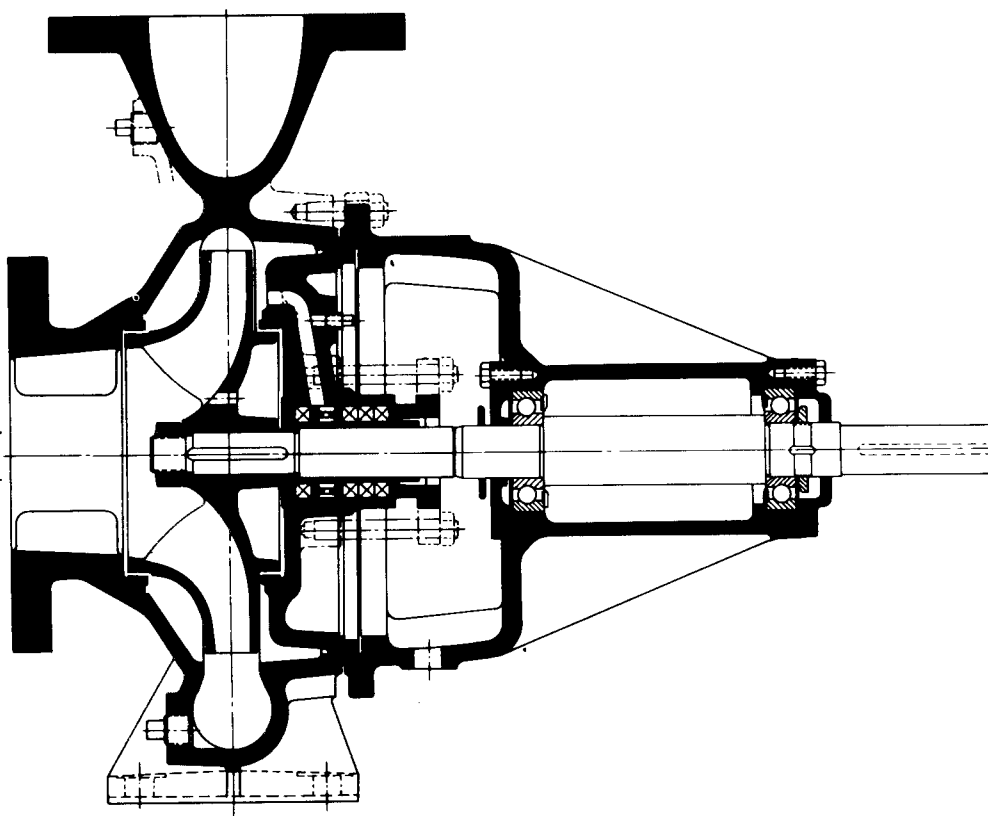


OPERATING AND MAINTENANCE INSTRUCTIONS**END SUCTION
SINGLE STAGE
CENTRIFUGAL PUMPS****ETA**

Preface

Our pumps are of sturdy design, and are constructed to give satisfactory service for a long period of time when the instructions outlined in this manual are followed.

The warranty applies only when the pumps:

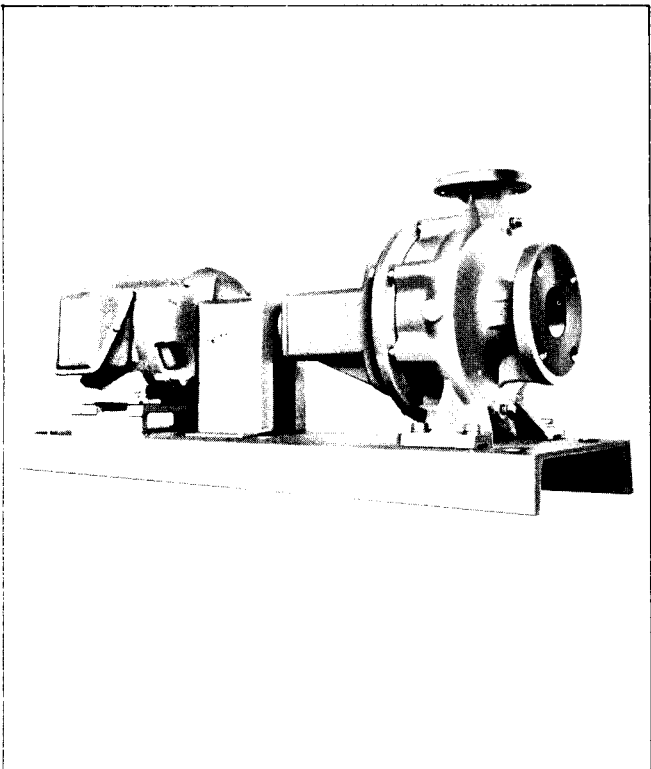
- (1) Have been installed in accordance with our installation instructions No. 010-I-506, which are attached to each pump.
- (2) Are put in operation and serviced as outlined herein following.
- (3) Are operated under such conditions as are specified in our Order Acknowledgment.

Should the pump be used for service other than designed conditions, such as different liquid, change in temperature, or other operating conditions, consult Carver Pump Co. or its distributor to ascertain suitability of the pump for the new conditions.

WARNING

Misapplication of unit may create a hazard. Unless operating conditions are supplied to vendor, customer assumes responsibility for proper application of unit.

The ETA pump is of horizontal end suction design with foot mounted volute casing. It provides back pullout removal of impeller from casing without disturbing pipe connection, and for units equipped with spacer type coupling, even without removing motor.



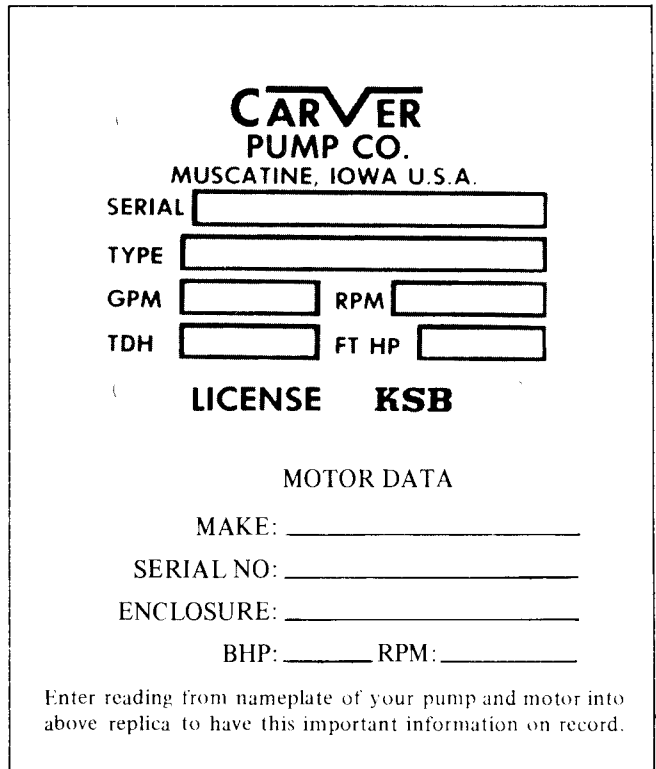
Typical Pump-Motor-Base assembly (pump shown with C-frame).

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I. Pump Identification

A nameplate is affixed to each pump containing the data shown in the photograph below. It is recommended that the data from this nameplate be recorded and placed in your files for ready reference. If information is required concerning the pump, or spare parts are needed, this data must be furnished to Carver Pump Co. or its distributor.



Pump Nameplate

II. Start-up Procedure

- a. Check final alignment of pump and driver as described in INSTALLATION INSTRUCTION No. 010-I-506 Para. VI, attached to shipment.
- b. Connect auxiliary connections. (Details below under Para. B).
- c. Check stuffing box packing or mechanical seal to be installed in good order. Gland nuts of packing gland should be finger tightened only.
- d. Check bearing lubrication (Details on page 3 under Para. C).
- e. Check driver to rotate in same direction as indicated by arrow on pump (Clockwise viewing from motor end towards pump).
- f. Connect both coupling halves.
- g. Check coupling for easy turning by hand, otherwise loosen stuffing box packing (packed pumps only) or recheck shaft alignment.
- h. Mount coupling guard in accordance with OSHA laws.
- i. Open suction valve and fill pump completely with fluid.
- j. Start driver and allow it to attain full speed.
- k. Open discharge valve slowly until full open. (Extended operation of pump against closed valve can cause hazardous overheating).
- l. Check unit for undue operation or noise. If it does not diminish within a short time, unit should be shut down for investigation of cause. For its remedy refer to Sect. X - Trouble Shooting, or consult factory.
- m. For packed pumps readjust stuffing box packing to reduce leakage. Do not over-tighten to stop leakage of standard type packing (cotton or asbestos type) completely. This will prevent sufficient lubrication to the packing rings which will burn out and fail. Over-tightening of any type packing can also cause undue wear on shaft sleeve and excessive torque load on pump shaft and driver.
- n. Check and record differential head also referred to as Total Dynamic Head (TDH) as follows: For suction head deduct suction gauge reading from discharge gauge reading. For suction lift add suction gauge reading to discharge gauge reading. Established TDH should be identical to that stamped on pump nameplate.
- o. Check and record pump bearing temperature which should not exceed 180° F.
- p. Check and record driver power input which should not exceed that stamped on motor nameplate.
- q. Set motor protection switch to trip before motor is overloaded and damaged.

B. Auxiliary Connections.

1. SHAFT SEAL FLUSH, unless specified differently is provided by internal connection for flow of pumping fluid from volute into stuffing box housing (Fig. 1).

Modification for external flush connection (Fig. 2) at factory, if specially requested, or at site, is possible. For pumping fluids contaminated with erosives, fibrous or other clogging substances external flush arrangement for stuffing box packing (Fig. 2) or mechanical seal (Fig. 3) can be provided for clean fluid from outside source or purified pumping fluid. In latter case dirt separator or filter has to be provided in external flush line to pump discharge nozzle.

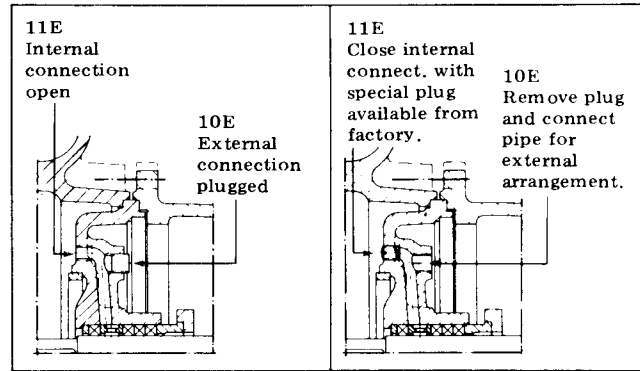


Fig. 1. Internal Liquid Seal

Fig. 2. External Liquid Seal

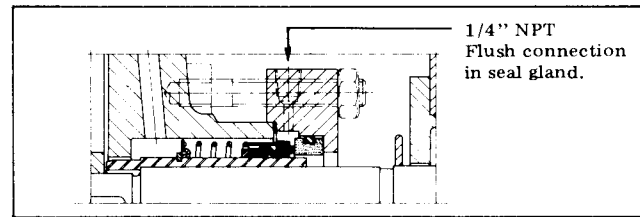


Fig. 3. Typical Mechanical Seal and Gland

For packed pumps handling fluid under vacuum external arrangement (Fig. 2) for seal fluid from clean outside source to lantern ring is required. Maintain seal flow also during shut down.

Pressure of flush or seal fluid from outside source must be at least 1-2 PSIG above pump suction pressure.

2. VACUUM BALANCE LINE (Fig. 4) is recommended for condensate application or where liquid to suction of pump is under vacuum, particularly if positive suction head is low. It serves the purpose to evacuate entrapped air and gas from pump. Connect line as close as possible to suction flange. At start up open valve E and close it after venting is completed. Valve A stays always open except at shutdown.
3. COOLING of stuffing box (Fig. 5) must be provided for packed pumps if temperature of pumping fluid exceeds 220°F. Clean, fresh water is to be used as coolant since sediments, calcium or lime deposits, will impair cooling effect. Periodic cleaning of cooling cavity is recommended. Provide valve in cooling water supply line for economical flow adjustment and shut-off during shutdown.

III. Maintenance

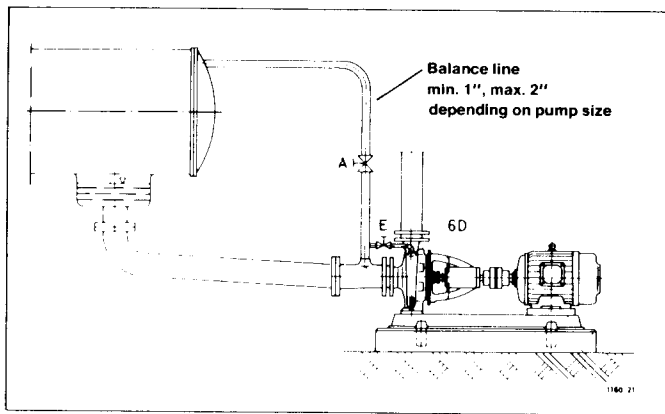


Fig. 4. Vacuum Balance Line

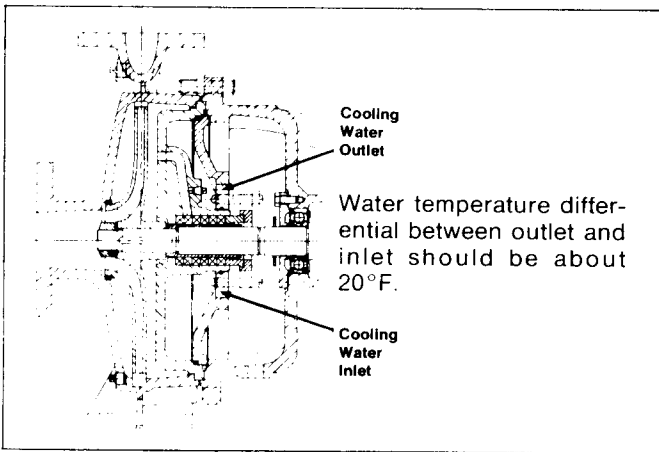


Fig. 5. Cooling water connection for packed pump with optional cooled stuffing box "High Temp Design".

PUMP IMPELLER SIZE	GALLONS/HR
125	22
160	25
200	30
250	40
315	55
400	130

Fig. 6. Cooling water requirements for operating temperatures over 220° F. (Based on 70° F. water temperatures).

The temperature difference between cooling water inlet and outlet should be about 20° F. Cooling water pressure must not exceed 85 PSIG.

C. Bearing Lubrication.

The ball bearings are grease lubricated. Factory grease packing is adequate for minimum of 8600 operating hours equivalent to 1 year round the clock service under normal conditions. After extended storage or storage exposure to unusual humid or hot environment, condition of bearings and their lubricant should be checked before placing pump into operation. For further details refer to OPERATING AND MAINTENANCE INSTRUCTIONS, Sect. III - "Maintenance" - Para. B1.

Generally the pumps do not need continuous supervision. Occasional visual checking is recommended. For detection of operational difficulties or of wear, and to ascertain that proper maintenance is being conducted, it is suggested that a maintenance record be kept for each pump, starting with the date and time the pump goes "on-stream," indicating any shut-down and re-start, as well as each field and shop inspection and findings of such inspections.

A. Field Inspection:

Requires no shut-down. It should be performed at regular intervals, and should cover the following:

1. Check of suction and discharge pressure, to establish differential head (TDH), which should conform to that stamped on pump nameplate.
2. Check of power input and speed of driver.
3. Check of pumping temperatures.
4. Check of pump for quiet running.
5. Check of stuffing box for increased leakage (adjust gland nut if required; do not over-tighten).
6. Check of bearings for smooth and quiet running. Also outside of bearing housing to maintain same surface temperature.

B. Field or shop service:

Requires shutdown. This should cover the following:

1. Grease change is recommended every 6 months but is required at least once a year, subject to normal operating conditions. To change grease connect grease gun to grease nipple at bearing cap. Pump in new grease until all old and discolored grease is squeezed out through overflow hole on opposite side of grease nipple. When new grease shows up on overflow hole the grease change is completed. Every 3 years removal of bearing for thorough cleaning and inspection of running surfaces for signs of deterioration is recommended. In case of serious deterioration bearings must be replaced. Bearings are lubricated at Carver Pump Company with Amoco Rykon Premium Grease No. 2EP, a non-soap, polyurea thickened grease with a drop point of 450 degrees F. This grease was selected because of its suitability to extreme pressures and its high temperature stability. **Never mix greases with differing properties.**

2. Replacing shaft seal.

a. Packed stuffing box.

Replacement of packing is required if gland nuts cannot be tightened any further to reduce excessive stuffing box leakage. Close suction and discharge valve, release pressure from casing. Remove gland

nuts, retract gland plate No. 17. Remove split gland ring No. 17A and inspect for damages. Pull packing ring No. 13 using special packing pulling device (commercially available). Watch for metallic or plastic lantern ring No. 29 which, if provided, follows after third packing ring. Lantern ring is split and slotted on outside diameter to facilitate its removal with wire hook. Make sure all packing rings are removed. Clean stuffing box bore, and neck of any residue. Check shaft sleeve for smooth surface, if necessary replace sleeve (See Dismantling, Sec. IV, page 5).

For repacking use either molded ring (available from factory) or make rings from random length packing material in accordance with specifications in Fig. 6A.

Bearing Frame Size	25	35	45
Packing Size, inches	$\frac{5}{16} \times \frac{5}{16}$	$\frac{3}{8} \times \frac{3}{8}$	$\frac{7}{16} \times \frac{7}{16}$
Required length "y" for 1 ring, inches	4 $\frac{1}{8}$	6 $\frac{1}{2}$	7 $\frac{3}{4}$

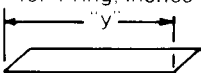


Fig. 6A. Specifications for stuffing box packing rings.

Cut in slant of approximately 30° for overlapping of ends when formed in a ring. (Fig. 7). Wrap pre-cut length around shaft sleeve and insert into stuffing box, applying slight pressure, followed by split lantern ring No. 29 (if provided). Off-set the overlapping ends of each pursuant installed packing ring approximately 90° from overlapping of prior in stalled ring, to avoid creeping of fluid through joints.

This applies also if split molded rings are used.

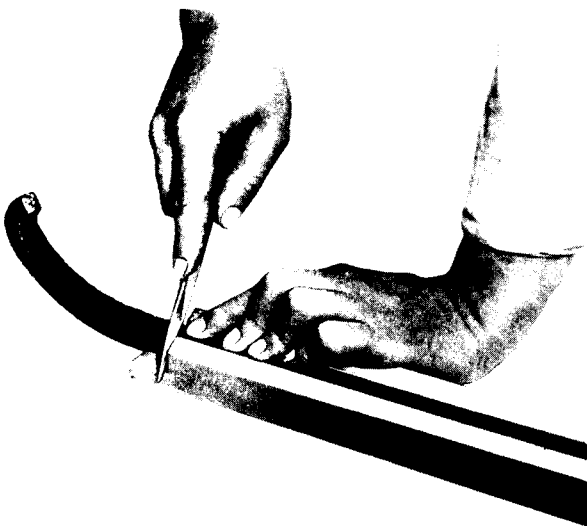


Fig. 7. Cutting packing rings at 30° angle.

Install either 1 packing ring followed by split lantern ring No. 79 and 3 further packing rings or 5 packing rings if no lantern ring No. 29 is provided. Install gland ring halves No. 17A to join over shaft and press assembly slightly into stuffing box so that last packing ring is recessed approximately 1/4" within stuffing box bore for positive guidance of gland ring and to avoid cocking. Slip gland plate No. 17 over gland studs and extending end of split lantern ring No. 17A. Adjust assembly equally with gland nuts until finger-tightened. Turn shaft by hand to ascertain that it turns freely. For final adjustment of stuffing box packing after restart of pump refer to Section II page 2, step M.

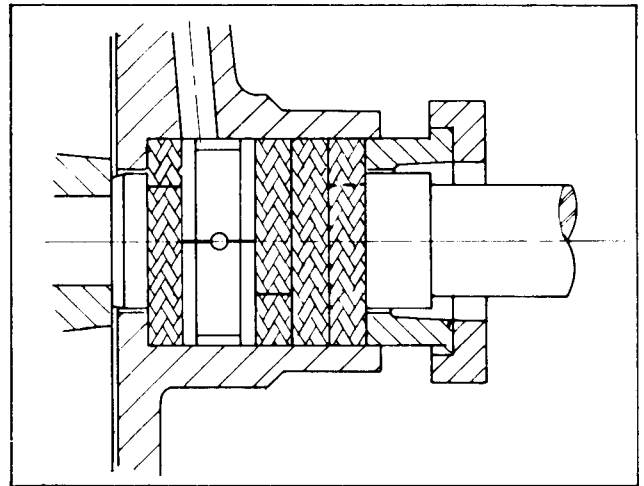


Fig. 8. Stuffing box packing arrangements.

b. Mechanical Seal.

Replacement of seal requires removal and dismantling of rotating element. Refer to Section IV, Dismantling, step a to o and continue Section VI Mechanical Seal, Para. c - Mounting of Mechanical Seals.

IV. Dismantling

Type ETA pump provides back pull out feature allowing removal of impeller, together with stuffing box cover and bearing frame, without disconnecting suction and discharge piping from casing, which remains bolted to the base. If spacer type coupling is provided the motor need not be moved either. (See Fig. 9).

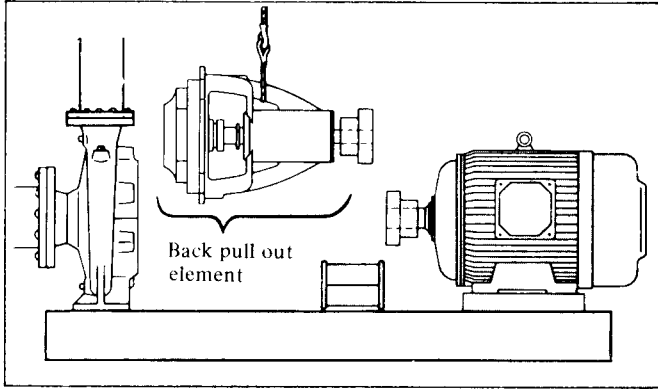


Fig. 9. Piping need not be disturbed, nor motor (when spacer coupling is used), when disassembling rotating parts and bearing frame.

After prolonged operation it may be difficult to separate some components. In this case rust solvent may be used and suitable extricating tools applied where possible. **NEVER USE FORCE.**

- a. Shut down pump.
- b. Close suction and discharge valve.
- c. Close off and disconnect all miscellaneous piping from stuffing box cover No. 11, gland No. 17 and bearing frame No. 19.
- d. Drain pump casing by removing drain plug (Auxiliary connection No. 6B).
- e. Remove coupling guard and disconnect coupling halves.
- f. If spacer type coupling is provided remove spacer sleeve otherwise driver must be moved to allow back pull-out clearance.
- g. Loosen nuts on casing studs.
- h. Pry gently bearing frame No. 19 out of casing No. 1, pull it back towards driver until back pull-out element disengages from casing studs (Fig. 10).

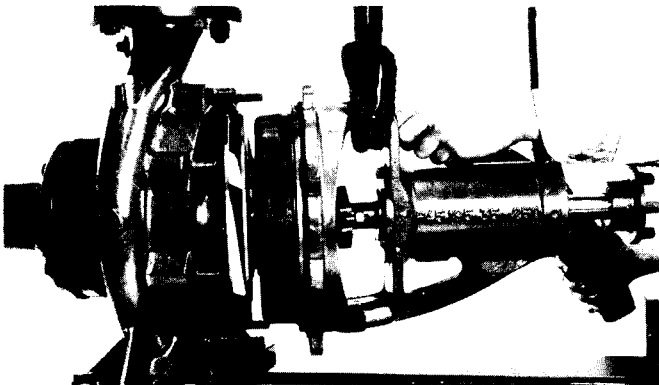


Fig. 10. Removing back pull-out unit. (K-Frame shown)

- i. Remove and discard casing gasket No. 73A. Inspect register faces for damage.
- j. The bearing frame assembly should now be securely mounted in vertical position to allow unobstructed removal of following parts:
- k. Remove impeller nut No. 24 (Fig. 11). Lockwasher No. 24A is provided and is to be removed only if no self locking impeller nut (plastic insert type) is used.

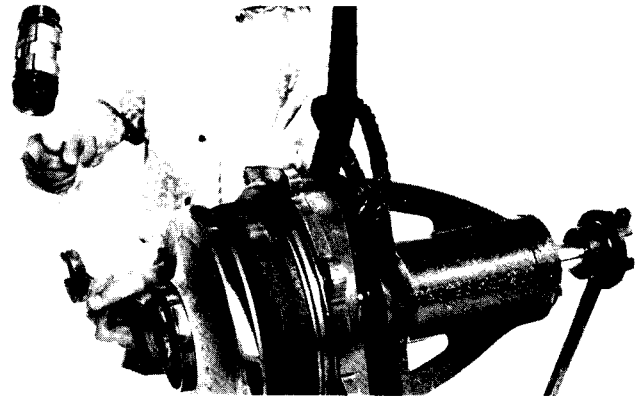


Fig. 11. Removing the impeller nut. (K-Frame shown)

- l. Pry impeller No. 2 gently from shaft (Fig. 12). Remove impeller key No. 32 from keyway in shaft and inspect for damages.

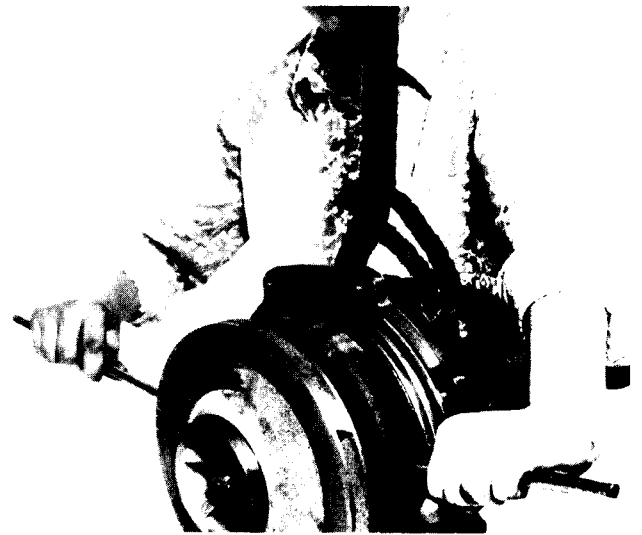


Fig. 12. Removing impeller, using two pry bars.

- m. Remove gland nuts and disengage gland No. 17 from gland studs.
- n. Drive gently stuffing box cover No. 11 out of register fit with flange of bearing frame housing No. 19. (Fig. 13).

NOTE: Dismantling procedure for C and K-Frame is the same.

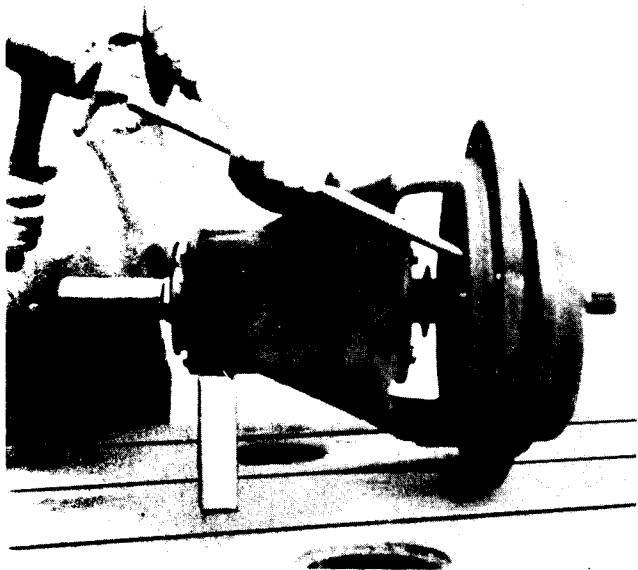


Fig. 13. Removing stuffing box cover from bearing frame. (C-frame shown)

- o. Check register faces to be unblemished.
- p. For high temperature design remove cooling cover No. 171 from rear of stuffing box cover. Check o-ring No. 73C and 73D for damage.
- q. Remove packing rings No. 13 and lantern ring No. 29, if provided, from stuffing box housing No. 11. (See Sect. III Maintenance, Para. B2).
- r. Remove deflector No. 40 from shaft No. 6.
- s. Remove coupling from shaft. Use commercially available pulling device.

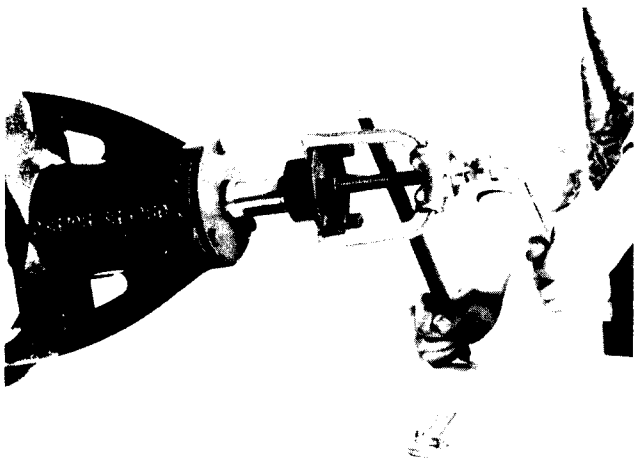


Fig. 14. Removing coupling half from shaft end. (K-Frame shown)

- t. Remove key from keyway in coupling end of shaft.
- u. Remove bearing cover No. 35 and No. 37 (Fig. 15).

NOTE: Dismantling procedure for C and K-Frame is the same.

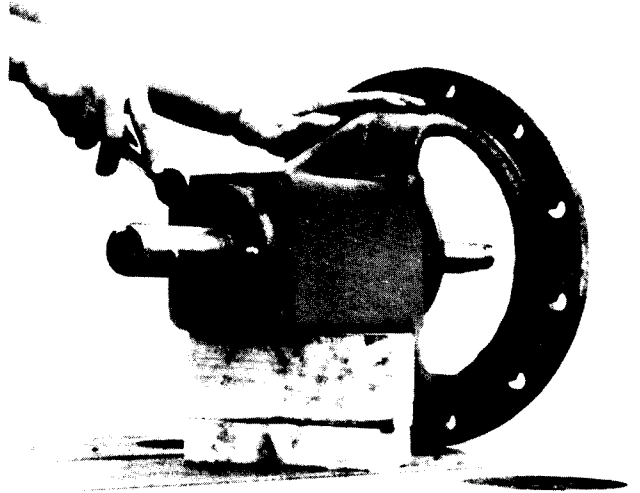


Fig. 15. Removing bearing cover, outboard end. (C-Frame shown)

- v. Remove shaft No. 6 from bearing frame by gently tapping threaded impeller side shaft end with plastic hammer (Fig. 16) until bearing disengage from slide fit in bearing housing, and pull it fully out by hand without banging the inboard bearing when passing through the larger outboard bearing bore.



Fig. 16. Driving pump shaft from bearing bracket. (K-Frame shown)

- w. For K-frame (cylindrical bearing housing) only.

Pull outboard and inboard bearing No. 16 and No. 18 from press fit of shaft. Use hydraulic press and make sure that inner race of bearing is supported while shaft is pressed out.

- x. For C-frame (square bearing housing) only.

Remove bearing locknut No. 25 which for smaller pumps on shaft unit 25 is of self locking insert type. For larger pumps on shaft unit 35 and 45 disengage lockwasher No. 25A and remove bearing locknut.

Pull outboard bearing No. 18 from slide fit of shaft. Pull inboard bearing No. 16 from press fit of shaft. Use hydraulic press and make sure that only inner race of bearing is supported while shaft is pressed out.

V. Reassembly

- a. Before reassembly: clean all dismantled parts and inspect them for wear and mechanical damage, especially mating faces and rabbet fits. If necessary, recondition or replace them.
- b. It is recommended that all gaskets and O-ring seals be used only once, and be replaced when the pump is reassembled.
- c. Follow Section IV - Dismantling, steps x to k in reverse procedure as described thereunder.
- d. Inspect wear ring No. 7 in casing. Pump sizes fitted with impellers having balancing holes around hub are also equipped with wear ring No. 27 in stuffing box cover. Wear rings must be replaced when diametrical clearance between impeller No. 2 and wear ring No. 7 and No. 27 (if applicable) exceeds .012". See Fig. 17 for proper installation of wear ring.

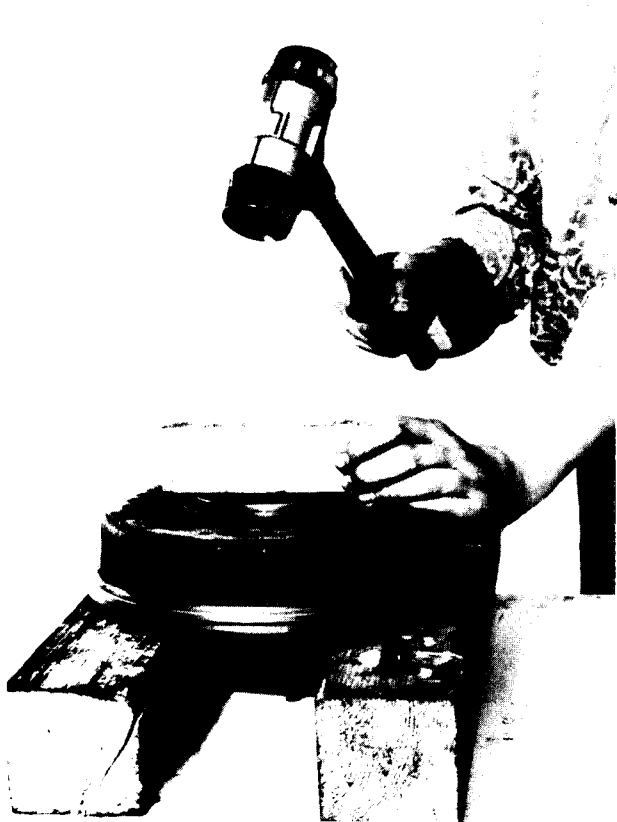


Fig. 17. Replacement of stuffing box wearing ring.

- e. Continue following section IV, Dismantling, in reverse procedure (steps i to a).
- f. Before re-starting pump, check to see that all nuts and bolts are evenly and properly tightened. Then follow start-up procedure as per Section II, (steps a to p).

VI. Mechanical Seals

The mechanical seal consists basically of a rotating member with springloaded "seal ring" (also termed "washer") being pressed against a complementary lapped flat surface of a stationary member, the "seat ring" (also termed "insert"). The rotating member is sealed towards the synchronously rotating shaft by a secondary seal, and the stationary seat ring is sealed by the gland elastomer.

The principle of a mechanical seal is the highly lapped flat surface of the rotating seat ring and stationary seat ring, contributing to the formation and maintaining of a lubricating film between the two contacting faces, hence reducing the leakage through these faces to microscopic quantities. The length of seal life, therefore, depends upon:

Protection of the lapped flat seal faces from wearing or pitting.

Always maintaining a liquid film between the contacting faces.

Removal of friction heat by adequate cooling circulation.

Keeping any abrasive impurities out of the seal face area. Maintaining accurate parallelism and compression of the seal faces.

a. Single mechanical seals:

Suitable for cooling and flushing by either clean appropriate cold pumped fluid by external or internal recirculation; or by clean cold fluid from an outside source. The cooling and flushing flow is directed towards the contacting seal faces, and returns through the stuffing box throat into the pump. The quantity of the recirculating flow can be adjusted by either an orifice, a regulating valve, or a flow controller in the external piping. If necessary, the external circulating system can also be provided with a pressure gauge, thermometer, product cooler and product filter or cyclone separator.

b. Double mechanical seals:

Generally consisting of two mechanical seals in back-to-back arrangement. Applicable to severely toxic, high-temperature, volatile, or abrasive-containing pumping fluids. Lubricating and cooling flow is entered as a buffer between the two rotating seal rings and can either be close-circulated through an external cooler (in which event the thermal circulation can be boosted by a pumping ring on the rotating seal member), or discharged into the return line of a through-flow system. The lubricating and cooling fluid must be compatible with the pumped fluid, because a small quantity will penetrate into the pump. The pressure of the lubricating and cooling flow should be 15 to 30 psig above the pressure to be sealed (stuffing box pressure), but should not exceed the pressure limits for unbalanced seals, which are usually (for Crane seals) 200 PSIG and (for Duramet-

allic seals) 80 PSIG. External accessories as mentioned for single mechanical seals can also be applied to installations with double mechanical seals.

c. Mounting of mechanical seals:

1. Dismantle the pump as per procedures in Section IV, steps a to o.
2. Mount complete bearing frame assembly with shaft in horizontal or vertical position, so that the following parts may be reassembled to the bearing frame over the free shaft end.
3. Check gland No. 17B to be unblemished. Mount stationary seal ring No. 77 in recess of gland. Mount gasket No. 80B in register of gland.
4. Slide gland No. 17B with mounted stationary seal ring and gasket over threaded end of shaft No. 6.
5. Check hook type shaft sleeve No. 14 to be unblemished. Check snap ring No. 80A (provided only with straight cylindrical shaft sleeve) to be unblemished and firmly seated in groove of shaft sleeve.
Push rotating unit No. 78 with mounted insert ring No. 79 over shaft sleeve until spring of rotating unit rests evenly on retaining face of stepped shaft sleeve or on snap ring No. 80A on straight sleeve.
6. Push shaft sleeve No. 14 with mounted rotating seal unit over threaded end of shaft No. 6 until hook (step in bore) rests evenly on retaining face of shaft.
7. Slide stuffing box cover No. 11 gently over threaded shaft end and over shaft sleeve No. 14 with mounted rotating seal unit No. 78. Press stuffing box cover fully into register of bearing frame No. 19 until it is firmly seated.
8. Mount impeller key No. 32 in keyway of shaft.
9. Check hub faces of impeller No. 2 to be clean and unblemished. Line up keyway in impeller hub with key No. 32 on shaft No. 6. Push impeller over threaded end of shaft and over key until it rests firmly against hook type shaft sleeve No. 14.
10. Mount lockwasher No. 24A (not required with self locking insert type impeller nut No. 24).
11. Mount impeller nut No. 24 and tighten firmly.
12. Slide gland No. 17B, mounted with stationary seal No. 77 and gasket No. 80B, gently over studs No. 33 until faces of stationary seal mates with insert ring No. 79 in rotating unit No. 78.
13. Mount hex head nuts on studs No. 33 and tighten them firmly.
14. Turn shaft by hand to ascertain free rotation.
15. Place gasket No. 73A in exposed register of stuffing box cover No. 11.

16. Slide flange of bearing frame No. 19, mounted with stuffing box cover No. 11 and gasket No. 73A, over casing studs and push it into register of casing No. 1.
17. Mount hex nuts on casing studs, tighten them firmly.
18. Turn once more shaft by hand to ascertain free rotation.
19. Reconnect all auxiliary piping to stuffing box cover No. 11 and gland No. 17B. Follow start-up procedure outlined under Section II.

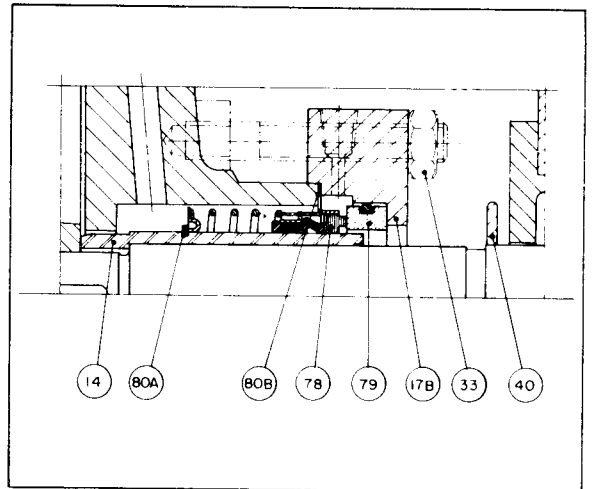


Fig. 18. Single mechanical seal, Crane Type 1 or equal.

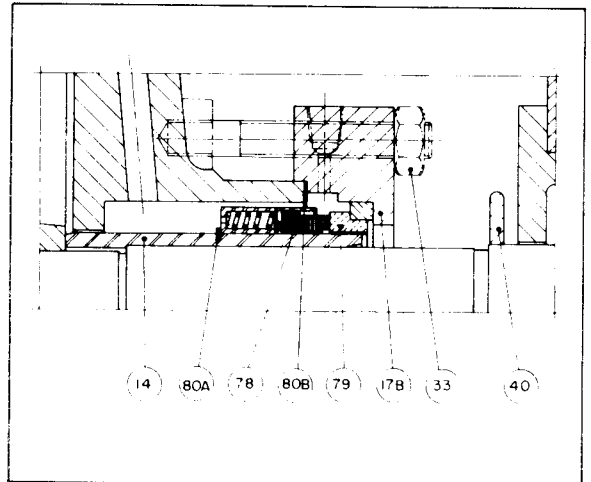
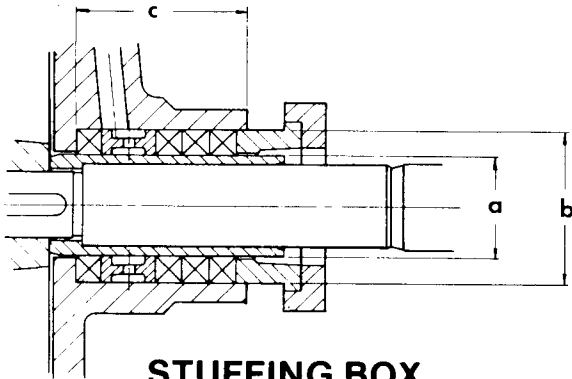


Fig. 19. Single mechanical seal, Crane Type 9T or equal.

PART NO.	QTY	PART NAME	PART NO.	QTY	PART NAME
14	1	Shaft sleeve	78	1	Rotating unit
17B	1	Seal gland	79	1	Insert ring
33	2	Studs with nuts	80A	1	Snap ring
40	1	Deflector	80B	1	Gasket
77	1	Stationary seal			

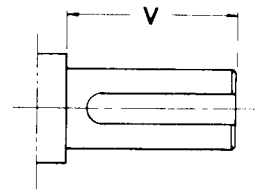
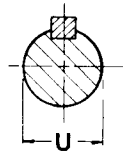
Fig. 20. Part list for mechanical seal

VII. Technical Data



STUFFING BOX

Fig. 21.



STUB SHAFT

Fig. 22.

	Shaft Unit	Bearing SKF Inboard/Outboard		Stuff. Box Dim.			Packing Size	Shaft End Dim.		
				a	b	c		U	Key	V
For K-Frame (cylindrical housing)	25	6305 RS/C3		1-3/16	1-13/16	2-1/8	5/16 x 5/16	15/16	1/4 x 1/16	3-1/8
	35	6307 RS/C3		1-5/8	2-3/8	2-5/8	3/8 x 3/8	1-1/4	1/4 x 1-3/8	4
	45	6409 /C3 (++)		2	2-3/4	2-5/8	3/8 x 3/8	1-5/8	3/8 x 13/16	5-1/16
For C-Frame (square housing)	-FAFNIR (x)									
	25	207 KD/CL.3	307 KD/CL.3	1-13/16	1-13/16	2-1/8	5/16 x 5/16	7/8	3/16 x 1-7/8	2-3/8
	35	210 KD/CL.3	309 KD/CL.3	1-3/4	2-5/8	2-5/8	7/16 x 7/16	1-1/4	1/4 x 2-1/2	3
	45	311 KD/CL.3	312 KD/CL.3	2	2-3/4	2-5/8	3/8 x 3/8	1-7/8	1/2 x 3-1/2	4-3/8

NOTES: (++) This bearing for K-frame requires one grease retainer (No. 51) on inside.
 (x) All Bearings for C-frame are shielded on outside.
 All bearings are of class 3 tolerance.
 For pump size/shaft unit assignment, see Sect. VIII, Fig. 23.

Application Limitation	Pressure	Temperature
Casing	150 psig 120 psig	- 22°F to +250°F +250°F to +320°F
Stuffing Box Packing-standard design Stuffing Box Packing-high temp. design Mechanical Seal		- 22°F to + 220°F up to +320°F up to +275°F

IX. Cross-section drawings and parts list.

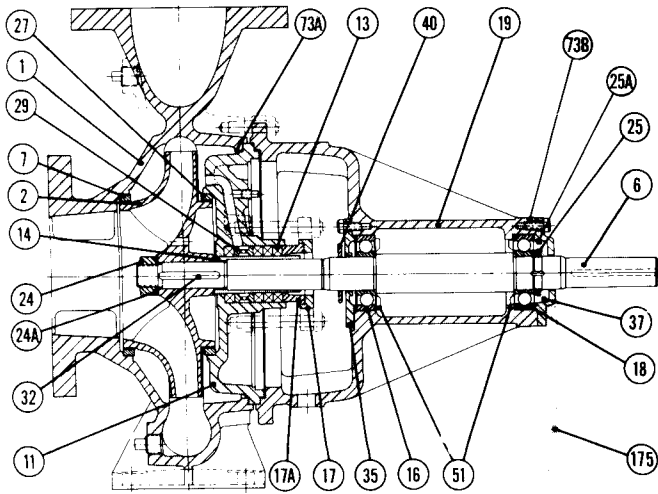


Fig. 23. Standard design

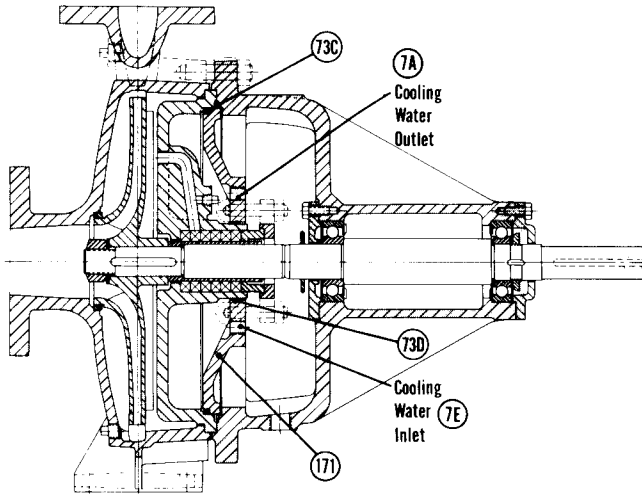


Fig. 24. High temperature design

PART NO.	PART NAME	STANDARD FITTED	BRONZE FITTED
1	Casing	Cast Iron	Cast Iron
2	Impeller	Cast Iron	Bronze
6	Shaft	Steel	Steel
7	Wear ring - Casing	Ductile Iron	Bronze
11	Stuffing Box Cover	Cast Iron	Cast Iron
13	Packing	Synthetic Fiber	Synthetic Fiber
14	Shaft Sleeve	Stainless Steel	Stainless Steel
16	Ball Bearing-Inboard	Steel	Steel
17	Packing Gland	Cast Iron	Cast Iron
17A	Packing Gland Ring	Graphite	Graphite
17B	Mechanical Seal Gland	Steel	Steel
18	Ball Bearing-Outboard	Steel	Steel
19	Bearing Frame	Cast Iron	Cast Iron
24	Impeller Nut	Steel	Steel
24A	Impeller Lockwasher	Steel	Steel
25 *	Bearing Locknut	Steel	Steel
25A**	Bearing Lockwasher	Steel	Steel
27 ***	Wear Ring - Cover	Cast Iron	Bronze
29	Lantern Ring	Teflon	Teflon
32	Impeller Key	Steel	Steel
32 †	Impeller Key	Steel	Steel
33	Coupling Key	Steel	Steel
35	Bearing Cover-Inboard	Cast Iron	Cast Iron
37	Bearing Cover-Outboard	Cast Iron	Cast Iron
40	Deflector	Buna-n	Buna-n
51 ††	Grease Retainer	Steel	Steel
73A	Gasket, Casing	Cellulose Fiber	Cellulose Fiber
73B†††	Gasket, Bearing Covers	Cellulose Fiber	Cellulose Fiber
73C	O-Ring, Jacket - O.D.	Buna or Viton	Buna or Viton
73D	O-Ring, Jacket - I.D.	Buna or Viton	Buna or Viton
80	Mechanical Seal Ass'y.	See Table	See Table
80A	Snap Ring	Steel	Steel
80B	Gasket - Seal Gland	Cellulose Fiber	Cellulose Fiber
171	Cooling Jacket Cover	Cast Iron	Cast Iron

07-1995

NOTE:

- + Not required with self locking (nylon) insert type impeller nut.
- * Only for C-frame - all shaft unit sizes.
- ** Only for C-frame - shaft unit size 35 and 45.
- *** Only for pump sizes fitted with impellers having balancing holes.
- † Only for shaft unit size 45 - K and C-frame.
- †† Only for K-frame - shaft unit size 45.
- ††† Only for K-frame - all shaft unit sizes.

Fig. 25.

AUXILIARY CONNECTIONS	Gauge Connection	Casing Drain	Prime or Vent	Cooling Water	Sealing Liquid, External	Stuffing Box Drain	Sealing Liquid, Internal
Pump Model Numbers	1M	6B	6D	7E/7A	10E	8B	11E
40-200	3/8	1/4	3/8	3/8	3/8	1/2	1/8 †
40-250, 40-315				1/2	1/2		
50-200				3/8	3/8		
50-250, 50-315				1/2	1/2		
65-160, 65-200				3/8	3/8		
65-250, 65-315				1/2	1/2		
80-160, 80-200	1/2	1/2	1/2	3/8	3/8		
80-250, 80-315, 80-400				1/2	1/2		
100-160, 100-200				3/8	3/8		
100-250, 100-315, 100-400				1/2	1/2		
125-200	1/2	1/2	1/2	3/8	3/8		
125-250, 125-315, 125-400				1/2	1/2		
150-200				3/8	3/8		
150-250, 150-315, 150-400				1/2	1/2		

†Special thread (available from Carver Pump Co.)

Fig. 26.

AUXILIARY CONNECTIONS

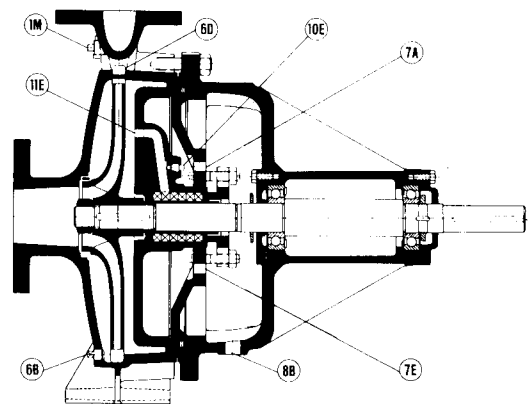


Fig. 27. Auxiliary connections

Exploded-View Drawings

Pump with stuffing box packing
(shown with C-frame)

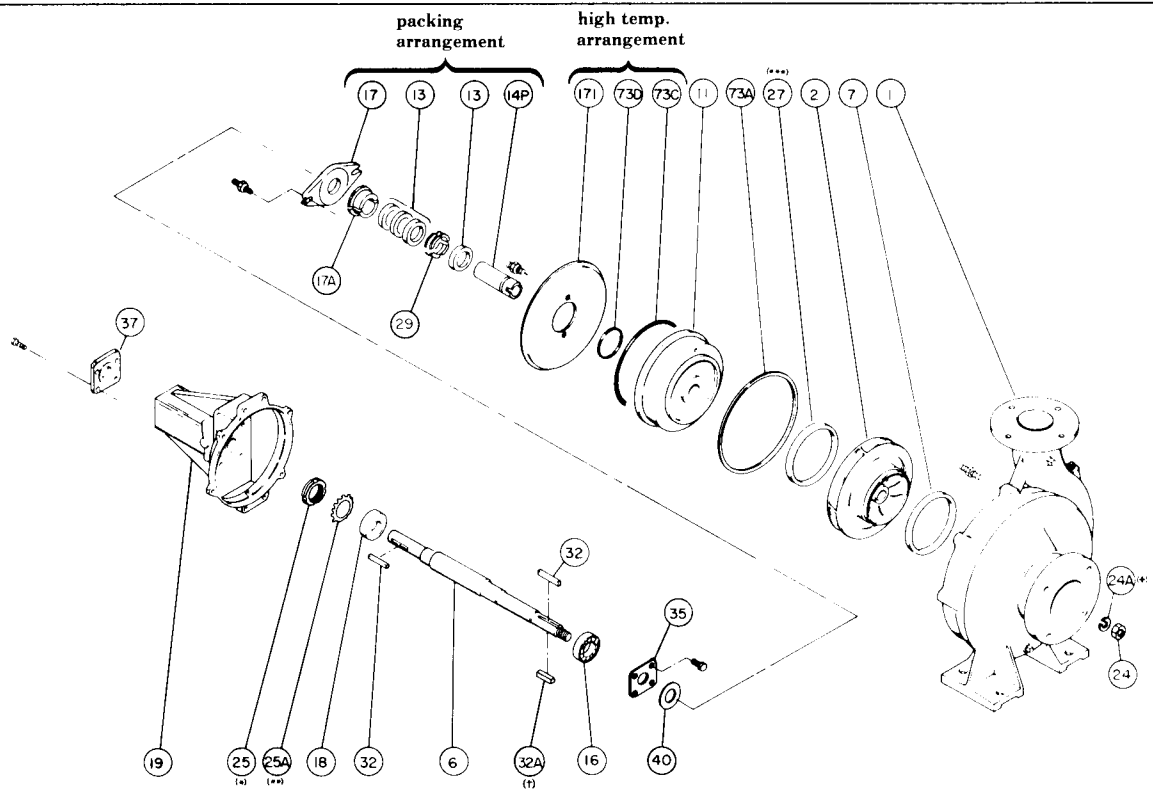


Fig. 28.

Pump with mechanical seal
(shown with K-frame)

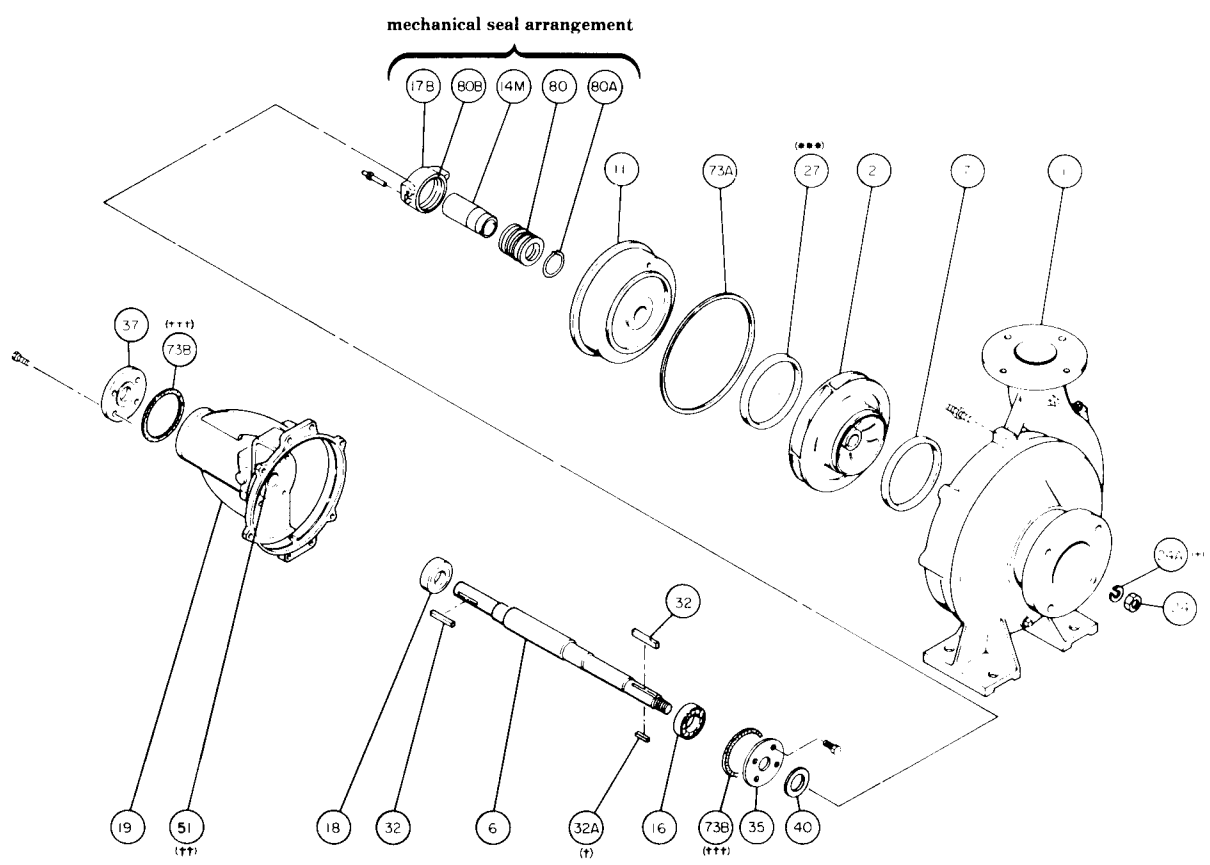


Fig. 29.

NOTE:
 + Not required with self locking (nylon) insert type impeller nut.
 * Only for C-frame - all shaft unit sizes.
 ** Only for C-frame - shaft unit size 35 and 45.
 *** Only for pump sizes fitted with impellers having balancing holes.
 + Only for shaft unit size 45 - K and C-frame.
 ++ Only for K-frame - shaft unit size 45.
 +++ Only for K-frame - all shaft unit sizes.

X. Troubleshooting.

All our pumps pass strict quality control procedures, and are adjusted for specific operating conditions ("design conditions") for which data has been furnished to us by the purchaser, and which are set forth in our Order Acknowledgment.

Operational problems which may develop are often a result of operating at other than "design conditions," or for

other reasons beyond our control. Some of these problems are listed in this section, accompanied by their possible causes and recommended solutions. If, after applying appropriate remedies as listed, an operational problem still exists, consult Carver Pump Co. or its representative.

Insufficient flow capacity or insufficient discharge pressure

Possible cause

1. Pump speed too low, or reverse rotation.
2. Actual suction pressure lower, and/or actual discharge higher, than stated for design conditions.
3. Specific gravity or viscosity of pumping fluid higher than stated for design conditions.
4. Worn impeller.

Suggested corrective action

Check driver speed and rotation.
Check whether all valves are fully open. Check piping for trapped air pockets, especially at elbows or high points. Check pipe friction computation and elevation of heads from pump center-line to suction and discharge level. Check pressure in suction source.
Check pumping fluid against that specified in design conditions.
Dismantle pump. See Section IV, follow step a to l.

If plant conditions cannot be adjusted to design conditions, consult Carver Pump Co. to ascertain whether pump impeller can be increased in diameter.

Excessive flow capacity or too high discharge pressure

Possible cause

1. Pump speed too high.
2. Actual suction pressure higher and/or actual discharge pressure lower than stated for design conditions.
3. Specific gravity or viscosity of pumped fluid is lower than stated for design.

Suggested corrective action

Check speed of driver.
Throttle discharge valve, or install orifice in discharge piping, or provide bypass line with regulating valve for return of excess flow to suction source.
Check pumped fluid against that specified in design conditions.

If plant conditions cannot be adjusted to design conditions, consult Carver Pump Co. to ascertain whether pump impeller can be reduced in diameter.

Excessive noise or vibration

Possible cause

1. Pump operating under cavitation, i.e. the fluid partially evaporates at pump entry because NPSH requirement of pump is equal to or exceeds NPSH available in plant. To determine whether pump cavitates, throttle discharge valve slowly until noise and/or vibration diminishes.
2. Baseplate not properly grouted.
3. Misalignment of pump and driver.
4. Pumped fluid contains solids creating shock load and clogging or damaging impeller.
5. Transient vibration from piping.

Suggested corrective action

Check valves in suction piping to see if fully open. Check suction piping for entrapped air pockets, especially in elbows and high points. Check suction well for vortex and, if necessary, provide baffles. Check pressure in closed suction tank. Check suction temperature, viscosity, and vapor pressure of pumped fluid.
Check baseplate grouting for air pockets by sounding off baseplate with hammer.
Check shaft alignment with dial indicator to be within ± 0.005 " tolerance. See Installation Instruction 010-I-506.
Install strainer in suction piping. Back-flush pump with clean fluid, or open pump to inspect and clean impeller. Support and secure piping, or provide compensators.

Excessive power consumption

Possible cause

Suggested corrective action

1. Pump speed too high.
2. Specific gravity and/or viscosity of pumped fluid higher than stated for design.
3. Stuffing box over-tightened.

Check driver speed.
Check pumped fluid against that specified in design conditions.
Loosen gland nuts of stuffing box and readjust as per Section II, Step m, or repack per Section III, Procedure B.2a.

Stuffing box leaks excessively

Possible cause

Suggested corrective action

1. Worn, unsuitable, or badly fitted packing.
2. Scoring or grooving of shaft protecting sleeve, due to improper tightening of stuffing box gland or due to wear.
3. Insufficient cooling water, or fouling of cooling water jacket.
4. The pump runs "rough", i. e., shaft chatters.

Tighten gland nuts to reduce leak to a couple of drips per minute. If stuffing box gland cannot be tightened any further, one additional packing ring may be installed. Otherwise, re-pack stuffing box in accordance with Sect. III-Maintenance, Para. B.2a.
The shaft protecting sleeve should be replaced. When the stuffing box has been re-packed, tighten gland carefully and evenly.
Remove cooling water jacket and thoroughly clean it. Ensure adequate cooling water supply to cooling jacket. Check pump bearings, replacing them if necessary. If this does not eliminate trouble, dismantle pump and check shaft for true-running, rebalancing entire rotating assembly. Re-assemble carefully in accordance with instructions given herein.

Mechanical seal leaks

Possible cause

Suggested corrective action

1. Mechanical seal is worn or damaged.

Replace mechanical seal. Refer to Section VI, Para. c.

Pump leaks at cooling water jacket

Possible cause

Suggested corrective action

1. O-rings are damaged.

Shut down pump, release pressure, and replace O-rings. Make sure pump has cooled down. To replace O-rings, refer to Section IV-Dismantling, step a to p.

Bearings run hot

Possible cause

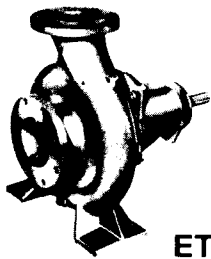
Suggested corrective action

1. Pump-motor set is misaligned.
2. Piping causes pump to "warp".
3. Motor exerts thrust on coupling because of incorrect coupling gap.
4. Excessive axial thrust caused by clogging of balance holes or excessive wear of wear rings.
5. Insufficient or unsuitable bearing grease.
6. Excessive high temperature of pumped liquid or ambient air.

Check alignment at coupling. Refer to Installation Instruction No. 010-I-506 attached to pump shipment. For additional copy, contact Carver Pump Co.
Ensure that piping transmits no stress to pump by altering piping layout if necessary. Re-align pump-motor set.
Check coupling gap and restore proper gap distance.
Clean out impeller balance holes. Install new wear rings.
If necessary, regrease bearings. Refer to Para. III, Sect. B. Lower temperature of pumped fluid or equip pump with stuffing box cooling. Improve ventilation at pump location.

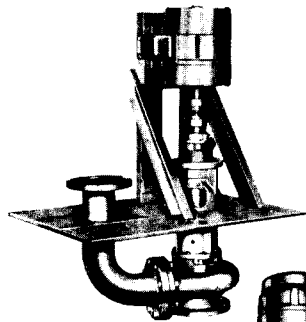
XI. Other Carver Pumps

For general, commercial and industrial service



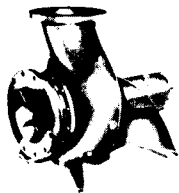
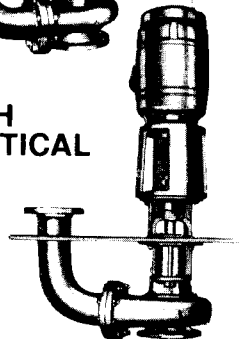
ETA

End suction, single stage with back pull-out feature for dismantling without disturbing pipe connections. Capacities to 2,700 gpm. Heads to 285 ft. Sizes 1-1/2" to 6". Temperatures to 320° F. For industrial, commercial, municipal and agricultural water supply and removal services. 28 sizes. Send for Bulletin No. 100.



**L & H
VERTICAL**

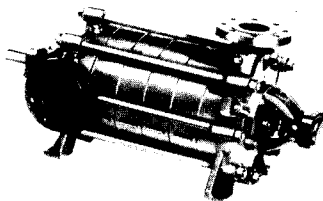
Vertical chair or barrel mounted. Capacities to 2,500 gpm. Heads to 330 ft. Sizes 1" to 6". Temperatures to 250° F. Applications include washers, paint spray booth service, coolant, plating machines, cooling towers or sumps. Send for Bulletin No. 170.



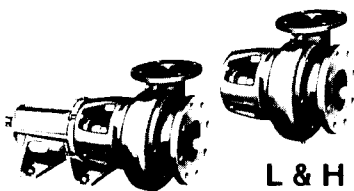
ETA-L

End suction, enclosed impeller. Capacities to 10,000 gpm. Heads to 375 ft. Sizes 6" to 12". Temperature to 220° F. For general service applications in industry, irrigation and municipal water supplies. 9 sizes. Send for Bulletin No. 130.

WKL



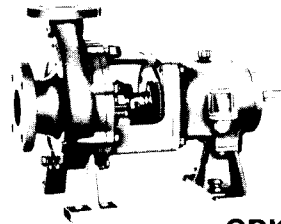
Multi-stage type for high pressure. Capacities to 2,200 gpm. Heads to 825 ft. Sizes 1-1/4" to 6". Temperatures to 285° F. Used in high-rise buildings, boiler feed service, pressure supply for hydraulic presses, irrigation service. Send for Bulletin No. 200.



L & H

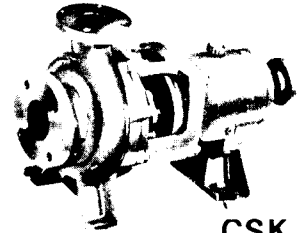
Close coupled or frame mounted. Capacities to 2,500 gpm. Heads to 370 ft. Sizes 1" to 6". Temperatures to 250° F. For industrial, commercial, chemical and pollution control. Enclosed or semi-open impellers. Send for Bulletin No. 160.

For the chemical process industry



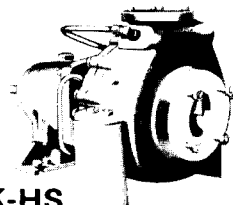
CPK

Standard medium duty. Capacities to 9,500 gpm. Heads to 700 ft. Sizes 1-1/2" to 12". Temperatures - 150° F. to + 600° F. Available with or without jacket. Casing is self-ventilating with back pull-out and centerline discharge. Meet virtually all CPI operating requirements. Send for Bulletin No. 320.



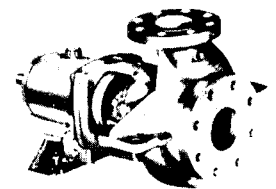
CSK

In accordance with ANSI standards Capacities to 850 gpm. Heads to 450 ft. ANSI sizes AA to A70. Temperatures - 150° to +600° F. Open-type impeller for unobstructed passage of entrained solids and fibrous matter. Send for Bulletin No. 310.



CPK-HS

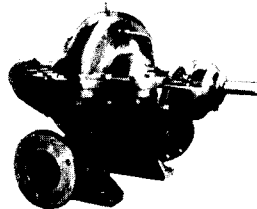
Standard medium duty. Capacities to 1,100 gpm. Heads to 750 ft. Sizes from 1-1/2" to 3". Temperatures to 600° F. Centerline mounted, fully jacketed to handle products that must be kept hot or cold to maintain proper viscosity. Send for Bulletin No. 320.



CPK-300

Standard heavy duty for high-pressure, high-temperature applications. Capacities to 9,500 gpm. Heads to 700 ft. (press. to 570 psig). Sizes 1-1/2" to 12". Temperatures to 650° F. Centerline mounting of casing allows unit to expand both upward and downward. Send for Bulletin No. 320.

Marine pumps 4NC2



Carver makes a complete line of auxiliary circulating bilge and ballast, sewage, fire and general service pumps for marine use. Meet federal requirements and "Dock Specs". Send for complete information.



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(563) 263-3410 • FAX (563) 262-0510