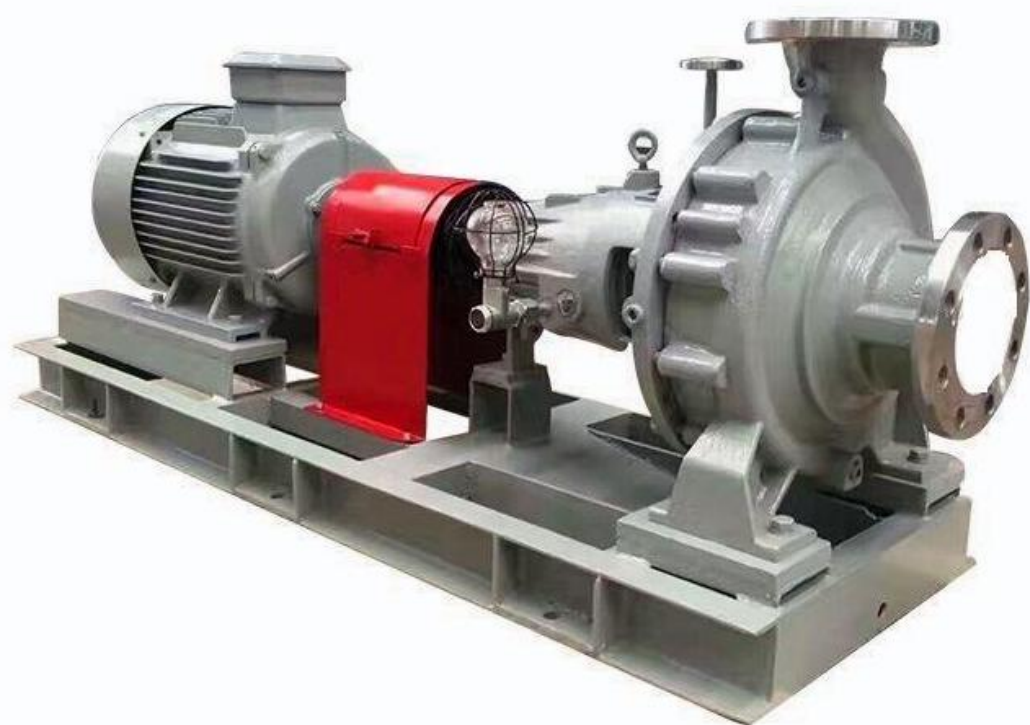


# ZA、ZE 系列石油化工流程泵

## ZA and ZE Series

### Petrochemical Process Pumps



辰禹（重庆）流体设备有限公司

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# 一、概述 Overview

## 1、产品特点 Product features

ZA、ZE 系列石油化工流程泵，是我公司根据美国石油协会 API610 标准第十版《石油、石化和天然气工业用离心泵》和 VDMA24297(轻、中型)规范设计的单级单吸悬臂式离心泵。该泵具有性能优良，抗气蚀性能好，效率高承载能力强，机封和轴承寿命长，运行可靠，结构新颖，检修方便等特点。

The ZA and ZE series petrochemical process pumps are single-stage, single-suction cantilever centrifugal pumps designed by our company in compliance with API 610 (10th Edition: Centrifugal Pumps for Oil, Petrochemical and Natural Gas Industries) and VDMA 24297 (Light and Medium Class) standards. These pumps feature superior performance, excellent cavitation resistance, high efficiency and load-bearing capacity, extended mechanical seals and bearing life, reliable operation, innovative structure, and easy maintenance.

本泵适合输送清洁或含有颗粒的液体，低温或高温的液体，中性或有腐蚀性的液体。

This pump is suitable for transporting clean or particulate-containing liquids, low-temperature or high-temperature liquids, neutral or corrosive liquids.

主要用于：

Mainly applied to :

- 炼油厂、石油化学工业、煤加工工业、铝加工工业和低温工程。
- Refinery, petrochemical industry, coal processing industry, aluminum processing industry, and cryogenic engineering.
- 化学工业、造纸、纸浆业、制糖业和普通流程工业。
- Chemical industry, papermaking, pulp industry, sugar industry, and general process industries.
- 供水厂、海水淡化厂。Water supply plant, seawater desalination plant.
- 供暖和空气调节系统。Heating and air conditioning systems.
- 发电厂。Power plant.
- 环境保护工程。Environmental engineering.
- 船舶及海上工业等。Ships and offshore industries, etc.

## 2、型号的组成及含义 Composition and meaning of models

### ZA25-200A

ZA-----	石油化工工艺流程泵 ( Z : 轻型 ; E : 重型 ; Y : 油品 ; N : 盐液 ; J : 碱液 ; C : 给排水 ; W : 污水 ) Pump for petrochemical process flow ( Z: light-duty; E: heavy-duty; Y: oil product; N: brine; J: alkali solution; C: water supply/drainage; W: wastewater)
25-----	泵出口直径 Outlet diameter of pump ( 25mm )
200-----	叶轮直径 impeller diameter ( 200mm )
A-----	叶轮代号 ( A-D ) , 叶轮切割次数 , 顺序以 A、B、C 来表示 Impeller code (A-D), number of impeller cuts, sequence represented by A, B, C

### 3、使用参数(设计点)Usage parameters (design points)

- 口径 ( Caliber ) DN : 25-450mm ;
- 流量 ( Flow ) Q : 0-2600m<sup>3</sup>/h ;
- 扬程 ( Head ) H : 3-300m ;
- 工作压力 ( Working pressure ) P : 13.5MPa ;
- 工作温度 ( Working temperature ) T : -80°C~+450°C。

### 4、输送介质 Transport medium

- (1)各种温度和浓度的硫酸、硝酸、盐酸和磷酸等无机酸和有机酸。Inorganic acids and organic acids such as sulfuric acid, nitric acid, hydrochloric acid, and phosphoric acid in various temperatures and concentrations.
- (2)各种温度和浓度的氢氧化钠、碳酸钠等碱性溶液。Alkaline solutions such as sodium hydroxide and sodium carbonate at various temperatures and concentrations.
- (3)各种盐溶液。Various salt solutions.
- (4)各种液态石油化工产品,有机化合物、其它有腐蚀性的原料和产品。Various liquid petrochemical products, organic compounds, and other corrosive raw materials and products.

## 二、结构特征与工作原理

### Structural Characteristics and Working Principle

#### 1、结构特征 Structural characteristics

(1)GZ 系列泵属卧式、单吸离心流程泵。该系列泵温度范围为-80°C ~ +450°C , 最高使用压力达 13.5MPa , 当使用温度高于 175°C时 , 泵采用水平中心支撑 , 以把热膨胀冷缩产生的变形及位移降低到最低限度。

(1) The GZ series pumps belong to horizontal single-suction centrifugal process pumps. The temperature range of this pump series is -80°C to +450°C, with a maximum operating pressure of 13.5 MPa. When the operating temperature exceeds 175°C, the pump adopts a horizontal central support structure to minimize deformation and displacement caused by thermal expansion and contraction.

(2)GZ 型流程泵,可保证流程工业要求的维修条件,轴承、轴封和叶轮为一转子组件可进行迅速的拆卸或装配,大大缩短了停车时间。

(2) The GZ-type process pump ensures maintenance conditions required by process industries. Its bearings, shaft seals, and impeller form a single rotor assembly that allows rapid disassembly or assembly, significantly reducing downtime.

(3)叶轮可用闭式、半开式、开式三种。可输送清洁,含颗粒,含少量气体介质,也可输送高温、低温、强腐蚀介质。叶轮设有平衡孔,平衡轴向力。

(3) The impeller can be classified into three types: closed, semi-open, and open. It is capable of conveying clean media containing particles and small amounts of gas, as well as high-temperature, low-temperature, and highly corrosive media. The impeller is equipped with balance holes to counterbalance axial forces.

(4)轴封腔(填料函)和泵盖是铸成一体的,它可以装填料密封及单端面 and 双端面机械密封,轴封腔外面铸有可供选择的水冷腔夹套,水

冷夹套的配备必须是特别提出要求或者当输送介质为水的温度超过 66°C ,以及碳氢化合物温度超过 150°C 时用。当输送介质需要保温时,在其夹套内还可以通入低压蒸气或其它保温液体。液体进入接头 G1/2" ,一般在泵盖下方,液体出口接头 G1/2" 在泵盖上方。蒸气进入接头 G1/2" 一般在泵盖上方,出口接头 G1/2" 泵盖下方。

(4) The shaft seal chamber (stuffing box) and pump cover are cast as a single unit, capable of accommodating packing seals as well as single-end and double-end mechanical seals. An optional water-cooling jacket is cast around the shaft seal chamber, which must be installed under specific conditions: when the transported medium is water with temperatures exceeding 66°C, or when hydrocarbon temperatures surpass 150°C. For thermal insulation requirements, low-pressure steam or other insulating fluids can be circulated within the jacket. The liquid inlet fitting G1/2 "is typically located below the pump cover, while the outlet fitting G1/2" is positioned above it. Similarly, the steam inlet fitting G1/2 "is generally situated above the pump cover, with the outlet fitting G1/2" positioned below.

(5) 轴承体具有较大的供轴承润滑的油池,同时装有一套径向轴承和两套背对背安装的推力球轴承,轴承采用甩油环润滑,油量适中。轴承体外表面铸有散热片,可为空气冷却 ( $T < 120^{\circ}\text{C}$ ), 还可选用风扇冷却 ( $T = 120^{\circ}\text{C} \sim 260^{\circ}\text{C}$ ) 和水冷却 ( $T = 260^{\circ}\text{C} \sim 450^{\circ}\text{C}$ ), 其中风扇冷却尤为适用却水或水质差的地区。

(5) The bearing housing features a large oil reservoir for lubrication, equipped with one set of radial bearings and two sets of back-to-back thrust ball bearings. The bearings utilize oil 甩 ring lubrication with moderate oil flow rates. The outer surface of the housing is cast with heat dissipation fins, supporting air cooling ( $T < 120^{\circ}\text{C}$ ), fan cooling ( $T = 120^{\circ}\text{C} - 260^{\circ}\text{C}$ ), or water cooling ( $T = 260^{\circ}\text{C} - 450^{\circ}\text{C}$ ). Fan cooling proves particularly suitable for regions with poor water quality or limited water supply.

(6) 当泵轴承使用风扇冷却时,风扇将取代防尘盘的位置,当泵轴使用水冷却时,径向球轴承外铸有水冷夹套。

(6) When the pump bearing is cooled by a fan, the fan replaces the dust shield. When the pump shaft is water-cooled, a water-cooling jacket is cast around the radial ball bearings.

(7) 轴承体两端装有铁或铜制防尘盘,伸向轴承压盖的内孔,既可以防止灰尘和水份进入,又可以防止油泄漏。当轴承盖万一破裂时,它还能起到支撑作用。靠泵端的防尘盘带有风扇,同时也能使轴封得到冷却,防止热量传入轴承处。

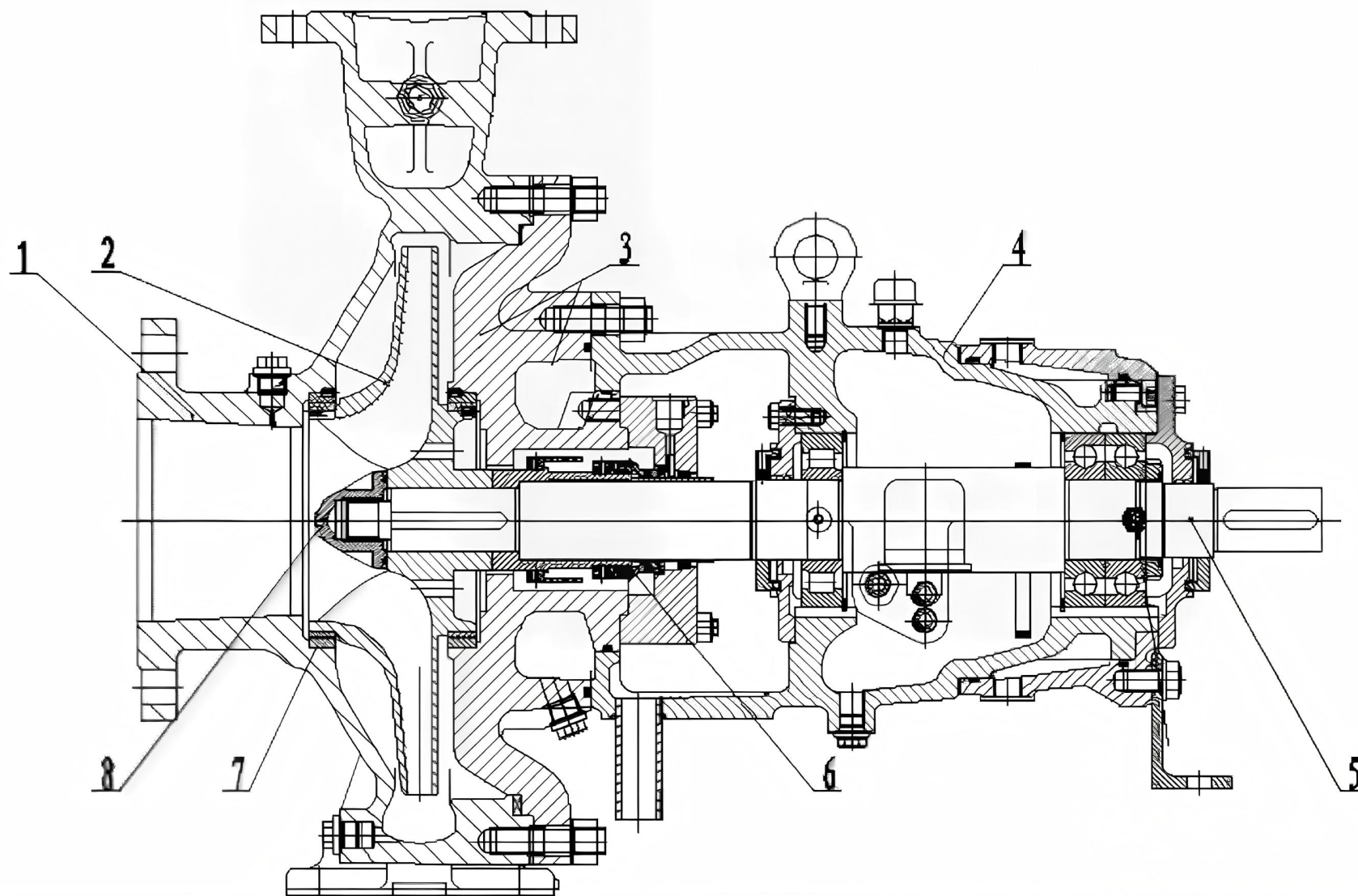
(7) The bearing housing is equipped with iron or copper dust shields at both ends, extending into the inner bore of the bearing gland. These shields serve dual purposes: preventing dust and moisture ingress while also stopping oil leakage. In the event of a bearing cover rupture, they provide structural support. The dust shield near the pump end incorporates a fan mechanism that simultaneously cools the shaft seal, effectively preventing heat transfer to the bearing assembly.

(8) 泵与驱动器间使用弹性联轴器作为连接元件,该元件可补偿小的轴向、径向和角度位移。

(8) An elastic coupling is used as the connecting element between the pump and the driver, which can compensate for small axial, radial, and angular displacements.

## 2、结构图 Flowchart

- 1、泵体 Pump body    2、叶轮 Impeller    3、泵盖 Pump cover    4、轴承箱部件 Bearing housing components  
5、轴 Shaft    6、密封部件 Sealing components    7、密封环 Sealing ring    8、叶轮螺母 Impeller nut



## 3、流程泵的管路系统 Pipeline system for process pumps

所有管路系统均执行 API610 标准第十版《石油、石化和天然气工业用离心泵》设计标准。根据工况条件，泵盖、轴承架和泵体支座可冷却，密封压盖可背部急冷；当输送易结晶或易凝固的介质时，泵体和泵盖可保温。每支管路的冷却水流量为：泵盖、轴承架和泵体支座各为 0.3~0.6m<sup>3</sup>/h；密封压盖急冷为 0.06m<sup>3</sup>/h。密封冲洗方案根据具体工况条件确定，如果外供密封冲洗液，建议机械密封冲洗液流量为 0.3~0.6m<sup>3</sup>/h，填料密封冲洗液流量为 0.06m<sup>3</sup>/h，压力高于密封腔压力 0.1MPa，届时我厂会通知用户具体数值；若属于易汽化的介质，应高于气化压力 0.175-0.2MPa。

All piping systems comply with the design standards specified in API610 Standard, 10th Edition "Centrifugal Pumps for Petroleum, Petrochemical, and Natural Gas Industries." Depending on operating conditions, pump covers, bearing frames, and pump body supports may be cooled, while sealing gland covers can undergo backside quenching. When handling media prone to crystallization or solidification, pump bodies and covers require thermal insulation. Cooling water flow rates are specified as follows: 0.3–0.6 m<sup>3</sup>/h for pump covers, bearing frames, and pump body supports; 0.06 m<sup>3</sup>/h for sealing gland quenching. Sealing flushing protocols are determined based on specific conditions. For externally supplied flushing fluids, mechanical seal flushing fluid should maintain 0.3–0.6 m<sup>3</sup>/h flow rate with packing seal flushing fluid at 0.06 m<sup>3</sup>/h, operating at a pressure 0.1 MPa above the sealing chamber pressure (specific values will be provided by our facility). For volatile media, the pressure must exceed vaporization pressure by 0.175–0.2 MPa.

## 4、API682 常用冲洗管路系统标准方案介绍 Introduction to Standard Solutions for Common API682 Flushing Pipeline Systems

- PLAN 01 方案 (单端面自冲洗) (Single-end self-flushing)
- PLAN 02 方案 (夹套冷却伴热) (Sleeve cooling with heating)
- PLAN 11 方案 (自冲洗) (Self-rinsing)
- PLAN 13 方案 (反向冲洗) (Back flush)
- PLAN 14 方案 (正+反向冲洗) (Forward and reverse flushing)
- PLAN 21 方案 (带冷却的自冲洗) (Cooled self-flushing)
- PLAN 23 方案 (带循环套的内部冲洗) (Internal irrigation with looped sleeve)
- PLAN 31 方案 (带悬液分离器的自冲洗) (Self-flushing with suspension separator)
- PLAN 32 方案 (外冲洗) (External irrigation)
- PLAN 41 方案 (带悬液分离器、换热器的自冲洗) (Self-cleaning with suspension separator and heat exchanger)
- PLAN 52 方案 (带无压缓冲罐的串联式密封) (Series sealing with unpressurized buffer tank)
- PLAN 53A 方案 (带有压密封液的双端面密封) (Double-face seal with pressure-sealed liquid)
- PLAN 53B 方案 (强制循环密封液的双端面密封) (Bidirectional sealing of forced circulation sealing fluid)
- PLAN 53C 方案 (带增压罐的双端面密封) (Dual-end face sealing with booster tank)
- PLAN 54 方案 (采用外引密封液的双端面密封) (Bidirectional sealing with externally introduced sealing fluid)
- PLAN 62 方案 (外冲洗或急冷防止密封面堆积固体颗粒) (External flushing or rapid cooling to prevent accumulation of solid particles on the sealing surface)
- PLAN 65 方案 (带浮子液位开关测量密封泄露量) (Using a float level switch to measure seal leakage rate)
- PLAN 72 方案 (采用隔离氮气用于易挥发介质的串联式干气密封) (Series dry gas seal for volatile media using isolated nitrogen)
- PLAN 74 方案 (双端面干气密封) (Bi-face dry gas seal)
- PLAN 75 方案 (用于不易挥发介质的串联式干气密封) (For series dry gas seals used in non-volatile media)
- PLAN 76 方案 (采用外引密封气的串联式干气密封) (Series dry gas seal with external sealing gas introduction)

## 5、旋转方向 Rotation direction

从驱动端看，泵为顺时针旋转；如有特殊要求时我公司可设计为逆时针旋转。

From the driving end perspective, the pump rotates clockwise; if special requirements are specified, our company can design it to rotate counterclockwise.

### 三、性能参数表 Performance parameter table

型号 Model	叶轮形式 Impeller configuration	额定转速 Rated speed n=2900r/min						额定转速 Rated speed n=1450r/min						
		流量	扬程	轴承架号	电机功率 KW			流量	扬程	轴承架号	电机功率 KW			
		Q m3/h	H m	Bearing housing number	比重 Proportion			Q m3/h	H m	Bearing housing number	比重 Proportion			
					1	1.35	1.84				1	1.35	1.84	
25-200	A	12	50	25	5.5	7.5	11	25	6	12.5	25	1.1	1.1	1.5
	B	10	42		4	5.5	7.5		5	10		1.1	1.1	1.1
	C	9	36		3	4	5.5		4.5	8.5		1.1	1.1	1.1
	D	7.5	28		2.2	3	4		4	6.5		1.1	1.1	1.1
	E	5	16		1.5	1.5	2.2		2.5	4		1.1	1.1	1.1
25-250	A	16	72	40	11	15	22	30	8.1	17.7	30	1.5	2.2	3
	B	14	62		11	15	18.5		7	15.6		1.5	2.2	3
	C	13	42		7.5	11	15		6.5	10.9		1.5	2.2	2.2
	D	11	24		5.5	7.5	11		5.5	6.2		1.1	1.1	1.5
25-315	A	20	120	40	30	37	55	40	10	32	40	5.5	7.5	7.5
	B	18	113		30	37	45		9	29		4	5.5	7.5
	C	17	99		22	30	37		8	24		3	5.5	5.5
	D	15	84		18.5	30	37		7	22		3	4	5.5
	E	14	76		15	22	30		7	19		2.2	3	4
	F	13	60		11	15	22		6	15		2.2	2.2	3
40-160	A	28	32	30	5.5	7.5	11	30	14	8	30	1.1	1.1	1.5
	B	25	28		5.5	7.5	11		13	7		1.1	1.1	1.5
	C	21	22		4	5.5	5.5		11	5		1.1	1.1	1.1
	D	20	16		2.2	3	4		9	4		1.1	1.1	1.1
40-200	A	27	54	30	11	15	18.5	30	14	13	30	1.5	2.2	3
	B	26	47		7.5	11	15		12	12.5		1.5	1.5	2.2
	C	21	38		5.5	7.5	11		11	9		1.1	1.1	1.5
	D	18	20		4	5.5	7.5		9	7		1.1	1.1	1.1
40-250	A	32	77	40	18.5	22	30	30	16	19	30	3	4	5.5
	B	30	72		15	18.5	30		15	18		2.2	3	4
	C	25	60		11	15	18.5		12	15		1.5	2.2	3
	D	21	47		7.5	11	15		10	11		1.1	1.5	2.2
40-315	A	42	113	40	37	45	75	40	21	29	40	5.5	7.5	11
	B	40	105		30	45	55		20	26		5.5	7.5	11
	C	34	82		22	30	45		17	20		4	5.5	7.5
	D	29	64		22	30	45		14	15		4	5.5	7.5
40-400	A	43	157	50	55	75	110	40	15	37	40	7.5	11	18.5
	B	40	137		45	55	90		20	32		7.5	11	18.5
	C	38	112		37	45	75		19	28		5.5	7.5	15

	D	36	92		30	37	55	18	20		4	5.5	11
50-160	A	50	35	40	11	15	15	25	8	30	1.5	2.2	2.2
	B	45	28		7.5	11	15	22	7		1.1	1.5	2.2
	C	38	22		5.5	7.5	11	19	5		1.1	1.1	1.5
	D	30	18		3	4	5.5	16	4		1.1	1.1	1.1
50-200	A	62	52	40	18.5	22	30	30	13	30	3	3	4
	B	52	45		15	18.5	22	25	12		2.2	3	4
	C	49	37		11	15	18.5	25	9		1.5	2.2	3
	D	43	28		7.5	11	15	20	7		1.1	1.5	2.2
50-250	A	70	82	40	30	37	55	35	20	40	4	5.5	7.5
	B	65	75		30	37	45	32	18		4	5.5	7.5
	C	50	60		22	30	37	30	15		3	4	5.5
	D	45	45		15	18.5	22	26	11		2.2	3	3
50-315	A	84	118	50	55	75	110	44	28	40	11	11	15
	B	80	100		45	75	90	40	24		7.5	11	15
	C	70	78		30	45	55	35	19		5.5	7.5	11
	D	50	54		22	30	37	30	14		3	4	5.5
50-400	A	82	194	50	110	160		41	48	40	15	22	30
	B	78	175		90	132	160	39	43		15	18.5	22
	C	70	140		75	90	132	35	34		11	15	18.5
	D	60	102		45	75	90	30	25		7.5	11	15
50-450	A	93	248	60	132			46.5	62		22	30	45
	B	87	233		132			43.5	58		22	30	45
	C	75	195		110	132		39	48		15	22	37
	D	56	141		55	75	110	28	35		11	15	22
80-160	A	90	34	40	15	18.5	30	47	8	40	2.2	3	4
	B	85	28		11	15	18.5	42	7		2.2	2.2	3
	C	75	21		11	11	15	38	5.5		1.5	2.2	2.2
	D	66	16		5.5	7.5	11	34	4		1.1	1.1	1.5
80-200	A	104	54	40	30	37	45	51	13.5	30	4	5.5	7.5
	B	95	48		22	30	37	47	12		3	4	5.5
	C	83	38		15	22	30	41	9.5		2.2	3	4
	D	70	32		11	15	22	36	7.5		1.5	2.2	3
80-250	A	127	82	40	45	75	90	64	20	40	7.5	11	15
	B	120	76		45	55	75	60	19		7.5	7.5	11
	C	105	59		30	45	55	52	14.5		4	5.5	7.5
	D	87	45		22	30	37	46	11		3	4	5.5
80-315	A	141	127	40	90	160		70	33	40	15	18.5	22
	B	135	121		75	160		66	30		11	15	22
	C	115	97		55	75		56	24		11	11	15
	D	90	74		37	45	75	45	18		5.5	7.5	11
80-400	A	171	187	50	160			85	46	40	22	30	45
	B	159	170		160			80	42		18.5	30	37
	C	135	130		90	132		65	33		15	18.5	30

	D	116	95		75	90	132	53	25		11	15	18.5
80-450	A	206	238	60				103	59.5		37	45	55
	B	196	221					98	55.5		30	37	45
	C	175	185					87	46		22	30	37
	D	140	129		110	132		70	32		18.5	30	37
100-160	A	162	29	40	22	30	37	81	7.2	40	3	4	5.5
	B	150	24		15	22	30	73	6		2.2	3	4
	C	130	17		11	15	18.5	63	4.3		1.5	2.2	3
	D	110	12		7.5	11	15	55	3		1.1	1.5	2.2
100-200	A	193	50	40	45	55	75	95	12.5	40	5.5	7.5	11
	B	180	44		37	45	75	90	10.5		5.5	7.5	11
	C	155	35		30	37	45	80	8.5		4	5.5	7.5
	D	135	26		18.5	30	37	70	6		3	3	4
100-250	A	230	79	40	75	90		115	20	40	11	15	18.5
	B	218	73		75	90		118	18		11	11	15
	C	190	58		45	75	90	100	14		7.5	11	11
	D	170	44		37	45	75	90	10		5.5	7.5	7.5
100-315	A	250	126	50	132			125	31	40	18.5	30	37
	B	240	120		132	160		119	29		18.5	22	30
	C	203	97		90	132	160	104	24		15	18.5	22
	D	170	71		75	75	10	86	17.5		11	11	15
100-400	A	300	194	60				150	48	50	37	45	75
	B	290	180					145	44		30	45	55
	C	260	145					130	36		22	30	45
	D	224	105		110	160		115	26		15	22	30
100-450	A	327	258	60				160	64	60	55	75	90
	B	307	241					150	60		45	55	75
	C	260	200					130	50		37	45	55
	D	200	145		160			100	36		22	30	37
100-500	A							180	75	60	75	90	110
	B							167	68		55	75	110
	C							142	53		37	55	75
	D							120	42		30	37	55
150-200	A	320	44	60	55	75		160	11	40	7.5	11	15
	B	300	39		45	75	90	152	9.5		7.5	11	15
	C	265	30		37	45	75	140	7		5.5	7.5	11
	D	220	23		22	30	45	123	5		3	4	5.5
150-250	A	390	74		110	160		195	18.5	40	15	22	30
	B	360	32		90	110	160	180	16		15	18.5	22
	C	320	46		75	90	110	160	11.5		11	11	15
150-315	A	442	125					220	32.5	50	30	45	55
	B	430	120					210	30		30	37	55
	C	372	94		160			180	24		22	30	37
	D	310	68		90	132	160	150	17		15	18.5	22

150-400	A	520	204					260	51	50	55	75	110
	B	500	192					250	48		55	75	90
	C	450	172					225	38		37	55	75
	D	400	112					200	28		30	37	55
150-450	A	546	260					273	65	50	75	90	110
	B	520	246					260	60		55	75	90
	C	452	208					226	50		30	55	75
	D	347	142					173	35				
150-500	A							300	77	50	110	132	55
	B							283	72		90	132	160
	C							233	59		75	90	110
	D							208	45		45	75	75
150-560	A							335	104	60	160		
	B							315	97		132		
	C							260	80		90	132	160
	D							212	60		75	90	110
150-630	A							360	115	60			
	B							338	105.5				
	C							274	82		132	160	
	D							220	60		75	110	160
200-250	A	610	72	50	160			305	17.5	50	22	30	45
	B	580	65		160			290	16		18.5	30	37
	C	520	47		110	132		260	12		15	18.5	30
	D	470	32		75	90	110	240	8		11	15	15
200-315	A	710	122	60				350	30	50	45	55	75
	B	680	114					340	29		37	55	75
	C	600	87					300	22		30	37	55
	D	480	65		132			250	15		18.5	22	30
200-400	A	850	203	70				426	50	50	90	110	160
	B	830	150					410	47		75	110	132
	C	750	145					370	36.5		55	75	110
	D	670	106					332	27		45	55	75
200-500	A							495	84	60			
	B							470	79		160		
	C							400	63		110	160	
	D							330	48		75	90	132
200-560	A							540	105	70			
	B							510	98				
	C							440	81		160		
	D							350	62		110	132	
200-630	A							580	132	70			
	B							550	125				
	C							468	100				
	D							372	75		132		

250-315	A							545	27	50	55	75	110
	B							528	25		55	75	90
	C							480	19		37	55	75
	D							434	13		30	37	45
250-400	A							660	49	60	132	160	
	B							630	46		110	160	
	C							565	36		75	110	160
	D							500	24		55	75	90
250-500	A							800	82	70			
	B							770	76				
	C							700	58		160		
	D							630	42		110	160	
250-560	A							860	106	70			
	B							830	98				
	C							760	78				
	D							665	57		160		
250-630	A							855	128	85			
	B							816	119				
	C							720	96				
	D							625	71				
300-400	A							1050	48	60			
	B							1010	45		160		
	C							900	34		132	160	
	D							780	26		90	132	160
300-500	A							1240	78	70			
	B							1170	75				
	C							1015	57				
	D							870	42		160		
300-560	A							1340	104	85			
	B							1280	97				
	C							1140	77				
	D							950	56				
300-630	A							1450	132	85			
	B							1375	125				
	C							1170	100				
	D							950	75				
400-500	A							1870	74	85			
	B							1800	70				
	C							1520	52				
	D							1300	38				
400-560	A							2040	98	85			
	B							1950	91				
	C							1760	74				
	D							1500	54				

400-630	A						2390	125	100			
	B						2280	117				
	C						1960	95				
	D						1610	70				

## 四、泵的安装、调整、管路及其辅助设备 Installation, Adjustment, Pipelines, and Auxiliary Equipment of Pumps

### 1、安装前的准备工作 Pre-installation preparations

**泵安装的好坏对泵的运行和寿命有重要影响，所以安装和校正必须仔细进行。**

**The quality of pump installation significantly impacts its operation and service life, thus requiring meticulous installation and calibration procedures.**

**(1) 基础的制作和校正 (本规范仅供参考，应以实际土建资料为准)。**

- ◆ 按照泵制造商提供的外形图和动静载荷等资料确定基础混凝土的标号、地脚螺栓孔的大小、深度及尺寸。
- ◆ 按泵的基础图尺寸制作基础，泵的地脚螺栓孔采用预留。电机功率 $\geq 155\text{KW}$ 的预留螺栓孔采用倒锥形。
- ◆ 待基础干涸后，清理干净表面和预留孔。
- ◆ 在预留孔四周打点，打点数 $\geq 75\%$ 。
- ◆ 在基础平面上修平，平面度 $\leq 5 : 1000$ 。
- ◆ 在基础平面上打点，打点数 $\geq 75\%$ 。

**(1) Foundation construction and alignment (This specification is for reference only; actual civil engineering data shall prevail).**

- ◆ Based on the pump manufacturer's provided schematics and static/dynamic load data, determine the concrete grade for the foundation, as well as the size, depth, and dimensions of anchor bolt holes.
- ◆ The foundation shall be constructed according to the basic drawing dimensions of the pump, with reserved bolt holes for pump footings. For motor power  $\geq 155\text{KW}$ , the reserved bolt holes shall adopt an inverted conical shape.
- ◆ After the foundation has completely dried, clean the surface and reserved holes thoroughly.
- ◆ Mark points around the reserved hole, with a marking density of  $\geq 75\%$ .
- ◆ The surface shall be leveled on the base plane with a flatness of  $\leq 5:1000$ .
- ◆ Points are plotted on the base plane, with a plotting density of  $\geq 75\%$ .

**(2) 设备搬运：设备的搬运应轻起轻放。**

- ◆ 在有搬运和起吊的条件下，设备可顺利就位到基础上。
- ◆ 在大型设备受到搬运和起吊的条件限制时，应采用以下方法搬运：

a) 在地面上铺设滚筒，采用吊车将设备吊在滚筒上；

B) 采用棒撬使滚筒滚动：滚动一段距离后，在其前方加设滚筒，不断重复，直到设备运至基础就位。

◆ 常用的搬运方法：

1、人工抬；2、汽运；3、吊车；4、滚筒

## **(2) Equipment handling: Equipment should be lifted and placed with care.**

◆ Under conditions permitting handling and lifting, the equipment can be successfully positioned onto the foundation.

◆ When large equipment is restricted by transportation and lifting conditions, the following methods should be adopted for handling:

a) Lay rollers on the ground and use a crane to hoist the equipment onto the rollers;

b) Use a rod lever to roll the rollers: after rolling a certain distance, install additional rollers in front of the equipment and repeat the process until the equipment is positioned at the foundation.

◆ Common transportation methods: 1.manual lifting; 2. Road transport; 3. Crane; 4. Roller conveyors

## 2、泵的安装 Pump installation

(1) 泵运输到安装现场，若存放时间超过六个月，安装前应拆卸清洗，并更换润滑油脂；若存放时间未超过六个月，则不需拆卸清洗。

The pump shall be transported to the installation site. If the storage duration exceeds six months, it must be disassembled and cleaned prior to installation, and the lubricating grease shall be replaced. If the storage duration does not exceed six months, disassembly and cleaning are not required.

(2) 清除底座上油腻的污垢，把底座放在地基上，地基应有足够的强度和刚度，且基础不能与泵发生共振。根据安装基础图制作安装基础<基础采用预埋槽钢制成>，并预留地脚螺栓孔。制作地脚螺栓<订货合同中未注明的，泵制造厂均未配带>。制作的基础应确保泵能顺利地安装和拆卸。

Remove greasy contaminants from the base plate. Position the base on a foundation with sufficient structural strength and rigidity to prevent resonance between the foundation and pump components. Construct the installation foundation according to the provided foundation diagram (using pre-embedded channel steel) while reserving bolt holes for anchor bolts. Fabricate anchor bolts (not specified in the order contract, as pump manufacturers do not provide them). The foundation design must ensure smooth installation and disassembly of the pump.

(3) 用水平仪检查底座的水平度，允许用楔铁找平。水平度允差为 1mm : 1000mm，预留地脚螺孔尺寸允差 $\pm 5 \sim 10$ mm。

Check the levelness of the base using a level; wedge iron may be used for leveling if necessary. The allowable levelness tolerance is 1mm per 1000mm, and the dimensional tolerance for reserved anchor screw holes is  $\pm 5$  to 10mm.

(4) 用水泥浇灌底座内的空腔和地脚螺栓孔眼。

The cavity in the base and the hole of the anchor bolt are filled with cement.

(5) 水泥干后应检查底座和地脚螺栓孔眼是否松动，合格后拧紧地脚螺栓，重新检查水平度。

After the cement has dried, inspect whether the base and anchor bolt holes are loose. If qualified, tighten the anchor bolts and recheck the levelness.

(6) 检查电机的绝缘等级，必要时应解体烘烤；检查电机的旋转方向，应以泵标示相同。

Inspect the insulation class of the motor and disassemble for baking if necessary; verify the rotation direction of the

motor, which should match the pump markings.

(7) 清理底座的支持平面，水泵脚及电机脚的平面，并把水泵和电机安装到底座上。

Clean the support plane of the base, the plane of the pump feet and motor feet, and install the pump and motor onto the base.

(8) 联轴器之间应保持一定的间隙，检查水泵轴与电机轴中心线是否一致（可用薄片垫泵端或电机端调整使其同心，并检查泵轴与电机轴是否有接触）。

Maintain a proper clearance between the couplings. Verify that the centerlines of the pump shaft and motor shaft are aligned (adjust using thin shims at the pump or motor end to ensure concentricity, and inspect for any contact between the shafts).

(9) 在安装高温泵时，还应按泵上所示配冷却水管、封液管。冷却水的流量  $Q=0.5 \sim 1\text{m}^3/\text{h}$ ，压力为  $0.03 \sim 0.05\text{MPa}$ 。功率越大时，冷却水量取大值。

When installing the high-temperature pump, cooling water pipes and sealing liquid pipes should also be installed as indicated on the pump. The cooling water flow rate  $Q$  ranges from  $0.5$  to  $1\text{ m}^3/\text{h}$ , with a pressure of  $0.03$  to  $0.05\text{ MPa}$ . For higher power capacities, a larger cooling water flow rate should be selected.

(10) 按电机和 XK 系列电控柜的图纸所示，对电机和电控柜进行正确的接线。

Follow the diagrams of the motor and XK series electrical control cabinet to properly connect the motor and control cabinet.

(11) 对旋转的零部件加设防护罩，对电机的接线盒加密封，对线缆设防护套，对可能发生泄漏的部位加设安全保护套。

Protective covers should be installed on rotating components, wiring boxes of motors should be sealed, cables should be fitted with protective sleeves, and safety protective sleeves should be added to areas prone to leakage.

(12) 安装说明 Installation instructions :

◆ 泵的安装高度，管路的长度、直径、流速应符合计算，力求减少不必要的水力损失。泵的进口和出口配管的内径不得小于泵的进出口口径，通常情况下，进出口所配的管径应大于泵的进出口口径。

◆ 长距离输送时应取较大管径、泵的管路应有自己的支架，不允许管路及附件的重量和其它外力作用加在泵上，避免把泵压变形，转子不灵活，所校正的间隙和偏差也会发生变化，致使泵不能正常工作甚至损坏水泵。

◆ 排出管路上设装止回阀，当泵停止时不需关闭出口阀时，止回阀应装在出口阀和泵出口之间。当泵每次停止时都要关闭出口阀时，止回阀应安装在出口阀之后（出口远端）。

◆ 出口阀和泵出口之间应设装压力表，压力表的位置应距泵出口至少 1 米，且在直试管道上。

◆ 吸入液面低于泵中心的系统，应在吸入管的最远端装设底阀。

◆ 按制造商提供的图纸，安装冷却水管、封液管、冲洗管、溢流管（若有要求时）。

◆ 出厂时间不超过 6 个月的泵，功率  $\leq 155\text{KW}$  时，可不拆卸解体，但应更换润滑脂（油）。

◆ 抽送可能有异物堵塞叶轮流道的液体时，吸入管路上应设过滤器。

◆ 进出口管路高位和弯头处应安装排气阀。

◆ The installation height of the pump, as well as the length, diameter, and flow rate of the piping system, should comply with calculations to minimize unnecessary hydraulic losses. The inner diameters of the inlet and outlet piping of the pump must not be smaller than the pump's inlet and outlet diameters. Typically, the pipe diameters for the inlet and outlet should be larger than the pump's inlet and outlet diameters.

◆ For long-distance transportation, larger pipe diameters should be selected, and the pump's piping system must have its own supports. The weight of the piping and accessories, as well as other external forces, must not be transmitted to the

pump to prevent deformation due to pressure, reduced rotor flexibility, and altered clearance and deviations during calibration. These factors may lead to pump malfunction or even damage.

- ◆ A check valve should be installed on the discharge pipeline. When the pump is not required to close the outlet valve during shutdown, the check valve should be installed between the outlet valve and the pump outlet. When the outlet valve must be closed during each pump shutdown, the check valve should be installed after the outlet valve (at the distal end of the outlet).
- ◆ A pressure gauge shall be installed between the outlet valve and the pump outlet. The pressure gauge must be positioned at least 1 meter away from the pump outlet and on the straight test pipeline.
- ◆ For systems where the inhalation liquid level is below the pump center, a bottom valve should be installed at the distal end of the inhalation tube.
- ◆ Install cooling water pipes, sealing liquid pipes, flushing pipes, and overflow pipes (if required) according to the manufacturer's provided drawings.
- ◆ When pumping liquids that may cause foreign body blockage in the impeller passage, a filter should be installed on the suction line.
- ◆ Exhaust valves shall be installed at the high points and elbows of import and export pipelines.

### 3、泵的校正 Pump calibration

#### (1) 调整校正联轴器间的间隙值 $g$ :

- ◆ 当电机功率  $N \leq 132\text{KW}$  时,  $g = 3 \sim 6\text{mm}$ , 功率大取大值;
- ◆ 当泵具有  $g_1$  的串量时,  $g = g_1 + (3 \sim 6)\text{mm}$ 。
- ◆ 当电机功率  $N \geq 132\text{KW}$  时,  $g = 5 \sim 8\text{mm}$ , 功率大取大值;
- ◆ 当泵具有  $g_1$  的串量时,  $g = g_1 + (5 \sim 8)\text{mm}$ 。

#### (1) Adjust the clearance value $g$ between the correction couplings:

- ◆ For motors with power  $N \leq 132\text{KW}$ ,  $g = 3\text{--}6\text{mm}$ ; select the larger value for higher power.
- ◆ If the pump has a series resistance  $g_1$ ,  $g = g_1 + (3\text{--}6)\text{mm}$ .
- ◆ When the motor power  $N \geq 132\text{ kW}$ ,  $g = 5\text{--}8\text{ mm}$ , with the larger value selected for higher power;
- ◆ When the pump has a series resistance  $g_1$ ,  $g = g_1 + (5\text{--}8)\text{ mm}$ .

#### (2) 调整校正联轴器径向偏差 :

采用百分表测量联轴器的外圆上下、左右偏差, 通过校正使其小于  $0.05 \sim 0.08\text{mm}$ 。

#### (2) Adjusting and correcting the radial deviation of the coupling:

Measure the vertical and lateral deviations of the coupling's outer circumference using a dial gauge, and adjust them to within  $0.05\text{--}0.08\text{ mm}$ .

#### (3) 调整校正联轴器的端面偏差 :

采用百分表或塞尺, 测量两联轴器端面间隙一周上最大和最小的间隙差。采用增减泵电机的垫片使其间隙差不超过  $0.03 \sim 0.1\text{mm}$ 。

#### (3) Adjust and correct the end face deviation of the coupling:

Use a dial indicator or feeler gauge to measure the maximum and minimum clearance differences around the circumference of the end face clearance between the two couplings. Adjust the washer thickness of the pump motor by adding or removing to ensure the clearance difference does not exceed 0.03–0.1 mm.

(4) 校正说明 Correction note :

- ◆ 以上要求的间隙和偏差，应视所有螺栓已拧紧后的间隙和偏差。
- ◆ 根据环境温度的变化，间隙和偏差也会变化，应随之而校正。
- ◆ 泵经过 72 小时试运转后也应检查其变化，必要时应校正。
- ◆ The specified clearance and tolerance values shall be determined based on the actual clearance and tolerance after all bolts have been tightened.
- ◆ Depending on variations in ambient temperature, clearance and deviation may also change and should be corrected accordingly.
- ◆ After 72 hours of trial operation, the pump should also be inspected for any changes and calibrated if necessary.

## 4、管路及其辅助设备 Pipelines and auxiliary equipment

(1) 吸入和排出管路 Inhalation and exhalation tubing

### ◆ 概述 Summary

装置的吸入和排出管直径通常是根椐吸入管路中流体流速约为 2m/s、排出管路中液体流速 3m/s 而设计，这在工作设计已确定（通常装置的排出管标准直径大于泵的吸入管的标准直径）。因此，这里只给出安装管路时必须考虑的一些实际问题。

The diameter of the device's suction and discharge pipes is typically designed based on fluid flow rates of approximately 2 m/s in the suction pipeline and 3 m/s in the discharge pipeline, as determined during operational design (where the standard diameter of the device's discharge pipe is generally larger than that of the pump's suction pipe). Therefore, only some practical considerations necessary during pipeline installation are outlined here.

### ◆ 安装 Install

- 支撑管路，这样就不致使泵支管由于管重和热应力引起的力矩而产生的过分变形。管路连接法兰必须平行于泵法兰。
- 安装水平管路时，进液端管径应逐渐向端部增大，出液端（与泵出口相接端）管径应逐渐向端部减小，这样可避免产生气囊。
- 设计有利于流动的支管，当由小管径变大管径时，要逐渐过渡，其规则为：圆锥过渡段的长度等于 5~7 倍的标准直径差。
- 对于法兰连接，不允许法兰间的密封垫遮住管路通道。
- 尤其要注意吸入和排出管路中的不规则过渡管段和短弯头，因为这些部位将增大管路阻力，应尽量避免使用。对泵吸入口处，大的管路阻力将使入口压力降低，若压力太低将导致叶轮入口处产生气蚀。
- 在安装几台泵情况下，除平行连接的备用的泵外，必须提供每台泵单独的吸入管路。备用泵与相对应的泵可有共同的吸入管路，这是因为在使用中始终只用一台。
- Support the piping system to prevent excessive deformation of pump branch pipes caused by torque due to pipe weight and thermal stress. The pipe connection flanges must be parallel to the pump flanges.
- When installing horizontal pipelines, the pipe diameter at the liquid inlet end should gradually increase toward the end, while the pipe diameter at the liquid outlet end (connected to the pump outlet) should gradually decrease toward the end. This configuration prevents the formation of air pockets.

- Design flow-favorable branch pipes, when transitioning from small to large pipe diameters, should follow a gradual change. The rule is: the length of the conical transition section equals 5–7 times the standard diameter difference.
- For flange connections, sealing gaskets between flanges must not obstruct the pipeline passage.
- Particular attention should be paid to irregular transition sections and short elbows in the suction and discharge pipelines, as these components increase pipeline resistance and should be avoided whenever possible. At the pump suction inlet, significant pipeline resistance will reduce inlet pressure, and excessively low pressure may lead to cavitation at the impeller inlet.
- In the case of installing multiple pumps, apart from the parallel-connected standby pump, separate suction lines must be provided for each pump. The standby pump may share a common suction line with the corresponding pump, as only one pump is used during operation.

#### (2) 管路清洗 Pipeline cleaning

开车前，必须认真清洗管路和供给箱中的所有污物和杂质。对于焊接部件必须清除焊接部件的金属突出物。

Prior to driving, all contaminants and impurities in the pipelines and supply tank must be thoroughly cleaned. For welded components, metal protrusions on the welded parts must be removed.

#### (3) 静水压试验 Hydrostatic test

检查管路是否密封,然后按规范要求静水压试验。

Check whether the pipeline is sealed, then perform a hydrostatic test according to the specifications.

#### (4) 管接头 Union joint

管接头的标准通径必须与管路标准通径一样。如果支管的标准通径小于管接头的标准通径,则必须在两者之间安装圆锥过渡段。供给管路中截止阀不允许直接与泵连接,以免液体的紊流现象影响泵的吸入腔。为避免气囊,安装截止阀时,其手轮轴心须向侧面或向下。

The standard bore size of pipe fittings must match that of the pipeline system. If the branch pipe's standard bore size is smaller than the fitting's, a tapered transition section must be installed between them. The shut-off valve in the supply pipeline must not be directly connected to the pump to prevent turbulence from affecting the pump's suction chamber. To avoid air pockets, the handwheel axis of the shut-off valve should be oriented sideways or downward during installation.

(5) 辅助设备适用于泵的控制(压力、温度等测量仪器)和维护保养(冷却、加热、冲洗和密封等)。所需的辅助设备应根据泵型号和使用条件来确定。如果所提供的泵及辅助设备适用,则在使用现场安装辅助设备前应考虑下列情况:

Auxiliary equipment is suitable for pump control (pressure, temperature measurement instruments) and maintenance (cooling, heating, flushing, and sealing). The required auxiliary equipment should be determined based on the pump model and operating conditions. If the provided pump and auxiliary equipment are compatible, the following considerations should be taken into account before installing the auxiliary equipment at the site:

◆压力表应安装在支架上,并通过Φ8的测量管连接到泵支管或临近管路懂得测量点上。为保证能终止和排泄,在压力表的前面必须安装一阀门。

The pressure gauge shall be mounted on a bracket and connected to the pump branch pipe or adjacent pipeline measurement point via a Φ8 measuring tube. To ensure termination and drainage, a valve must be installed before the pressure gauge.

◆泵的排液能通过长管排泄到底座收到液槽中,或排泄到泄漏液收集管中。在泄漏液管路中必须安装一个至少与泵体标准压力相等的截止阀。

The liquid discharged by the pump can be discharged through a long pipe to the base receiving liquid tank or into the leakage liquid collection pipe. A shut-off valve with a pressure equal to or exceeding the standard pressure of the pump

body must be installed in the leakage liquid pipeline.

◆机械密封的泄漏液也能通过长管排泄到底座收液槽中，或排泄到泄漏液收集管路中。

The leakage fluid from mechanical seals can also be discharged into the base liquid collection tank via long pipes or into the leakage fluid collection pipeline.

◆需要带冷却系统的泵，在冷却腔体的最低位置布置冷却水给水管路，最高位置布置冷却水排水管路。在给水管路中必须安装一个调节阀，在闭式系统的排水管路中安装一个流量指示器，在开式系统中，排水管路必须通过排水漏斗来引导。

For pumps requiring cooling systems, the cooling water supply pipeline should be installed at the lowest point of the cooling chamber, while the drainage pipeline should be positioned at the highest point. A control valve must be installed in the supply pipeline. In closed systems, a flow indicator should be installed on the drainage pipeline, whereas open systems require the drainage pipeline to be directed through a drainage funnel.

◆机械密封辅助系统必须根据图纸中给定的系统执行。如果管线是导向热交换器，压力传感器或密封槽的，则在管线最高点处应提供一个排气孔。在温差循环情况下，其管直径最小必须为 3/4"，最好为 1"。流动线路中必须从连续上升的方式布置，并且不允许有明显的弯曲。

The mechanical seal auxiliary system must be implemented according to the system specifications provided in the drawings. If the pipeline is connected to a heat exchanger, pressure sensor, or sealing groove, an exhaust vent should be installed at the highest point of the pipeline. In temperature difference circulation systems, the minimum pipe diameter must be 3/4 inch, preferably 1 inch. The flow path must be arranged in a continuously ascending manner without any significant bends.

◆根据机械密封结构，如果要求冷却或冲洗是次要的，则必须安装急冷装置。

Depending on the mechanical seal structure, if cooling or flushing is secondary, a rapid cooling device must be installed.

◆最小流量控制，在输送的流量位于规定的最小流量点以下时，流体将发生中间过热直到汽化，此时叶轮和口环处将严重损坏，导致泵的卡死，同进也将导致机械密封的损坏。为避免这一现象发生，必须设置一最小流量装置来控制输送液始终保持在规定的最小流量之上。

Minimum flow control: When the conveyed flow rate falls below the specified minimum flow point, the fluid will undergo intermediate overheating until vaporization. This process causes severe damage to the impeller and port ring, leading to pump seizure and mechanical seal failure. To prevent such occurrences, a minimum flow control device must be installed to maintain the conveyed liquid flow consistently above the specified minimum flow rate.

◆最小流量控制装置—恒量旁通管。在泵出口法兰和排出管路中的截止阀之间连接通向供给箱的旁通管路，在管路中安装一个用来限制流过流量的截流阀和截止阀。

Minimum flow control device—constant bypass pipe. A bypass pipeline connected to the supply tank is installed between the pump outlet flange and the shut-off valve in the discharge pipeline, with a throttle valve and shut-off valve installed in the pipeline to limit the flow rate.

◆最小流量控制装置不在泵制造厂的供货范围内，必须由用户自己提供。在开式系统中，开车前必须关闭最小流量控制装置中的截止阀。

The minimum flow control device is not included in the supply scope of the pump manufacturer and must be provided by the user. In open systems, the shut-off valve in the minimum flow control device must be closed prior to startup.

## 五、泵的使用和操作 Use and Operation of Pumps

### 1、启动前的准备工作 Pre-start preparations

◆ 清洗泵的进出口管路和泵体内流道。进出口管路中的异物严禁进入泵内。泵的进出口管路应采用刷洗，敲击（适度）甚至酸洗的方法进行，确保无异物。酸洗时必须采取正确的方法进行酸洗，不得对设备造成损失，酸洗后要进行彻底地清洗。

Clean the inlet and outlet pipelines of the pump as well as the internal flow channels within the pump body. Foreign objects in the inlet and outlet pipelines must be strictly prevented from entering the pump. The inlet and outlet pipelines of the pump should be cleaned using methods such as brushing, tapping (moderate), or even acid washing to ensure the absence of foreign matter. Acid washing must be performed using correct techniques to avoid equipment damage, and thorough cleaning must be conducted after acid washing.

◆ 与电动机联接前，先空转电动机，查看电机旋转方向是否正确。

Before connecting to the motor, run it in no-load condition first to verify the correct rotation direction.

◆ 对泵进出口管道进行水压试验，试压压力为额定压力的 1.25 倍，压力维持 30min，无泄漏、冒汗等缺陷。若试压时连同泵一起试压，但压力不得超过泵标牌上的、额定压力的 1.25 倍，否则可能损坏泵的密封。

Perform hydraulic testing on the pump inlet and outlet pipelines at a pressure equal to 1.25 times the rated pressure, maintaining the pressure for 30 minutes without leakage or sweating defects. If the pump is tested simultaneously during the pressure test, the combined pressure must not exceed 1.25 times the rated pressure indicated on the pump label; otherwise, it may damage the pump seals.

◆ 打开进口阀门。

Open the import valve.

◆ 关闭吐出管路上的闸阀，向泵内灌满水或用真空泵引水，并在泵和管路的高位排尽气体，排气时应手盘泵轴不停旋转。

Close the gate valve on the discharge pipeline, fill the pump with water or draw water using a vacuum pump, and purge air from the pump and pipeline at the high position. During air discharge, keep the pump shaft rotating manually.

◆ 打开冷却水、封液水、冲洗水的阀门，并通水（若有时）。

Open the valves for cooling water, sealing liquid water, and rinse water, and supply water (if applicable).

## 2、启动前的检查工作 Pre-startup inspection procedures

◆ 检查所有螺栓、螺母是否拧紧（要求拧紧）。Check whether all bolts and nuts are tightened (required).

◆ 检查轴承位是否加油（应加油到规定油位）。

Check whether the bearing position has been lubricated (it should be lubricated to the specified oil level).

◆ 盘动泵轴，检查泵轴是否转动灵活，有无异常的卡堵（转动应轻松灵活）。

Rotate the pump shaft to check for smooth rotation and any abnormal blockage (rotation should be effortless and flexible).

◆ 检查电机和电控柜的接线是否正确、牢固，地线应接牢固、可靠和安全，所有线不得裸露和线线相碰，盖上接完线的电机接线盒。否则是极其危险的。

Check whether the wiring of the motor and electrical control cabinet is correct and secure. The ground wire should be connected firmly, reliably, and safely. All wires must not be exposed or in contact with each other. Cover the motor junction box after completing the wiring. Otherwise, it may pose extreme hazards.

◆ 检查泵的进出口管路、冷却系统是否有泄漏，必要时进行处理。

Inspect the inlet and outlet pipelines of the pump and the cooling system for leaks, and take necessary measures if required.

◆检查泵进出管路、泵体、电机、联轴器上无其它物品（不得有不相干的物品或工具）。

Inspect the pump inlet and outlet pipelines, pump body, motor, and coupling for any other objects (no irrelevant items or tools are allowed).

◆检查进口阀门是否全开（应全开）。Check whether the inlet valve is fully open (it should be fully open).

◆检查出口阀门是否全闭（应全闭）。Check whether the outlet valve is fully closed (it should be fully closed).

◆检查泵的进口管和泵体内是否灌满水（应灌满水并排尽空气）。

Check whether the inlet pipe and pump body are filled with water (they should be fully filled with water and free of air).

◆电控柜是否通电（应通电）。Is the electrical control cabinet powered (should be powered).

◆对电控柜进行空试（不给电机通电）。检查电控柜的功能和动作是否齐全和敏感。当采用降压启动时，应检查降压启动经切换到高速状态的时间，时间通常为4至8秒。

Perform an air test on the electrical control cabinet (without energizing the motor). Check whether the functions and actions of the electrical control cabinet are complete and sensitive. When using voltage reduction starting, inspect the time required for the system to switch to high-speed operation, which typically ranges from 4 to 8 seconds.

◆撤离现场人员，杜绝联轴器方向有人员和重要设备，必要时设置防护装置。

Evacuate personnel from the scene and ensure no personnel or critical equipment are present in the coupling direction. Protective devices should be installed when necessary.

◆有经验的操作人员就位：操作人员必须记住泵的额定流量和扬程以及电机的额定电流，并分别就位到控制室和出口阀门处。

Experienced operators are positioned: Operators must memorize the pump's rated flow rate and head, as well as the motor's rated current, and proceed to their respective positions at the control room and outlet valve.

### 3、泵启动程序 Pump startup procedure

(1)第一步 点动泵：点动时应一手放在启动位，另一手放在停止位。启动与停止动作仅隔1~2秒种（新安装或长期不用的泵必须点动，但经常使用运转的泵则不需点动）。检查各系统及转向均正常。

**Step 1:** Spot pump operation: During spot operation, one hand should be placed in the start position and the other in the stop position. The start and stop actions should be performed with a 1–2 second interval (spot operation is required for newly installed or long-term unused pumps, but not for frequently used operational pumps). All systems and steering were checked and found to be normal.

(2)第二步 等待：因电机点动时会发热，等待电机冷却。通常大型电机（22KW以上）应等30分钟以上，小型电机（18.5KW以下）应等5分钟以上。

**Step 2:** Wait: As the motor generates heat during intermittent operation, allow sufficient cooling time. Typically, large motors (over 22KW) require a waiting period of more than 30 minutes, while small motors (below 18.5KW) should be waited for at least 5 minutes.

(3)第三步 启动水泵：按下泵的启动按钮，使泵启动。操作人员随时检查降压启动经切换到高速状态的电流，此时的电流应小于额定电流，并同时观察泵在运转中是否异常，若不正常应立即按下停机按钮。

**Step 3:** Start the pump: Press the pump's start button to initiate operation. The operator should continuously monitor the current during the voltage reduction startup process after switching to high-speed mode. The current at this stage should be less than the rated current, while simultaneously observing whether the pump exhibits any abnormalities during operation. If

abnormalities are detected, immediately press the shutdown button.

(4)第四步 当泵达到正常转速后，现场操作人员再逐渐打开吐出管路上的阀门，并观察出口压力表，使压力表显示的读数大于或等于泵的扬程（扬程 H 约等于出口压力表读数×100）。泵出口阀门在全闭情况下不得超过 1 分钟，否则泵体会过热。

**Step 4:** After the pump reaches normal operating speed, the on-site operator should gradually open the valve on the discharge pipeline and monitor the outlet pressure gauge to ensure the displayed reading is greater than or equal to the pump's head (head  $H \approx$  outlet pressure gauge reading  $\times 100$ ). The pump outlet valve must remain fully closed for no more than 1 minute; otherwise, the pump body may overheat.

(5)第五步 检查现场操作人员应检查泵的运转情况。检查的内容包括：震动、噪音、轴承温度、密封泄漏、现场压力表读数等。

**Step 5 :** On-site operators shall inspect the pump's operational status. The inspection items include: vibration, noise, bearing temperature, seal leakage, and on-site pressure gauge readings.

(6)第六步 记录：应按下表进行记录。**Step 6** Recording: Records should be made according to the table below.

项目	轴承温度 temp0C		电机外壳 shell0C		泄漏量 L/min				压力表读数 MPa		震动	噪音 noise	电流 current	
	理论	实测	理论	实测	理论		实测		理论	实测			理论 theory	实测
					填料	机封	填料	机封						
时间 ( min )														
5	小于 80		小于 90		小于 300~ 1200ml/h	小于			额定扬程左右 15%				小于额定电流	
15														
30														
60														
90														
150														
240														
480														
1200														

**注 notes :**

- 记录的轴承温度，温度小于 800C 或温升小于 400C。
  - 离心泵在扬程越低时，流量越大，轴功率越大。当泵的扬程较低时，电机会过载。
  - 当填料的泄漏量较大时，应适当拧紧填料压盖的螺母即可。
  - 启动说明：
  - The recorded bearing temperature is below 80°C or the temperature rise is less than 40°C.
  - The flow rate and shaft power of a centrifugal pump increase with decreasing head. When the pump operates at low head, the motor may experience overload.
  - When the leakage rate of the packing is high, simply tighten the nut on the packing gland to address the issue.
  - Start instructions:
- <1> 控制室操作人员不得擅自离开操作室。
- <2> 现场操作人员不得擅自离开工作现场。
- <3> 当泵在运行中，出口压力表显示值与铭牌中有如下差异时应作如下处理：

<1> Control room operators must not leave the control room without authorization.

<2> On-site operators are not allowed to leave the work site without authorization.

<3> When the pump is in operation, if the reading on the outlet pressure gauge differs from the values specified on the nameplate, take the following measures:

a、差异的原因：因用户所需的扬程是通过理论计算提供给制造商的装置扬程。这个理论值目前世界上还没有准确计算公式，只是经验计算。因此，这个理论值与实际值会有差异，有时差异会更大。用户在选泵时通常是在理论值上加一定的裕量。

The discrepancy arises because the head required by users is provided to manufacturers as the theoretical head of the equipment. Currently, there is no precise calculation formula for this theoretical value worldwide; it is derived solely from empirical calculations. Consequently, there may be discrepancies between this theoretical value and the actual value, with some variations being more pronounced. When selecting pumps, users typically apply a certain margin above the theoretical value.

b、当出现压力表中扬程值远高于铭牌中的扬程值时，会出现泵流量偏小。原因是用户所提供的理论扬程偏低。处理方法：更换叶轮或更换泵。

When the head value displayed on the pressure gauge significantly exceeds the rated head value on the nameplate, the pump flow rate will be reduced. The cause is the user-provided theoretical head being underestimated. Solution: Replace the impeller or replace the pump.

c、当出现压力表中的扬程值远低于铭牌中的扬程值时，会出现泵的流量偏大，电机电流增加，电机甚至发热或烧毁，造成的原因是用户所提供的扬程偏高。处理方法：采用切割定律对叶轮进行切割或适当关闭泵出口阀，使电流不超过电机的额定电流。

When the head value displayed on the pressure gauge is significantly lower than the rated head value on the nameplate, the pump may exhibit excessive flow rate, increased motor current, and even motor overheating or burnout. The root cause is the user-provided head value being too high. Solution: Apply the cutting law to modify the impeller or appropriately close the pump outlet valve to ensure the current does not exceed the motor's rated current.

注：泵出口压力表显示值为近似于实际所需的装置扬程，装置扬程是用户系统所固有的，但随着流量变化，装置扬程有所变化。

Note: The pump outlet pressure gauge reading approximates the actual required head of the equipment. The equipment head is inherent to the user system, but may vary with flow rate changes.

## 4、泵的停止 Stoppage of the pump

(1)第一步 关闭吐出管路上的阀门(自动启停的泵则不需要关闭)。

(2)第二步 切断电源。

(3)第三步 关闭其它的冷却水等阀门。

(4)第四步 慢慢打开排气阀，对泵的出口及泵内卸压（主要是指扬程高于 100m 的泵）。

**注：**如环境温度低于 0°C，应将泵内水放出，以免冻裂；

如长期停止使用，应将泵拆卸清洗上油，包装保管。

(1) Step 1: Close the valve on the exhaust pipeline (automatic start-stop pumps do not require closure).

(2) Step 2: Cut off the power supply.

(3) Step 3: Close other cooling water valves and similar components.

(4) Step 4: Gradually open the exhaust valve to depressurize the pump outlet and interior (primarily applicable to pumps with a head exceeding 100 m).

**Note:** If the ambient temperature is below 0°C, drain the water from the pump to prevent freezing cracks ;

If long-term discontinuation of use is required, the pump should be disassembled, cleaned, lubricated, and stored in its original packaging.

## 六、故障原因及消除方法

### Cause Analysis and Elimination Methods for Faults

故障 breakdown	故障原因 failure cause	排除方法 Exclusion method
The pump is not pumping water. 泵不出水	吸入或排出阀未开 Inhalation or exhaust valve not open	打开吸入或排气阀 Open the suction or exhaust valve
	吸入管内漏气 Intraluminal leakage in the inhalation tube	消除漏气现象 Eliminate air leakage
	吸程太高或压力太低 Excessive suction head or insufficient pressure	降低吸程、提高吸入压力 Reduce the suction head and increase the suction pressure
	过滤器或吸入口堵塞 Filter or suction inlet obstruction	拆卸并消除异物 Disassemble and remove foreign bodies
	吸入管路内气体太多 Excessive gas in the inhalation tubing	排除气体 Exclusion of gases
	装置扬程太高 The installation head is too high	降低装置扬程或更换扬程较高的泵 Reduce the device's head or replace with a pump of higher head.
	泵旋转方向不对 The pump rotation direction is incorrect	改变电动机方向 Change the direction of the motor
The pumping volume is insufficient to meet the design flow rate. 泵出水量达不到设计流量	有空气吸入 Air inhalation	检查管路连接部位是否有空气吸入 Check for air entrainment at the pipeline connection points
	泵流道堵塞 Pump flow channel blockage	消除堵塞物 Remove the obstruction
	叶轮内有异物堵塞 Foreign body obstruction in the impeller	拆卸并清除异物 Disassemble and remove foreign bodies
	密封环间隙太大 The sealing ring gap is too large	更换密封环 Replace the sealing ring
	泵转向不对 Pump misalignment	改变电动机转向 Change motor direction
	泵装置扬程太高 The pump unit has an excessively high head	降低装置扬程或更换扬程较高的泵 Reduce the device's head or replace with a pump of higher head
Excessive pump power 泵功率过大	在设计流量或扬程点以外运行 Operating outside the designed flow rate or head point	提高泵扬程或减少泵流量，使泵在设计点左右运行 Increase the pump head or reduce the pump flow rate to operate the pump around the design point
	泵轴弯曲 pump shaft bending	校正或更换 Calibrate or replace
	介质中混有其它异物 The medium contains other foreign substances	排除异物 Foreign body removal
The pump generates noise and vibration 泵产生噪音振动	吸入压力太低，管路阻力太大 The inhalation pressure is too low, and the pipeline resistance is too high	检查吸入管路有否堵塞，清洗过滤器中的滤网，降低吸程，提高吸入压力
	吸入管路有气体 Gas present in the inhalation tubing	检查吸入管路有否泄漏，排除气体，降低油温或增加吸入压力 Check for leaks in the suction line, purge the system, reduce oil temperature, or increase suction pressure
	轴承磨损 Bearing wear	更换轴承 Replace the bearing

	泵体、叶轮内有杂物 Foreign bodies in the pump body and impeller	清理泵体、叶轮内的杂物 Clean debris from the pump body and impeller
	泵与电动机不同轴 Pump and motor are not coaxial	调整同轴度 Adjust coaxiality
	泵流量过小 Insufficient pump flow rate	作平衡检查，平衡量控制在 3 克左右，或更换叶轮 Perform balance checks, with the balance weight controlled at approximately 3 grams, or replace the impeller.
电动机轴承发热 Motor bearing overheating	轴承缺油或油粘度太大 Lubrication oil deficiency or excessive oil viscosity in bearings	加油或换粘度小的油 Add fuel or switch to a lower viscosity oil
	轴承磨损 Bearing wear	更换新轴承 Replace the bearing
	泵与电机不同轴 Pump and motor are not coaxial	调整同轴度 Adjust coaxiality

## 七、泵的维护和保养 Maintenance and Care of Pumps

### 1、日常检查和维护 Daily inspection and maintenance

在使用期间中检查泵机组运转的平稳性和有无振动现象，注意异常的运转噪音。在未知的噪音和故障发生的情况下立即停车，查明原因并排除。

During operation, monitor the stability of the pump unit's performance and detect any vibration phenomena, paying attention to abnormal operational noises. In the event of unidentified noises or malfunctions, immediately shut down the system, identify the cause, and resolve the issue.

(1) 定期检查联轴器的校正（至少一年一次），排除变形，避免再损坏。

Regularly inspect the coupling for alignment (at least once a year) to eliminate deformation and prevent further damage.

(2) 如果有下列辅助设备，在使用期间应进行检查：

- ◆ 冷却：检查流量和温度。
- ◆ 加热：检查温度和压力。
- ◆ 密封的冲洗：检查压力、温度和流量。

The following auxiliary equipment should be inspected during use:

- ◆ Cooling: Check flow rate and temperature.
- ◆ Heating: Check temperature and pressure.
- ◆ Sealed flushing: Check pressure, temperature, and flow rate.

(3) 设备用备用泵的情况下，为了保证能立即投入使用状态，应定时启动这些泵。在长期停车情况下，应排除输送的液体，如有冷却水也应排出。

In cases where backup pumps are installed for equipment, these pumps should be periodically activated to ensure immediate operational readiness. During prolonged shutdowns, the conveyed liquids must be drained, including cooling water if applicable.

(4) 如果泵性能不是因为管路系统的改变或水垢引起管路阻力的改变而产生降低，则泵性能的降低可能是泵内部零件的磨损引起的。此时必须检修泵，更换已磨损的零件。

If the reduction in pump performance is not caused by changes in the pipeline system or alterations in pipeline resistance due to scale buildup, then the performance decline may result from wear of internal pump components. In such cases, the pump must be inspected and the worn parts replaced.

## 2、润滑 Lubrication

### (1) 轴承润滑 Bearing lubrication

泵每运转 600~1000 小时，应加注润滑油脂一次，润滑脂为钙基脂黄油，使用加油枪或油杯；若采用稀油润滑，应随时注意油位，当油位低时，应立即补充润滑油，常用润滑油为 20#机械油或汽轮机油。若有特殊润滑要求，将在出厂的产品资料上特别注明。新换轴承后，运行 100 小时应清洗换油；以后每运行 1000—1500 小时换油一次，油脂每运行 2000—2400 小时换油。

The pump should be lubricated with calcium-based grease once every 600 to 1,000 operating hours using a grease gun or oil cup. For thin oil lubrication systems, maintain real-time oil level monitoring and replenish lubricant promptly when low, preferably using 20# mechanical oil or steam turbine oil. Special lubrication requirements will be explicitly specified in the manufacturer's product documentation. After new bearings installation, perform oil change after 100 hours of operation. Subsequent oil changes should occur every 1,000–1,500 hours, while grease replacement is recommended every 2,000–2,400 hours.

- ◆ 轴承需要适量的润滑油来润滑，并且润滑油中不允许含有任何杂质和酸。
- ◆ 轴承在运转过程中自身发热将对润滑油的粘度变化起非常重要的作用，粘度将直接影响到润滑性能。为保证轴承具有良好的润滑条件，要求在轴承的使用温度范围内润滑油的运动粘度至少为 12mm<sup>2</sup>/s，所以润滑油的粘度必须如下选取：
- ◆ Bearings require an appropriate amount of lubricating oil for lubrication, and the lubricating oil must be free from any impurities or acids.
- ◆ The heat generated by bearings during operation significantly impacts the viscosity of lubricating oil, which directly affects lubrication performance. To ensure optimal lubrication conditions for bearings, the kinematic viscosity of lubricating oil must remain at least 12 mm<sup>2</sup>/s within the operating temperature range. Therefore, the viscosity of lubricating oil should be selected as follows:

温度 Temperature°C		运动粘度 Kinematic viscosity mm <sup>2</sup> /s		最低熔点 Lowest melting point
润滑油 Lube	轴承支架 Bearing support	40°C	50°C	°C
> 40 ~ 65	> 50 ~ 75	45	36	145
> 65 ~ 75	> 75 ~ 85	65	25	145

- ◆ 在首次交付使用或者轴承检修后重新使用情况下，泵运转 10~15 小时后将所有的润滑油排除，并清洗，然后重新换润滑油，投入正常使用。正常使用期间应按下列周期定期更换润滑油：

In cases of initial delivery for use or reuse after bearing maintenance, all lubricating oil should be drained and cleaned after the pump has operated for 10–15 hours, followed by replacement with new lubricating oil before resuming normal operation. During normal operation, lubricating oil should be replaced at the following intervals:

温度 Temperature°C		换油周期 Change-over period
润滑油 Lube	轴承支架 Bearing support	月
> 40 ~ 65	> 50 ~ 75	12
> 65 ~ 75	> 75 ~ 85	6

◆ 定期检查轴承箱内润滑油或轴承腔的温度，允许范围如下：

Regularly monitor the temperature of lubricating oil in the bearing housing or the bearing chamber. The allowable range is as follows:

范围检测点 Range detection point	位于轴承附近轴承箱表面处 located on the surface of the bearing housing near the bearing	轴承外圈处 At the outer ring of the bearing	轴承箱内油温 Oil temperature in bearing housing
正常长期运转 Normal long-term operation	≤80°C	≤90°C	≤70°C
应注意 Note	80°C ~ ≤90°C	90°C ~ ≤100°C	70°C ~ ≤80°C
机组应切断 The unit must be shut down	90°C ~ ≤100°C	100°C ~ ≤110°C	80°C ~ ≤90°C

## (2) 油标的补油 Oil mark replenishment

◆通过轴承箱上的加油孔填充润滑油，直到油标开始充上油为止。在使用中时常检查油标油位情况，发现油位下降要立即补充润滑油。

◆如果轴承箱体中的油位降低，则要通过从油箱及时加油，直到达到上述油位。

◆Fill the lubricating oil through the oiling hole on the bearing housing until the oil level indicator begins to fill up. During operation, regularly check the oil level indicator and immediately replenish lubricating oil if a drop is observed.

◆If the oil level in the bearing housing drops, promptly replenish oil from the tank until the specified level is reached.

## 3、轴封 Shaft seal

### 填料密封 Packing seal

#### (1)结构 Structure

◆标准结构图：整个填料腔用软填料环填满。轴封处的最小压力为 0.05 ~ 0.1MPa。(液体必须具有润滑型并绝对清洁)

◆Standard structural diagram: The entire packing cavity is filled with soft packing rings. The minimum pressure at the shaft seal is 0.05–0.1 MPa. (The liquid must be lubricating type and absolutely clean)

◆具有水封环衬套结构：为了防止污液进入填料环，在填料的底部安装了可提供清洁冲洗液的水封环衬套。密封压力最小为 0.6MPa，超过轴封处压力。

◆The design incorporates a water seal ring bushing structure: To prevent contaminated liquid from entering the packing ring, a water seal ring bushing capable of supplying cleaning flushing fluid is installed at the bottom of the packing. The minimum sealing pressure is 0.6 MPa, exceeding the pressure at the shaft seal.

◆具有水封环的结构：在填料腔的中部装有可供给密封液的水封环。当轴承处的压力≤0.13MPa 并且液体润滑性较差时这种密封式必要的。密封压力：最小为 0.6MPa，超过轴封处压力。

◆Structure with water seal ring: A water seal ring capable of supplying sealing fluid is installed at the center of the packing chamber. This sealing method is essential when the bearing pressure is ≤0.13 MPa and the liquid lubrication performance is poor. Sealing pressure: Minimum requirement is 0.6 MPa, exceeding the shaft seal pressure.

◆可冷却的填料压盖结构：输送高温液体时为了避免气化，对填料压盖进行冷却时必要的，(例：水温超过 110°C)这是因为在轴封处有压力释放。借助一个调节装置，冷却水两盒压力(大约为 0.5m<sup>3</sup>/h, 0.13MPa)必须是可调的。冷却水的混合温度泄漏时最高温度为 40°C。

◆Coolable packing gland structure: Cooling the packing gland is essential when transporting high-temperature liquids to prevent vaporization (e.g., water temperature exceeding 110°C), as pressure release occurs at the shaft seal. A regulating device ensures adjustable cooling water flow rates (approximately 0.5 m<sup>3</sup>/h at 0.13 MPa). The maximum leakage temperature of the cooling water mixture is 40°C.

## (2) 使用方法 Usage method

填料函的功能取决于施加在其内部各个面上的压力(即液体的内压),由此我们可用填料将填料函和轴套之间除了一点径向间隙之外的空间填满,这样固定部件和传动部件之间泄漏将被大大的节制。为了达到令人满意的功能,良好的润滑性和热导性是必要的。

The functionality of a stuffing box depends on the pressure exerted across its internal surfaces (i.e., the internal liquid pressure). By utilizing packing material, we can completely fill the space between the stuffing box and the shaft sleeve, excluding only a minimal radial clearance, thereby significantly reducing leakage between fixed and moving components. To achieve optimal performance, excellent lubrication and thermal conductivity are essential.

## (3) 填料 Filling

◆在装入填料之前应清洗轴套和填料腔并检查轴套的表面。

◆填料环切割长度=轴套直径+1.3 填料厚度×3.14 用填料压盖一个接一个的将填料环推入密封腔内,且填料的截面应错开 90°C互相靠紧。在装有水封环的结构中应在水封环的前部放入几根填料,密封液进入孔应不被阻塞。

◆在泵停车,还未灌泵时均匀的上紧填料压盖,不要上。检查压盖法兰与填料函之间各点的距离是否一致,然后松开填料压盖并用手拧上螺母。

## (4) 监督 Supervise

为了填料函能正常运转、润滑和冷却,有限的泄漏是必要的。当泄漏温度不超过 60°C时泄漏量从 1 升/小时(大约是每秒一滴)到 15 升/小时(大约为 2mm 直径的细液流)被视为正常。

泵在轴封处的压力 < 6.5MPa 时:

在较高泄漏损耗的情况下应均匀的上紧填料压盖,不要使其偏斜也不要上的太紧。尽量再次上紧填料压盖,如果泄漏量太大且泄漏已达到不允许的温度时,应更换所有的填料环。

泵在轴封处的压力 > 6.5MPa 时:

在泵运转的情况下再次上紧填料压盖会导致轴封失效。如果泄漏损失太大应更换新填料。每个新填料函都有一段跑合运转时间,在这段期间必须对其经常检查。跑合运转以后稍高的泄漏量可自行减小。

## 机械密封 Mechanical seal

### (1) 单端面机械密封 Single mechanical end face seal

◆在机械密封的情形,输送介质的出口被两个平面相互平行的研磨环表面封住。这两个密封环靠弹簧力和液体压力,压在一起。密封环(动环和静环)的密封是通过密封连接件(例如 O 型环)靠连在泵零件上而进行的,与此同时密封连接件起着弹性支承座的作用。

◆In mechanical seals, the outlet of the conveyed medium is sealed by two parallel grinding ring surfaces. These sealing rings are pressed together by spring force and liquid pressure. The sealing between the sealing rings (dynamic ring and stationary ring) is achieved through sealing components (such as O-rings) attached to pump parts, while simultaneously serving as elastic support seats.

◆机械密封的维护仅限于辅助装置的控制,泄漏量的控制以及滑动环盖温度的控制。在靠循环进行常规冲洗的情况下温度不得高于与其

相连的泵体的温度。

◆Maintenance of mechanical seals is limited to the control of auxiliary devices, leakage rate control, and sliding ring cover temperature control. Under conventional flushing conditions using recirculation, the temperature must not exceed that of the connected pump body.

注：泄漏量从看不见到最大为 10cm<sup>3</sup>/h 时是正常的，在输送液体高损耗的情况下（50cm<sup>3</sup>/h）必须考虑滑动环对的泄漏或密封连接件的泄漏。在这种情况下如果两个滑动环不能贴合则必须更换有缺陷的部件。在每次安装时必须更换密封连接件（O 型环）。

Note: Leakage from undetectable to a maximum of 10 cm<sup>3</sup>/h is considered normal. In cases of high liquid loss during transportation (50 cm<sup>3</sup>/h), leakage from sliding ring pairs or sealing connectors must be considered. If the two sliding rings fail to adhere properly, defective components must be replaced. Sealing connectors (O-rings) must be replaced during each installation.

## （2）“背靠背”安装的双端面机械密封 Double-end face mechanical seal installed in "back-to-back" configuration

轴封由两对（一个内部的，一个外部的）机械密封组成，它们背靠背的安装。在两个密封之间必须允许具有密封液，其压力应比在内部密封出输送介质的压力高（最小≥0.6~2MPa，最大为 4.5~6.4MPa）密封液的过压可导致：

The shaft seal consists of two pairs of mechanical seals (one internal and one external) installed back-to-back. A sealing fluid must be maintained between the two seals, with its pressure exceeding that of the conveyed medium in the internal seal (minimum ≥0.6–2 MPa, maximum 4.5–6.4 MPa). The overpressure of the sealing fluid may lead to:

- ◆ 由于增加了接触压力，使润滑环对密封得更好
- ◆ 有利于滑动环的润滑
- ◆ 防止了输送介质的泄漏
- ◆The increased contact pressure enhances the sealing performance of the lubrication ring.
- ◆Contributes to the lubrication of the sliding ring.
- ◆Prevents leakage of the conveyed medium.

密封液必须满足如下条件：

- 1)提供的液体是中性的
- 2)良好的润滑性能
- 3)汽化温度大大高于工作温度
- 4)无杂质

The sealing fluid must meet the following conditions:

- 1)The provided liquid must be neutral;
- 2) It must exhibit excellent lubrication properties;
- 3) Its vaporization temperature must be significantly higher than the operating temperature;
- 4) It must be free of impurities.

为使双端面机械密封正常运转，其辅助导流系统承当以下的工作：

- 吸收密封液
- 形成必要的过压
- 密封液循环

➤降低温度

➤在运转期间将密封液充满

To ensure the normal operation of double-face mechanical seals, the auxiliary flow guidance system performs the following functions:

➤Absorb sealant

➤Generate necessary overvoltage

➤Sealant fluid circulation

➤Reduce the heat

➤Fill the sealing liquid during operation

双端面机械密封的维护主要包括按时充满密封液和控制滑动环盖及辅助导流系统的温度。为了降低温度必须有供液和回流管路。

**注意：密封液损失较大的情况可能是密封滑动环泄漏或密封连接件泄漏引起的。在这种情况下，如果重新研磨滑动环没有可能，在必须更换失效的部件。密封连接件（即 O 型环）在每次安装时必须被更换。**

Maintenance of double-end face mechanical seals primarily involves regular sealing fluid replenishment and temperature control of the sliding ring cover and auxiliary flow guidance system. To reduce temperature, liquid supply and return pipelines are essential.

**Note: Significant loss of sealing fluid may result from leakage of the sealing sliding ring or the sealing connector. In such cases, if regrinding the sliding ring is not feasible, the failed component must be replaced. The sealing connector (i.e., O-ring) must be replaced with each installation.**

### **(3) “串联”安装的双端面机械密封（平衡的前置密封） Double-face mechanical seal installed in series (balanced front seal)**

◆具有密封环对的轴封是靠两个平面平行的，精密重合的密封环表面密封介质的，两个密封环靠弹簧能量和液体压力压在一起，因此输送的介质实际是不可能漏出的。密封环（动环和静环）的密封是通过辅助密封（例如 O 型环）靠连在泵零件上而进行的，同时辅助密封起着弹性支承座的作用。

◆The shaft seal with sealing ring pairs relies on two parallel planes with precisely aligned sealing ring surfaces to seal the medium. The two sealing rings are pressed together by spring energy and liquid pressure, ensuring virtually zero leakage during material transfer. The sealing between the sealing rings (dynamic and static rings) is achieved through auxiliary seals (e.g., O-rings) mounted on pump components, which simultaneously serve as elastic support bases.

◆为了无故障运转，在密封表面间形成一定的液膜是必要的。

◆To ensure fault-free operation, it is essential to form a certain liquid film between the sealing surfaces.

◆机械密封的维护包括辅助设备、泄漏量和密封环盖的控制。在用循环液进行常规清洗的情况时，密封不能比与其相连的泵体有更高的温度。

◆Maintenance of mechanical seals involves control of auxiliary equipment, leakage rate, and sealing ring cover. During routine cleaning with circulating fluid, the seal temperature must not exceed that of the connected pump body.

◆注意：泄漏量从看不见最大为 10cm<sup>3</sup>/h 是正常的；在输送介质损耗较高=50cm<sup>3</sup>/h 的情况下，原因是密封发生故障可使集液箱内的液体迅速增加。

◆Note: A leakage rate ranging from undetectable to a maximum of 10 cm<sup>3</sup>/h is considered normal. In cases where the medium loss during transportation is relatively high (≥50 cm<sup>3</sup>/h), the cause may be a sealing failure, which can lead to a rapid increase in liquid volume within the collection tank.

◆必须考虑密封环对的泄漏和密封连接件的泄漏。在这种情况下，如果密封环不能在此研磨，则必须将有故障的零件更换。在每次安装

时，密封连接件（即 O 形环）必须更换。

◆ Leakage from the sealing ring pair and leakage from the sealing connector must be considered. In such cases, if the sealing ring cannot be ground here, the faulty component must be replaced. During each installation, the sealing connector (i.e., O-ring) must be replaced.

◆ 由于安全的原故，安装的前置密封几乎都为无压冷却。另外允许的最大压力为：在主要密封处泵内部的压力为—0.6MPa。如果没有工业用水可在泵的上方放置一个冷却介质水箱（容量为 5~10 升）。通过进水和回水管与前置密封部位相连。在运转期间，必须注意或保证恒定的供给冷却介质。在使用水箱的情形，必须安装压力控制装置，当压力增加时。必须有泄压装置。为避免拖长停车检修周期，应尽早采购好所必要的备品备件（如磨损的零件）。当采购备件时，应向制造厂提供零件确切的种类（名称等），泵型号和制造厂编号（见泵标牌）。

◆ For safety reasons, pre-installed seals are typically designed for non-pressurized cooling systems. The maximum allowable pressure is specified as -0.6 MPa at the pump's main sealing point. If industrial water is unavailable, a cooling medium tank (5-10 liters capacity) may be installed above the pump, connected to the pre-seal section via inlet and return pipes. During operation, continuous cooling medium supply must be maintained. When using a water tank, pressure control devices must be installed, with pressure relief mechanisms required when pressure increases. To minimize downtime for maintenance, necessary spare parts (e.g., worn components) should be procured in advance. When purchasing spare parts, provide manufacturers with exact part specifications (including names), pump model, and manufacturer part numbers (refer to pump labels)