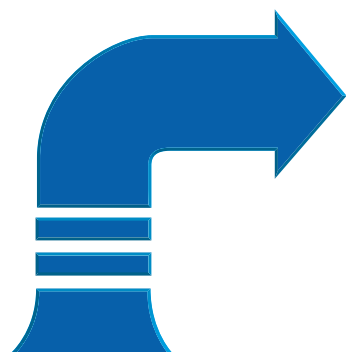




American National Standard for

Rotodynamic (Vertical) Pumps

for Nomenclature and Definitions

ANSI/HI 2.1-2.2-2008



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Rotodynamic (Vertical) Pumps

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Approved September 10, 2008
American National Standards Institute, Inc.

American National Standard

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Published By

Hydraulic Institute
6 Campus Drive, First Floor North
Parsippany, NJ 07054-4406
www.Pumps.org

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Printed in the United States of America

ISBN 978-1-880952-85-6



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Contents

Page

Foreword	v
2 Rotodynamic (vertical) pumps	1
2.1 Types and nomenclature	1
2.1.1 Scope	1
2.1.2 Definition of rotodynamic (vertical) pumps	1
2.1.3 Types of vertical pumps	1
2.1.4 Classification by configuration	13
2.1.5 Classification by impeller design	13
2.1.6 General information	16
2.2 Definitions, terminology, and symbols	22
2.2.1 Rate of flow (capacity) (Q or q) [Q]	25
2.2.2 Speed (n)	25
2.2.3 Head (h) [H]	26
2.2.4 Condition points	28
2.2.5 Suction conditions	29
2.2.6 Power	30
2.2.7 Pump pressures	31
2.2.8 Impeller balancing	31
2.2.9 Rotodynamic (vertical) pump icons – vertically suspended	32
Appendix A Hollow shaft driver	37
Appendix B Index	39
Figures	
2.1.3 — Vertical pump types – vertically suspended – single and multistage	2
2.1.3.1 — Deep well pumps (VS1)	3
2.1.3.2a — Vertical single or multistage, short setting, open lineshaft (VS1)	4
2.1.3.2b — Mixed flow vertical — open lineshaft (VS1)	5
2.1.3.2c — Vertical double suction, short setting, open lineshaft (VS2)	6
2.1.3.2d — Vertical, axial flow impeller (propeller) type (enclosed lineshaft) below floor discharge configuration (VS3)	7
2.1.3.3a — Vertical, single, or multistage diffuser (double casing) barrel or can pump (VS6)	8
2.1.3.3b — Vertical double suction, single or multistage barrel or can pump (VS7)	9
2.1.3.3c — Vertical, multistage volute (double casing) barrel or can pump (VS7a)	10
2.1.3.4 — Vertical in-line casing diffuser pump (VS8)	11
2.1.3.5 — Vertical, multistage, submersible pump (VS0)	12
2.1.4.4 — Wearing ring arrangements	14
2.1.5.5 — General impeller types	17

2.2.3.4 — Datum elevation for various pump designs at eye of first-stage impeller	27
2.2.4.6 — Typical performance curve for rotodynamic pumps.	29
2.2.9.1.1.1 — Submersible turbine (VS0)	32
2.2.9.1.2.1 — Discharge through column – diffuser – wet pit (VS1)	32
2.2.9.1.2.2 — Discharge through column – volute – wet pit (VS2)	33
2.2.9.1.2.3 — Discharge through column – axial flow – wet pit (VS3)	33
2.2.9.1.3.1 — Separate discharge – lineshaft – vertical sump (VS4).	34
2.2.9.1.3.2 — Separate discharge – cantilever (VS5)	34
2.2.9.2.1 — Vertically suspended – double casing – double suction – diffuser (VS6).	35
2.2.9.2.2a — Vertically suspended – double casing - volute - diffuser (VS7)	35
2.2.9.2.2b — Vertical volute multistage double casing pump (VS7a)	35
2.2.9.3.1 — Vertically suspended – in-line casing – multistage diffuser (VS8)	36
A.1 — Vertical hollow shaft driver coupling dimensions.	38

Tables

2.1.6.5 — Alphabetical part name listing	18
2.2a — Principal symbols	22
2.2b — Subscripts	24

Foreword (Not part of Standard)

The purpose and aims of the Institute are to promote the continued growth of pump knowledge for the interest of pump users and manufacturers and to 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 collect and disseminate information of value to its members and to the public;
- c) To appear for its members before governmental departments and agencies and other bodies in regard to matters affecting the industry;
- d) To increase the amount and to improve the quality of pump service to the public;
- e) To support educational and research activities;
- f) 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 sent to the Hydraulic Institute. The inquiry will then be directed to the appropriate technical committee for provision of a suitable answer.

If a dispute arises regarding the content of an Institute Standard or an answer provided by the Institute to a question such as indicated above, the point in question shall be sent in writing to the Technical Director of the Hydraulic Institute, who shall initiate the Appeals Process.

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.

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

Consensus for this Standard was achieved by use of the canvass method. The following organizations recognized as having interest in rotodynamic (vertical) pumps for nomenclature and definitions 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.

A.W. Chesterton	Malcolm Pirnie
Bantrel	Moyno, Inc.
Bechtel Ltd	National Pump Company
Bechtel Power Corp.	Patterson Pump Company
Black & Veatch Corp.	Peerless Pump Company
Brown and Caldwell	Pentair Water
Fairbanks Morse Pump Corporation	Pentair Water, Delavan
Fluid Sealing Association	POWELL KUGLER, Inc.
Grundfos Pumps Corp.	Sulzer Pumps
Healy Engineering	Suncor
ITT	Taco, Inc.
J.A.S. Solutions Ltd.	Tecsult, Inc.
John Crane	Weir Specialty Pumps
King County WTD	Whitley Burchett & Associates

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 the standard was approved, the committee had the following members:

Chair – Allen Hobratschk, National Pump Company, LLC
Vice-chair - Randal Ferman, Flowserve Pump Division

Committee Members

Michael S. Cropper
Michael Derr
Al Iseppon
Richard O'Donnell
Greg Towsley
Fred Walker

Company

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Afton Pumps
Pentair Water
ITT - Industrial Process
Grundfos Pumps Corporation
Weir Floway, Inc.

Other Members

William Beekman
Jason Davis
Michael Mueller
Aleksander Roudnev
Arnold Sdano

Company

Weir Floway, Inc.
Pentair Water
Flowserve Pump Division
Weir Minerals North America
Fairbanks Morse Pump Corporation

Preface

Symbols are used throughout this standard to identify the pump types. When originally introduced, the convention is to define the term in text, followed by the HI symbol in parenthesis (xx), and followed, when different, with the ISO symbol in brackets [xx].

Standard ANSI/HI 2.3 *Rotodynamic (Vertical) Pumps for Design and Application* complements the nomenclature and definitions content defined in this document with detailed information about the design and application of rotodynamic (vertical) pumps.

2 Rotodynamic (vertical) pumps

2.1 Types and nomenclature

2.1.1 Scope

This standard is for types, nomenclature, and definitions of vertical turbine, mixed flow, axial flow vertical diffuser, submersible motor deepwell and short-set pumps, types VS0, VS1, VS2, VS3, VS6, VS7, and VS8 (Figure 2.1.3) that are driven by vertical electric motors or horizontal engines with right-angle gears. Excluded from the scope of this document are vertical in-line volute pumps; horizontal centrifugal pumps mounted vertically, such as sewage pumps; and vertical overhung impeller types VS4 and VS5 (Figure 2.1.3).

2.1.2 Definition of rotodynamic (vertical) pumps

Rotodynamic pumps are kinetic machines in which energy is continuously imparted to the pumped fluid by means of a rotating impeller, propeller, or rotor. The most common types of rotodynamic pumps are centrifugal (radial flow), modified radial flow (turbine pumps), mixed flow, and axial flow (propeller pumps). (Refer to Sections 2.1.5.2 to 2.1.5.5.)

These pumps, particularly the radial flow and modified radial flow types, are usually designed for multistaging, by bolting or threading individual bowls together.

The pumping element (bowl assembly) is usually suspended by a column pipe, which also carries the liquid from the bowl (assembly) to the discharge opening.

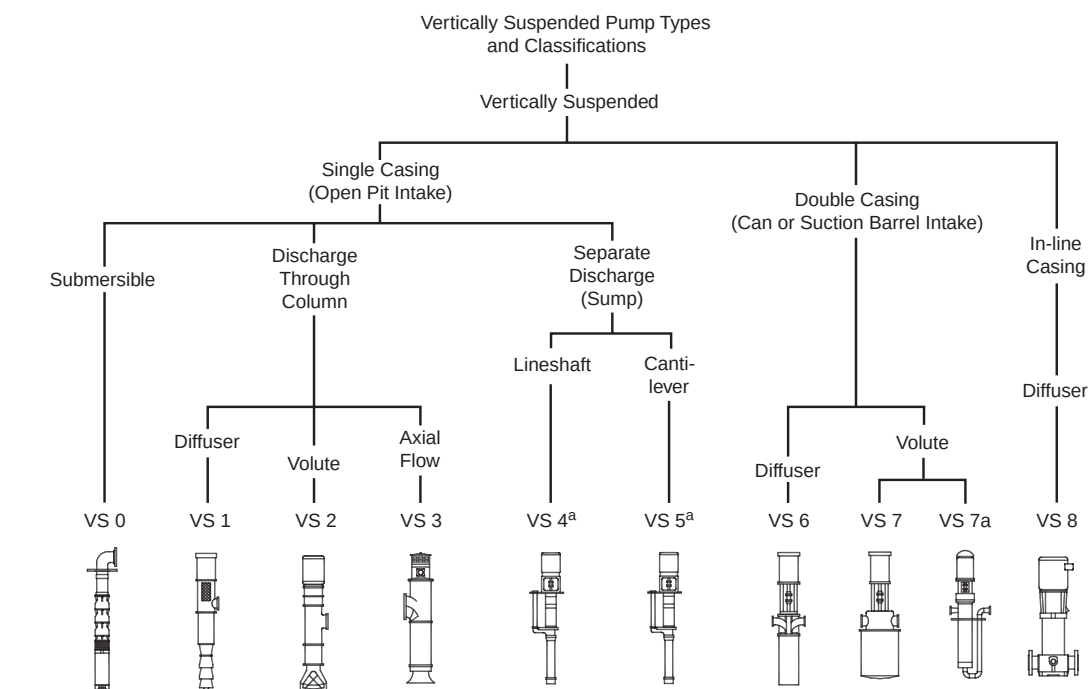
Rotodynamic (vertical) pumps are normally classified as deep well, short set, or submersible motor-driven. The driver for these pump configurations is mounted either on the discharge head (lineshaft pumps); directly to the bowl assembly, either above or below (i.e., pumps with submersible motors); or in a horizontal configuration, such as an electrical motor or engine, driving through a right-angle gear.

2.1.3 Types of vertical pumps

See Figures 2.1.3 to 2.1.3.5.

2.1.3.1 Deep well (lineshaft)

This type of vertical pump is commonly installed in a drilled and cased well. Its function is to move liquid (usually water) from the liquid level in the well to the surface and provide a specified discharge pressure at the surface (see Figure 2.1.3.1). The pumping element consists of a single or multistage bowl assembly. The first-stage impeller is located below the lowest liquid level. The bowl bearings are usually lubricated by the pumped liquid. The open lineshaft pump is often referred to as a *product-lubricated* or *water-lubricated pump*. The lubrication for an enclosed lineshaft pump may be oil, grease, filtered pump discharge water, or clean water from an external source. The column pipe and lineshaft assembly is either an open-type, product-lubricated assembly or enclosed-type oil or external liquid-lubricated assembly. The column pipe is supported at the surface by a discharge head. The discharge



^a See ANSI/HI 1.1-1.2 *Rotodynamic (Centrifugal) Pumps for Nomenclature and Definitions*.

Figure 2.1.3 — Vertical pump types – vertically suspended – single and multistage

head directs the water from vertical to horizontal flow and also supports a driver or right-angle gear. A shaft sealing arrangement is contained within the discharge head. This type of pump is self-priming. Typically the vertical electric motor or vertical right-angle gear drive is of the “hollow shaft” design.

2.1.3.2 Wet pit, short set (lineshaft) – single and double suction

This type of vertical pump usually is suspended in a wet pit. (See Figures 2.1.3.2a, b, c, and d.) The pumping element can be fitted with a bowl assembly of any desired specific speed. Normally the bowl assembly bearings are product-lubricated; however, they can be force-lubricated by grease, water, or other lubricants. The column pipe assembly supports the bowl assembly and houses a lineshaft. The lineshaft bearings are usually open-type, product-lubricated. However, enclosed-type lineshaft, force-feed lubrication with oil, grease, or water may also be supplied. A shaft sealing arrangement is contained within the discharge head on product-lubricated pumps. This type of pump is self-priming.

2.1.3.3 Barrel or can (lineshaft)

This type of pump is mounted in an enclosed container (barrel or can) and typically is used in booster applications where inadequate suction pressure conditions exist, or where the upstream flow under pressure or vacuum must be conveyed to the pumping unit. The can pump contains the same pumping elements and column pipe as the wet pit type pumps (see Figures 2.1.3.3a and b). The lineshaft bearing assembly is usually product-lubricated. The discharge head performs the same functions as the wet pit head except the base is sealed to atmosphere. Liquids other than water are commonly pumped by this type of pump. This type of pump is very effective where inadequate system net positive suction head (NPSH) is available. Additional NPSH is created by extending the pump can length and lowering the bowl assembly by lengthening the column assembly to create additional submergence (suction head). In applications with limited floor space, and where high developed pressure is required, the vertical, multistage volute arrangement shown in Figure 2.1.3.3c may be used.

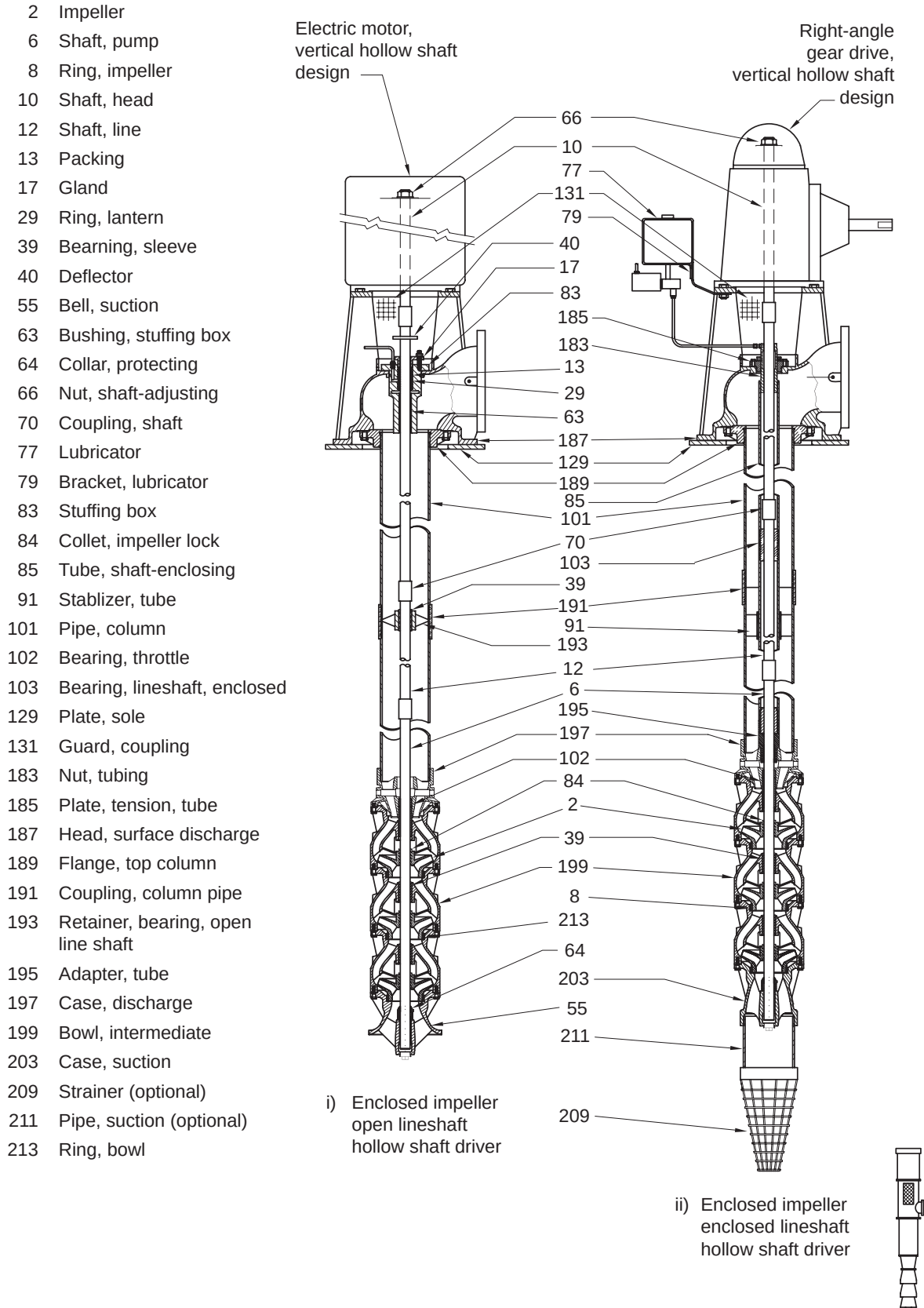


Figure 2.1.3.1 — Deep well pumps (VS1)

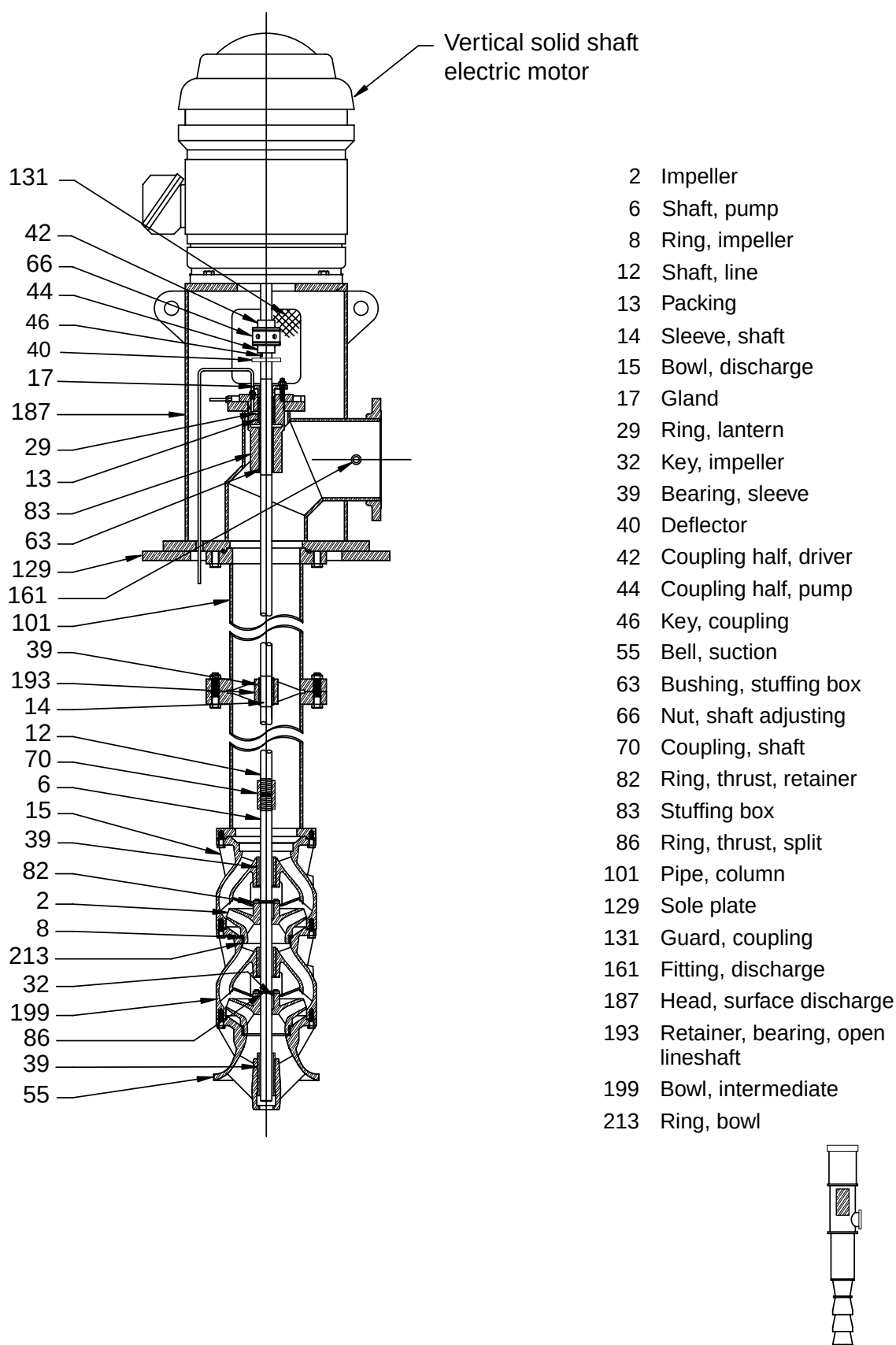


Figure 2.1.3.2a — Vertical single or multistage, short setting, open lineshaft (VS1)



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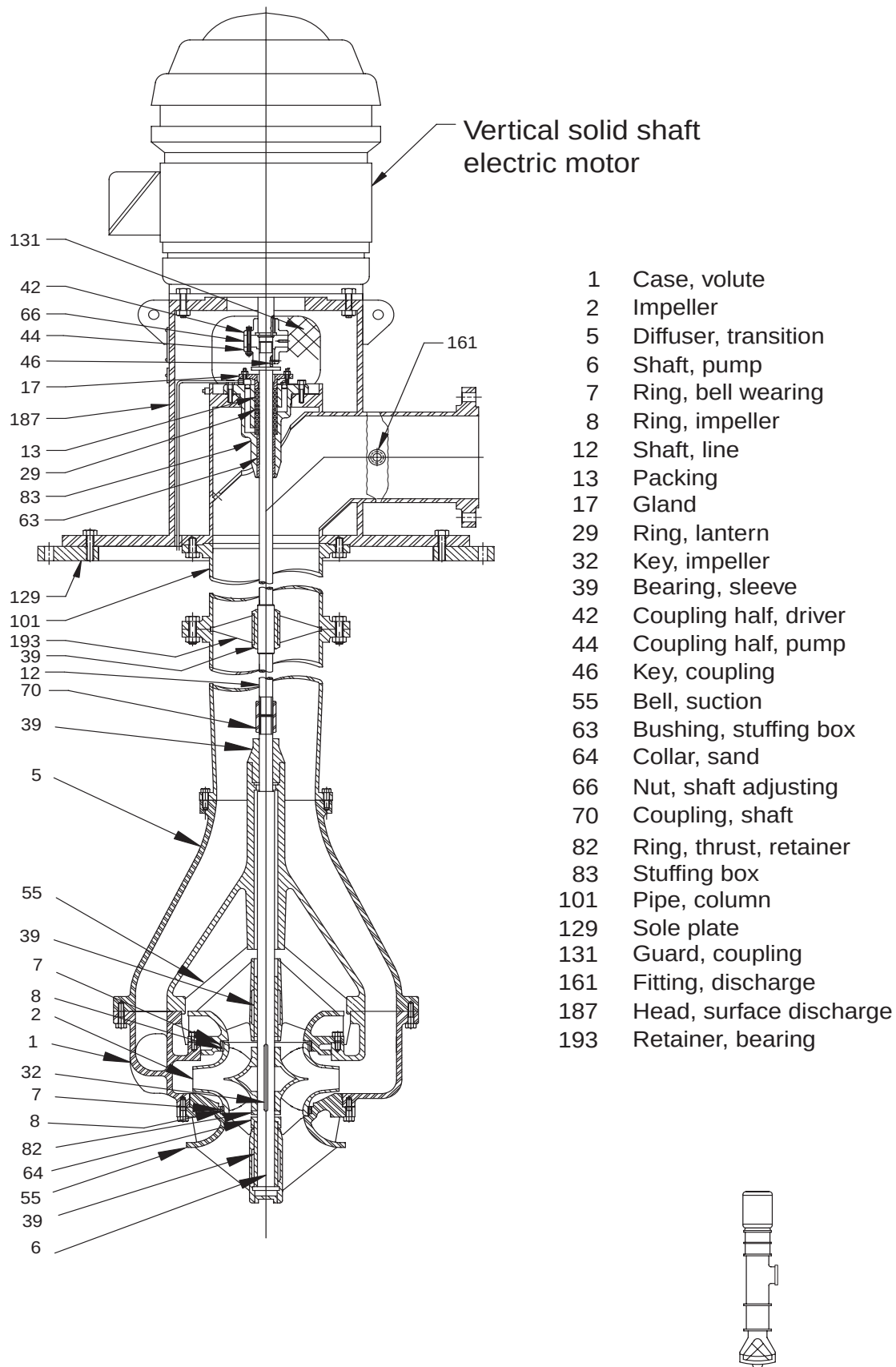


Figure 2.1.3.2c — Vertical double suction, short setting, open lineshaft (VS2)

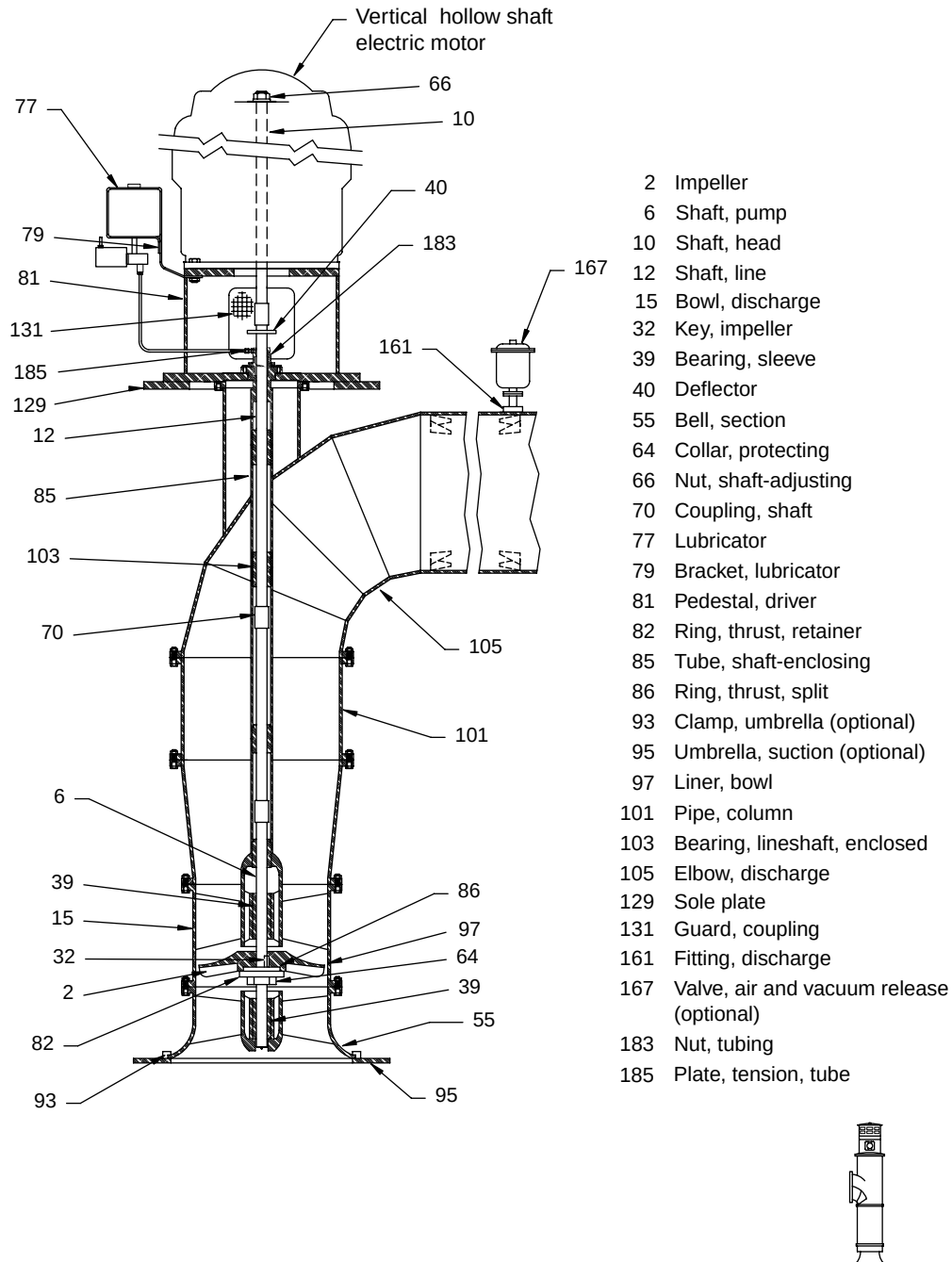


Figure 2.1.3.2d — Vertical, axial flow impeller (propeller) type (enclosed lineshaft) below floor discharge configuration (VS3)