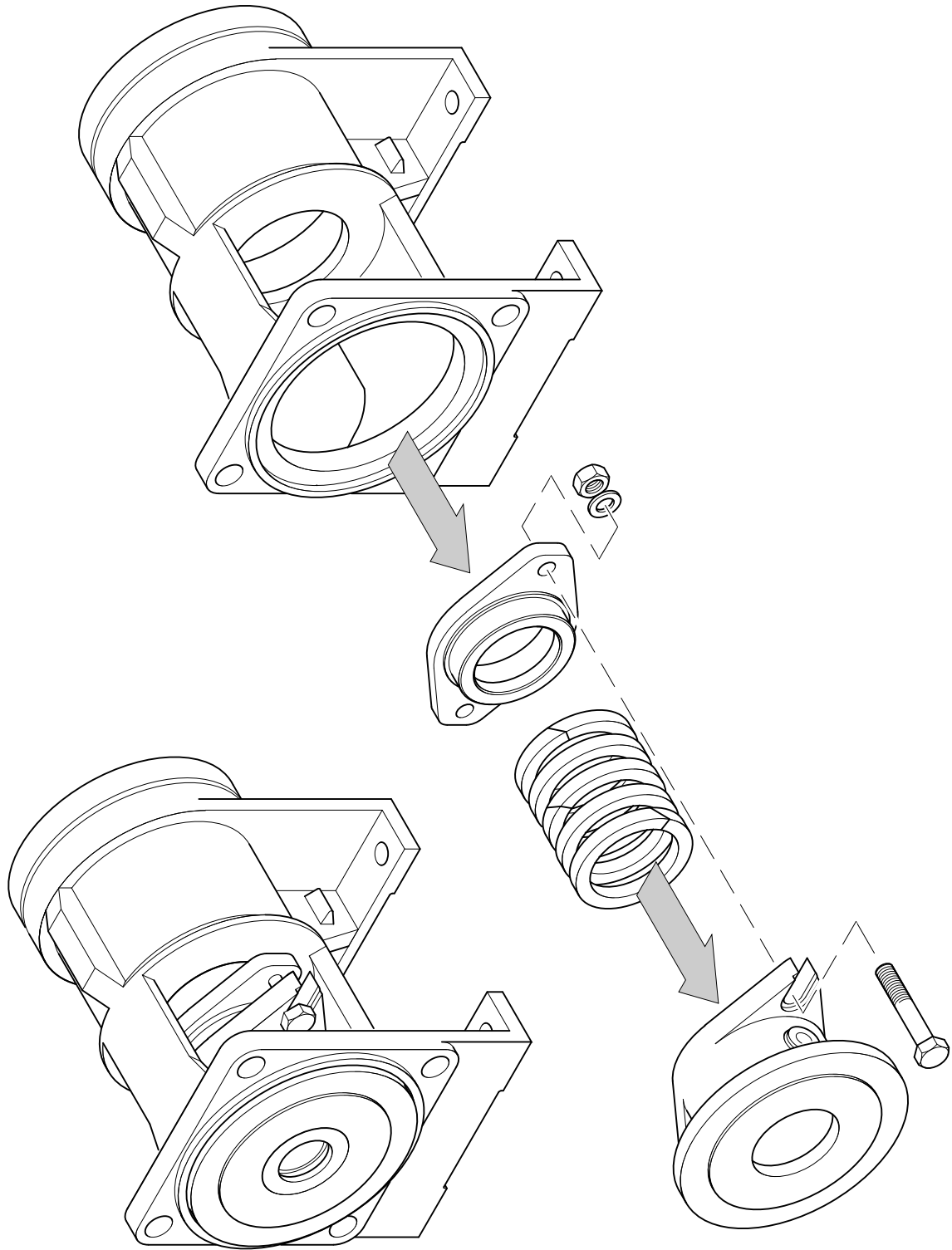


# Dismantling & Assembly Diagrams



FOR PUMP SIZES: E026, E028, E034, E0X2

# Dismantling & Assembly Diagrams



FOR PUMP SIZES: E026, E028, E034, E0X2

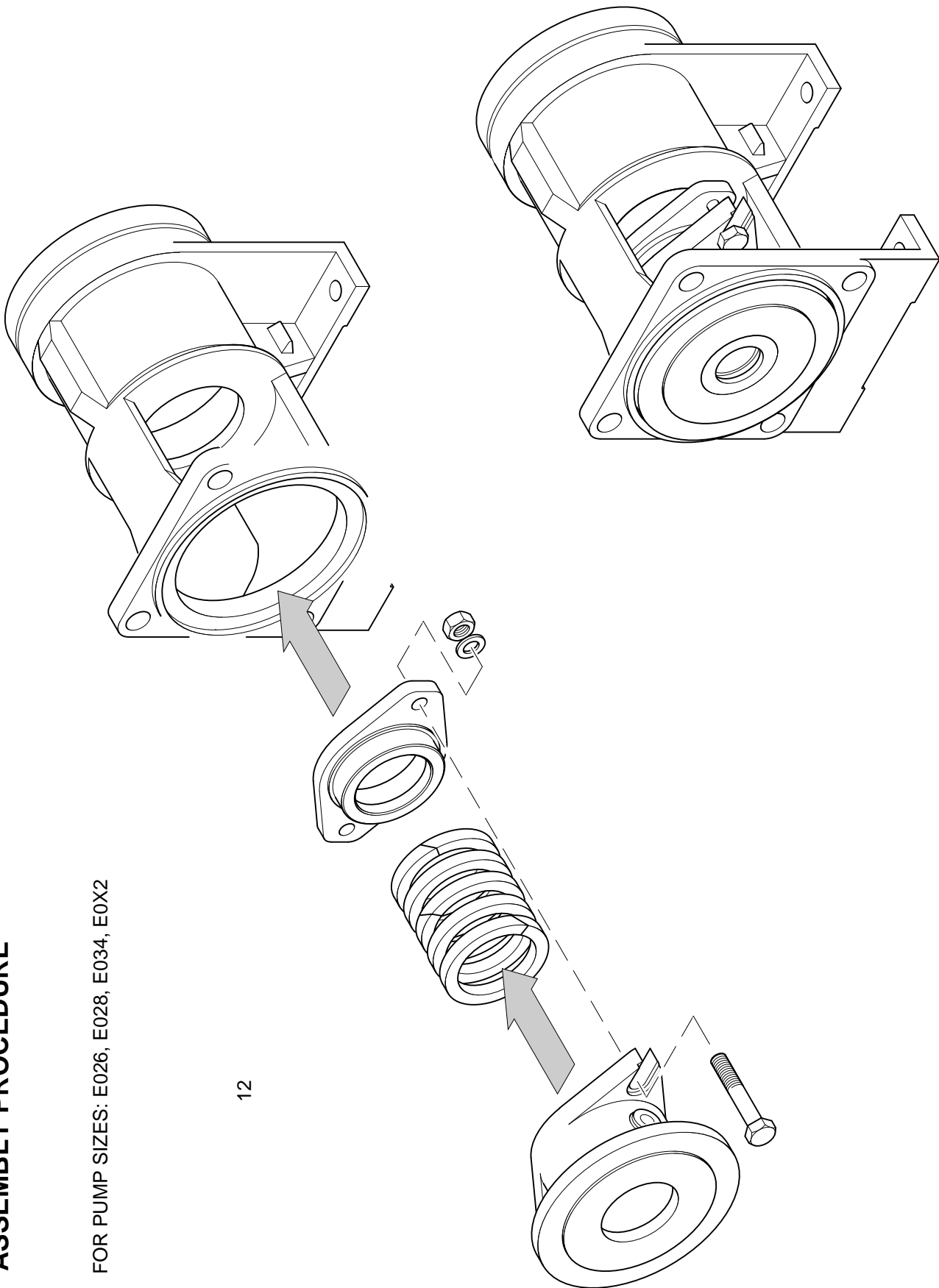


# Dismantling & Assembly Diagrams

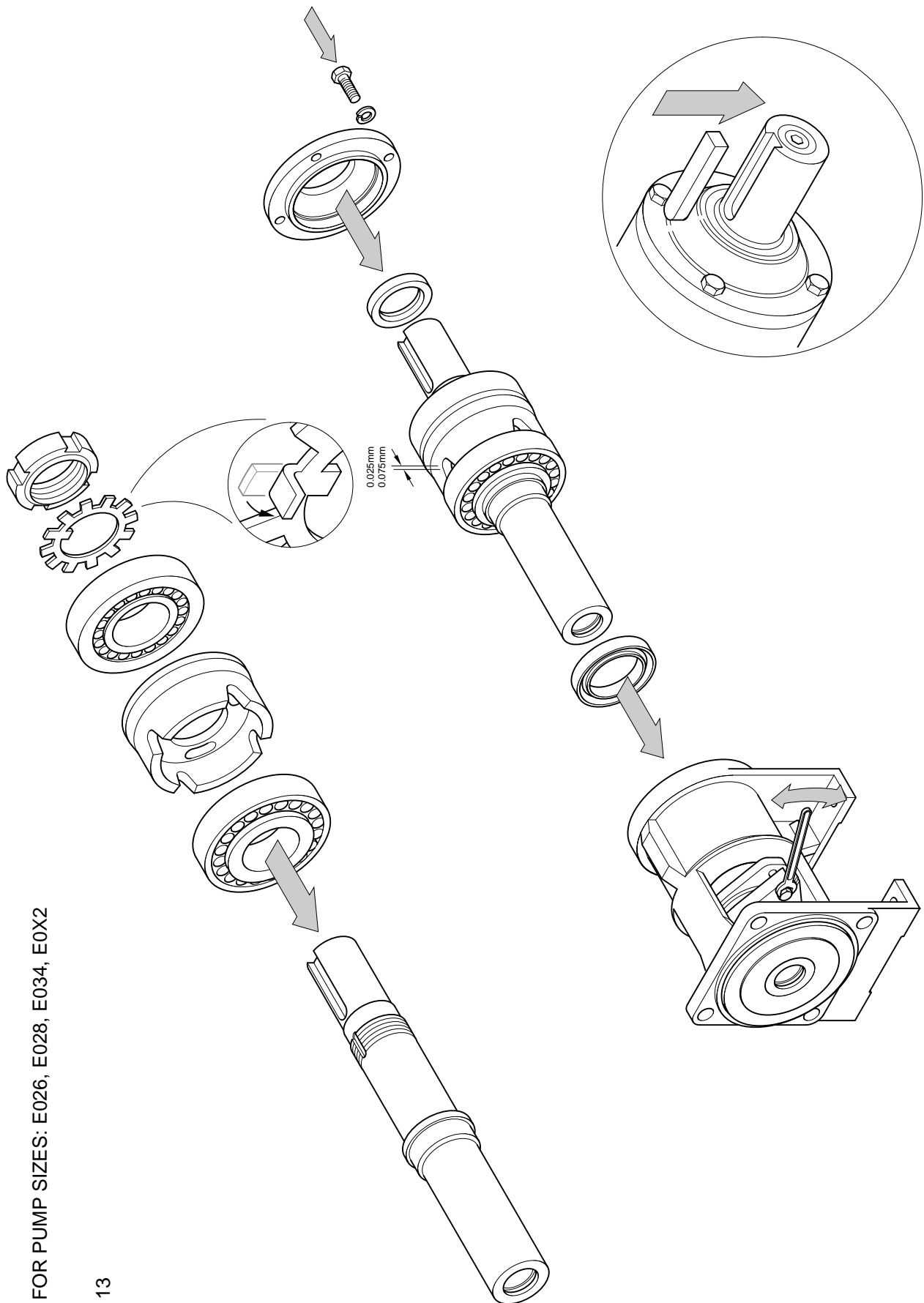
**ASSEMBLY PROCEDURE**

FOR PUMP SIZES: E026, E028, E034, E0X2

12



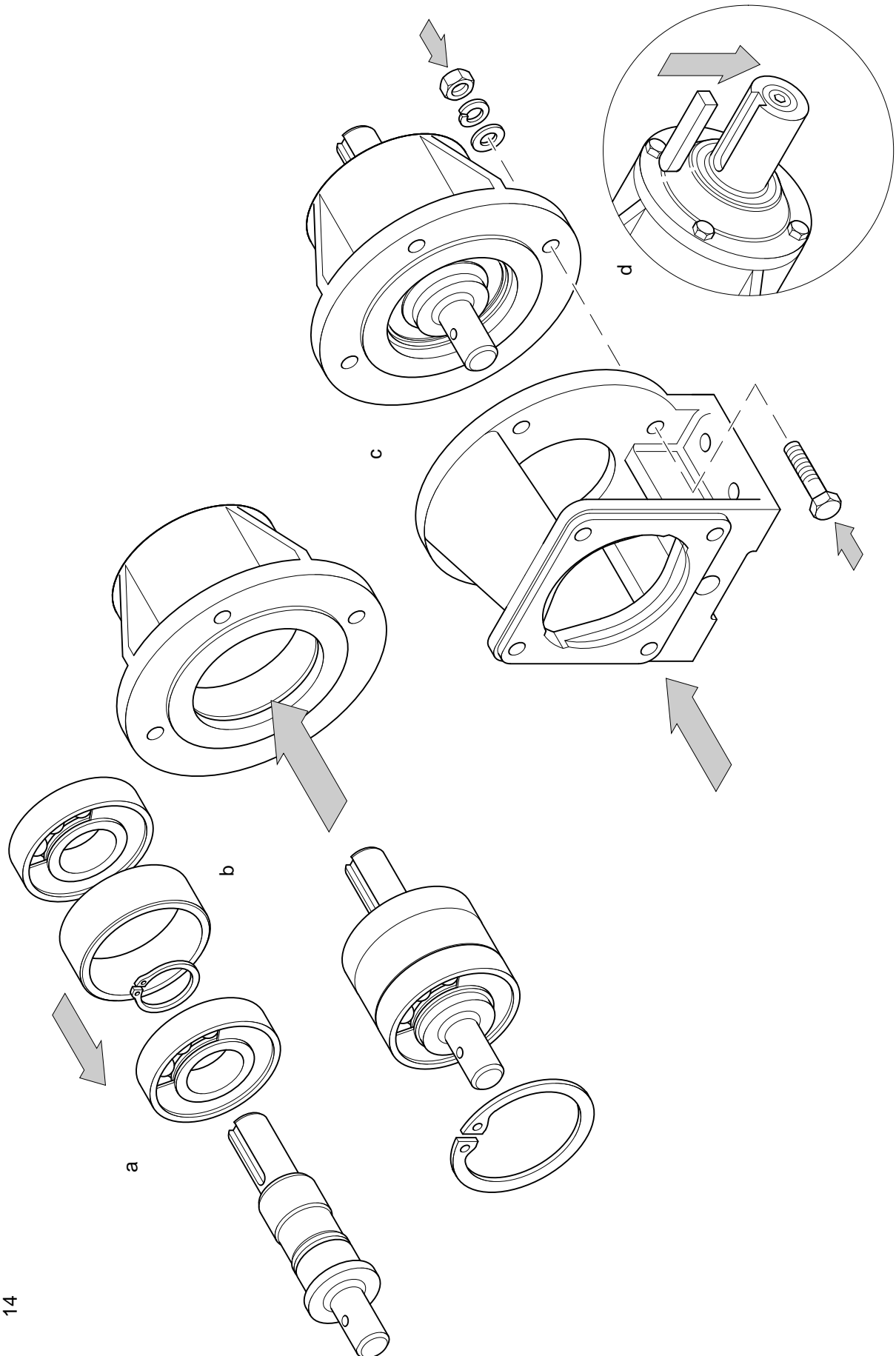
# Dismantling & Assembly Diagrams



FOR PUMP SIZES: E026, E028, E034, E0X2

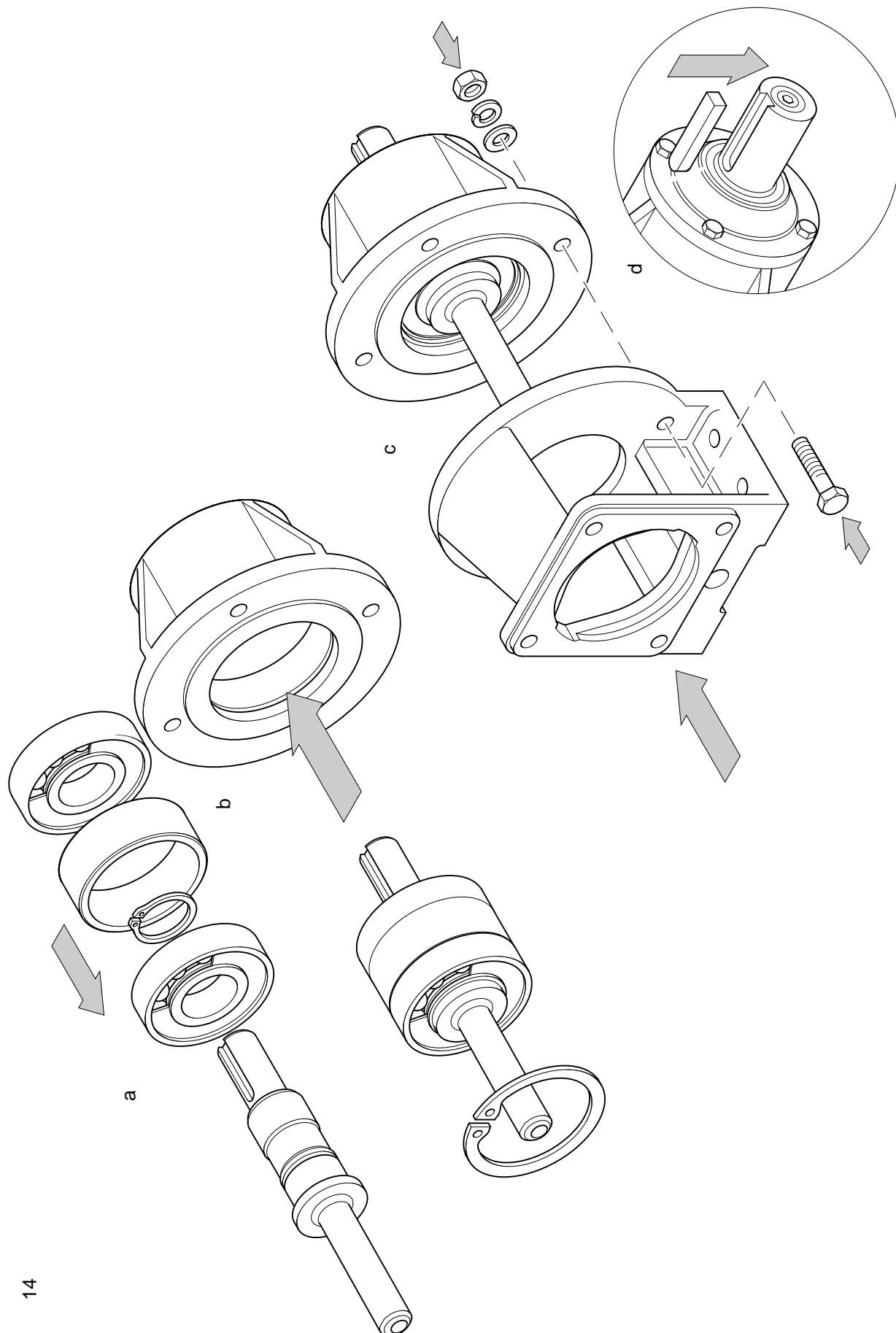
# Dismantling & Assembly Diagrams

FOR PUMP SIZES: E012, E014, E021, E022, E024, E031, E03K, E032, E0X1 - TWO PIECE SHAFT DESIGN



# Dismantling & Assembly Diagrams

FOR PUMP SIZES: E012, E014, E021, E022, E024, E031, E03K, E032, E0X1 - SINGLE PIECE SHAFT DESIGN

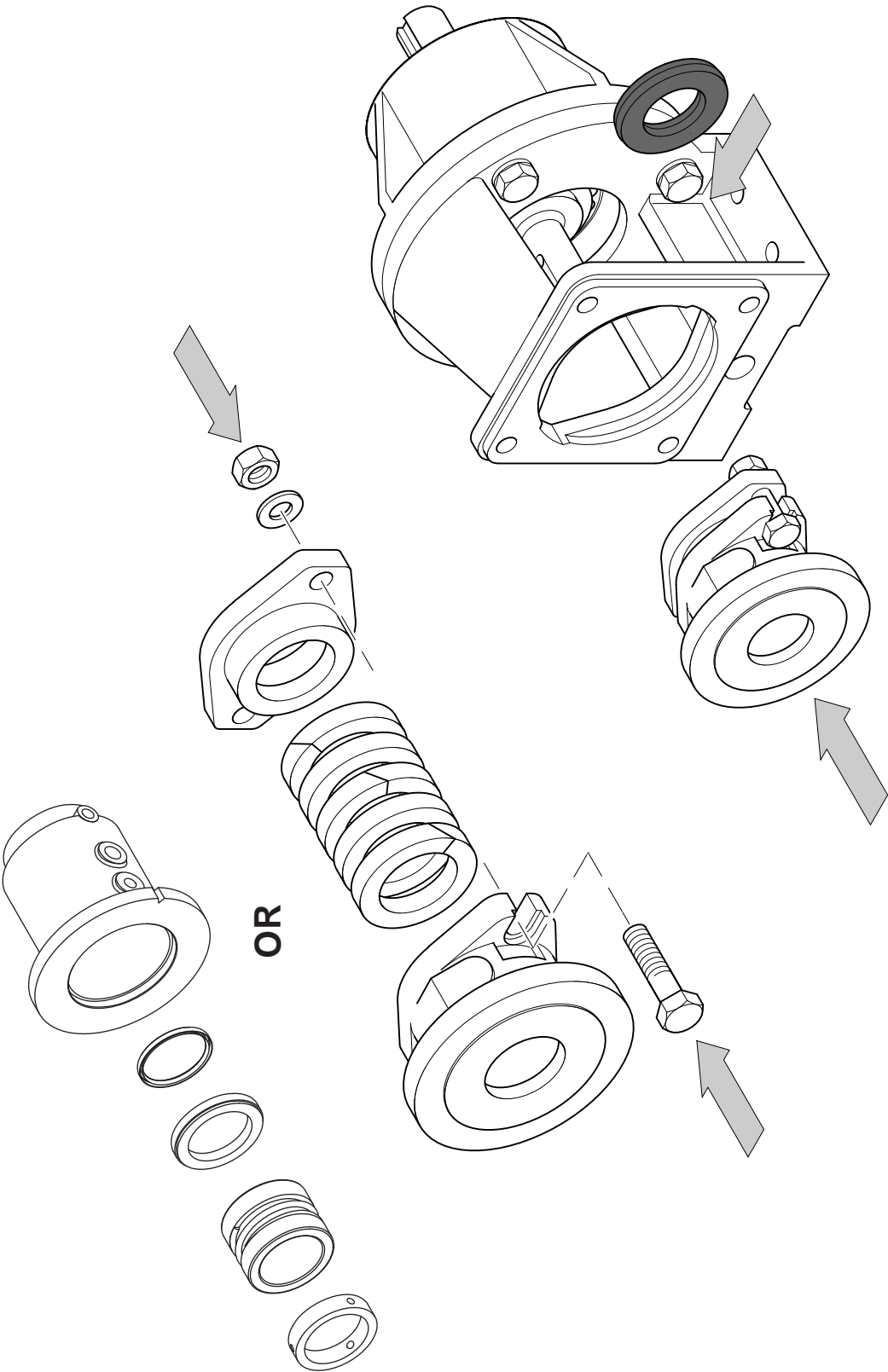


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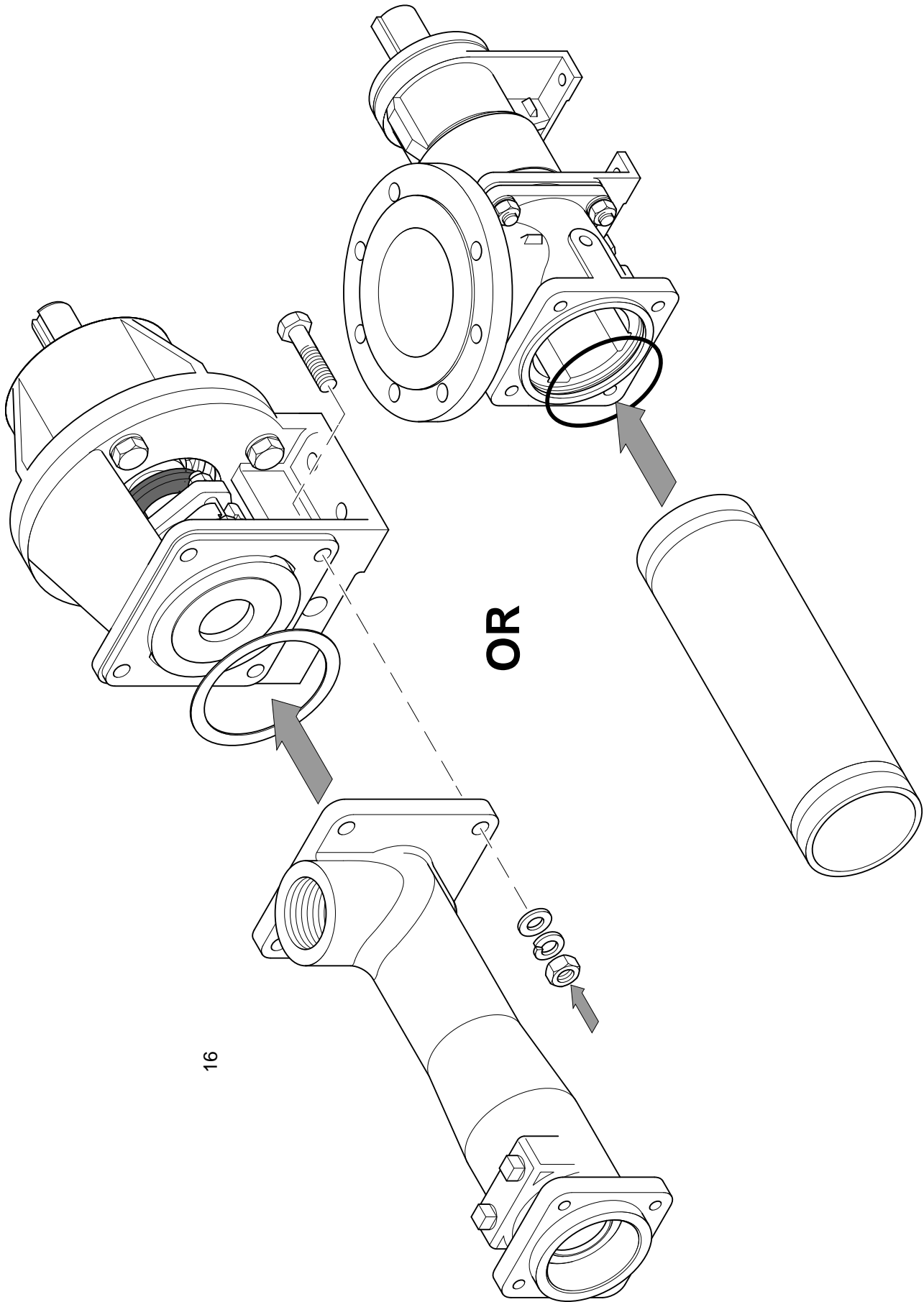
# Dismantling & Assembly Diagrams

FOR PUMP SIZES: E012, E014, E021, E022, E024, E031, E03K, E032, E0X1

15

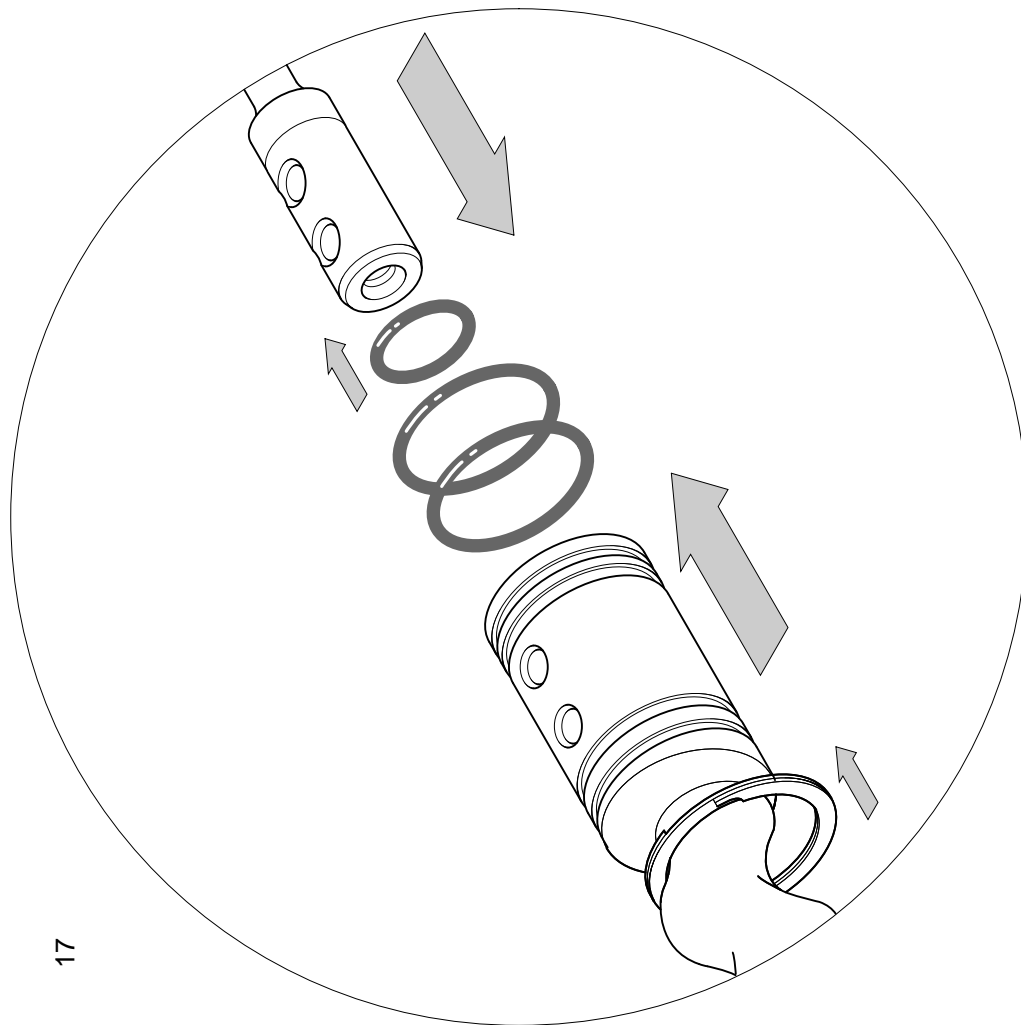
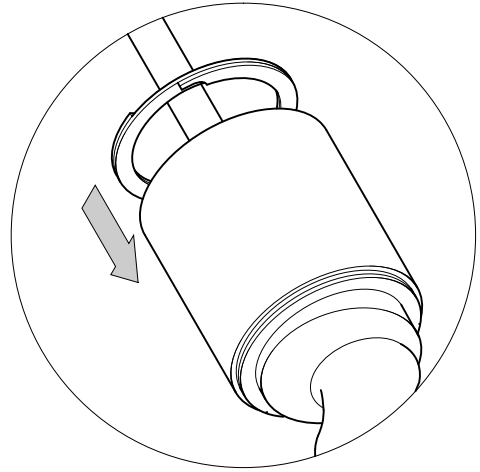
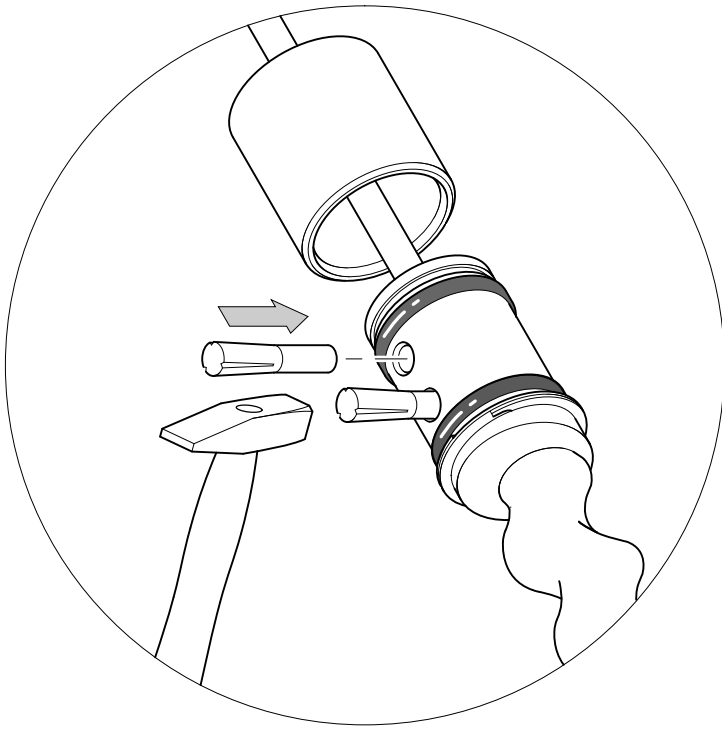


# Dismantling & Assembly Diagrams



16

# Dismantling & Assembly Diagrams

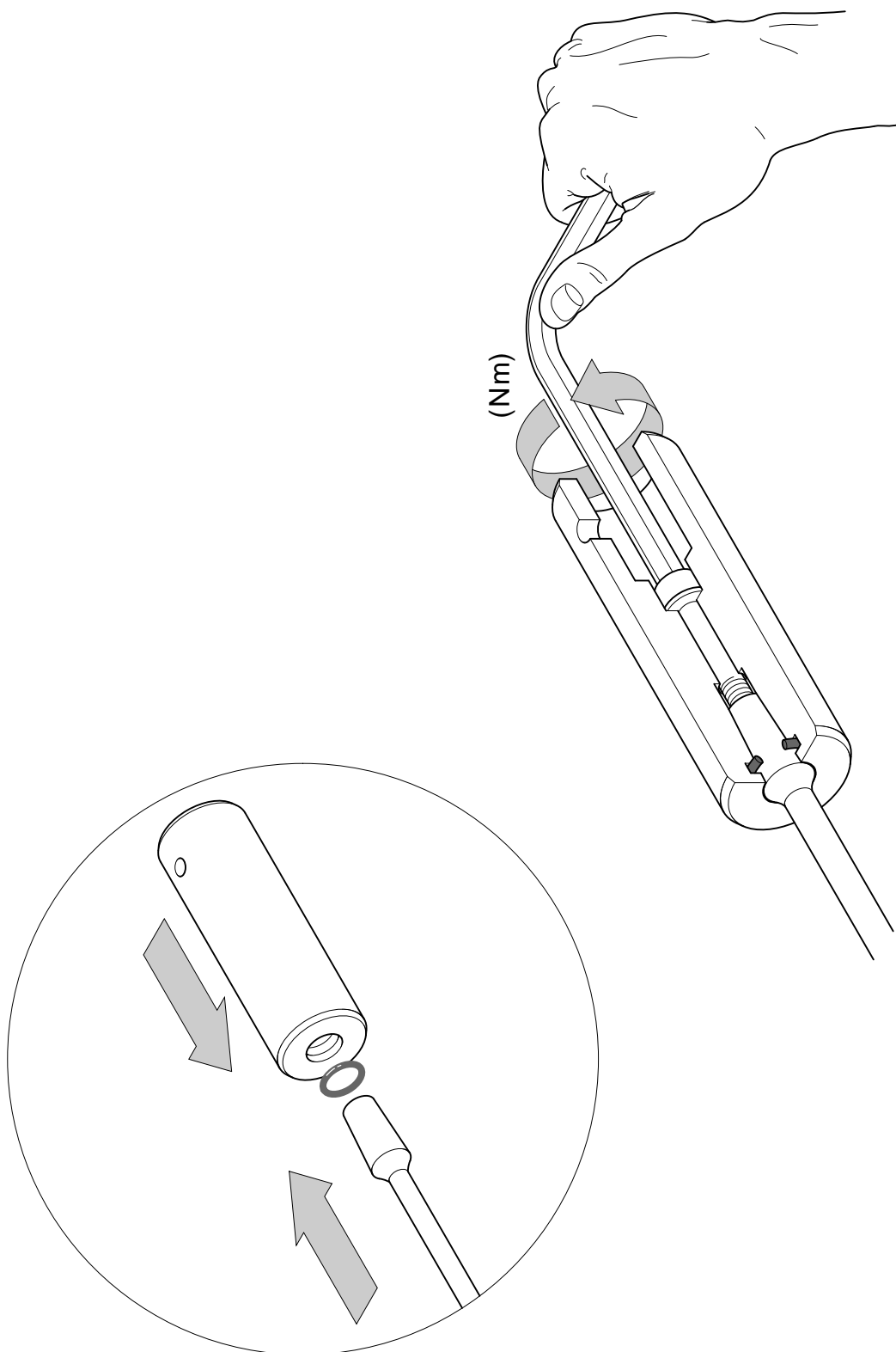


17

# Dismantling & Assembly Diagrams

FOR PUMP SIZES: E012, E014, E021, E022, E024, E031, E03K, E032, E0X1 - TWO PIECE SHAFT DESIGN

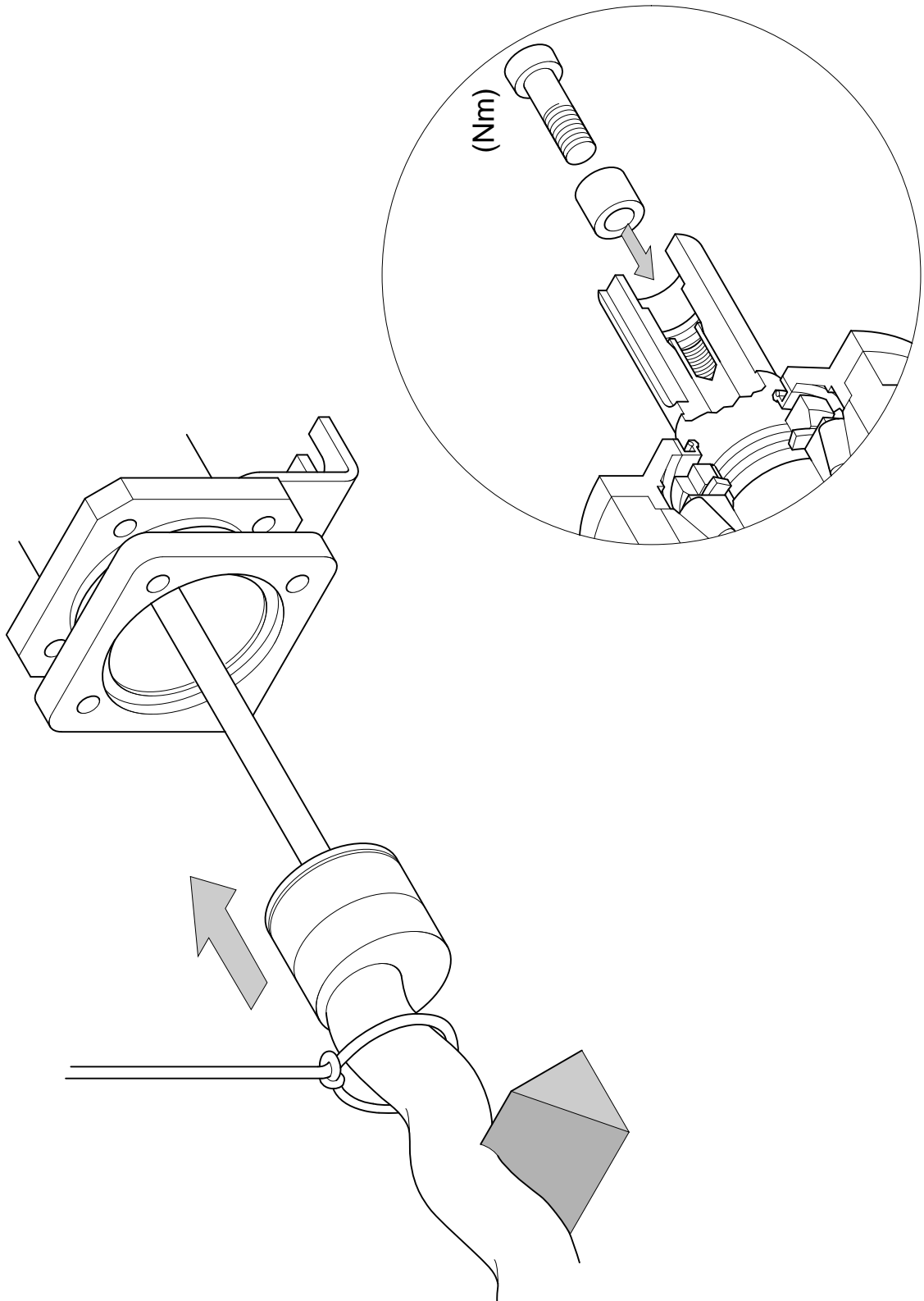
18





# Dismantling & Assembly Diagrams

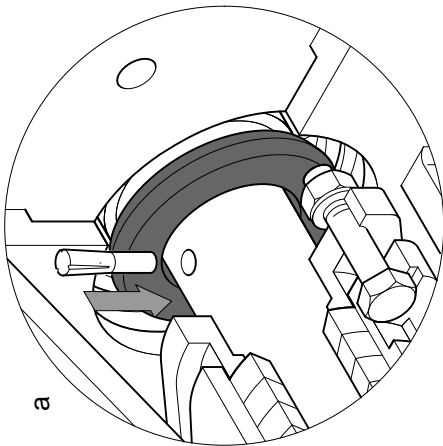
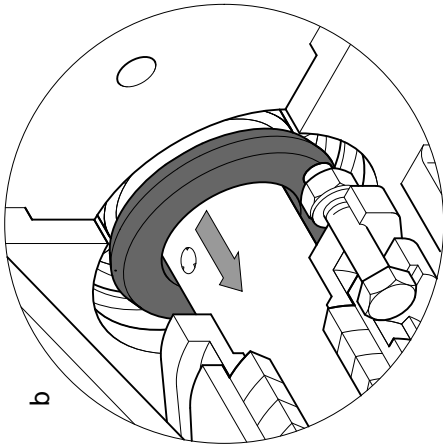
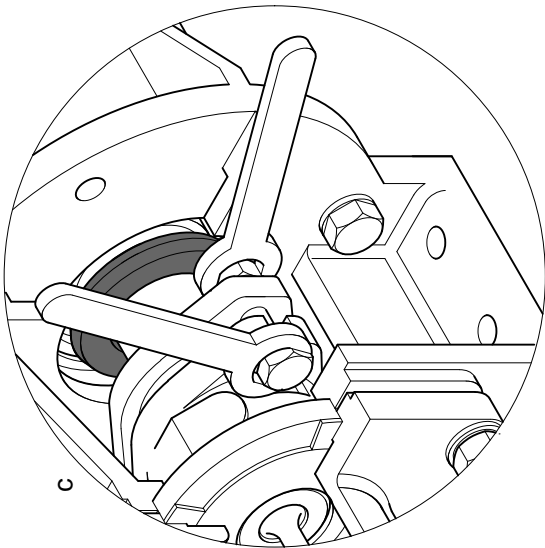
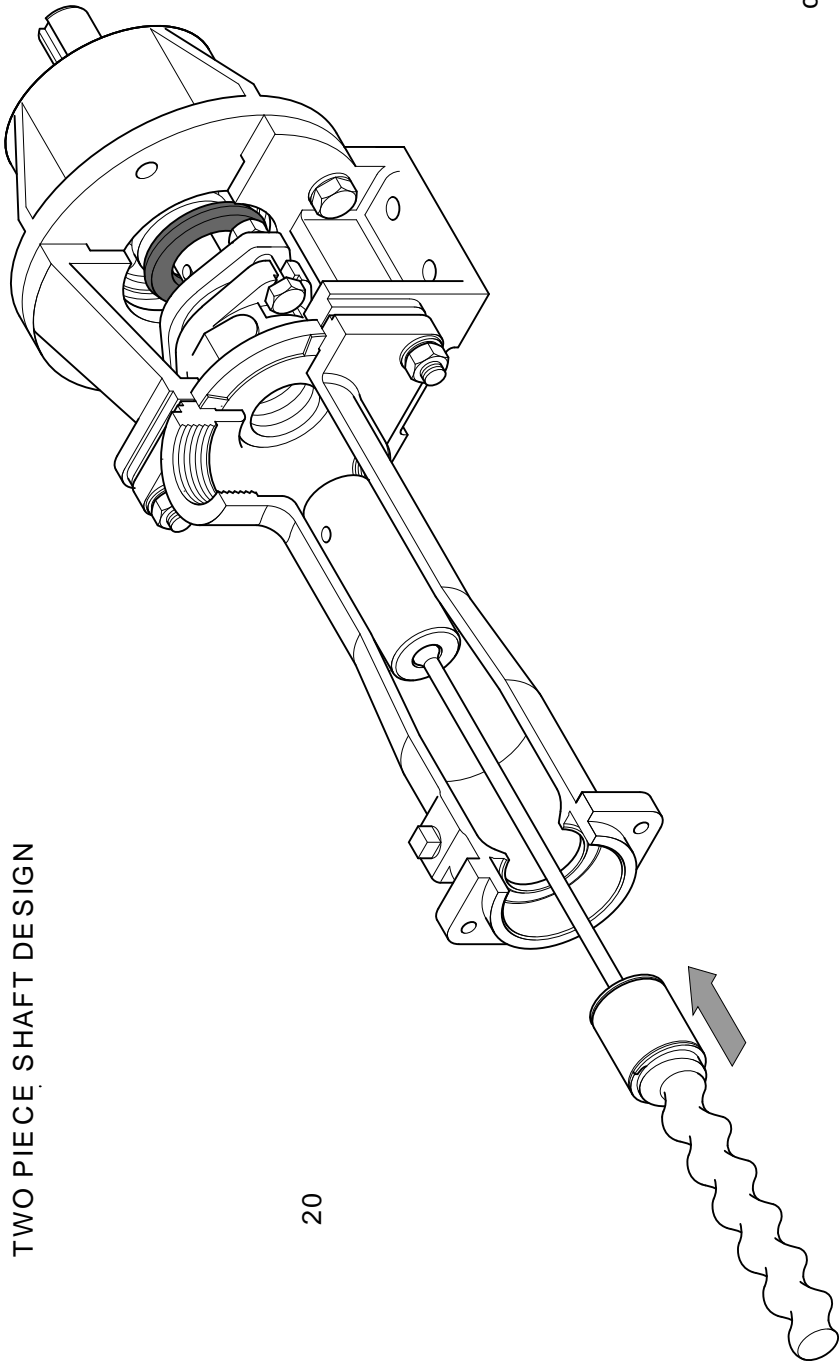
FOR PUMP SIZES: E034, E0X2, E026, E028 and sizes E012, E014, E021, E022, E024, E031, E03K, E032, E0X1  
- SINGLE PIECE SHAFT DESIGN



# Dismantling & Assembly Diagrams

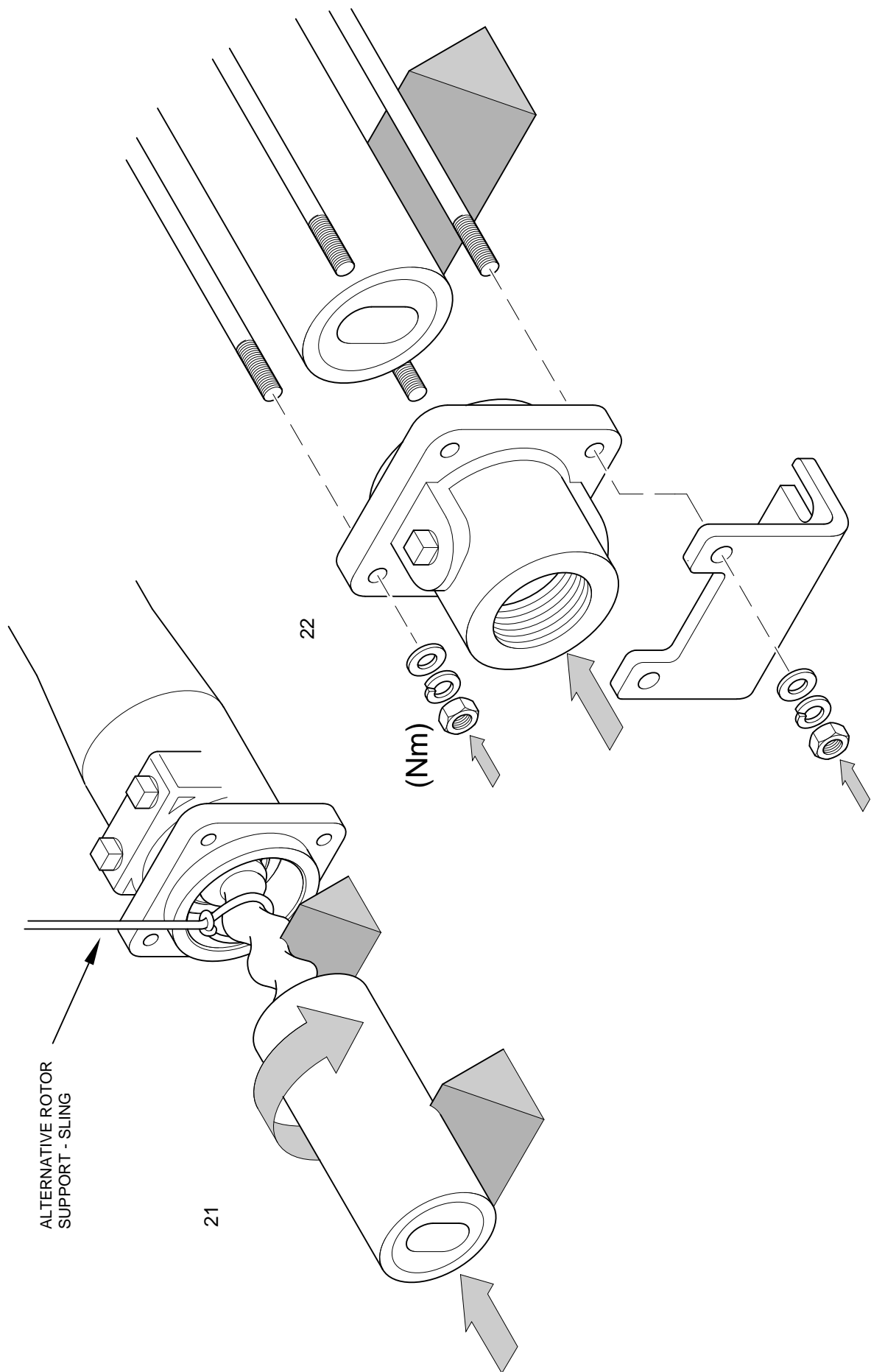
FOR PUMP SIZES: E012, E014, E021, E022, E024, E031, E03K, E032, E0X1  
TWO PIECE SHAFT DESIGN

20

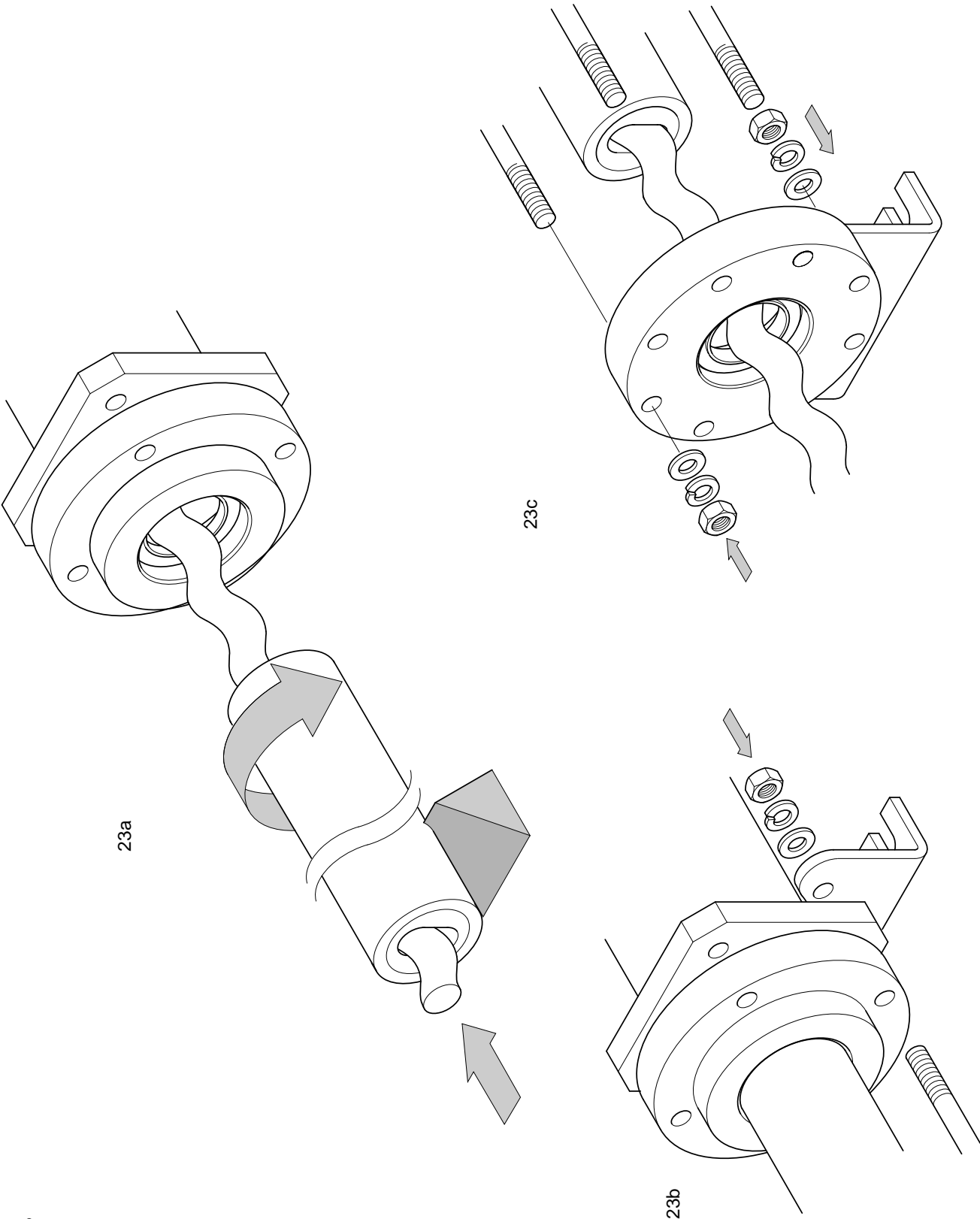


# Dismantling & Assembly Diagrams

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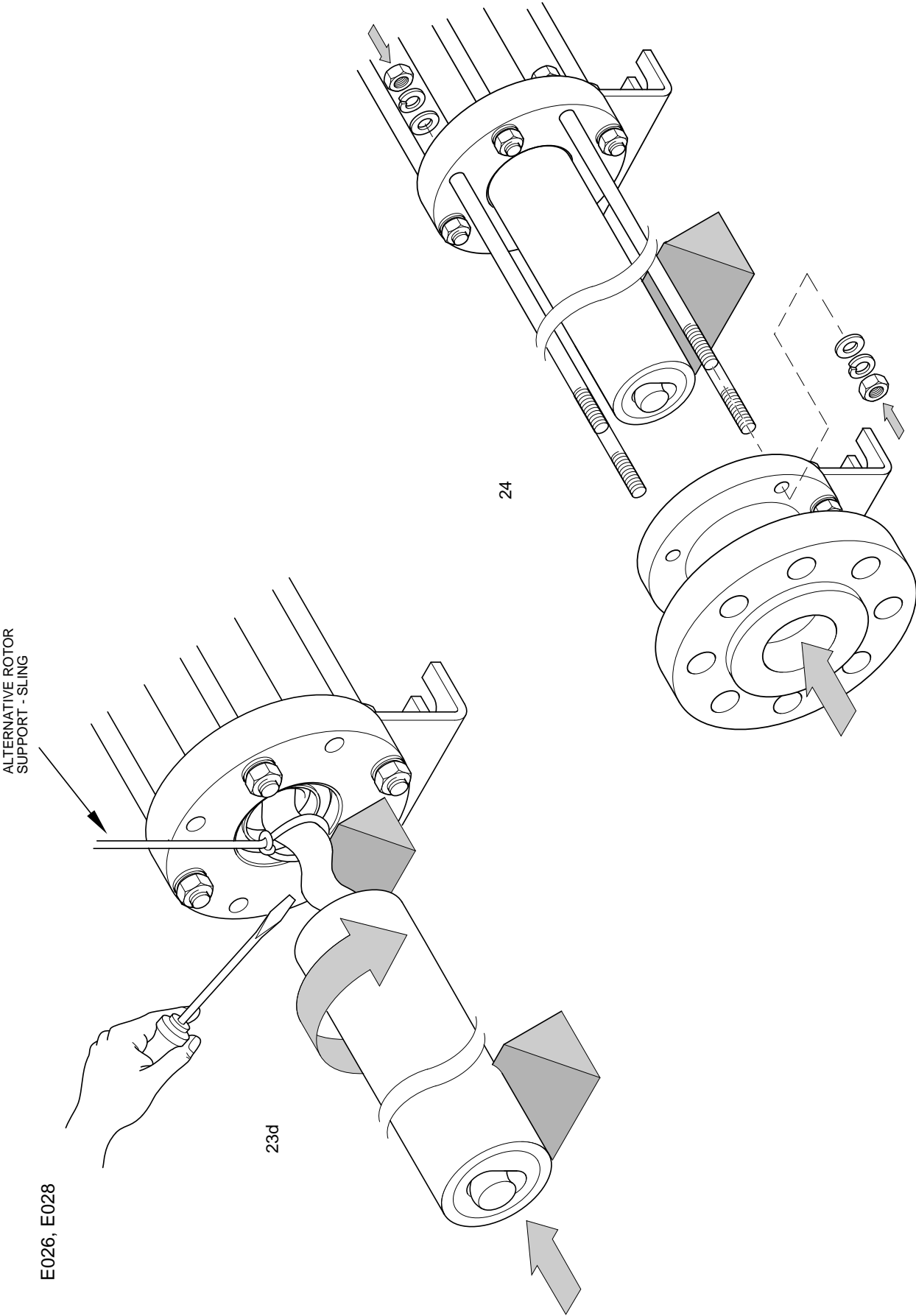


# Dismantling & Assembly Diagrams

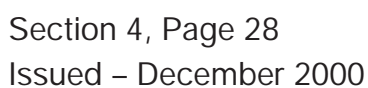


E026, E028

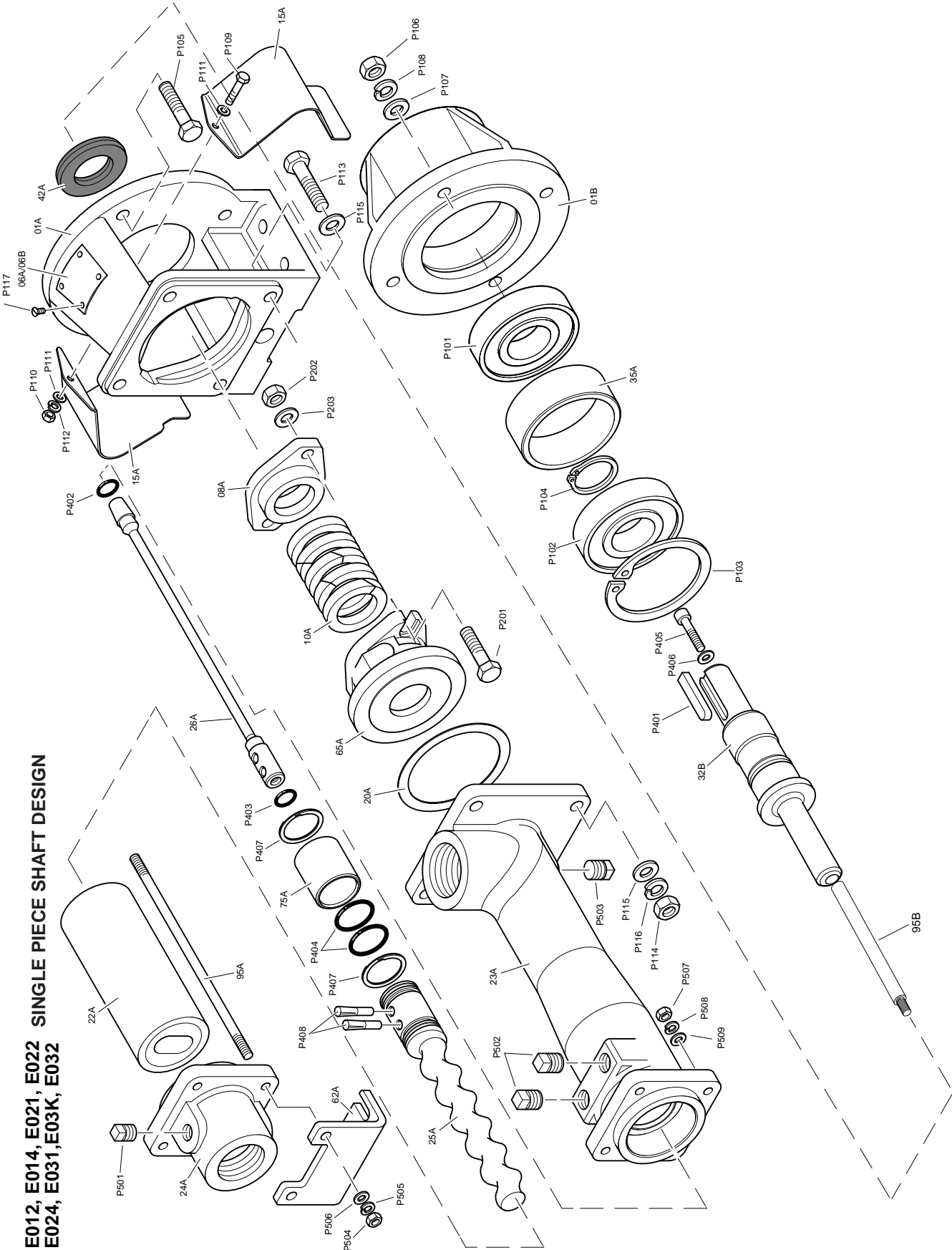
# Dismantling & Assembly Diagrams



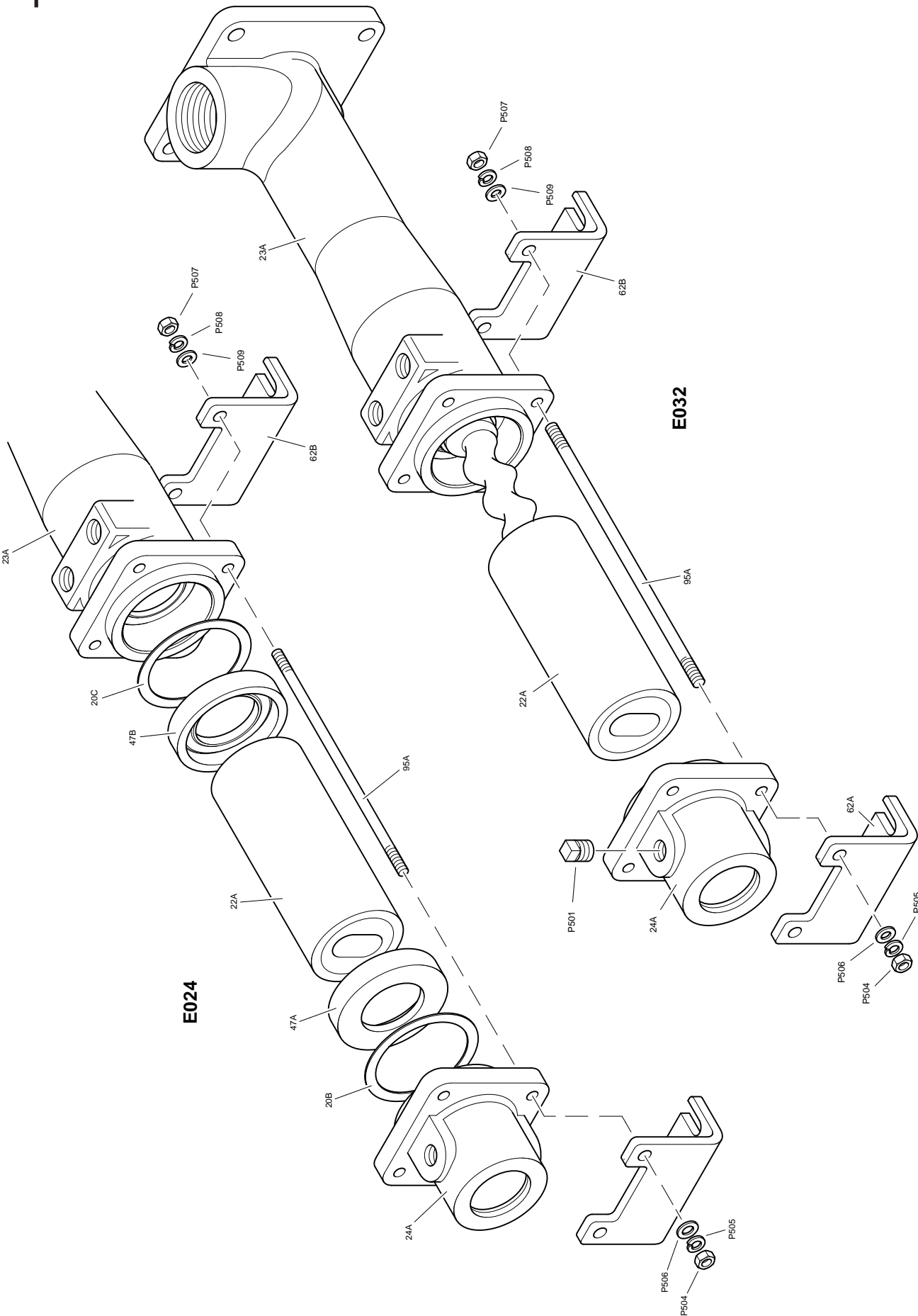
**E012, E014, E021, E022  
E024, E031, E03K, E032**



# Exploded Views

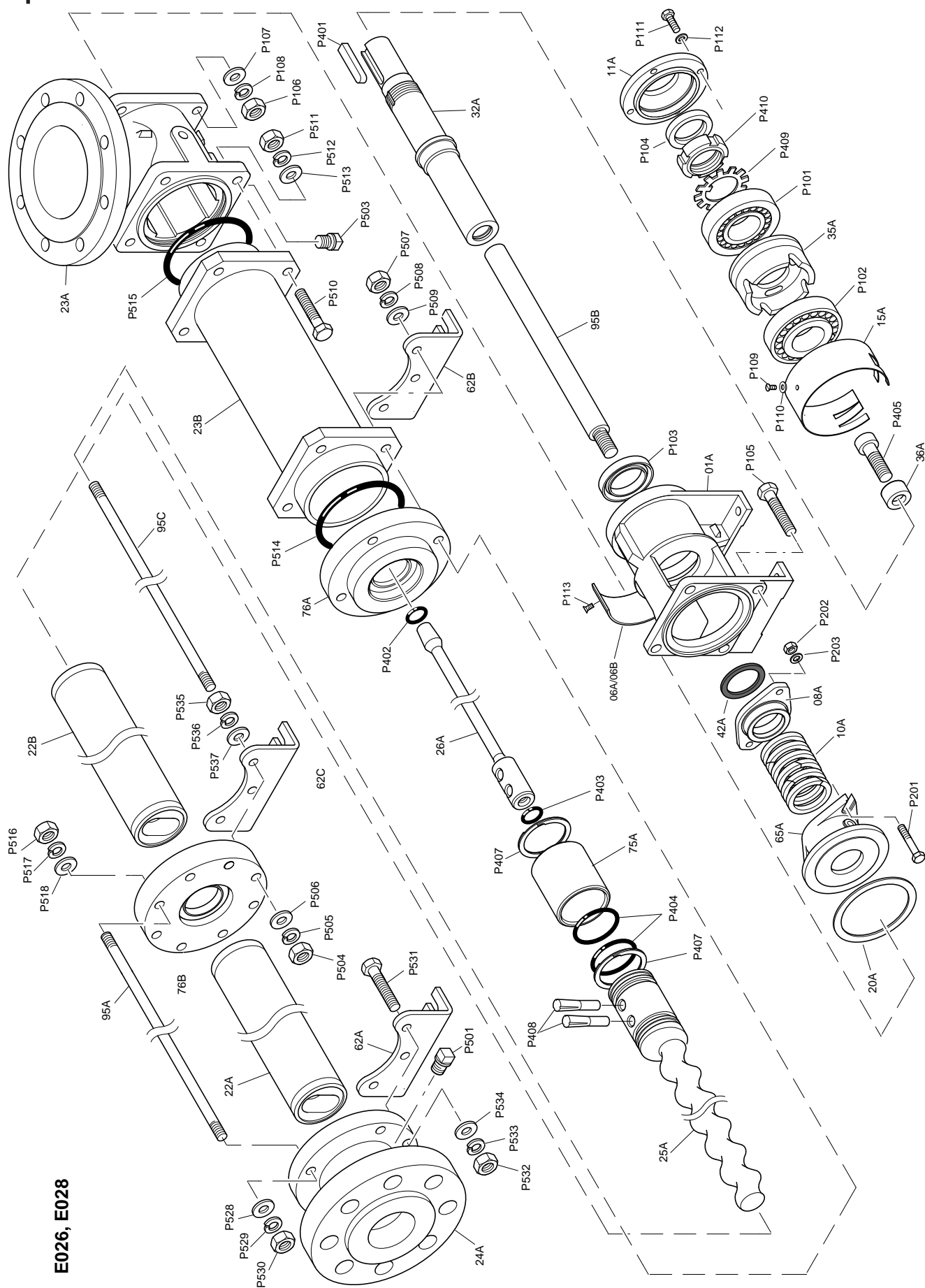


# Exploded Views





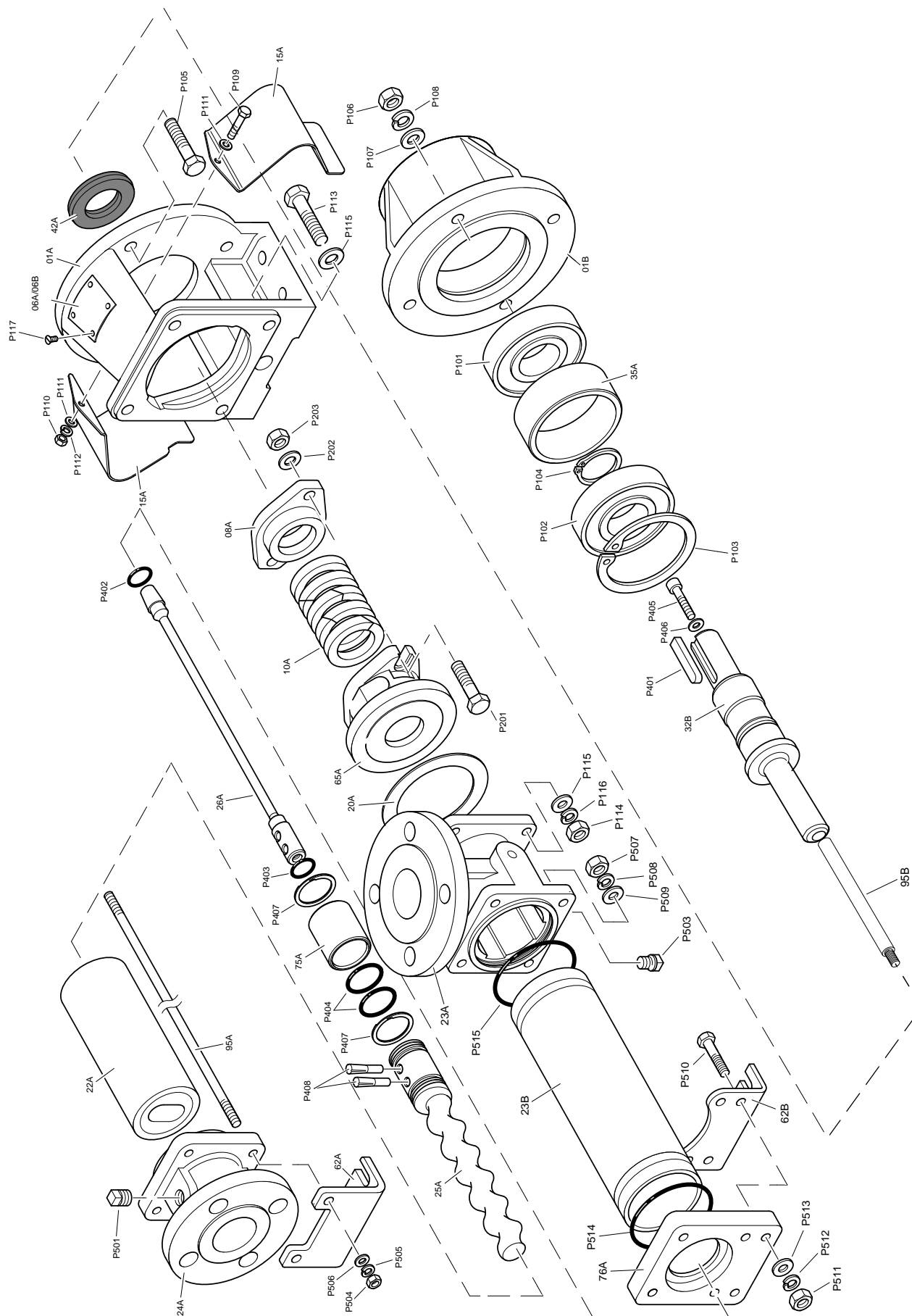
# Exploded Views



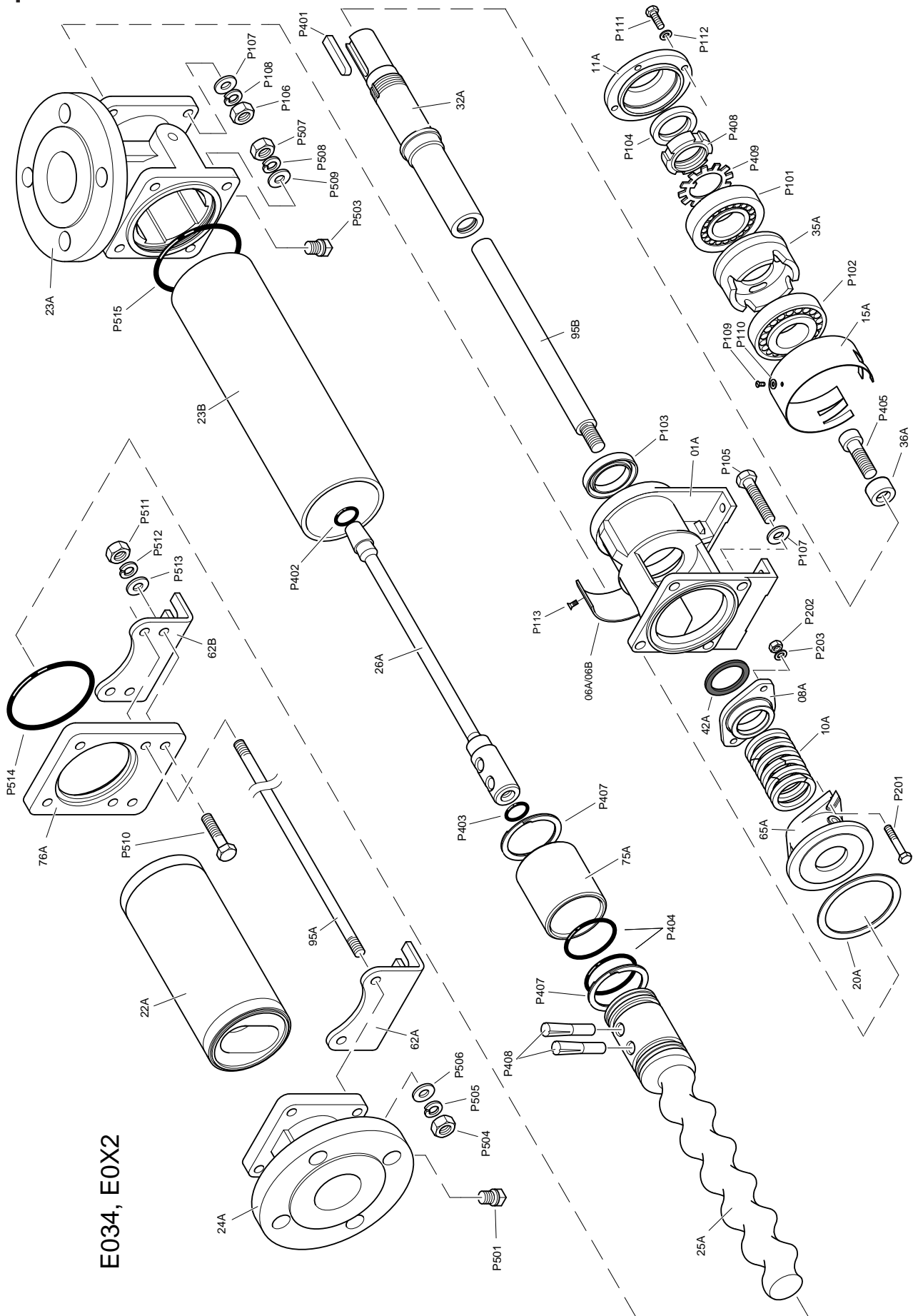
## E0X1 - TWO PIECE SHAFT DESIGN



# Exploded Views

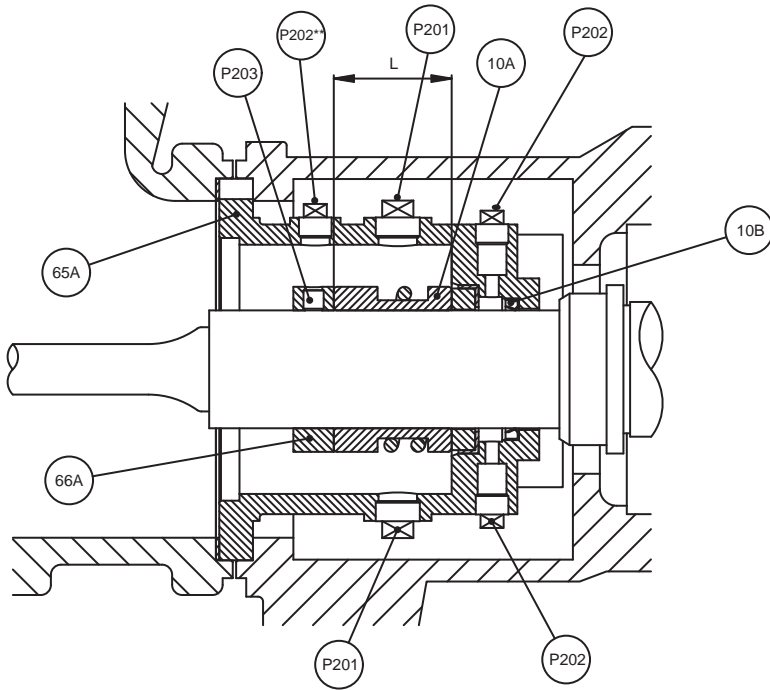


# Exploded Views



E034, E0X2

# Setting Length - Mechanical Seal



Drawing Identification Number	Description
P201	¼" NPSI Taper Plug
P202	⅛" NPSI Taper Plug
P203	Grub Screw
10A	Mechanical Seal
10B	Lipseal (Optional)
65A	Seal Housing
66A	Abutment Ring

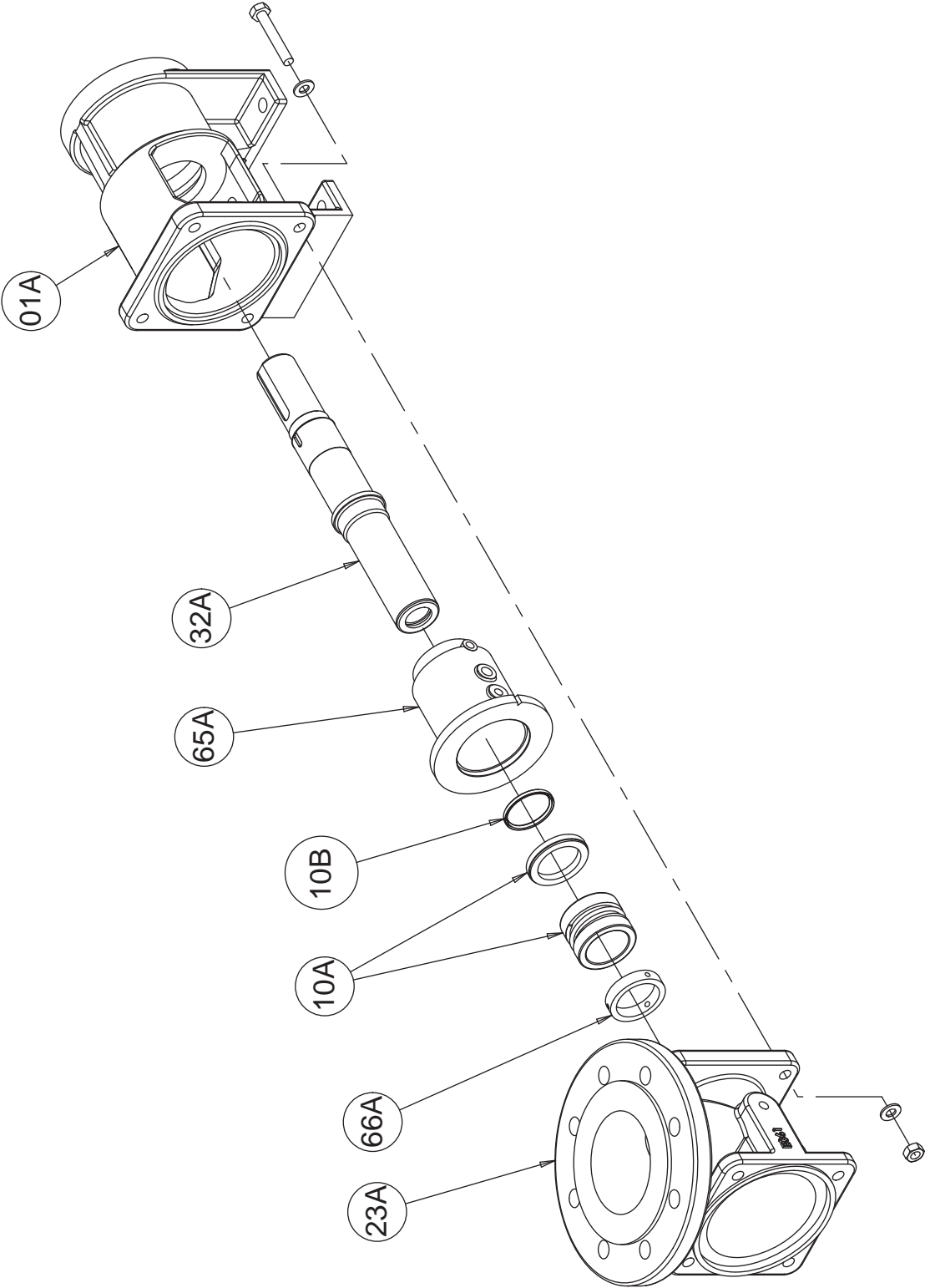
Pump Models	Seal Housing	Shaft Diameter (mm)	Setting Length L Crane 2100* (mm)
E021 E022 E024 E03K E031 E032 E0X1	E012	32	35.5
E026 E028 E034 E0X2 E04K E041	E041	32	35.5
E0X4 E042 E05K E051	E051	35	34.5
E044 E048L E052 E06K E061	E061	45	37
E048 E054 E062 E07K E071 E08K E081	E081	55	37.5
E064 E072 E082 E09K E091 E10K E101	E101	65	40.5
E066 E068 E074 E084 E092 E102 E12K E121	E121	85	47.5

\* For seals other than the Crane 2100 please refer to the manufacturer's instructions.

\*\* Not on Seal Housing size E012

# Exploded Views - Mechanical Seal

FOR PUMP SIZES: E026, E028, E034 AND E0X2



# Torque Tightening Figures

PUMP SIZE	SUCTION CHAMBER/ SUCTION EXT.		STATOR TIE BAR		BEARING COVER		**DRIVE END FLEXISHAFT CAP SCREW	**DRIVE END SHAFT TIEBAR CAP SCREW
	Nm		Nm		Nm		Nm P405	Nm P405
	P106	P114	P504, P507	P516, P531	P111	P106		
E012	-	10	4	-	-	10	15	-
E014	-	10	4	-	-	10	15	-
E021	-	10	4	-	-	10	15	-
E022	-	10	4	-	-	10	15	-
E024	-	10	4	-	-	10	15	-
E026	13	-	10	10	10	-	-	15
E028	13	-	10	10	10	-	-	15
E031	-	10	4	-	-	10	15	-
E03K	-	10	4	-	-	10	15	-
E032	-	10	4	-	-	10	15	-
E034	13	-	10	-	10	-	-	15
E0X1	-	10	10	-	-	10	15	-
E0X2	10	-	10	-	10	-	-	15

**Note:** Torque tolerances are +/- 5% of stated nominal figures.

**\*\*** Apply thread-locking compound to screw threads and male thread of Flexishaft tie bar (95B) prior to assembly.

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