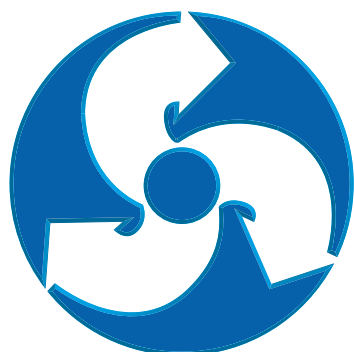




American National Standard for

Sealless Rotodynamic Pumps

for Nomenclature, Definitions,
Application, Operation, and Test

ANSI/HI 5.1-5.6-2010



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Approved June 25, 2010
American National Standards Institute, Inc.

American National Standard

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Foreword (Not part of Standard)

Scope

The purpose and aims of the Institute are to promote the continued growth and well-being of pump manufacturers and further the interests of the public in such matters as are involved in manufacturing, engineering, distribution, safety, transportation and other problems of the industry, and to this end, among other things:

- a) To develop and publish standards for pumps;
- b) To appear for its members before governmental departments and agencies and other bodies in regard to matters affecting the industry;
- c) To increase the amount and to improve the quality of pump service to the public;
- d) To support educational and research activities; and
- e) To promote the business interests of its members but not to engage in business of the kind ordinarily carried on for profit or to perform particular services for its members or individual persons as distinguished from activities to improve the business conditions and lawful interests of all of its members.

Purpose of Standards

- 1) Hydraulic Institute Standards are adopted in the public interest and are designed to help eliminate misunderstandings between the manufacturer, the purchaser, and/or the user and to assist the purchaser in selecting and obtaining the proper product for a particular need.
- 2) Use of Hydraulic Institute Standards is completely voluntary. Existence of Hydraulic Institute Standards does not in any respect preclude a member from manufacturing or selling products not conforming to the Standards.

Definition of a Standard of the Hydraulic Institute

Quoting from Article XV, Standards, of the By-Laws of the Institute, Section B:

"An Institute Standard defines the product, material, process or procedure with reference to one or more of the following: nomenclature, composition, construction, dimensions, tolerances, safety, operating characteristics, performance, quality, rating, testing and service for which designed."

Comments from users

Comments from users of this standard will be appreciated, to help the Hydraulic Institute prepare even more useful future editions. Questions arising from the content of this standard may be directed to the Hydraulic Institute. It will direct all such questions to the appropriate technical committee for provision of a suitable answer.

If a dispute arises regarding contents of an Institute publication or an answer provided by the Institute to a question such as indicated above, the point in question shall be referred to the Executive Committee of the Hydraulic Institute, which then shall act as a Board of Appeals.

Revisions

The Standards of the Hydraulic Institute are subject to constant review, and revisions are undertaken whenever it is found necessary because of new developments and progress in the art. If no revisions are made for five years, the standards are reaffirmed using the ANSI canvass procedure.

Disclaimer

The term *sealless* is a generic, industrial word used for pumps not employing packing or mechanical shaft seals as the prime method of sealing liquid or vapor from the atmosphere. *Hermetic* would accurately describe the construction of these types of pumps. It is understood that static seals may be used in pumps that are designated sealless. Use of the term *sealless* herein should not be construed as any type of warranty or guarantee against pump leaks.

Units of measurement

Metric units of measurement are used; and corresponding US customary units appear in brackets. Charts, graphs, and sample calculations are also shown in both metric and US customary units.

Since values given in metric units are not exact equivalents to values given in US customary units, it is important that the selected units of measure to be applied be stated in reference to this standard. If no such statement is provided, metric units shall govern.

Consensus for this standard was achieved by use of the Canvass Method

The following organizations, recognized as having an interest in the standardization of sealless rotodynamic pumps were contacted prior to the approval of this revision of the standard. Inclusion in this list does not necessarily imply that the organization concurred with the submittal of the proposed standard to ANSI.

Buse Fred, Consultant
DuPont
Healy Engineering, Inc.

KBR
Malcolm Pirnie
Pentair Water - Berkley Pumps

Committee list

Although this standard was processed and approved for submittal to ANSI by the Canvass Method, a working committee met many times to facilitate its development. At the time it was developed, the committee had the following members:

Chair – Roger Turley, Flow Solutions Group
Vice-chair – Peter Gaydon, Chempump, a Division of Teikoku USA

Committee Members

Charles Cappellino
Peter Brule

Company

ITT - Industrial Process
Iwaki America Incorporated

5 Sealless rotodynamic pumps

5.1 Types and nomenclature

5.1.1 Scope

This standard covers types and nomenclature, definitions, design and application, installation, operation and maintenance, and test of sealless rotodynamic pumps driven by canned motors or magnetic couplings.

Not included are submersible wastewater pumps that do not have external shaft seals and are therefore not susceptible to external shaft leakage. Deep well submersible pumps are also excluded.

5.1.1.1 Objective

To clearly outline the information necessary to define and describe the construction and use of sealless pumps.

5.1.1.2 Introduction

The sealless pump is used when there is a need to contain toxic, dangerous, and/or valuable fluids. Application may be dictated by space, noise, environment, or safety regulations. This section outlines types, nomenclatures, and components of sealless rotodynamic type pumps.

The driven shaft is completely contained in a pressurized vessel containing the pumped fluid. The pressurized vessel or primary containment device (chamber) is sealed by static seals, such as gaskets or O-rings.

The power required by the driven shaft is transmitted through a containment barrier. Methods include (1) the “canned motor pump,” with a liner (can) placed between an induction motor’s armature and stator; and (2) the “magnetic drive pump,” with a shell(s) located between an outer rotating element with permanent magnet(s) and a mating inner ring that follows the driving magnets. The inner rotor may have permanent magnets or it may be an induction device.

See Figure 5.1.1.2 for a diagrammatic breakdown of the types of sealless rotodynamic pumps.

5.1.2 Canned motor pump (CMP)

5.1.2.1 Close-coupled, end suction

Figure 5.1.2.1 — In this group, the impeller(s) is mounted on the end of the shaft that is overhung from its motor bearing supports.

The impeller is mounted directly on the rotor assembly, making one rotating assembly. The bearings are supported by housings at each end of the rotor assembly. The motor components are protected from the process liquid by nonmagnetic liners (shells).

During operation, the motor section and bearings are cooled and lubricated by the process liquid. This fluid is either a flush introduced from an external source or, more commonly, taken from the pump discharge. The latter can be directed internally, or by way of an external circulation line that allows for the installation of a filter to remove particulates from the fluid before its introduction into the bearing area.

5.1.2.2 Close-coupled, in-line

Figure 5.1.2.2 — In this group, the pump and motor are mounted vertically. A single-stage overhung impeller is used in conjunction with a casing with in-line flange connections. Motor and bearings are cooled and lubricated by the process liquid.

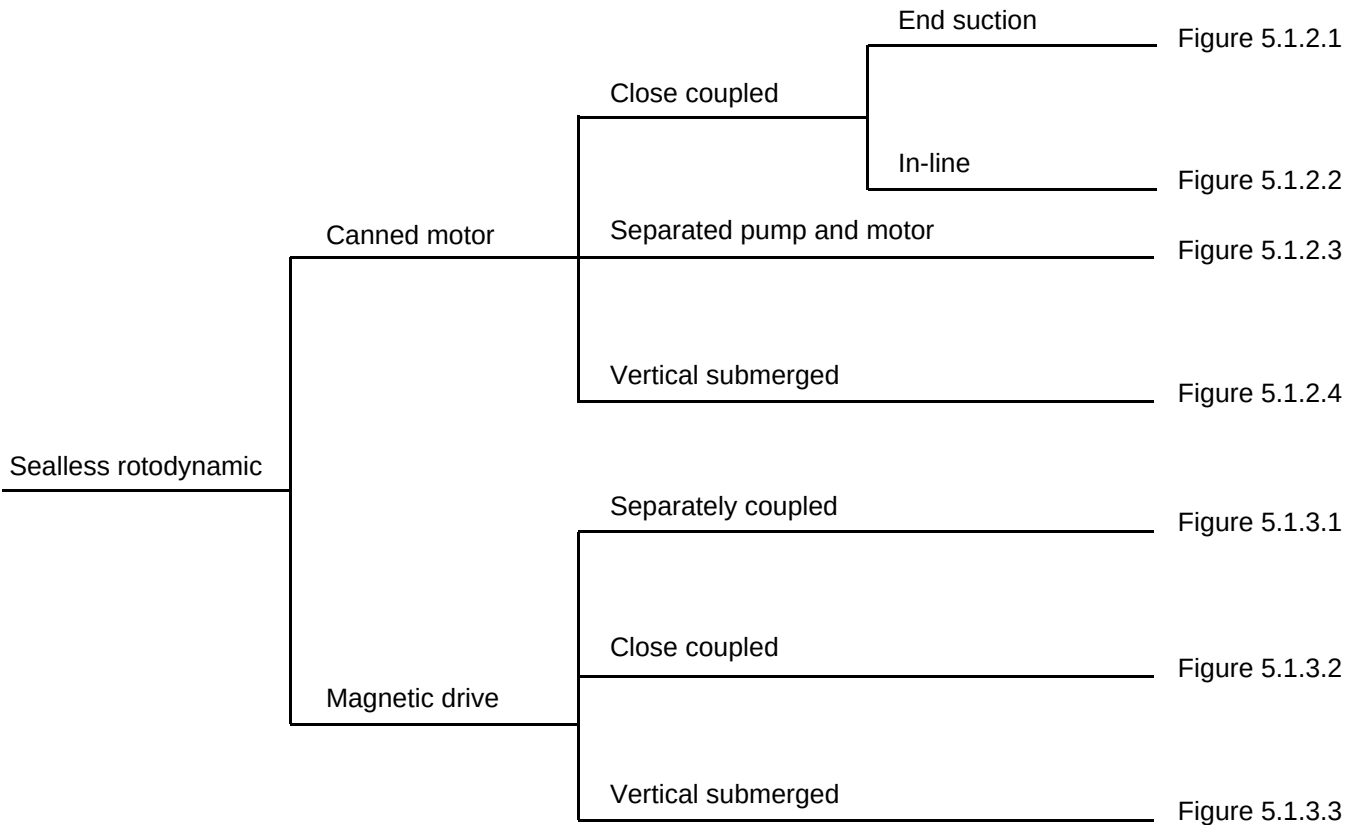


Figure 5.1.1.2 — Types of sealless rotodynamic pumps

5.1.2.3 Separated pump and motor

Figure 5.1.2.3 — This group has single or multistage overhung impellers; however, the pump and motor are separated by a thermal barrier, or air space. The impeller is mounted on the rotor assembly that is supported by bearings at each end. The rotor assembly contains an auxiliary impeller that circulates the process liquid in the motor section through a heat exchanger for control of the fluid temperature.

5.1.2.4 Vertical submerged canned motor pump

Figure 5.1.2.4 — This group of pumps is of the single-stage overhung impeller design that is suspended from a cover plate. The complete pump and motor is immersed in the process fluid. This method of installation provides sealless pump application inside a sealed vessel.

5.1.3 Magnetic drive pump (MDP)

5.1.3.1 Separately coupled

Figure 5.1.3.1 — This group of pumps is end suction, single-stage or multistage, overhung impeller design. The impeller is mounted on a rotor assembly that contains the inner magnet ring of a magnetic drive. The process fluid is retained by a containment shell that separates the inner magnet ring and the outer magnet ring.

The outer magnet ring is mounted on the shaft of a frame that is coupled to a motor or power device. All of the above is mounted on a common baseplate.

5.1.3.2 Close coupled

Figure 5.1.3.2 — This group of pumps is of the same construction as described in Section 5.1.3.1, except the outer magnet ring is mounted directly on the driver shaft.

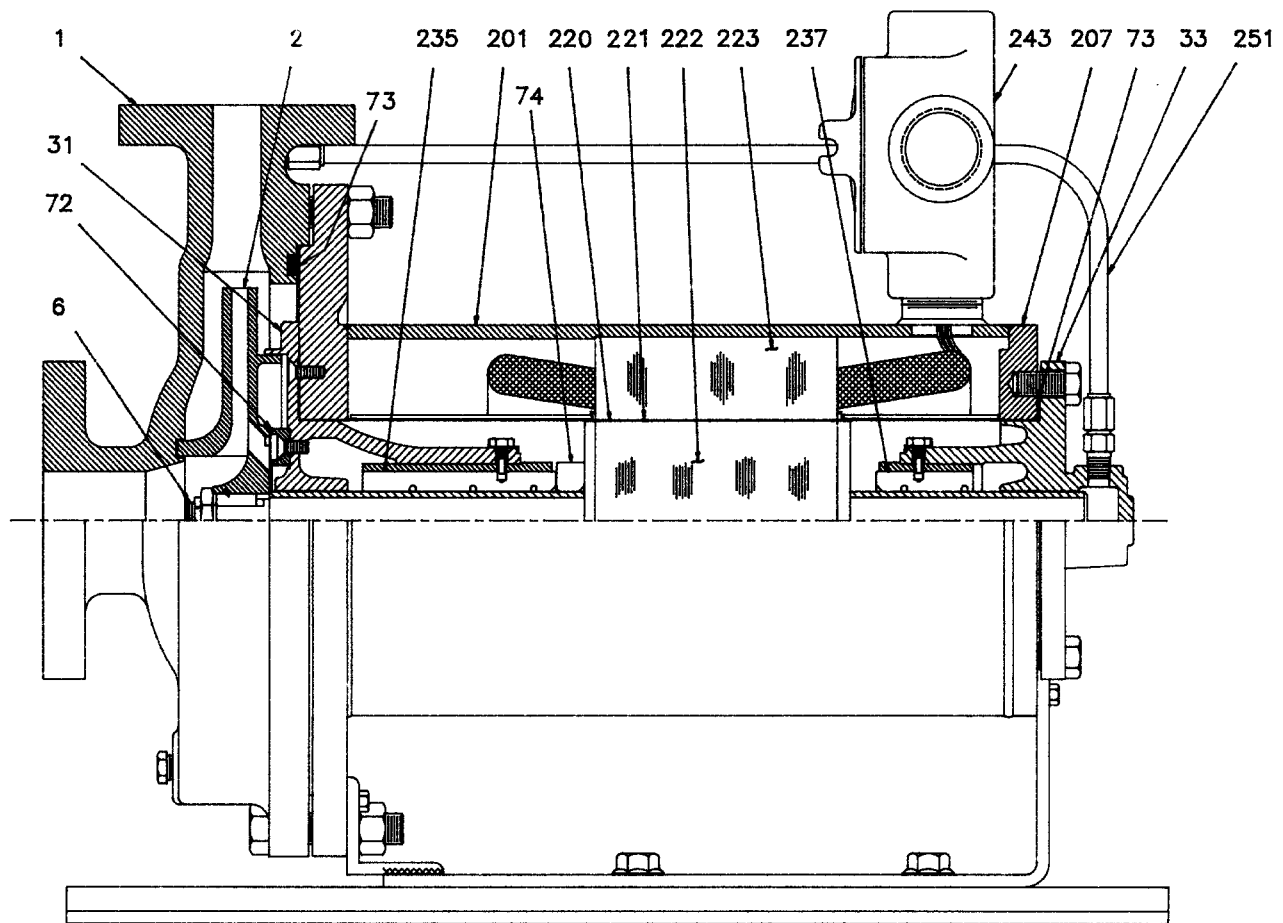
5.1.3.3 Vertical submerged

Figure 5.1.3.3 — In this group of pumps, the impeller is mounted on the end of a shaft that is overhung from its drive bearing supports. The drive section uses permanent magnets or an eddy current drive system to transmit power to the pump. This type of sealless pump uses a standard motor to drive the outer magnet ring, which in turn drives an inner magnet ring. A containment shell that contains the process fluid separates the magnet components.

The containment shell in the drive permits sealless pumping from a sealed vessel using a submersible pump.

5.1.4 Sealless pump part names

Table 5.1.4 lists the names of most parts that go into the construction of sealless rotodynamic pumps. The reference numbers are the same as those shown in Figures 5.1.2.1 through 5.1.3.3.



1 Casing	207 Cover, motor end
2 Impeller	220 Can, rotor
6 Shaft, pump	221 Liner, stator
31 Housing, bearing, inboard	222 Assembly, rotor
33 Housing, bearing, outboard	223 Assembly, stator
72 Bearing, axial thrust, inboard	235 Bushing, bearing, inboard
73 Gasket	237 Bushing, bearing, outboard
74 Collar, axial thrust, outboard	243 Box, electrical connection
201 Housing, stator	251 Tube, circulation

Figure 5.1.2.1 — Canned motor pump: close-coupled, end suction, overhung impeller

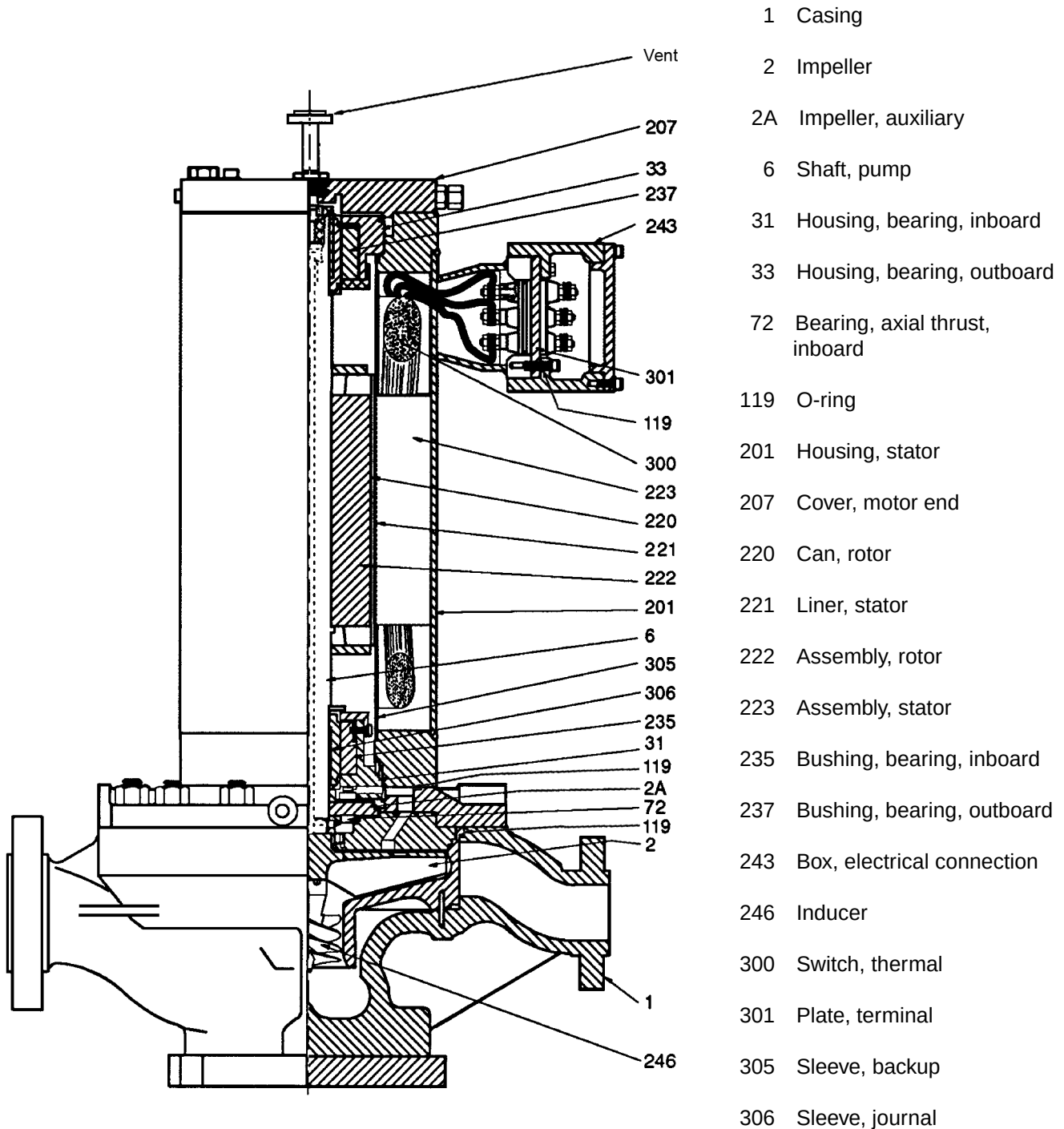
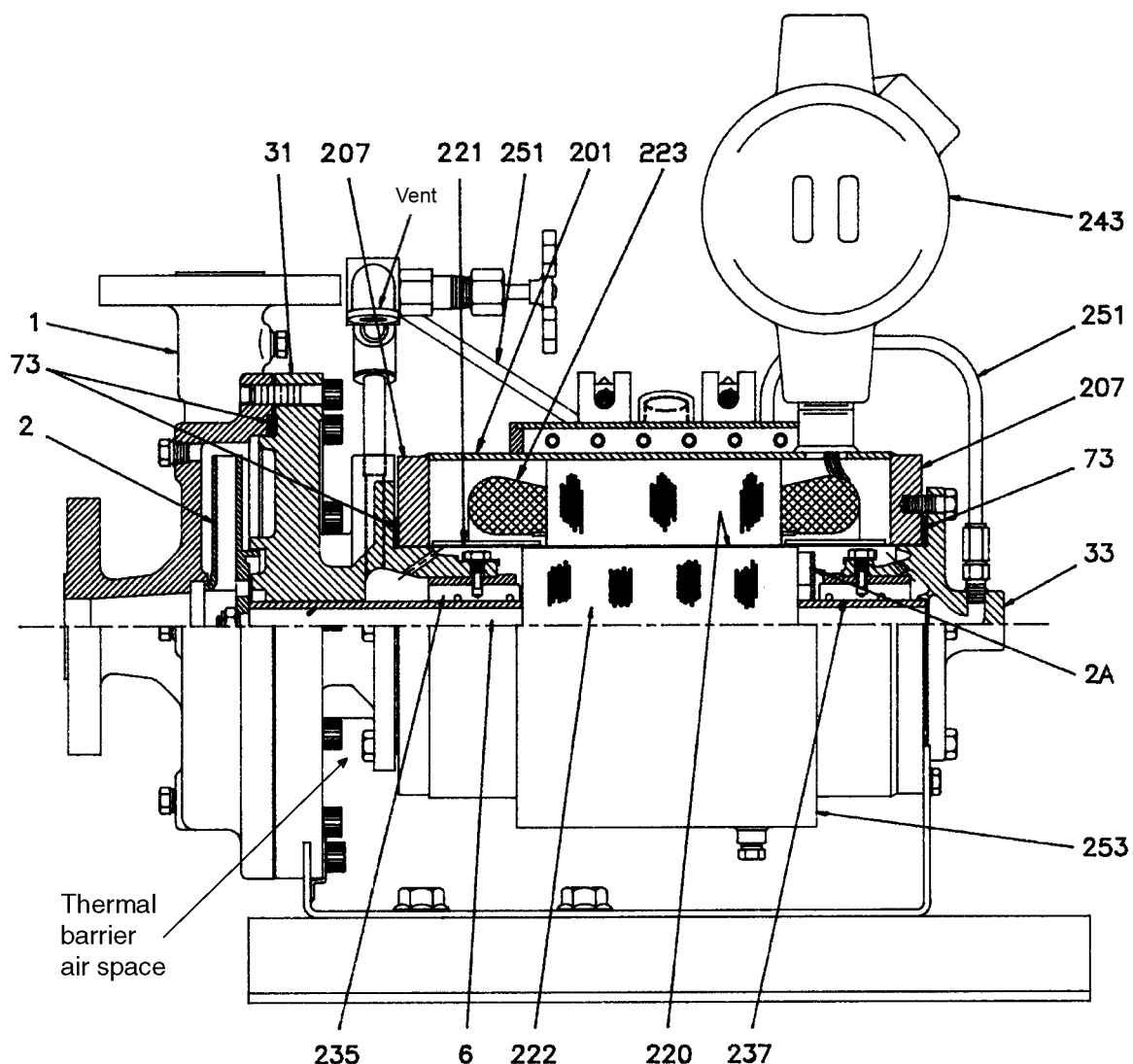


Figure 5.1.2.2 — Canned motor pump: close-coupled, vertical in-line



- | | |
|-------------------------------|--------------------------------|
| 1 Casing | 220 Can, rotor |
| 2 Impeller | 221 Liner, stator |
| 2A Impeller, auxiliary | 222 Assembly, rotor |
| 6 Shaft, pump | 223 Assembly, stator |
| 31 Housing, bearing, inboard | 235 Bushing, bearing, inboard |
| 33 Housing, bearing, outboard | 237 Bushing, bearing, outboard |
| 73 Gasket | 243 Box, electrical connection |
| 201 Housing, stator | 251 Tube, circulation |
| 207 Cover, motor end | 253 Exchanger, heat |

Figure 5.1.2.3 — Canned motor pump: motor and pump separated by thermal barrier

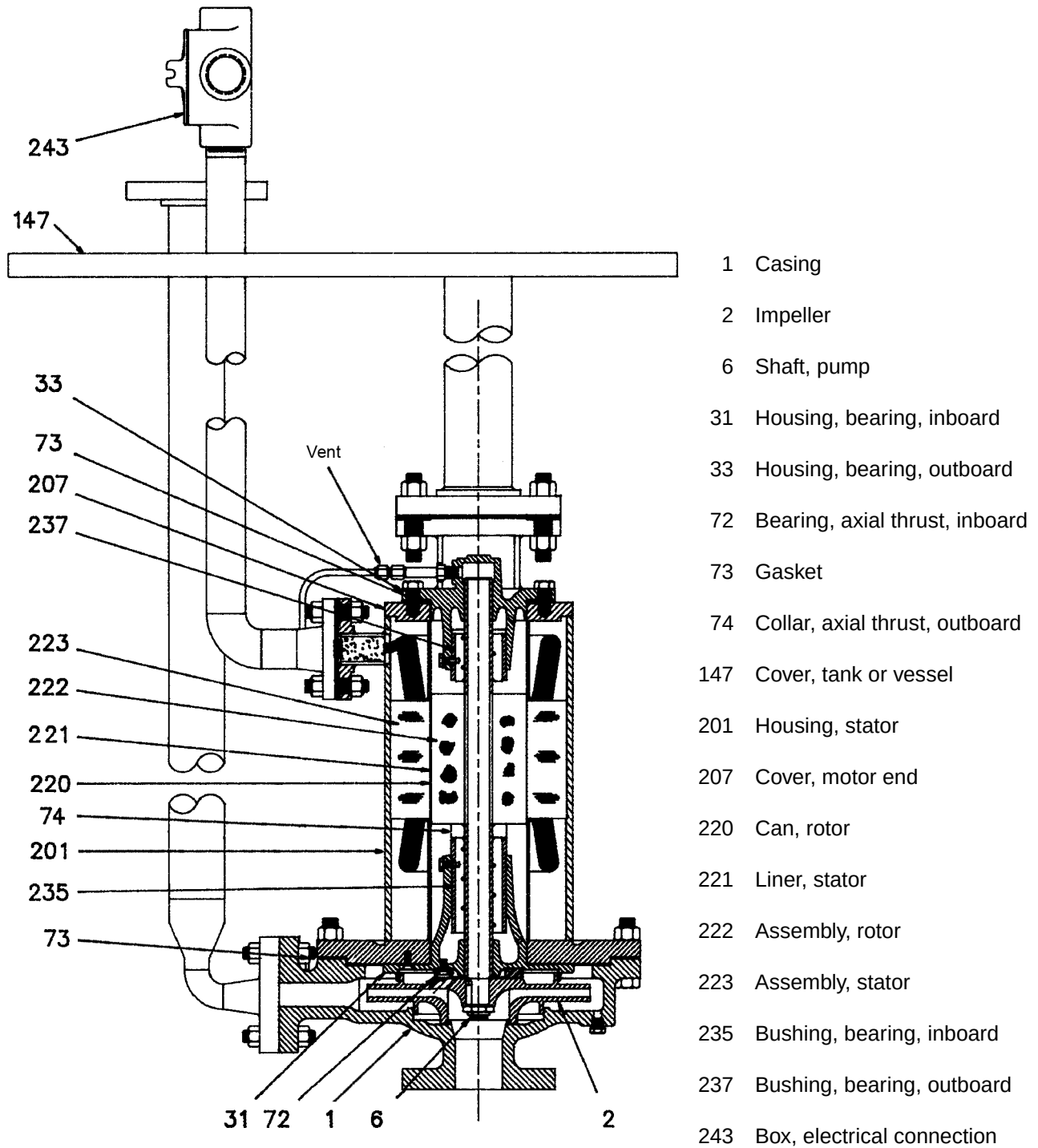
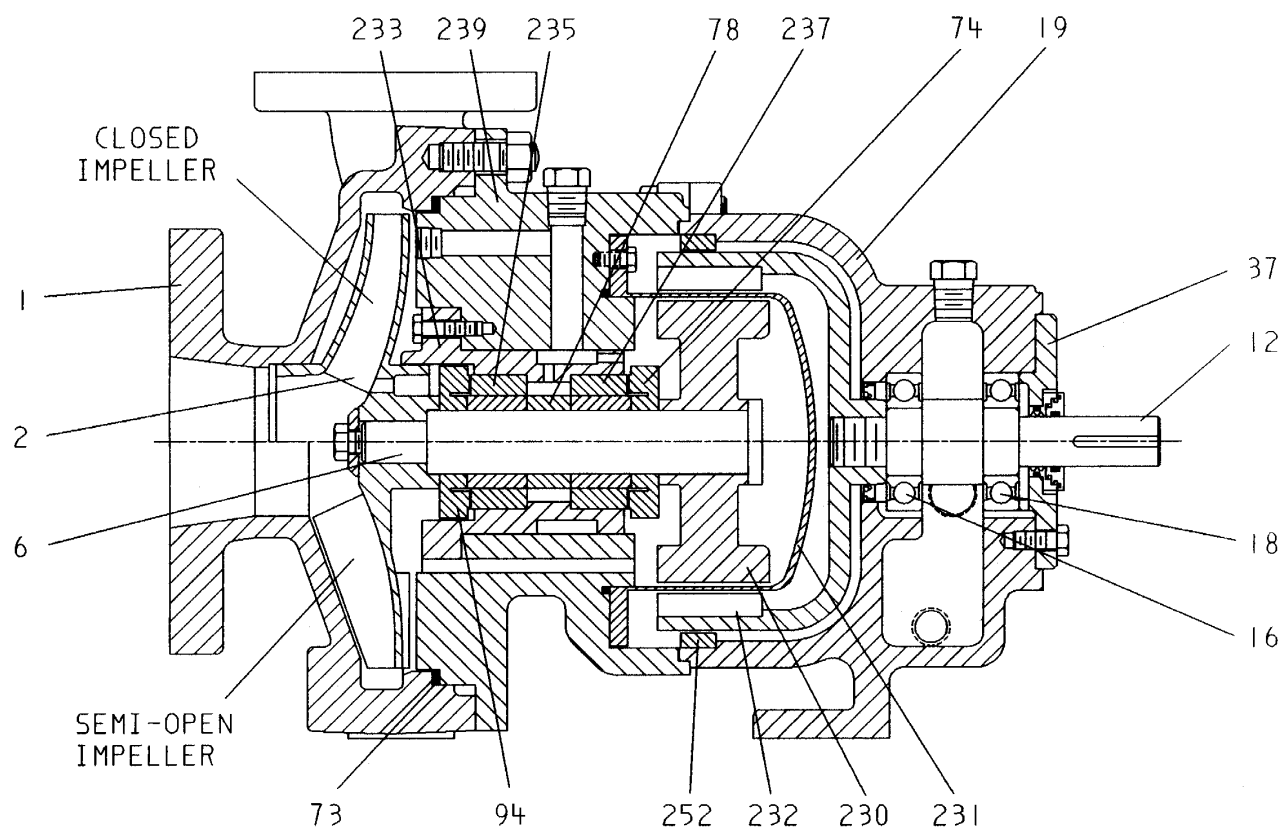
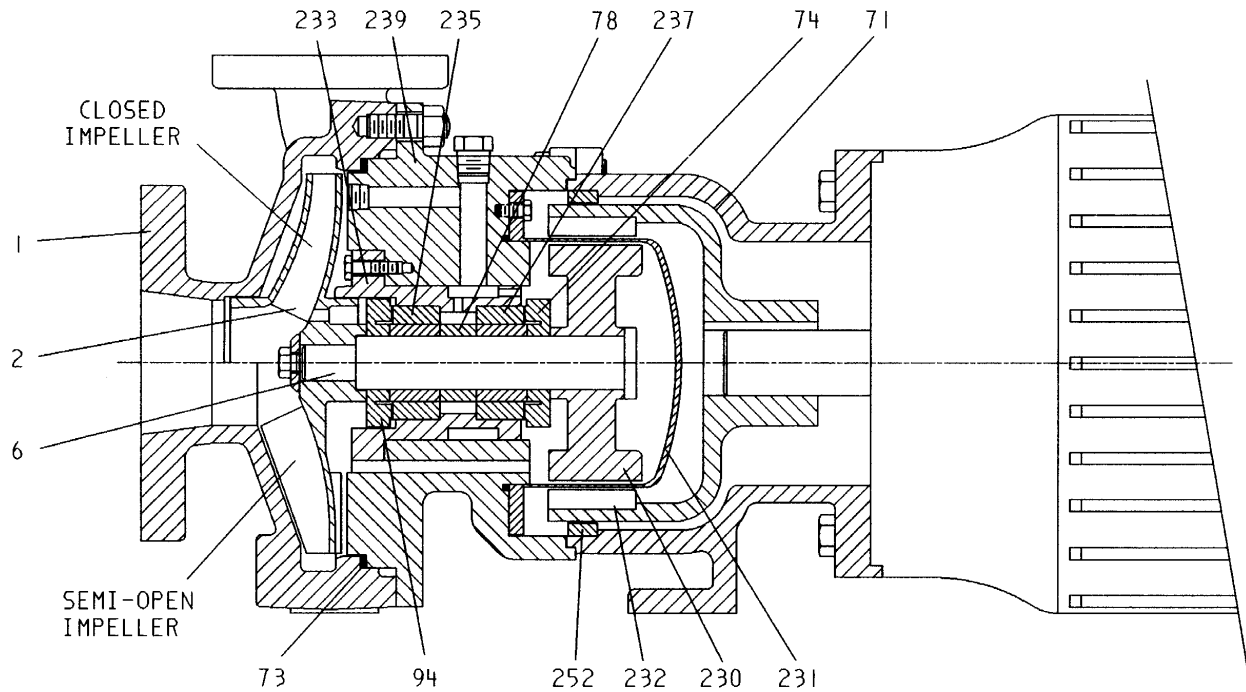


Figure 5.1.2.4 — Canned motor pump: vertical – submerged



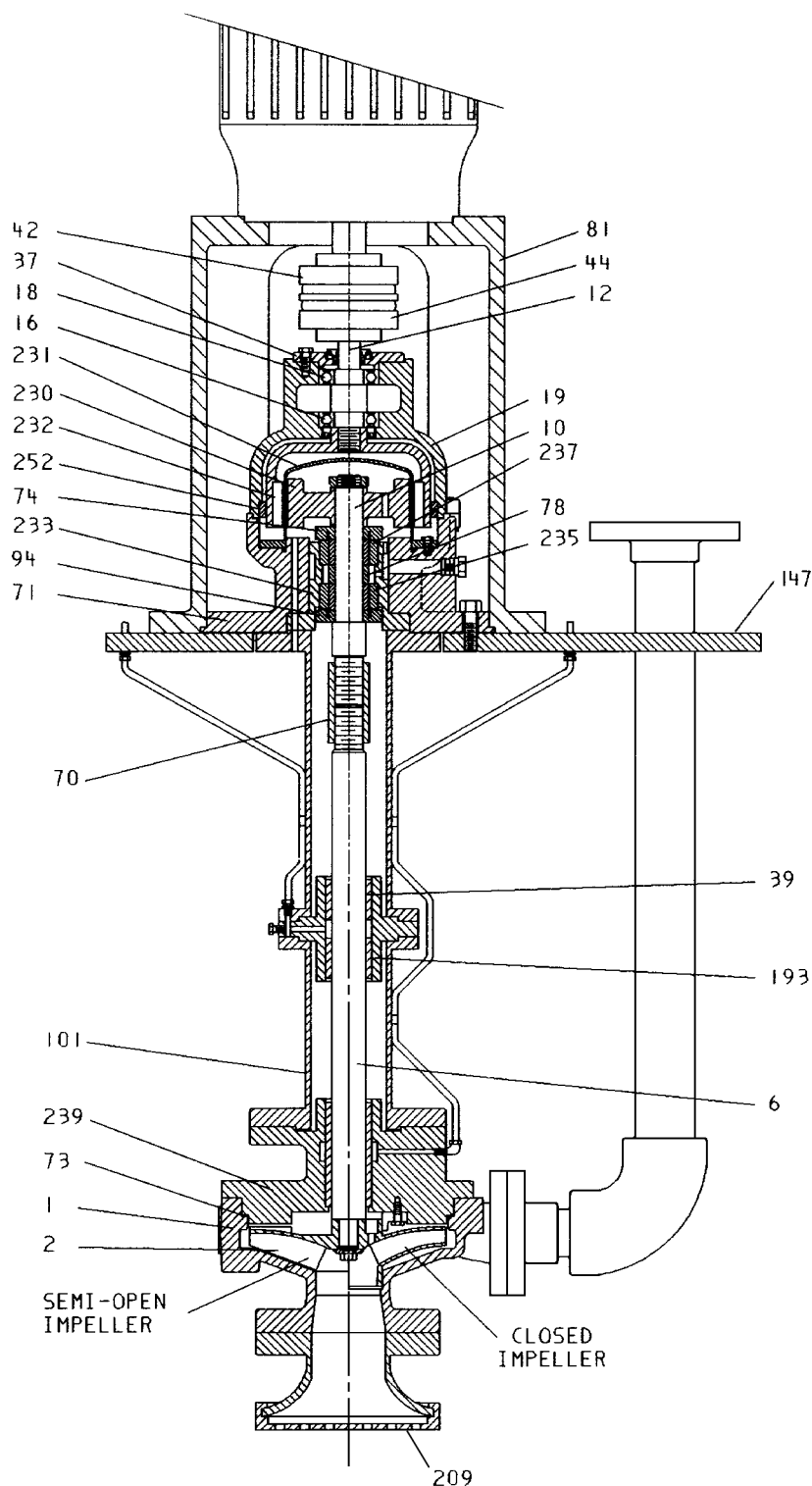
- | | |
|-----------------------------------|----------------------------------|
| 1 Casing | 78 Spacer, bearing |
| 2 Impeller | 94 Collar, axial thrust, inboard |
| 6 Shaft, pump | 230 Magnet assembly, inner |
| 12 Shaft, drive | 231 Shell, containment |
| 16 Bearing, inboard | 232 Magnet assembly, outer |
| 18 Bearing, outboard | 233 Housing, bearing, bushing |
| 19 Frame | 235 Bushing, bearing, inboard |
| 37 Cover, bearing, outboard | 237 Bushing, bearing, outboard |
| 73 Gasket | 239 Cover, casing |
| 74 Collar, axial thrust, outboard | 252 Ring, rub |

Figure 5.1.3.1 — Magnetic drive pump: separately coupled (closed or semi-open impeller)



- | | |
|-----------------------------------|--------------------------------|
| 1 Casing | 230 Magnet assembly, inner |
| 2 Impeller | 231 Shell, containment |
| 6 Shaft, pump | 232 Magnet assembly, outer |
| 71 Adapter | 233 Housing, bearing, bushing |
| 73 Gasket | 235 Bushing, bearing, inboard |
| 74 Collar, axial thrust, outboard | 237 Bushing, bearing, outboard |
| 78 Spacer, bearing | 239 Cover, casing |
| 94 Collar, axial thrust, inboard | 252 Ring, rub |

Figure 5.1.3.2 — Magnetic drive pump: close coupled (closed or semi-open impeller)



- 1 Casing
- 2 Impeller
- 6 Shaft, pump
- 10 Shaft, head
- 12 Shaft, drive
- 16 Bearing, inboard
- 18 Bearing, outboard
- 19 Frame
- 37 Cover, bearing, outboard
- 39 Bushing, bearing, intermediate
- 42 Coupling half, driver
- 44 Coupling half, pump
- 70 Coupling, shaft
- 71 Adapter
- 73 Gasket
- 74 Collar, axial thrust, outboard
- 78 Spacer, bearing
- 81 Pedestal, driver
- 94 Collar, axial thrust, inboard
- 101 Pipe, column
- 147 Cover, tank or vessel
- 193 Retainer, bearing
- 209 Strainer, suction
- 230 Magnet assembly, inner
- 231 Shell, containment
- 232 Magnet assembly, outer
- 233 Housing, bearing, bushing
- 235 Bushing, bearing, inboard
- 237 Bushing, bearing, outboard
- 239 Cover, casing
- 252 Ring, rub

Figure 5.1.3.3 — Magnetic drive pump: vertical submerged (closed or semi-open impeller)

Table 5.1.4 — Sealless pump parts names

Part name	Number	Definition
Adapter	71	A machined piece used to permit assembly of two other parts, or for a spacer, or for a heat barrier on a high-temperature sealless motor pump.
Assembly, rotor	222	The rotating assembly of an electrical machine containing laminations and conductors, that, when interacting with stator core assembly, produces torque.
Assembly, stator	223	The stationary portion of the electric machine containing laminations and conductors. Energizing these conductors creates an interaction with the rotor assembly, producing torque.
Bearing, axial thrust, inboard	72	Bearing that supports load parallel to the axis of revolution, which is lubricated by the pumpage.
Bearing, inboard	16	Rolling element bearing in the frame nearest the pump.
Bearing, outboard	18	Rolling element bearing closest to the motor.
Box, electrical connection	243	Electrical box in which the motor leads are joined with the power source.
Bushing, bearing, inboard	235	Sleeve type bearing in the drive section closest to the impeller, which is lubricated by the pumpage.
Bushing, bearing, intermediate	39	The removable portion of a sleeve bearing in contact with the journal.
Bushing, bearing, outboard	237	Same as 235 but farther from pump impeller.
Can, rotor	220	Liner that isolates rotor core from process fluid.
Casing	1	The portion of the pump that includes the impeller chamber and volute or diffuser.
Collar, axial thrust, inboard	94	A circular collar mounted on the shaft to absorb unbalanced axial thrust in the pump.
Collar, axial thrust, outboard	74	A circular collar mounted on a shaft to absorb the unbalanced axial thrust in the pump.
Coupling, shaft	70	A mechanism used to transmit power from the drive shaft to the pump shaft, or to connect two shafts.
Coupling half, driver	42	The coupling half mounted on the driver shaft.
Coupling half, pump	44	The coupling half mounted on the pump shaft.
Cover, bearing, outboard	37	An enclosing plate for either end of the outboard bearing of double suction or multistage pumps, or for the coupling end of the bearing of end suction pumps.

Table 5.1.4 — Sealless pump parts names (continued)

Part name	Number	Definition
Cover, casing	239	The portion of the pump that encloses the outboard side of the impeller. It may be integral with the containment shell, integral with the bearing holder, or a separate piece.
Cover, motor end	207	A piece that encloses the end(s) of a motor stator housing.
Cover, tank or vessel	147	A removable piece used to enclose a tank or vessel, and often used to support a pump and/or piping or electrical conduit.
Exchanger, heat	253	Additional member including heat exchanger tubing for control of process and motor temperature.
Frame	19	A member of a pump to which are assembled the rotating outer magnet ring and the drive motor or element.
Gasket	73	Resilient material of proper shape and characteristics for use in joint sealing between parts to prevent leakage.
Housing, bearing, bushing	233	A device in which the bearing is mounted.
Housing, bearing, inboard	31	A part in which the inboard bearing is mounted.
Housing, bearing, outboard	33	A part in which the outboard bearing is mounted.
Housing, stator	201	A housing in which a stator core assembly is mounted.
Impeller	2	The bladed member of a rotating assembly of the pump, which imparts the principal force to the liquid pumped.
Impeller, auxiliary	2A	An additional and typically different style impeller that is part of the rotating assembly of a pump, which helps reduce fluid flashing in the motor, produces additional head for a fractional portion of the pump main flow, creates an additional circulation path for a fractional portion of the pump main flow, or serves another special purpose in the pumping system.
Indicator, bearing wear	304	Mechanical or electrical device that indicates bearing wear.
Inducer	246	A high specific speed impeller installed in the front of the first-stage impeller of a rotodynamic pump to reduce NPSHR.
Liner, stator	221	A member that isolates the stator from the process fluid.
Magnet assembly, inner	230	The permanent magnet or induction device assembly attached to the pump shaft, located within the containment shell and driven by the outer magnet assembly.
Magnet assembly, outer	232	The permanent magnet assembly attached to the power drive shaft, located outside of the containment shell and driven by a driver.
O-ring	119	A radial or axial type seal.