NASH
A Gardner Denver Product

Gardner Denver Nash Machinery Ltd. / 佶缔纳士机械有限公司

Department / 部门	**Location / 地点**	**Date / 日期**
ESE / GDNC	Boshan,ZiBo / 淄博，博山	2013-5-17
Handled/处理	**Tel./电话**	**Order No./订单号**
Hou Gang	0533-4654755	48185

Distribution / 下发：
Customer / 客户：

Documentation list of AT3006E liquid ring pump package
AT3006E 液环泵机组资料清单

No. / 序号	Dscription / 描述	Remarks/备注
1	General arrangement drawing / 外形图	V326007
2	Flow diagram / 流程图	V326008
3	Terminal box layout drawing / 接线箱图	V325998
4	Terminal wirring drawing / 接线端子图	V325999
5	PNEUMATIC SYSTEM DIAGRAM / 气动原理图	V326000
6	ON/OFF logic / 逻辑图	
7	Instruments list / 仪表清单	
8	DCS I/O 清单	
9	Pump operating instruction / 真空泵操作和维修手册	
10	System operating instruction / 系统操作说明	

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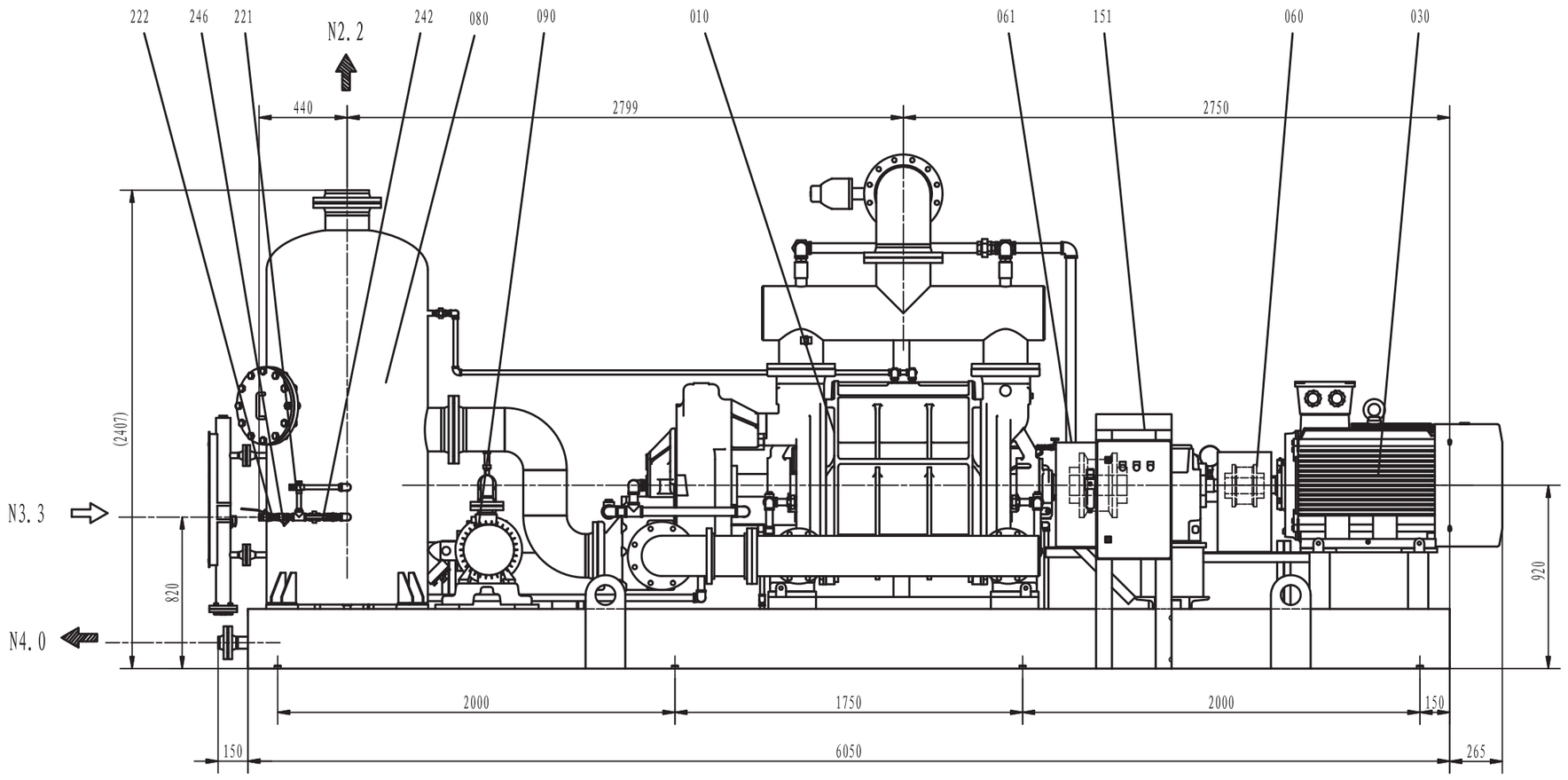
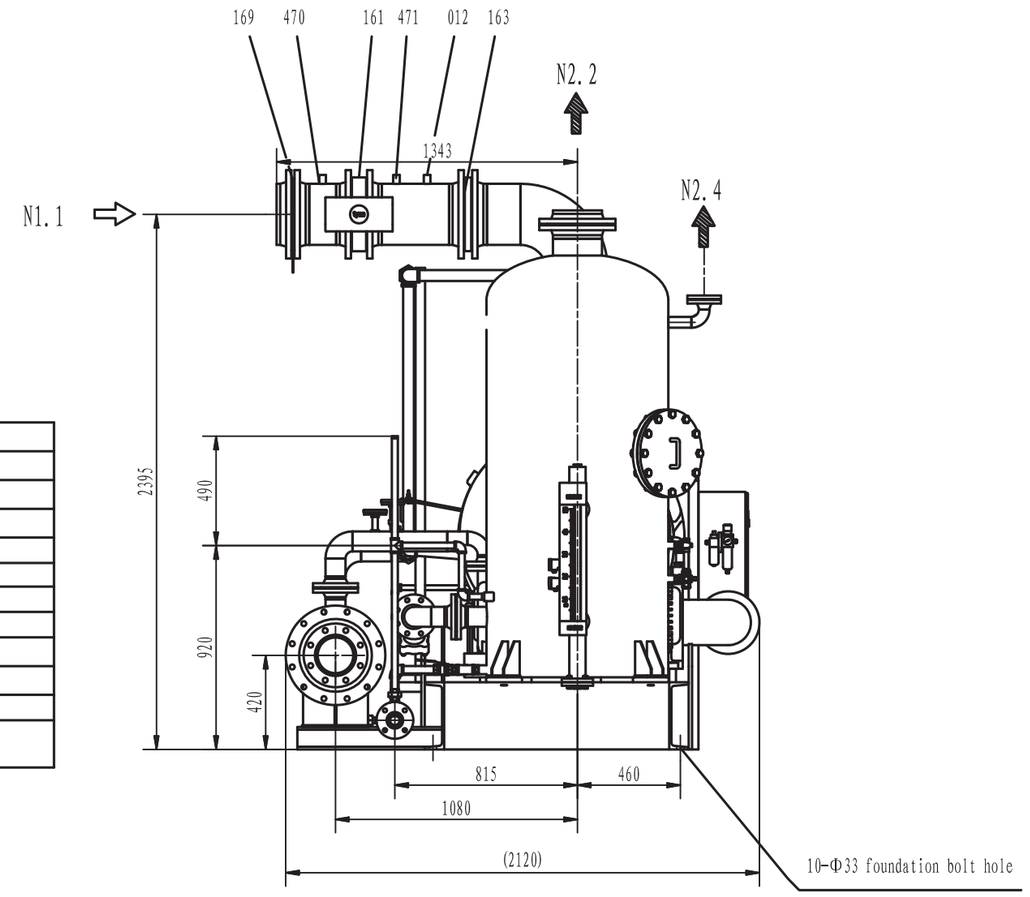
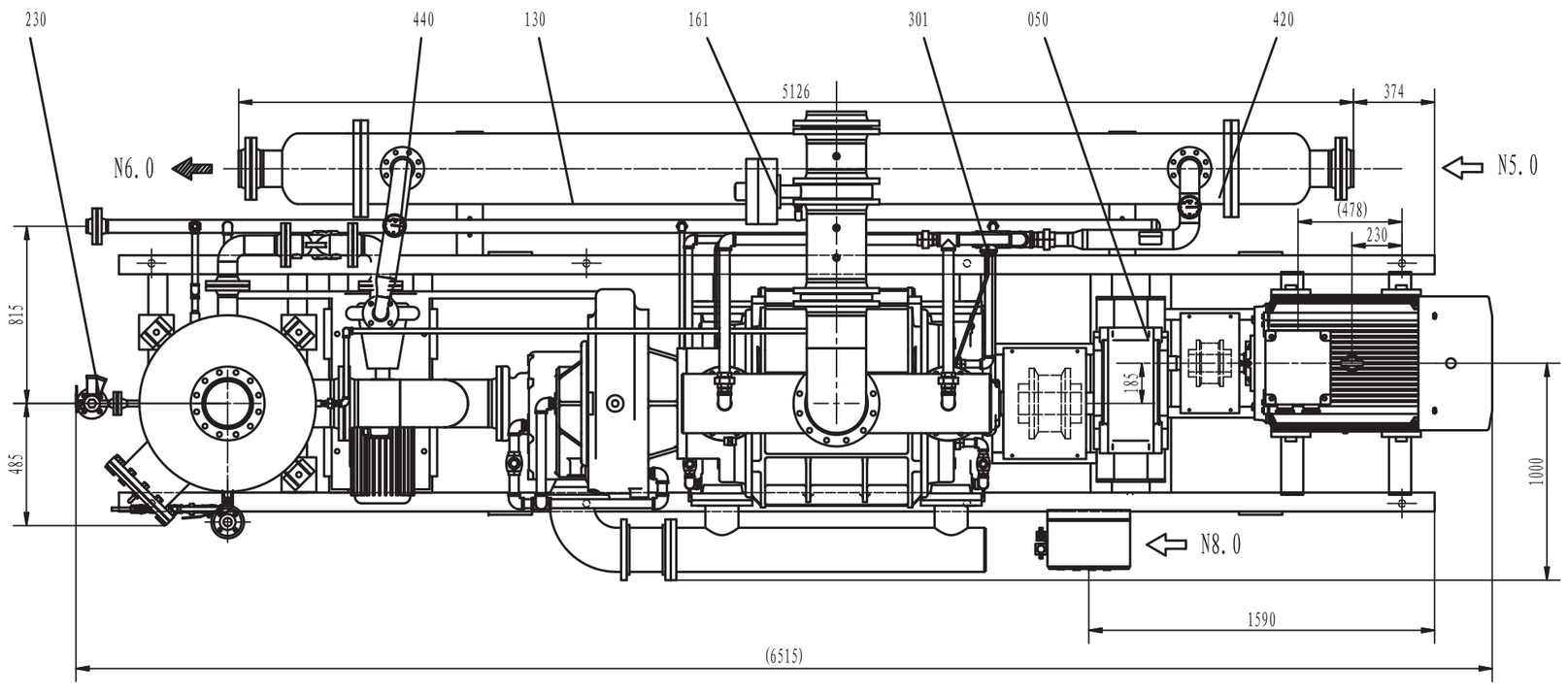
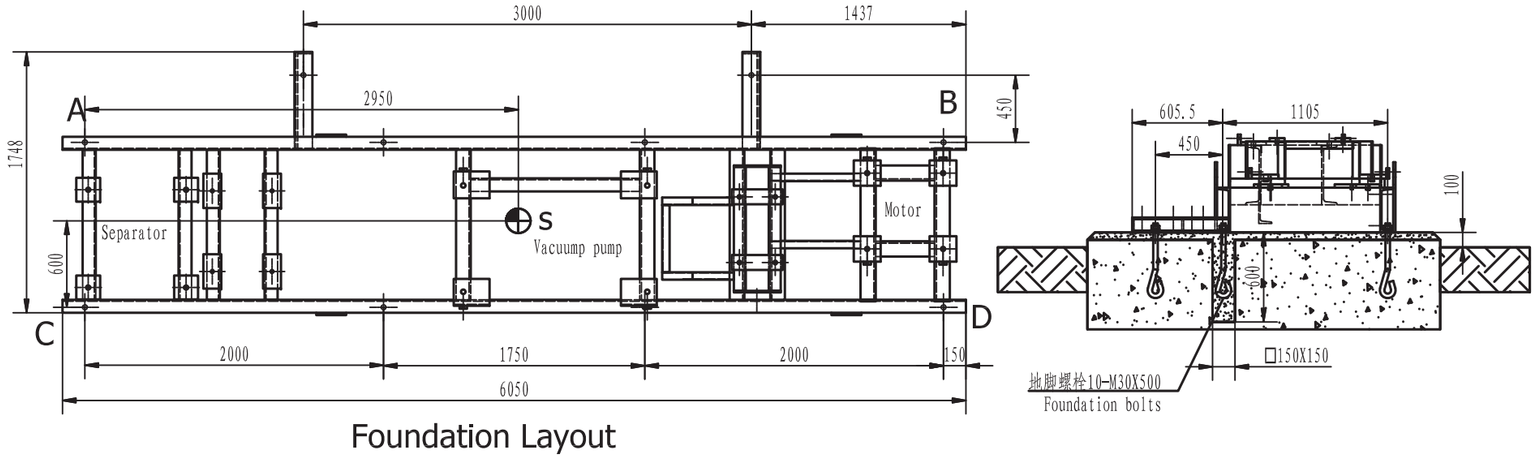


名称Name	重量Weight
真空泵Pump	3350kg
电机Motor	1150kg
底盘Base	1200kg
联轴器Coupling	100kg
换热器Heat Exchanger	655kg
分离器Separator	450kg
减速机Gear Box	300kg
循环泵REC. Pump	36.3kg
附件Accessar	355kg
干重Dry Weight	7740kg
操作重量Operation Weight	8440kg







Foundation Layout

基础载荷 FOUNDATION LOAD		
Motor 电机: Y2 315L-4/160KW		
Force in N (UNIT with filling) 受力 (牛) (机组充水)		
Supporting force	in A	21750 N
Supporting force	in B	22910 N
Supporting force	in C	18530 N
Supporting force	in D	19500 N
Total weight	in S	8440 Kg

接口/CONN.	标准/NORM	描述/DESCRIPTION
N1.1	DIN 2633 Type C Series 1 WN250-PN10 RF 20# φ273*8.8mm	吸气口/SUCTION
N2.2	DIN 2633 Type C Series 1 WN 200-PN10 RF 20# φ219*8.0mm	排气口/DISCHARGE
N2.4	DIN 2633 Type C Series 1 WN 50-PN16 RF 20#	备用口/STAND BY
N3.3	NPT 3/4"	工作液进口/SEAL WATER INLET
N4.6	DIN 2633 Type C Series 1 WN50-PN16 RF 20# φ60*4.0mm	排空口/TOTAL DRAIN
N5.0	DIN 2633 Type C Series 1 WN150-PN16 RF 20# φ168*7.1mm	冷却水进口/COOLING WATER INLET
N6.0	DIN 2633 Type C Series 1 WN150-PN16 RF 20# φ168*7.1mm	冷却水出口/COOLING WATER OUTLET
N8.0	NPT 1/4"	压缩气体进口/PRESSURE AIR INLET

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REV.	DATE	DESIGNED BY	CHECKED BY	REVIEWED BY	APPROVED BY	DESCRIPTION
G1	3. April. 2013	HG	WYY	JYL	ZZX	FINAL
G	17. JULE. 2012	HG	WYY	JYL	ZZX	

OWNER: VIETNAM ELECTRICITY THERMAL PROJECT MANAGEMENT BOARD NO.3

CONSULTANT: POWER ENGINEERING CONSULTING JOINT STOCK COMPANY 2

CONTRACTOR: DONGFANG ELECTRIC CORPORATION LIMITED

SUBCONTRACTOR: Gardner Denver Nash Machinery Ltd.

EVN REF. No.

DEC REF. No.

PROJECT : DUYEN HAI 1 THERMAL POWER PLANT PROJECT

CONTRACT NO. : DH1-30032010

比例/Scale	1:20	名称/Title	General Arrangement Drawing 总装图
重量/Weight			
材料/Material			
第 1 页/Pape	共 1 页/Pages	型号/Type AT-3006E	图号/Drawing No. V326007
设计/Design		2013.05.16 12:02:30 +08'00'	
校核/Check		2013.05.16 12:04:40 +08'00'	
批准/Approval		2013.05.16 12:51:22 +08'00'	

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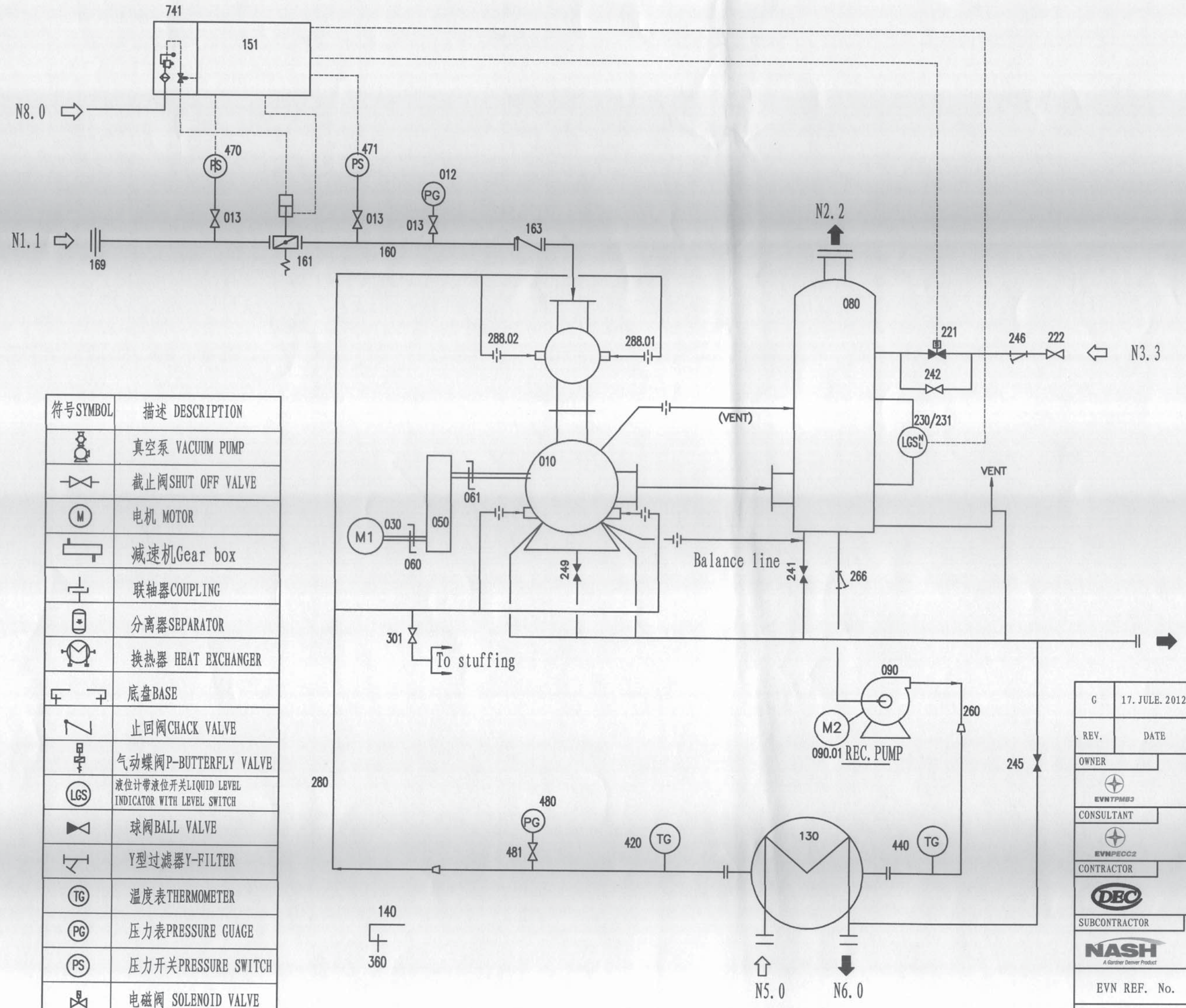

符号SYMBOL	描述 DESCRIPTION
	真空泵 VACUUM PUMP
	截止阀SHUT OFF VALVE
M	电机 MOTOR
	减速机Gear box
	联轴器COUPLING
	分离器SEPARATOR
	换热器 HEAT EXCHANGER
	底盘BASE
	止回阀CHACK VALVE
	气动蝶阀P-BUTTERFLY VALVE
LGS	液位计带液位开关LIQUID LEVEL INDICATOR WITH LEVEL SWITCH
	球阀BALL VALVE
	Y型过滤器Y-FILTER
TG	温度表THERMOMETER
PG	压力表PRESSURE GUAGE
PS	压力开关PRESSURE SWITCH
	电磁阀 SOLENOID VALVE
	进/出INLET/OUTLET

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REV.	DATE	DESIGNED BY	CHECKED BY	REVIEWED BY	APPROVED BY	DESCRIPTION
G	17. JULE. 2012	HG	WYY	JYL	ZZX	FINAL

OWNER
EVNTPMB3
VIETNAM ELECTRICITY
THERMAL PROJECT MANAGEMENT BOARD NO.3

CONSULTANT
EVNPECC2
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CONTRACTOR
DEC
DONGFANG ELECTRIC CORPORATION LIMITED

SUBCONTRACTOR
NASH A Gardner Denver Product
Gardner Denver Nash Machinery Ltd.

EVN REF. No.

DEC REF. No.

PROJECT :
DUYEN HAI 1 THERMAL POWER PLANT PROJECT

CONTRACT NO. :
DH1-30032010

比例/Scale		名称/Title	Flow Diagram 流程图
重量/Weight			
材料/Material			
第 1 页/Page	共 1 页/Pages	型号/Type AT 3006E	图号/Drawing No. V326008
设计/Design			
校核/Check			
批准/Approval			

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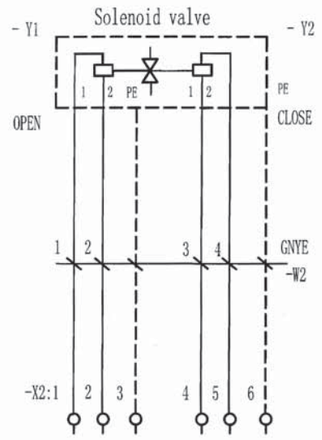
161



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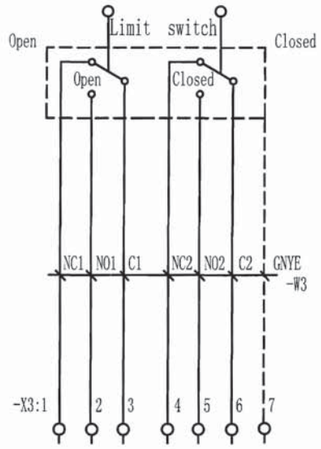

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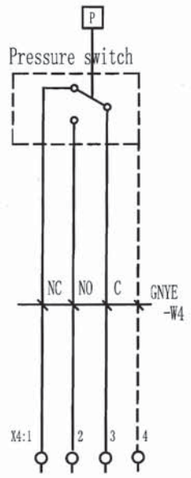

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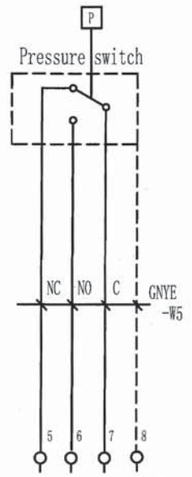

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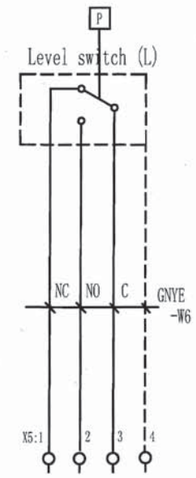

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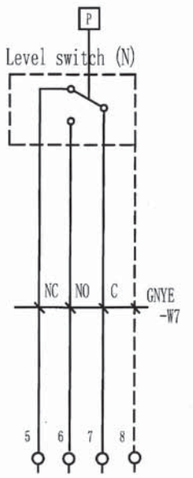

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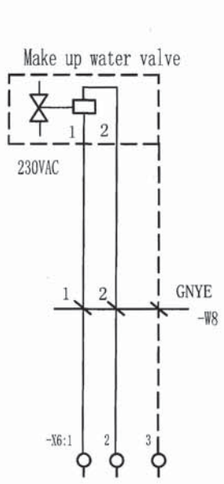

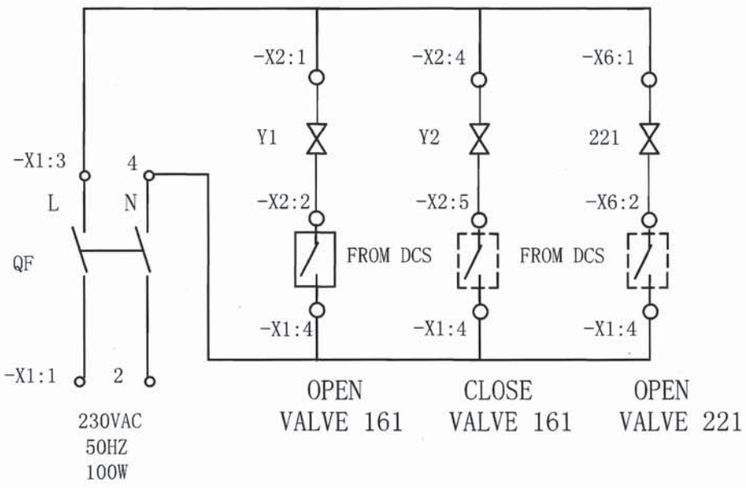

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A	2011.11.04	PRE		LKG
版本	日期	状态	修改 说明	批准
编码 Doc.No.	工程代码			
项目/ Project	越南沿海燃煤电厂一期2×622MW			
比例/Scale		名称/Title	Condenser vacuum pump terminal wiring diagram 凝汽器真空泵接线端子图	
重量/Weight				
材料/Material				
第 1 页/Page	共 1 页/Pages	型号/Type	AT-3006E	图号/Drawing No. V325999
设计/Design	李建果	佶缔纳士机械有限公司 Gardner Denver Nash Machinery Ltd.		
校核/Check				
批准/Approval				

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NO.	DESCRIPTION	SIZE	QT'Y	TAG NO.
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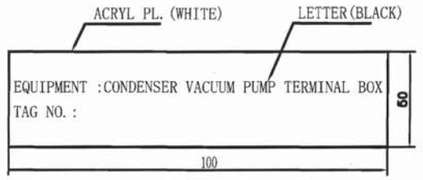
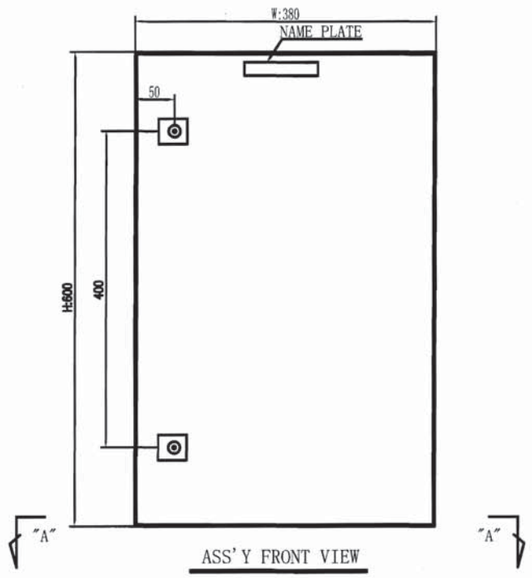
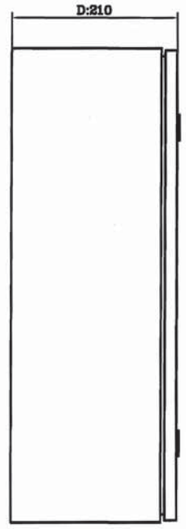
2	POWER SWITCH	230VAC, 50Hz	1	QF
3	TERMINAL BLOCK		1	N.A



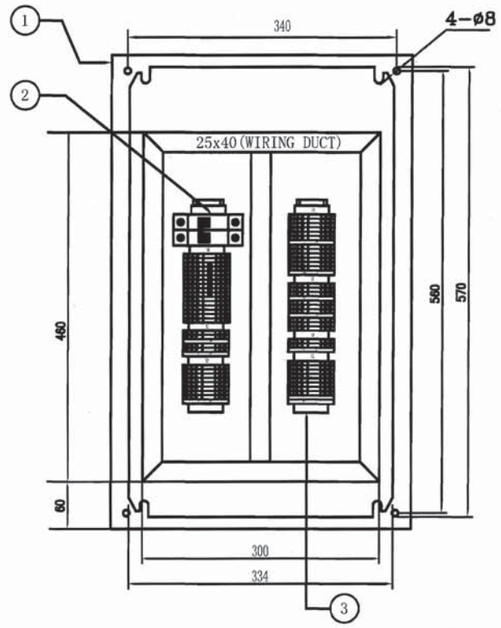
SS NAME PLATE: 1mm



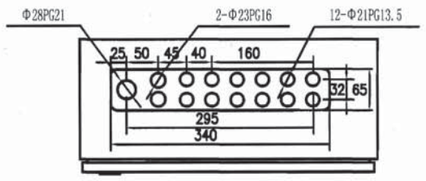
ASS'Y FRONT VIEW



SIDE VIEW



FRONT VIEW



SECTION "A-A"

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版本	日期	状态	修改 说明	批准
编码 Doc.No.	工程代码			
项目/Project	越南沿海燃煤电厂一期2×622MW			
比例/Scale		名称/Title	Condenser Vacuum Pump Terminal Box Layout 凝汽器真空泵接线盒外形图	
重量/Weight				
材料/Material				
第 1 页/Page	共 1 页/Pages	型号/Type	AT-3006E	图号/Drawing No. V325998
设计/Design	李英果	佶缔纳士机械有限公司 Gardner Denver Nash Machinery Ltd.		
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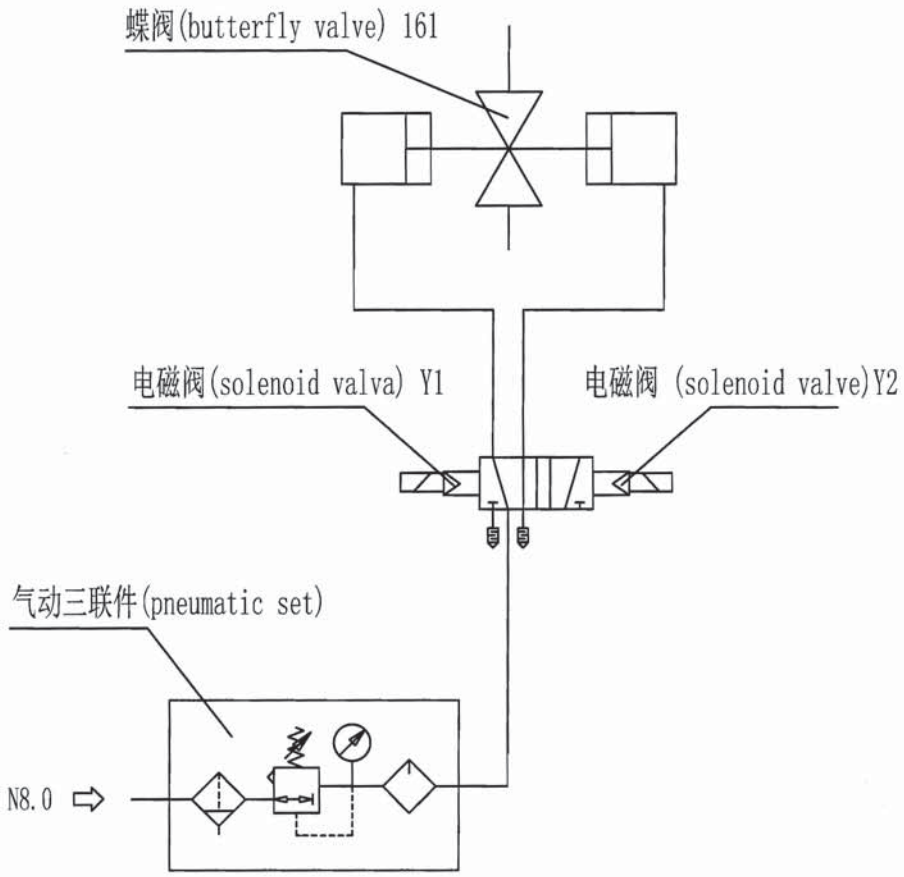

控 制 说 明
CONTROL DESCRIPTION

1. 电磁阀 Y1 通电.Y2 断电，蝶阀161开(Y1 turn on ,Y2 turn off,161 to open)
2. 电磁阀 Y2 通电.Y1 断电，蝶阀161关(Y2 turn on,Y1 turn off,161 to close)
3. 电磁阀 Y1.Y2 均断电，蝶阀保持在断电时的状态(Y1 and Y2 all turn off,161 remain as before)
4. 不允许电磁阀 Y1 .Y2 同时通电(Y1 and Y2 can not turn on at same time)

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A	2011.11.04	PRE		LKG
版本	日期	状态	修改 说明	批准

编码 Doc.No.	工程代码					

项目/Project	越南沿海燃煤电厂一期2×622MW		
比例/Scale		名称/Title	Condenser vacuum pump pneumatic system diagram 凝汽器真空泵气动原理图
重量/Weight			
材料/Material			
第 1 页/Page	共 1 页/Pages	型号/Type AT-3006E	图号/Drawing No. V326000
设计/Design	李克果		
校核/Check	徐丹		
批准/Approval	毛小东		

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1.0 工业用 NASH 闭环真空泵安全说明

警告

该设备运行中存在危险电压，任何错误操作都可能导致人身伤亡及财产损失。

必须严格遵守本章及产品标签上有关说明。

- o 必须由有资格人员进行维修维护。
- o 维修维护前必须切断设备电源并接地。
- o 维修过程中只能用被批准认可的零部件。
- o 要严格遵守有关检修的周期及更换零部件的规定。

1.1 工作及预备条件

泄漏到电站凝汽器中的空气会降低其工作效率。凝汽器投入使用前（抽空操作）及运行中（维持操作）都必须将泄漏空气抽除。NASH 真空泵 AT3006E 正是用于这一目的。

该闭环真空泵交付使用前，操作人员必须仔细阅读操作说明书。任何因未仔细阅读说明书而引起的损失及损害我们概不负责。

保修期内的维修及更换必须由我们的机械师同意才能进行。若实际工况及运行数据与下订单时的数据有差异，请与我们联系，否则原有保证无效。

1.2 描述及功能介绍

外形尺寸图 V326008

流程图 V326007

该闭环真空泵主要包括 NASH 泵（010）和三相电机（030），分离器（080）循环泵（090），换热器（130），底盘（140），和管线（160，170，240，260，269，280，290）。

压力开关（470）的作用是启用/停用备用真空机组。

压力开关（471）的作用是在预先规定的压力下打开系统入口蝶阀（161）。

吸气管路上配有冷却喷嘴，经过换热器冷却的工作液通过喷嘴进入泵口，与吸入泵内的饱和气混合，使饱和气内的水蒸气迅速冷凝，并一起进入泵内。

真空泵运行过程中，来自凝汽器中的空气通过管线（160），蝶阀（161）以及止回阀（163）被吸入 NASH 泵（010）。

止回阀（163）用于防止泵突然停止时，空气返流回系统。

空气携带部分泵工作液，从泵通过排气管线（170）排至分离器（080）。在分离器内，空气与水分离。空气被压缩至大气压力， 通过法兰口 N2.2 排出系统。

分离器（080）配带磁浮子液位计（230），液位开关（231），溢流管线（248），电磁阀（221），旁通阀（242）。

通过法兰接口 N3.3 和电磁阀（221），新鲜水补充至分离器和泵内。

分离器内液位由液位计（230）指示，液位开关（231）控制电磁阀的动作。当液位低于正常位置时，液位开关（231）发出信号，打开电磁阀开始补水，直至液位达到正常液位时，液位开关（231）控制电磁阀关闭。

溢流管线 （248）用于溢流多余的水以保证系统内正常的液位。分离器的排空阀(241)用于彻底排净分离器（080）的水。真空泵(010)通过排空阀(249)排净水.

工作液用于形成泵的水环。工作液通过管线（260），自分离器（080）流入换热器（130），冷却后通过管线（280）返回泵。在此过程中，压缩产生的热及随被抽气体带入的热被释放掉。

工作液温度及压力分别由管线（280）上的温度计（420）（440）和压力表（480）监测。

1.3 安装

该闭环真空泵配有如外形尺寸图所示的所有内部管线和底盘。只能通过焊接在底盘框架边侧的 4 个吊钩起吊设备，不允许通过内部管线或其它点起吊。提升和降落过程中，应避免急速移动。

基础用混凝土或钢结构制作。其承载能力与机组重量相符。混凝土基础应预留灌浆口。

机组安装好后，需重新调整并上紧螺栓。重新调整电机和泵，保证同轴，因运输过程中可能会出现轻微的偏差。

对中不正会导致不平稳运转而损坏联轴器。整个联轴器凸缘圆周上间隙必须保持一致，并且同心，最大允许偏差 0.1mm. 实际偏差每年测量并记录两次。

在检查所有螺栓连接点是否准确安装到位及调整维修后，螺栓可能松动，如有必要，将其上紧。同泵相连的管路不应施予真空泵张力及应力，这些管线应作始当支撑或悬吊以防止将其载荷传递给水环真空泵。

外部颤动和震动，如从厂房传给真空泵的，应加防震板消除。

在泵周围进行安装，焊接等工作时，一定要对泵作适当保护。所有尚未连接的接口都应加盖保护，以防外部污染物（如工具、残余焊条、焊渣、焊球、灰尘等）进入泵中。因为这些物质在泵运转时可能破坏泵内零部件。

供排管线将与以下法兰连接（尺寸见接口表）：

N1.1	NASH 闭环 真空泵气体入口
N2.2	NASH 闭环 真空泵气体出口
N3.3	工作液供应、补充
N4.6	总排空
N5.0	冷却水入口
N6.0	冷却水出口
N8.0	压缩气体入口

连接以前，工厂安装现场各管段都应清理，或在开车运行的头几周内在泵入口设置过滤器。

所有电气接线及接口都应遵守地方管理部门的有关规章。

除主驱动电机（030）外，所有电气件都与接线盒（151）连接。

1.4 试运行

1.4.1 准备

应根据流程图和尺寸图进行检查以保证管路和NASH真空泵在整个布局中的安装是正确的。

在第一次启动泵前，一定要用手或其他合适工具盘动泵轴。

泵轴旋转方向要通过点动电机进行检测，以保证与泵上所标箭头方向一致。进行此工作前，应先稍微松动填料压盖，然后再紧住。

排气口（N2.2）必须全开，另外压力表（012、480）和压力开关（470、471）的截止阀（013、481）也要打开，阀（241、249）一定要关闭。

工作液一定要供至N3.3接口，冷却水供至N5.0接口。

第一次试车前，开车后约4周及长时间停车后，真空泵应用洁净水（软水）进行清洗，这一点非常重要。

1.4.2 泵的注水

通过法兰接口 N3.3向闭环真空系统内注入工作液（如果需要，打开（242）旁通阀，可加速泵的灌注）。同时通过管线（260）、换热器（130）及管线（280）向NASH 真空泵充水.
当分离器内水位提高，电磁阀停止水的供应时，充水过程完成。分离器内的水位 可通过液位计（230）监测，大约5分钟后重新检查水位（此时平衡已建立）。

1.4.3 启动

启动电机（030）和水泵电机（090），打开冷却水阀及系统进气阀，NASH真空泵即投入运行，当水环建立起来后，系统进入工作状态。

1.4.4 停车

1）停真空泵（010）的驱动电机（030）和水泵电机（090）。
2）关闭吸气入口阀门（161）以保证规定的启动状态。
3）关闭冷却水阀。

停车后，泵（010）和分离器（080）之间通过工作液管线（260、280）自动实现液位平衡。当泵需要放液时，所有相关放液出口必须打开。

注意：如果要长时间停车（1个月或更长时间），则必需将泵内水排空。

1.4.5 运转中的检查

a. 经常性的，至少每周一次

a.1 工作液温度 TI （420、440），温度升高表示换热器（130）受到污染，根据所附换热器的维修说明清理。

a.2 真空泵入口与凝汽器的压力差。该压差升高表明吸入管线上某处可能阻塞。

a.3 分离器（080）的液位 LI（230）， 液位显示在最高和最低标线之间，如果显示高于最高值，表明溢水管线（248）有问题。 如果低于最低值，表明补水电磁阀不起作用或没有水供应。

b. 至少每月一次

b.1 工作液压力 PI（480），其显示应与 NASH 真空泵有关试验证书的数据相吻合。

b.2 真空泵（010）和电机（030）的运转平稳性，超常的振动、噪音或轴承温度的升高表明联轴器的对中不好。

b.3 泵（010）的填料压盖处的状况：少量的水从填料函溢出以保证有足够的冷却。细节参阅 NASH 真空泵的使用说明书。

c. 每年一次，大修

c.1 排净系统内液体，并用干净水冲洗。

c.2 通过检查孔检查真空泵内部，如需要，拆开泵维修。

c.3 检查所有阀门、各控制阀、开关及仪表，确保功能正确。

c.4 检查所有过滤器（如果有），清理干净。

c.5 检查换热器(130)状况。

1.5 一般要求

请同时参阅附后的机器及组件说明书。

保持状态：

建议泵轮流运行，例如一台泵运行 4 周后切换到另一台泵。

泵在运行过程中必须保证换热器有足够的冷却水供应，所有组件，泵的填料函、换热器、泵及分离器（排空及溢流）等各处的放液管全部连在一公用的放液管上，不允许有背压。

工作液通过接口 N3.3 补加。补充水必须是冷凝水，需防止污染并保证无固体杂质，通常在运行状况下不需要补充水，因为被抽蒸汽在液环中冷凝后完全可以补充损失量。

1.6 防护

整个 NASH 液环真空泵在发货前全都用防护剂 Anticorith DMS 做了防护处理，这样的防护措施所能保护的储存期为小于 6 个月。

1.7 长时间储存及长期停车时的保护

如果从发货到首次开车的时间超过 6 个月或 NASH 闭环真空泵的停车时间太长， 则要采取下列措施：

1）NASH 闭环真空泵需完全放液。

2）使用好的防锈剂处理 NASH 闭环真空泵约 5 分钟，每隔 6 个月进行一次。推荐使用防锈剂：Anticorith DMS.

3）同时要松开填料压盖以保证填料函也被防锈剂冲洗。

4）排空防锈剂，干燥 NASH 真空泵。

5）至少 4 周一次，手工盘动泵轴。

6）使用之前取出所有填料，用防锈剂冲洗填料函，然后重装。轴承也应当冲洗，并根据使用说明重新抹润滑油脂。

1.0 Safety Instruction of NASH Closed Circuit Vacuum Pump for Industry Application

WARNING

The machines are under running including dangerous voltage, when any improperly using, the machines may cause serious personal injury or material damage.

Particular note must be taken of the following:

- Only qualified personnel are entrusted to work on the machines.
- The machines must be power off, and properly grounded, before maintenance.
- Only permitted parts can be used, during repairing work.
- Must obey the regulations for maintenance period and for replacing parts.

1.1 Working and Precondition

The leakage into the power plants condenser will decrease the efficiency. The leaking air must be evacuated, before condenser operated, as hogging operation, and during operation, as holding operation. NASH Vacuum pump AT3006E is used for these purposes.

Before starting up the closed circuit vacuum pump, all operators must read the operating manual carefully. Any loss because of ignoring the instructions, is not due to us.

In guarantee period, all repairing work must be done , or permitted by us. If there is some difference between real working condition and the order specification, please contact with us , otherwise the original guarantee is invalid.

1.2 Description and Function Introduction

Flow diagram (P&I D) V326008

General arrangement drawing V326007

This closed circuit vacuum pump mainly includes: NASH Vacuum Pump (010) , three-phase motor (030), Separator (080), Cyc pump （090） , heat exchanger (130), base frame (140), and piping works (160,170, 240, 260, 280).

Pressure switch (470) is used for opening the bypass butterfly valve.

Pressure switch (471) is used for opening the system inlet butterfly valve (161) under pre_setted pressure.

When condenser connected, and inlet valve (161) opened, the air is evacuated from flange connection N1.1, and through piping (160) , into NASH pump (010).

Non-return valve (163) is used for prevent the air and water from flowing back into the condenser, when pump stopped by accident.

Air, with some pump operating liquid, is discharged from the pump(010) into the separator (080), through the discharge piping (170). The air and the water is separated in the separator. The air is compressed into atmosphere pressure , and discharged from flange connection N2.2.

Separator (080) is fitted with liquid level indicator (230), drain valve (241), overflow piping (248), filling solenoid valve(221), bypass filling valve (242) and level switch(231) .

Through flange connection N3.3 and filling solenoid valve (221), fresh water is continually filled into the separator and the pump.
The water level in the separator is indicated by level indicator (230). When the level is lower than the normal level, the low level switch(231) will open the solenoid valve (221) , till reach the right water level ,at this time the high level switch will close the solenoid valve. The rest water drains out through overflow piping (248) and total drain piping (240). Drain valve (241) is used for completely draining the separator (080).
Through drain vales (249), the pump (010) are drained.

Working liquid is for forming the pump water ring. Through piping (260), the water flows from separator (080) into heat exchanger (130), after cooled, it flows back into pump through piping (280). During this circuit, the heat from compression, and taken in from air, is got rid of.

The temperature and pressure of the working liquid is monitored by thermometer (420), thermometer (440) and pressure gauge (480).

1.3 Installation

The closed circuit vacuum pump is including all inner piping works and base frame showed in the general arrangement drawing. The pump must be lifted by the 4 hanging rings welded on the base frame, other hanging points, such as the inner piping etc., are not permitted. Rapid moving is avoided during lifting and launching.

The foundation shall be made of concrete or steel construction. For the load capacity, the unit weight must be considered.

After installation, the bolts must be re-tightened. Re-aligning motor and pump couplings to assure the co-axial. Because there must be slight deviation during transportation.

Wrong alignment will cause uneven running and coupling damage. The clearance between the 2 coupling halves must be even, and co-axial, the maximum permitted deviation is 0.1mm. The real deviation must be measured and recorded twice per year.

After checking all the bolts in the right position and realignment, the bolts may be loosed, tightened if necessary. No out tension from the piping connected with the pump is permitted, these piping works must be properly supported or hanged.

For the vacuum pump, outside vibration and shock, such as that from the workshop, must be removed.

When making installation and welding work around the pump, the pump must be protected. All unconnected opens must be protected with caps, so s to prevent from outside contamination (i.e. tools, residual welding rod, welding residue, welding ball, dirt etc.) Especially when welding balls enter the pump, parts in the pump shall be damaged.

Supply piping connected with the following flanges (see connection list for size) :

N1.1 Gas inlet of NASH closed circuit vacuum pump
N2.2 Gas outlet of NASH closed circuit vacuum pump
N3.3 Filling & replenishing of operating liquid
N4.6 Total drainage
N5.0 Cooling liquid supply
N6.0 Cooling liquid discharge
N8.0 Compressed air supply

Before connection, all piping areas in the site must be cleaned, or add starting filters at pump inlet connection, during first few weeks.

Local management department's stipulations must be observed, when making electrical wiring and connection.

Except motor (030), all electrical components connected to terminal box (151).

1.4 Preparations for start up

1.4.1 Preparation

Check and assure all installation for NASH pump is right, according to flow diagram and general arrangement drawing.

Before first start up, pump shaft must be turned by hand or other proper tools.

Check pump shaft rotary direction by switch on and off quickly, make sure that it is the same direction as the arrow on the pump. Before this work, you must loose the stuffing gland, and tighten it again.

Discharge port (N2.2) must be opened completely, and also open the shut-off valves (013) for pressure gauge (012, 480) and pressure switch (470,471), and the valves (241, 249) must be closed.

Working liquid must be supplied to N3.3, and cooling water to N5.0.

It's very important that, clean the pump with clean water (soft water) , before first start up, or shutdown for more than 4 weeks after start up.

1.4.2 Filling the Pump

Fill the closed circuit pump from connection N3.3 (You can speed up the filling by opening the bypass valve 242, if necessary), and then the water fill the NASH pump through piping (260), heat exchanger (130), and piping (280). Water level high up, and when the auto make-up valve stops filling, filling work finished.
The level in the separator is monitored by the level indication (230), check the level after about 5 minutes (now the balance reached).

1.4.3 Start up

When motor (030，090) switched on, and cooling water valve and system inlet valve opened, NASH is running, and after water ring established in the pump, the system turns into working condition.

1.4.4 Shut down

1.) Stop the driving motor (030) of vacuum pump (010).and the driving motor (090) of cyc pump
2.) Close inlet valve (161) to assure the needed starting condition.
3.) Close the cooling water valve.

After shutting down, pump (010)and separator (080) reach the water level balance automatically by working liquid piping (260,280). When you want to drain the pump, open all the related connections.

Caution: For long time shutting down (1 month and/or longer), you must drain the pump.

1.4.5 Inspection during Running

a. Regularly, i.e. at least once per week

a.1 Working liquid temperature TI (420, 440), temperature increasing means heat exchanger (130) is contaminated, you shall clean the heat exchanger.

a.2 Pressure difference of system inlet and heat exchanger, the increasing pressure difference means some block in the piping.

a.3 Water level LI (230) of the separator, normal level shall between higher and lower level, if level showed higher than higher level, it means some problem with the overflow piping (248).
if level showed lower than lower level, it means auto filling valve doesn't work or no water supplied.

b. At least once per month

b.1 working liquid pressure PI (480), the value must be the similar to related testing certification.

b.2 Evenly running of vacuum pump (010) and motor (030), abnormal vibration and noise or increasing bearing temperature means bad alignment of couplings.

b.3 condition of stuffing box of pump (010) : some water flowing out of the stuffing box can assure enough cooling.
For detail, see NASH vacuum pump operating instructions.

c. Once per year, annual maintenance

c.1 Drain the system, and clean it with clean water (see part 1.4.4).

c.2 Inspect the pump condition inside through the inspection open, if necessary, dismantle the pump for repairing.

c.3 Check all valves, switches, gauge and other electric components, assure the normal working, and proper function.

c.4 Check all filters, if necessary, clean them.

c.5 Check the working condition of heat exchanger (130).

1.5 General demand

Please refer to the instruction of the construction parts as well.

Holding condition:
It's recommended to run the pumps in turn, i.e. after 1st pump running for 4 weeks, switch the system to another pump.

Assure sufficient cooling water supply for heat exchanger during pump operation, the drainage of all parts, incl. heat exchanger, pump and separator , are connected to the common total draining piping, no back pressure permitted.

Operating liquid is replenished through connection N3.3. The water must be condensed water, prevented from pollution and solid residue. No replenishment needed under normal operating condition, because the condensation in the water ring from the sucked vapor can compensate the working water loss.

1.6 Protection

All NASH vacuum pumps are treated with anti-corrosion agent of Anticorith DMS, the pump with such treatment can be stored less than 6 months.

1.7 Protection for long time storing and prolonged shutting down

If the period of from delivery to first start up is longer than 6 months, or the prolonged shutting down period is too long, the following methods shall be taken:

1.) Completely drain the NASH closed circuit vacuum pump.

2.) Wash the NASH closed circuit vacuum pump with good anti-corrosion agent for about 5 minutes, do once per 6 months. It's recommended to use anti-corrosion agent: Anticorith DMS.

4.) Drain the anti-corrosion agent, dry the NASH vacuum pump.

5.) Turn the pump shaft manually, at least once per 4 weeks.

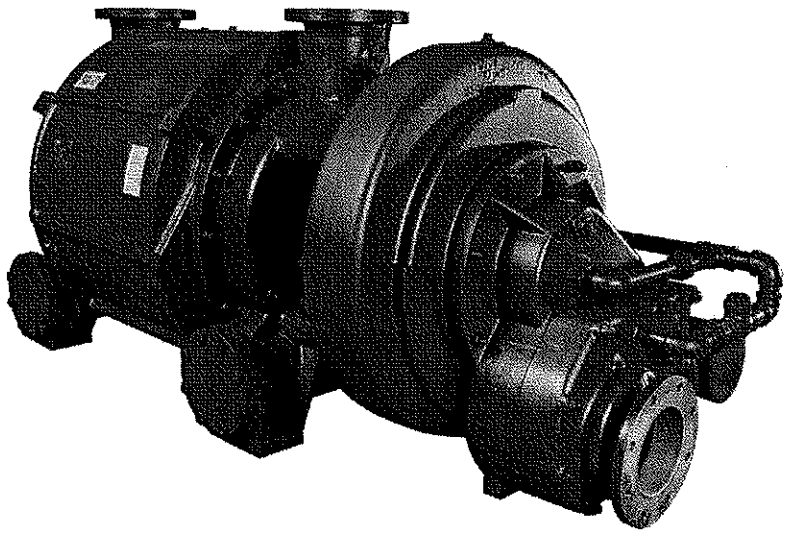
6.) Before turn into using, take out all packing rings, wash the stuffing box with anti-corrosion agent, then re-assembly the packing. The bearings must be washed also, and re-lubricated according to the pump operating instructions.

NASH
A Gardner Denver Product

Operation and Maintenance

Two-Stage Vacuum Pumps

AT SERIES



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About this manual

This manual contains information for owners and operators of Gardner Denver Nash Two-Stage Vacuum Pump Models AT 404, 704, 706, 1004, 1006, 2004, 2006, 3004, 3006. This information includes a description of how to operate and maintain the unit.

Note:
The vacuum pump is built using English units of measure. Metric SI conversions (shown in parentheses) are included for reference only; use the English system values when performing maintenance procedures. The metric conversions for pressure, expressed in kilopascals (kPa), are in absolute pressure for all pressures above and below atmospheric pressure.

These operating instructions

- apply to liquid-ring vacuum pumps of the series AT
- contain instructions bearing on transport and handling, installation, commissioning, operation, shut-down, storage, servicing and disposal
- must be completely read and understood by all operating and servicing personnel before beginning to work with or on the pump
- must be strictly observed
- must be available at the operating location of the pump.

For the operating and service personnel

- these persons must be trained and authorized for the work to be carried out
- work on electrical installations may be carried out by trained and authorized electricians only.

The **AT**

- are pumps for generating vacuum
- are used to extract and transport the following **pumped gases/vapors**:
  - dry and moist gases without dangerous properties
  - for gases/vapors that differ, an inquiry must be made with Gardner Denver Nash
- are designed for operation with the following **seal liquids**:
  - liquids which are not flammable, explosive, corrosive or toxic; generally water
  - the operating liquid must be free of solid materials (such as sand)
  - for operating liquids that differ, an inquiry must be made with Gardner Denver Nash
- are intended for industrial applications
- are designed for continuous operation

Foreseeable misuse

It is prohibited:

- to use the pump in non-industrial applications, unless the necessary protection is provided on the system, e.g. guards suitable for children's fingers
- to use the device in rooms in which explosive gases can occur if the pump is not expressly intended for this purpose
- to extract and to deliver explosive, flammable, corrosive or toxic fluids, unless the pump is specifically designed for this purpose
- working with or on the pump by unqualified persons

Any unauthorized modifications of the pump are prohibited for safety reasons. Maintenance and repair work by the operator are only permitted in the scope described in these operating instructions. Any maintenance and repair work going beyond this may only be conducted by companies authorized by the manufacturer (inquiry with the Service Department necessary).

1 Safety

While the pump is running, the following safety precautions should be followed:

Operational

- avoid the suction and discharge connections
- do not touch the casing and the cover while the pump is working and conveying hot fluids
- do not go close to the pump while it is working with a special or toxic fluid and the mechanical seals or packing is leaking
- do not operate the pump for long periods of time while cavitating, causing loud and prolonged noises
- do not operate without the coupling guard in place
- check the safety system periodically

Services

Prior to any operation, the following safety precautions should be adhered to:

- stop the pump as described in chapter 5.1, pg. 23
- bleed air into/out of the piping so that the pump internal pressure is the same as atmospheric pressure
- be sure that the current supply is off, the circuit breaker is open, locked, and tagged out of service
- empty the service liquid as described in chapter 5.2, pg. 23

1.1 Spare parts

Please refer to the parts list on pages 32-33.

1.2 Warranty claims and returns

Nash warrants that (i) the goods will be of the kind described on its acceptance of Buyer's order as modified by any subsequent mutual agreement of the parties, (ii) it will convey to Buyer good title to such goods, (iii) such goods will be delivered free of any lawful security interest or lien or encumbrances unknown to Buyer, and (iv) such goods will be of merchantable quality and free from defects in material or workmanship under normal use and prescribed maintenance for a period of two (2) years from the date of shipment. The warranties specified shall also extend to goods manufactured by others and supplied by Nash, unless such goods have been separately stated and quoted by Nash, in which case only the warranties in clauses (i), (ii), and (iii) shall apply. NASH MAKES NO WARRANTY, EXPRESS OR IMPLIED, AS TO THE MERCHANTABILITY OF GOODS MANUFACTURED BY ITS SUPPLIERS AND SEPARATELY STATED AND QUOTED HEREIN. Nash's warranty in clause (iv) above shall not apply to goods of standard construction when handling corrosive gases or using corrosive liquid compressants nor will clause (iv) apply to goods which have been damaged, altered or negligently maintained after delivery. Buyer's exclusive remedy for Nash's breach of the warranties set forth in clauses (i), (ii) and (iii) above shall be the replacement by Nash of non- conforming goods with conforming goods, without extra costs to Buyer, F.O.B. Trumbull, Connecticut, with transportation prepaid to U.S. destination or domestic port, and Buyer's exclusive remedy for Nash's breach of the warranty contained in clause (iv) above shall be the repair by Nash without charge, or the furnishing by Nash, F.O.B. Trumbull, Connecticut, with transportation prepaid to US. destination or domestic port of a part or item of equipment to replace any part or item of equipment which is proved to have been defective; provided that (i) Buyer shall have notified Nash of any such breach not later than 10 days after the expiration of two (2) years from the date of shipment of the goods, and that (ii) Nash shall have the option of requiring the return of any defective material transportation prepaid to establish a claim. Nash shall in no event be liable for Buyer's manufacturing costs, lost profits, goodwill, expenses, or any other consequential or incidental damages resulting from a breach by Nash of any warranty. THERE ARE NO OTHER WARRANTIES, EXPRESS OR IMPLIED, WHICH EXTEND BEYOND THE WARRANTIES SET FORTH HEREIN.

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⚠ WARNING

Improper use of the pump can result in serious or even fatal injuries!

These operating instructions

- must have been read completely and understood before beginning any work with or at the pump,
- must be strictly observed,
- must be available at the operating location of the pump.

This pump may only be operated

- for the purposes indicated under "Intended Use"!
- with the fluids indicated under "Intended Use"!
- with the values indicated under "Technical Data"!

All work on and with the pump (transport, installation, commissioning, shut-down, maintenance, disposal) may only be carried out by trained, reliable qualified personnel!

⚠ WARNING

Danger due to gauge pressure and vacuum:
sudden escaping of fluid (skin and eye injuries),
sudden pulling in of hair and clothing!

Danger due to escaping fluid:
Burns/scalding!
Slipping and falling!

For inlet and discharge side, as well as for the feed and discharge of operating liquid and sealing liquid the following applies:

Use connections, lines fittings and containers with sufficient freedom from leaks and strength for the resulting pressures.

Before commissioning, following dismantling and assembly, as well as at regular intervals, check the connections of the pipe/hose connections, lines, fittings and containers for strength, leaks and firm seating.
Check connection elements and tighten if necessary.

⚠ WARNING

Danger from rotating parts (impeller, shaft):
Cutting/cutting off of extremities, grabbing/winding up of hair and clothing!

Danger due to gauge pressure and vacuum:
sudden escaping of fluid (skin and eye injuries),
sudden pulling in of hair and clothing!

Danger due to escaping fluid:
Burns/scalding! Slipping and falling!

Before beginning work on the pump or dismantling, carry out the following measures:

- Shut down pump and secure against being switched on again.
- Hang a warning sign on the system controller and on the control elements for the pump:
  "DANGER! Maintenance work on vacuum pump/compressor!
  Do not switch on!"
- Wait for the pump to come to a complete stop.
  Watch run-on time.
- Shut off lines.
  Release pressure.
  Drain off excess liquid.
- Make sure that no gauge pressure or vacuum is present in the lines, tanks etc. to be opened.

Commissioning and operation should only be carried out under the following conditions:

- After completing all work on the pump.
- In the completely mounted state.

In particular:

- With connected lines on inlet and discharge connections.
- With mounted lines and fittings on the connections in the end shield.
  Keep unused connections closed with the sealing devices provided (plugs, covers).

⚠ WARNING

When working on the pump, there is a danger of injury,
e.g. in the form of cuts/cutting off, crushing, burns and grasping!

During all work on and with the pump (transport, installation, commissioning, shut-down, maintenance, disposal) always wear personal safety equipment (safety helmet, protective gloves, safety boots, hair net)!

⚠ DANGER

Danger due to gauge pressure and vacuum:

Impermissibly high pressures lead to bursting of parts, abrupt escaping of fluids (skin and eye injuries), and sudden drawing in of hair and clothing!

Extreme danger!

The pump may not be operated with a blocked inlet or discharge!

Before putting into operation, ensure the following:

- The closures of the inlet and discharge connections used must be removed.
- All pipes must be connected.
- The shut-off device (e.g. valves, gate valves etc.) in the lines must be open.
- The connections and lines may not be or become clogged with deposits or solid materials.
- When feeding fluids containing solid materials, suitable screens or filters must be connected upstream of the pump.

⚠ WARNING

Danger of burns/scalding by hot fluids and by hot surfaces of the pump (shaft bearings)!

Do not touch during operation!
Allow to cool after shut-down!

This especially applies to inlet and pressure lines and the surface of the shaft bearings!

⚠ WARNING

Danger from rotating parts (exposed shaft ends, drive, drive motor, gear unit, coupling):

Injuries from rubbing (scrapes, burns),
crushing of extremities,
grasping/winding up of hair and clothing!

For the attachment of the drive (drive motor, gear unit, coupling) and the exposed shaft end, the following applies:

- Rotating parts must be protected against touching.
  Provide safety device (e.g. cover).
- Only start up and operate with safety device mounted.
- Before removing the safety device, wait for the rotating parts to come to a complete stop.
  Watch run-on time.

⚠ WARNING

Openings in bearing bracket/shaft mounting of end shields:

Danger from rotating parts (shaft):
Injuries from rubbing (scrapes, burns),
cutting on shaft shoulders,
grasping/winding up of hair and clothing!

Danger from fluids spraying out:
Skin and eye injuries!

For the openings in the bearing bracket/shaft mounting of the end shields, the following applies:

- Do not look or reach into the openings in the bearing bracket/shaft mounting of the heads while the pump is running.
- Always only conduct work in this area after the shaft has come to a complete stop.
  Watch run-on time.

⚠ WARNING

Danger of injuries from tilting or falling of the pump or of parts!

Take the following measures:

- The pump must be installed on a level surface.
- The pump must be anchored to the installation surface.
- Check following each removal and remounting whether all mounting elements have been re-mounted and tightened.
- Only carry out start-up and operation in the completely assembled state.
- Check mounting elements regularly for secure seating.

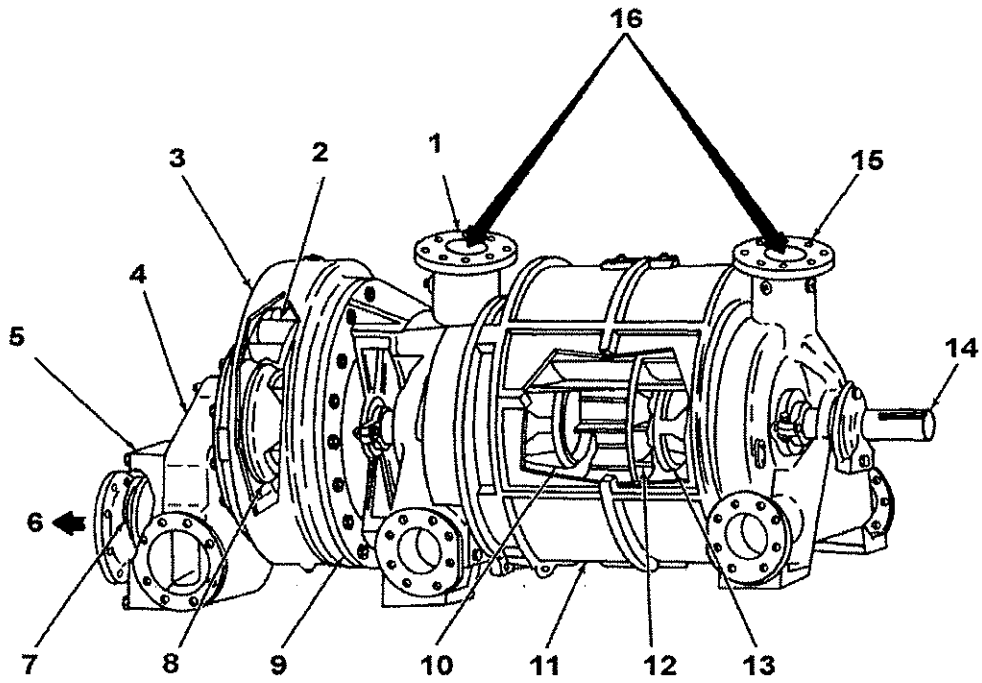
⚠ CAUTION

Danger of slipping and falling due to escaping liquid!

Before start-up and operation, following removal and remounting as well as at regular intervals:

Check shaft seal for leaks.
If necessary, readjust or replace.

Bind escaped liquid by means of a suitable binding agent and dispose of it.



1 – IE Head
2 – 2nd Stage Rotor
3 – 2nd stage lobe
4 – 2nd stage manifold
5 – Manifold cover
6 – Gas Discharge
7 – Interstage check valve
8 – 2nd stage cone
9 – IE Bracket
10 – 1st stage IE cone
11 – 1st stage body
12 – 1st stage rotor
13 – 1st stage DE cone
14 – Shaft
15 – DE head
16 – Vacuum pump 1st stage inlet

Figure 1: Major components of two-stage vacuum pump

2 How the pump works

The main components of the vacuum pump are shown in Figure 1. An electric drive motor is direct coupled to a pump drive shaft that is common to both stages of the two-stage vacuum pump. Rotors in each stage are rigidly mounted on the shaft and rotate at the same speed as the shaft.

The operating principles of the vacuum pump, which is of the liquid ring type, is shown in Figure 2. A rotor revolves without metal contact in a circular body that contains a liquid compressant. The rotor is a casting consisting of a series of blades that project from a hollow cylindrical hub through which the shaft is pressed. These blades are shrouded at the sides and form a series of chambers. The curvature of the blades is in the direction of rotation. The body is offset from the centerline of the shaft.

Starting in view A, Figure 2, the rotor chambers are filled with liquid compressant. The liquid compressant rotates with the rotor, but follows the contour of the body, and it recedes into the body as the rotor advances (as shown in view B) and empties the rotor chamber.

The converging body forces the liquid compressant back into the rotor chamber, as shown in view C, until the rotor chamber is full again. This cycle occurs once during each revolution of the rotor. As the liquid compressant recedes from the rotor chamber in view B, the liquid compressant is replaced by air drawn through an inlet port in the stationary cone that connects to the pump inlet. As the rotor turns through 360 degrees and liquid compressant is forced by the body back into the rotor chamber, the air that has filled the chamber is forced through discharge ports of the cone to the pump discharge, as shown in view D.

Evacuated gas and liquid compressant are discharged by the first stage of the vacuum pump into the second stage discharge manifold. During low-vacuum operation, a check valve in the second stage manifold is open, allowing the first stage discharge to flow directly to an externally located atmospheric discharge separator. Thus, at low vacuum, only the first stage of the vacuum pump performs an evacuation function. During high-vacuum operation, the check valve is automatically closed. The first stage discharge is then routed to the inlet of the second stage and through the second stage before being discharged through the second stage manifold to the separator. Operation under low- and high-vacuum conditions is shown in Figure 3.

Liquid compressant (seal water) is applied to the vacuum pump to provide the makeup for the liquid in the pump, and to seal the clearances between the cone and rotor. The liquid compressant enters the vacuum pump at the first stage heads. It then flows through a passage in the heads to the cones and through the clearance between the cones and rotor into the rotor chamber. Liquid compressant is discharged with the evacuated gas into the second stage manifold. From the second stage manifold it passes directly into the atmospheric discharge separator (low-vacuum operation) or flows into the second stage inlet (high-vacuum operation) before being discharged with the evacuated gas into the separator.

Stuffing boxes on the vacuum pump at the first stage heads contain packing rings and, in the first stage stuffing boxes only, lantern gland seals. These stuffing boxes are lubricated by the liquid compressant. Liquid compressant is applied to the lantern glands under a pressure of

2 to 5 psig (115 to 136 kPa) from the second stage shroud (bracket). The seal thereby provided prevents atmospheric air from entering the vacuum pump through the stuffing boxes.

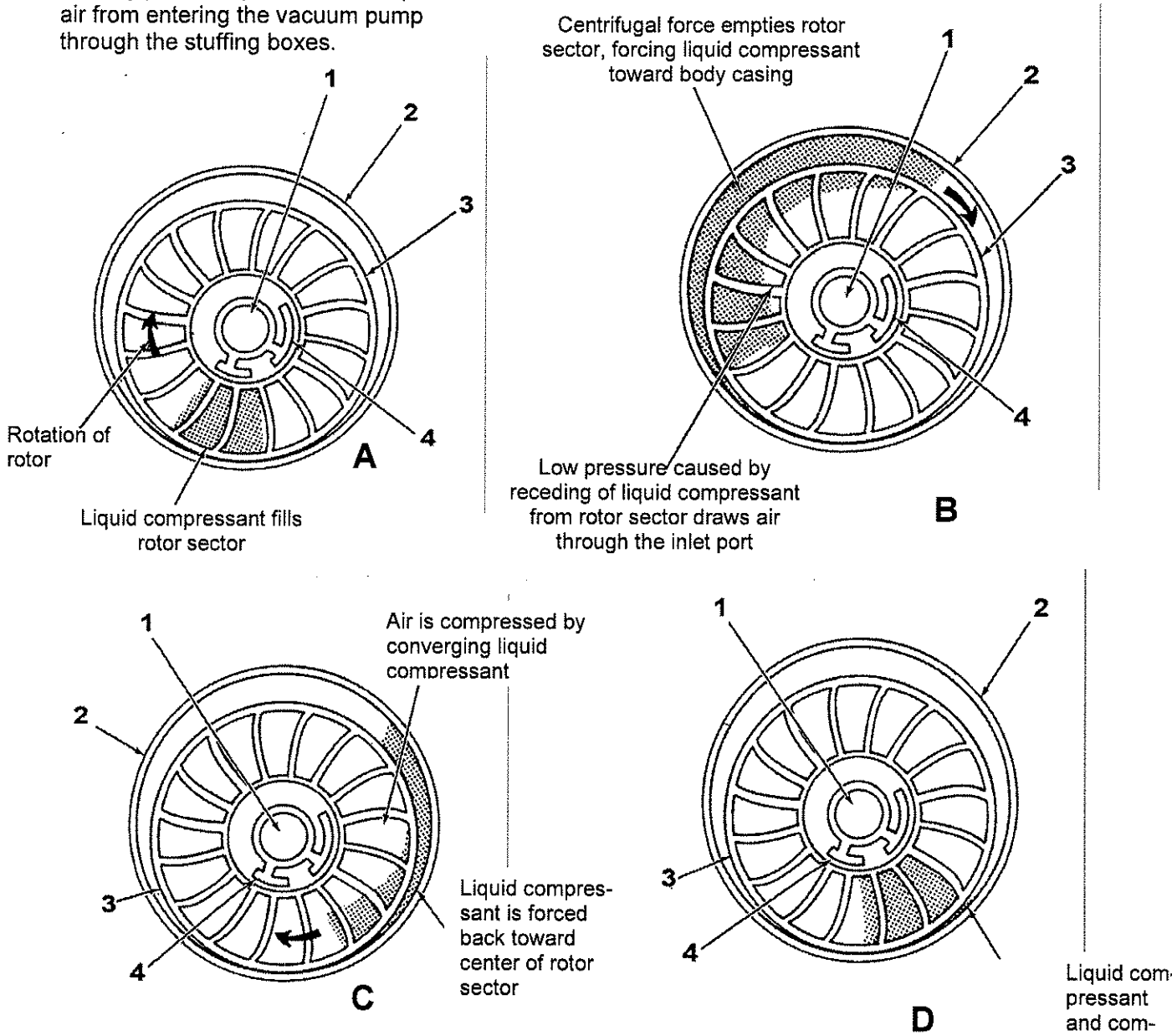


Figure 2: Vacuum Pump Operating Principles

1. Shaft 2. Body 3. Rotor 4. Cone

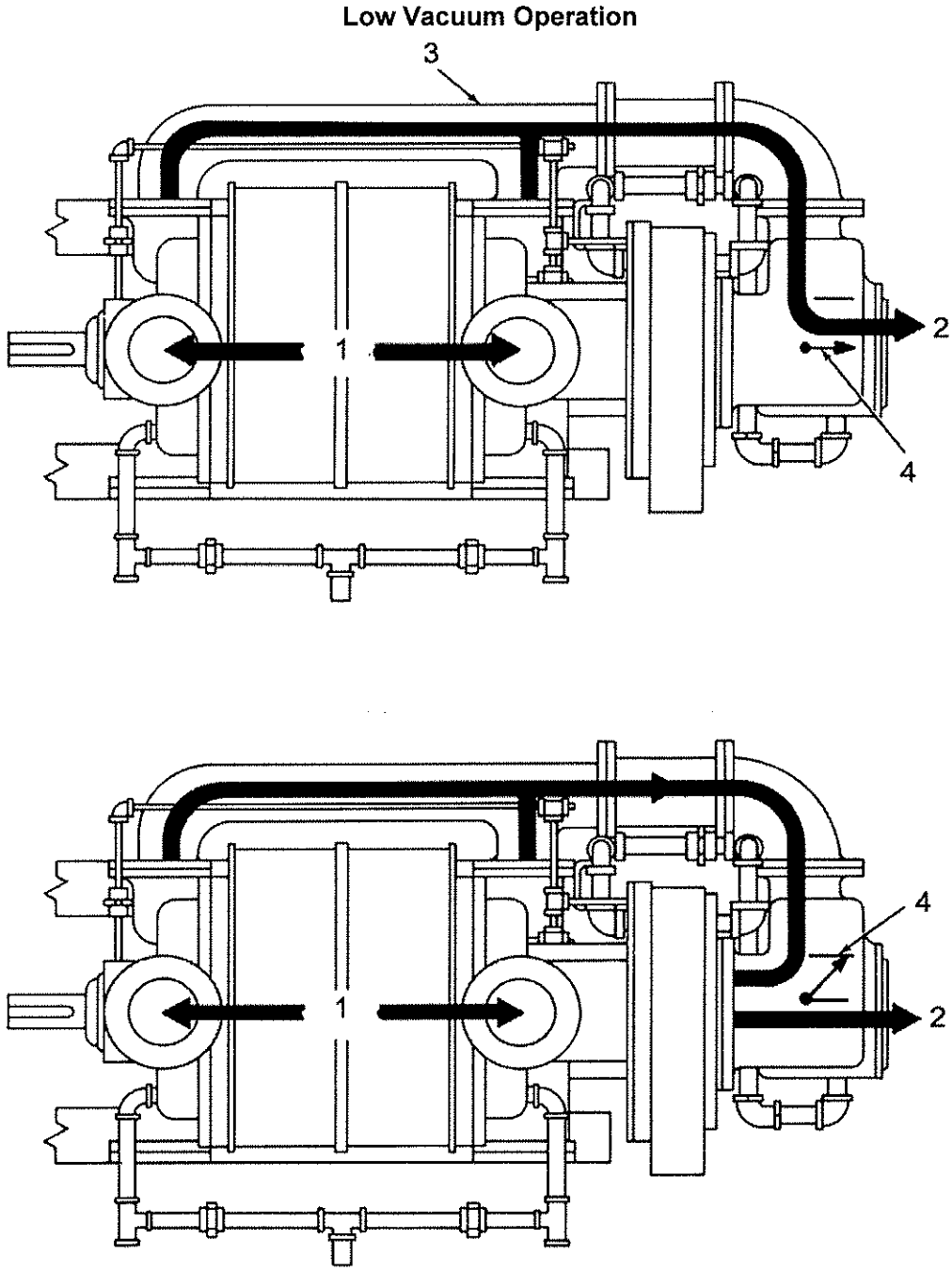


Figure 3: Low- and High-Vacuum Operation

1 Air Inlet
2 Interstage Piping
3 Discharge to Atmospheric Separator
4 Check Valve

2.1 Operating seal liquid

Proper operation of the pump requires that liquid compressant (seal liquid) be provided at the proper rate of flow.

Variations in the quantity of seal liquid flowing to the pump affect the performance of the pump. The quantity supplied should be regulated to produce the best results under individual operating conditions. Regulation can be provided by an orifice union, adjusting valve, and pressure gauge combination or by a flow control valve. A strainer should be connected in the upstream piping, with whichever flow regulation technique is used.

Flow control valves compensate for pressure fluctuations to maintain constant flow rate. The valves are suitable for upstream pressures of 15 to 125 psig (205 to 963 kPa).

Orifice unions provide a flow rate that is dependent upon pressure differential. Flow is regulated by the control of upstream pressure at 10 psig (1.7 bar) whether one or two orifice unions are used.

⚠ CAUTION

Do not start motor for pump until the seal liquid supply has been turned on. The seal liquid must be provided to the unit and both stages primed before the unit is started, even if the pump is only being operated to check the direction of shaft rotation or for any other test purposes.

3 Transportation & Handling

⚠ WARNING

Danger from lifting heavy loads!

For the pump weight, see chapter 8.1, pg. 34.

Use lifting gear or transport equipment suitable for the transport!

⚠ WARNING

Danger from tipping or falling loads!

Prior to transport and handling make sure that all components are securely assembled and secure or remove all components the fasteners of which have been loosened!

When transporting, observe the following basic rules:

- Use suitable lifting gear (e.g. belts or ropes/cables) and transport equipment (e.g. forklift truck, low-lift platform truck, crane).
- The lifting capacity of lifting equipment and lifting gear must be at least equal to the pump's weight.
  For the pump weight, see chapter 8.1, pg. 34.
- The pump must be secured so that it cannot tip or fall.
- Do not stand or walk under suspended loads!

– Watch the following:

Transport with a crane and lifting belts, with forklift truck or with low-lift platform truck.

– Secure lifting belts

- the lifting belts must be sufficiently long (spread angle smaller than 90°)
- the lifting belts must be protected against damage (e.g. by rubbing through edges). Use lifting belts with a rugged edge protection
- the lifting belts must be attached at suitable attachment points)
- suitable attachment points are, for example:
  - the bearing housings
  - the upper inlet connection
  - openings and lifting pins on base plates
- the lifting belts must be routed (e.g. in undercuts) so that the pump cannot slip out or tip)
- make sure that no damage is caused to any attached fittings

⚠ WARNING

Never secure the lifting belt to the following points:

- shaft end
- attached individual components or fittings
- attachment points of individual components, as these are only designed for the separate transport of the individual component.

4 Commissioning & Operation

Preparations for commissioning

Before starting the pump, carry out the following preparatory measures:

a. make sure that all voltage sources to drive are isolated and disconnected, and are secured with signs to prevent accidental starting
b. set up sufficiently large catch container below heads of pump
c. remove plugs (22-1 thru 22-6) for complete draining (see chapter 5.2, pg. 23) of the heads
d. flush the pump with water until only clear water flows out of all drain openings

NOTE

Pumps operated with **operating liquids which are not water-compatible** must be thoroughly **dried** after flushing.

e. after completely draining and, if necessary, drying pump:
remount plugs (22-1 thru 22-6) with pipe-thread sealing compound
f. check pump to ensure that all drain plugs are properly fitted
g. fill pump manually with operating liquid first time until operating liquid flows out of overflow
h. check all pipes to ensure that connections to pump and its supply system are properly installed
i. check whether pump and drive mounting screws, as well as base and bottom plate screws are firmly tightened
j. check all other operating component connections connected to pump to make sure that they comply with respective manufacturer's recommendations
k. check all pump control elements (control valves, measuring devices etc.) to make sure that they have been attached in accordance with installation drawings. Make sure that these elements are installed in the piping scheme with the proper orientation to ensure their proper operation.
l. check the inlet connection of the pump to ensure that the screen on the inlet connection and the flushing connections have been carefully cleaned and are free of tools, equipment and chips
m. make sure that the operating liquid connection is free of soiling
n. remove the coupling and turn the shaft by hand in the rotating direction indicated with the arrow on the housing and shown in the installation drawing
o. **the shaft must turn freely**. If the shaft is jammed and cannot be turned free by hand, it is necessary to enquire with Gardner Denver Nash Service.

⚠ CAUTION

Improper use of the pump can result in serious or even fatal injuries!

Never attempt to release a jammed shaft using the drive motor. This can result in serious damage.

p. check coupling
q. prepare the pump as described above and open main valves
r. briefly start motor and check correctness of the pump rotating direction

⚠ CAUTION

Never operate the pump without sufficient operating liquid and a sufficient stream of sealing liquid. A high operating liquid pressure does not necessarily result in a sufficiently high flow rate.

⚠ WARNING

Danger of injury in the form of grasping / winding parts of the body / clothing!
Make sure the coupling guard is installed before starting the drive motor.

The following section applies when the pump is drained or dry (i.e. during commissioning or restarting after longer breaks in operation or repairs).

Proceed as follows:

a. initial technical status:
   - all lines for pumped gases/vapors are correctly connected
   - all shut-off fittings are closed
   - no shut-off or non-return fittings are to be installed on the discharge side

b. pour in operating liquid and adjust operating liquid level:
   - open shut-off fitting for operating liquid. Depending on the pump size, this must take place approx. 0.5 to 2 minutes before start-up
   - the working area of the pump fills up to the overflow level at the discharge connection

⚠ CAUTION

During start-up the operating liquid level in the pump may not be higher than the shaft center!

Take the following measures:
- Carry out or repeat the adjustment of the operating liquid level in the working space of the pump directly prior to start-up.
- Make sure that no major additional quantities of liquid (operating liquid or sealing liquid) collect in the pump between the preparations for commissioning and start-up!

NOTE

Contact Gardner Denver Nash Service for support when starting up.

c. shaft seal:
   - **with stuffing box with internal lubrication:**
     After the pump has been running for 10 minutes with steady leakage from the stuffing boxes, tighten the gland nuts evenly one quarter turn at a time. Repeat at 10 minute intervals until there is a leakage of approximately 45 to 60 drops per minute from the gland with no overheating. This dripping is necessary to provide added lubrication for the packing and thereby prevent it from scoring and burning the shaft. Subsequent tightening of the gland nuts should be done with the pump operating at normal working temperature and vacuum.

⚠ CAUTION

At a feed pressure of > 4.35 psi (> 0.3 bar) above discharge pressure, liquid spray can escape.

Danger of damage to pump by escaping liquid spray!

The feed pressure of the sealing liquid may not exceed 4.35 psi (0.3 bar) above the discharge pressure!

For information on the volumetric flow or feed pressure of the sealing liquid, see chapter 2.1, pg. 17. Check the values using the volume flow meter or the pressure gauge.

4.1 Operation

Once the preparations for commissioning and the tests prior to commissioning have been completed, start the pump and check operation.

4.2 Start-up

NOTE

If malfunctions occur when carrying out the following steps, refer to chapter 5.6, pg. 25.

Once the preparations for commissioning and tests prior to commissioning have been completed, start the pump and check operation as follows:

a. check the pump and the system for sufficient operating liquid and then turn on the feed from the operating liquid and sealing liquid to the pump and to the heat exchanger (if used)

b. check the sealing-liquid flow rate to the pump while the pump is set to the required vacuum. Make sure that the sealing liquid flows out of the liquid separator or its outlet on the silencer

NOTE

If the pump runs roughly, the vibrations level increases and the volumetric flow decreases. If the pump does not stabilize, switch off the system immediately and determine the cause.

c. continuously check the temperature of the housing during start-up. If the temperature quickly increases or it is 40°F (22°C) or more above the operating liquid temperature, immediately switch off the pump and determine the cause

⚠ CAUTION

Improper use of the pump can result in serious or even fatal injuries!

If the bearing bracket temperature is 50°F (28°C) or more above the housing temperature, immediately switch off the pump and determine the cause.

⚠ CAUTION

In case of unusual bearing noises, vibrations, odors or smoke, switch off the pump immediately and determine the cause.

After starting the pump, check the temperature of the bearing brackets until the bearing bracket temperature is stable for at least 30 minutes.

4.3 Shut-down

NOTE

These preservation procedures apply to standard cast iron or all-cast iron pumps only, maintained in covered storage.

a. remove priming plugs (22-1 thru 22-6) and drain plugs (22-2 , 22-5 and 22-6) from pump and drain all seal liquid. Replace priming and drain plugs
b. disconnect discharge piping and blank off pump discharge flanges
c. add 10 gallons (38 l) of water soluble preserving oil, Cortec VCI-379E or equivalent, through inlet flanges of first stage heads (102 and 103)
d. remove priming plug (22-4) from top of second stage lobe (601) and add 3 gallons (11 l) of preserving oil, specified in step c, to second stage lobe. Replace priming plug
e. start pump and rotate for 5 to 15 seconds and shut down. Start pump again and rotate for 5 to 15 seconds and shut down
f. drain all preserving oil from pump for reuse by removing priming and drain plugs as specified in step a. Replace priming and drain plugs using pipe thread sealing compound
g. remove all packing as specified in chapter 6.5, pg. 28) and flush stuffing boxes with rust inhibitor
h. touch up any areas where paint has chipped and apply Houghton's Rust Veto #344 coating compound, or equivalent, to external surfaces as necessary
i. blank off pump inlets

NOTE

For long term preservation procedures for storage periods of more than 1 year, contact your Gardner Denver Nash Representative.

When the vacuum pump is put back into service, proceed as follows:

a. drain and flush the vacuum pump (Refer to chapter 5.2, pg. 23)
b. repack the stuffing boxes with new packing. (Refer to chapter 6.5, pg. 28)
c. if the vacuum pump has been in storage for more than 6 months, change the lubricant in the outer DE and IE bearing caps. (Refer to chapter 5.2, pg. 23.)
d. start the vacuum pump in accordance with the instructions in chapter 4.2, pg. 21.

5 Shutting Down for Longer Periods

5.1 Shutting down and securing pump

a. make sure that the drive motor is electrically de-energized. Secure against being switched on again
b. hang a warning sign on the system controller and on the control elements for the pump:
"DANGER! Maintenance work on vacuum pump/compressor!
Do not switch on!"
c. depressurize pump lines

5.2 Draining

Follow draining procedures in chapter 4.3, pg. 22.

⚠ CAUTION

Danger of slipping and falling due to escaping liquid!

Provide suitable catch container when draining the pump and the mechanical seal.

⚠ WARNING

Danger of environmental damage!

If the sealing liquid is harmful to the environment:

Provide suitable catch container when draining mechanical seals.
Dispose of sealing liquid in accordance with country-specific and/or local regulations.

5.3 2-3 Week Period

When shutting down the pump for 2-3 weeks, proceed as follows:

- the impeller must be moved a few turns at least once a week to prevent the formation of rust between the parts and possible jamming.

5.4 Periods Longer than 3 Weeks

A longer shutdown period of the pump can, for example, occur during operation or between a brief test run and actual commissioning.

You have two options:
Either the pump remains connected in the system, or the pump is removed for storage.

Special preparations

The additional, special preparations to be made for a longer shutdown period are dependent on the type material pump.

For pumps with parts not corrosion-resistant:

a. neutralize pump
To do this use a fluid that is both harmless to the pump and to the process, generally clean water
b. drain pump,
as described in chapter 4.3, pg. 22

NOTICE

The periods/intervals for the specified measures are highly dependent on the environmental conditions.

With unfavorable conditions (e.g. high humidity, salty air, sandy or dusty air) the periods/intervals may need to be shortened.

If in doubt, it is necessary to enquire with Gardner Denver Nash Service.

5.5 Storage Conditions

This chapter applies in the following cases:

- new pumps
- pumps prepared for a longer shutdown periods, as described in chapter 5.4, pg. 23

All openings on the pump to which lines can be connected (connections, connections in end shield) must be closed off,

- if the pump is installed in the system: make sure that all pipes and hoses are connected, make sure that closures are mounted on all openings not required (e.g. blind flanges on connections, plugs on threaded connections)
- if the pump stands separately, e.g. in the storage area: make sure that closures are mounted on all openings (e.g. blind flanges or plastic caps on connections, plugs on threaded connections)

5.6 Troubleshooting

Performance Indicators

Nash Two-Stage Vacuum Pumps require little attention other than checking the ability of the pump to obtain full volume or maintain constant vacuum. If an operating difficulty arises, make the following checks:

a. check for proper seal liquid flow rate. Check the flow rate by catching and measuring the liquid discharge to the separator. The pressure gauge in the inlet seal liquid piping line upstream of the orifice union should indicate approximately 10 psig (1.7 bar)

b. check the operation of the solenoid valve in the seal liquid supply line by removing and then reapplying electric power to the valve. When power is reapplied, the solenoid in the valve should be heard clicking into place

c. check for the correct direction of the vacuum pump rotation (the direction of the arrow cast on the pump casing)

d. check that the vacuum pump is operating at the correct rpm – not necessarily the test rpm stamped on the vacuum pump nameplate

e. check for an obstruction in the air discharge piping. Back pressure in excess of 5 psig (1350 kPa) at the air discharge reduces vacuum and increases the driving horsepower that is required

f. check for a restriction in the air inlet (see Fig. 1). Undersize inlet piping and line obstructions produce a higher vacuum on a vacuum gauge installed in the pump inlet than readings obtained at the work or process

g. check the operation of the interstage check valve in the second stage discharge manifold to make certain that the clapper operates freely and seats properly (see Fig. 3)

h. if the vacuum pump is shut down because of a change in temperature, noise and/or vibration from the normal operating conditions, check the bearings lubrication, bearings condition, and coupling alignment. Refer to Bulletin No. 642, Installation Instructions, for alignment procedures

NOTE

If the trouble is not located through these checks, the internal first and second state rotor-to-cone clearances may have changed due to wear. Check and adjustment of these clearances requires dismantling the pump. Call you Nash Representative before dismantling the pump. He/she will assist you in locating and correcting the trouble.

6 Maintenance

The primary cause of bearing failure is improper maintenance. MAXIMUM RELIABILITY OF THE VACUUM PUMP BEARINGS CAN ONLY BE ACHIEVED BY CONSCIENTIOUSLY ADHERING TO THE RECOMMENDED MAINTENANCE PROGRAM DESCRIBED BELOW.

⚠ WARNING

Improper use of the pump can result in serious or even fatal injuries!

Before beginning any work, the following safety precautions are to be observed:

Switch off the pump as described in chapter 5.1, pg. 23.

Vent/bleed the pipe so that the internal pressure and atmospheric pressure are equal.

Make sure that the power supply is switched off, and the main switch is switched off, locked and marked as switched off.

Drain the operating liquid as described in chapter 4.3, pg. 22.

If the pump has been operated with a toxic liquid, careful flushing with a suitable liquid is required.

6.1 6-month interval

NOTE

Adapt time schedules to your specific operating conditions.

- if the drive coupling is lubricated, it should be filled with oil or grease in accordance with the coupling manufacturer's instructions
- check the pump bearings and lubricate, if necessary as specified in Table 1, pg. 27
- lubricate drive motor bearings according to motor manufacturer's instructions
- clean the seal liquid line strainer. Clean the strainer more often as required

6.2 12-month interval

NOTE

Adapt time schedules to your specific operating conditions.

- replace the stuffing box packing as specified in chapter 6.5, pg. 28.
- inspect the interstage check valve (529) Make certain that the elastomer on the clapper is intact
- check that shroud vent check valves operate freely

6.3 Lubricating the bearings

The pumps described in this manual have grease lubricated bearings. Bearings are lubricated before shipment and require no further lubrication for approximately six months. To check bearings, move the bearing caps back and inspect the condition and quantity of grease inside the bearing housing. If the condition and quantity of the grease is satisfactory, fasten the bearing caps back in place.

If the bearing grease is contaminated or the quantity is low, replace or add grease. Using a clean putty knife or similar tool, pack the bearing on both sides with grease in accordance with the specifications in Table 1 until the grease is flush with the edge of the bearing inner and outer race. Pack each bearing cap 1/4 to 1/3 full and reassemble the bearing cap. Use "clean" grease and make certain that no dirt enters the bearing housing. Be careful when replacing gaskets and shims that the original shaft adjustments are maintained.

Repeat the bearing check and lubrication procedure every six months. If the pump is being operated in a corrosive atmosphere or with a liquid compressant other than water, the interval should be shortened.

6.4 Permissible Greases

General requirements

A. Premium quality industrial bearing grease.

B. Degree of consistency: NLGI #2

C. Oil viscosity (minimum):

100 °F (38 °C)	108 cSt	500 SSU
210 °F (99 °C)	10 cSt	58 SSU

D. Thickener (base): lithium or lithium complex for optimum WATER RESISTANCE.

E. Behavior characteristics at operating temperature:

1. Operating temperature range; at least 0 °F to 250 °F (-18 °C to 121 °C)
2. "Long-Life" performance
3. Good mechanical and chemical stability.

F. Additives - Mandatory:

1. Oxidation inhibitors
2. Rust inhibitors

G. Additives - optional:

1. Anti-wear agents
2. Corrosive inhibitors
3. Metal deactivators
4. Extreme pressure (EP) *) agents

H. Additives - objectionable:

1. Molybdenum sulphide (MoS_2)
2. Tackiness agents

*) only required on pumps with taper roller bearings

Table 1: Permissible greases

Note on compatibility of grease types: The grease types listed above are standard grease types. To guarantee the highest possible lubricating performance, it is recommended that the mixing of different grease types be restricted to a minimum.

6.5 Stuffing boxes (packing replacement)

A preventive maintenance schedule should be established for the tightening and replacement of the packing in the stuffing boxes of the pump. The packing in the stuffing boxes in pumps used in continuous process systems should be replaced annually. More frequent replacement may be required on severe process applications in which liquid compressant in the pump is contaminated by foreign material or is incompatible with the existing packing material. The packing consists of four or five rings. In some cases, a different packing material may be required because of the liquid compressant used.

NOTE

For preservative maintenance of the stuffing boxes used, we recommend keeping an **inspection log**.
The inspection log should contain the following information:

- date
- type designation and serial number of pump
- date for tightening and replacing the stuffing box;
  when the pump is used continuously, at least once a year.

Replacement at shorter intervals may be required due to difficult operating conditions, e.g. due to soiled operating liquid.

NOTE

Log the number and position of the packing rings on each side of the lantern gland. This information is important for ensuring that the sealing-water distribution ring is properly aligned.

When replacing the packing in the stuffing box, remove the old packing as follows:

a. slide slinger (3 or 3-2) and slinger spring (3-1 or 3-4) away from stuffing box on shaft

NOTE

Steps **b** through **i** apply to first stage stuffing boxes. Procedure for removing packing from the second state stuffing box in bracket (608) is identical except that no lantern gland is used.

b. loosen and remove gland nuts (102-1 or103-1, Fig. 7) from studs (102-2 or 103-2)
c. slide packing gland assembly (112) as far from stuffing box as it will go or loosen two packing gland nuts (2) holding halves of packing gland assembly together and remove two halves
d. screw tip of packing puller (2, Fig. 4) into packing (1)
e. pull packing out of stuffing box
f. form two lantern gland pullers from 1/8 in. (3.2 mm) diameter steel wire as shown in Fig. 5
g. work bent tip of each lantern gland puller around outer diameter of lantern gland in stuffing box until pullers are felt, catching in slots in lantern gland on opposite sides
h. pull lantern gland out of stuffing box
i. screw the tips of the packing puller (2, Fig. 4) into remaining packing in stuffing box and pull packing
j. thoroughly clean stuffing box before installing new packing

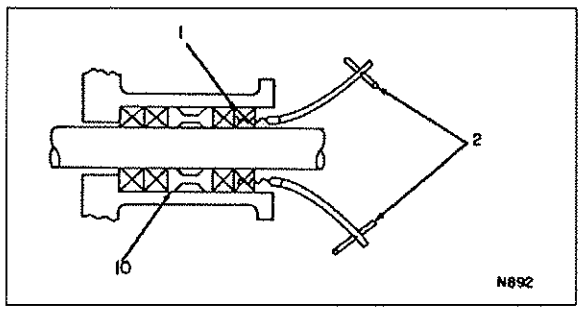


Figure. 4: Removing stuffing box packing

Figure 5: Lantern gland puller

Lay in new packing, proceed as follows:

a. produce two hard rubber strips which are fit between outside diameter of shaft and inside diameter of stuffing box and used as packing ring pushers. See Fig. 6C, pg. 30
b. lubricate inside diameter of packing rings with Molykote G-N paste or a comparable product
c. open packing spirally by pulling ends apart in axial direction, as shown in Fig. 6A, pg. 30
d. lay each packing ring around shaft and lay in stuffing box, as shown in Fig. 6B, pg. 30
e. push first packing ring into stuffing box as firmly as possible with pusher produced as described above. Make sure that packing ring is fit into face of stuffing box. As soon as another packing ring is laid in, move joint gap of ring so that joint gap of following rings is offset by 180 degrees. Make sure that each packing ring is firmly fitted.
f. lay in lantern gland (10), if it was included
g. lay in all other packing rings as described above
h. install two halves of stuffing box gland on shaft and connect with two nuts, washers and bolts. Push stuffing box gland onto gland bolts so that it is flush with last packing ring laid in. Screw on gland nuts and tighten evenly by hand.
i. start pump as specified in chapter 4.2, pg. 21. Check temperature in stuffing box area during operation
j. make sure that the stuffing box has leakage at all times. If no leakage occurs, or if stuffing box overheats, switch off pump and determine cause. Replace packing if necessary
k. After the pump has been running for 10 minutes with steady leakage from the stuffing boxes, tighten the gland nuts evenly one flat at a time. Repeat at 10 minute intervals until there is a leakage of approximately 45 to 60 drops per minute from the gland with no overheating. This dripping is necessary to provide added lubrication for the packing and thereby prevent it from scoring and burning the shaft. Subsequent tightening of the gland nuts should be done with the pump operating at normal working temperature and vacuum.

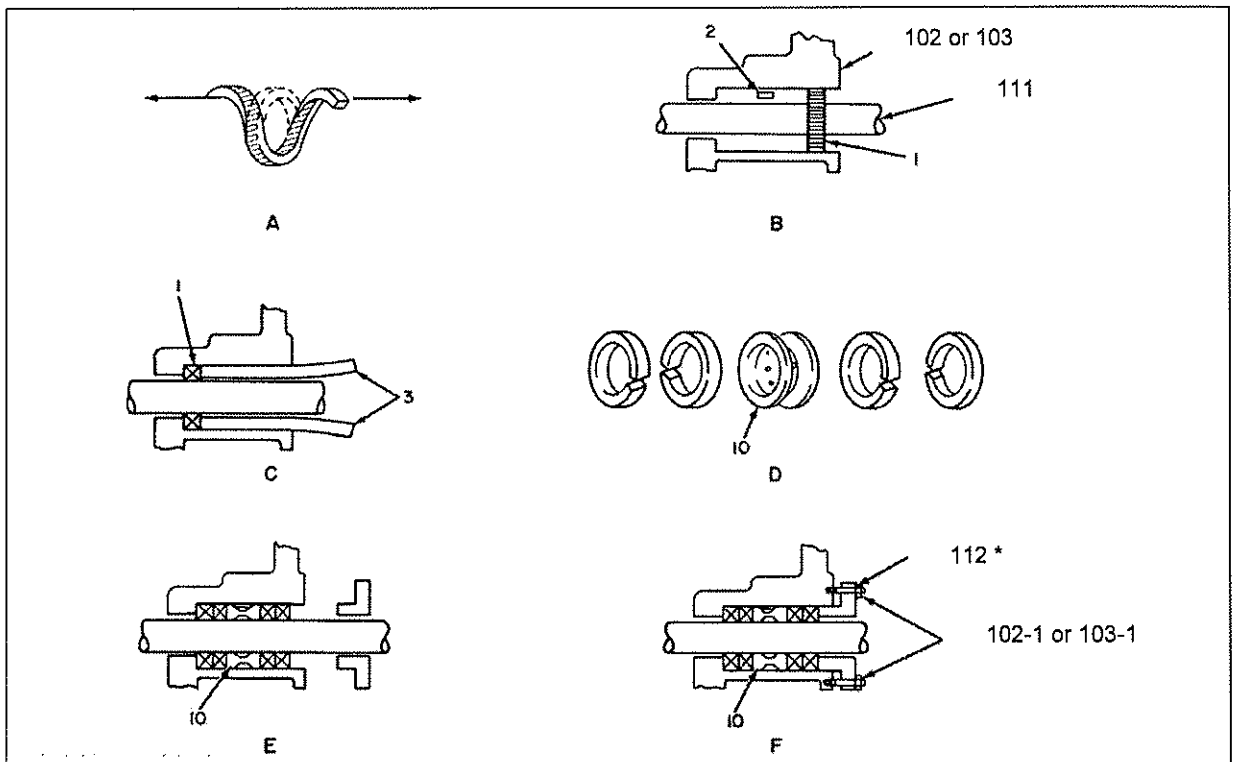


Figure 6: Stuffing box packings

7 Technical Data

7.1 Exploded view

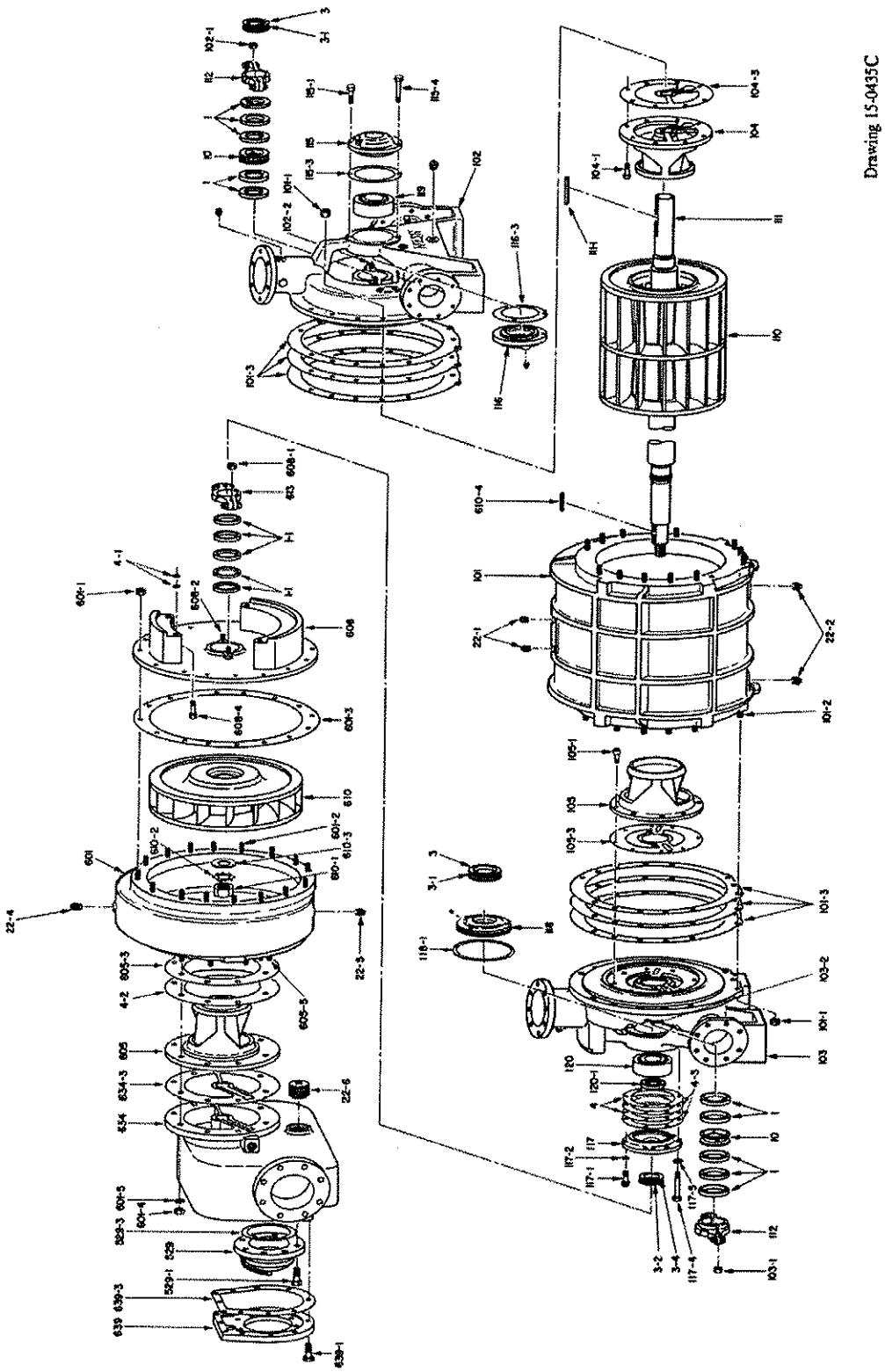


Figure 7: Two-stage vacuum pump exploded view

7.2 Parts List

Index No.	Qty.	Part Name (weight)
1	10 rings	*First Stage Packing
1-1	5 rings	*Second Stage Packing
3	2	* First Stage Slinger
3-1	2	* First Stage Slinger Spring
3-2	1	* Second Stage Slinger
3-4	1	* Second Stage Slinger Spring
4	AR	*Shim
4-1	AR	*Shim
4-2	AR	*Shim
4-3	AR	*Shim Gasket
10	2	* First Stage Lantern Gland
22-1	2	Priming Plug
22-2	2	Drain Plug
22-4	1	Priming Plug
22-5	1	Drain Plug
22-6	1	Drain Plug
101	1	First Stage Body
101-1	13	First Stage Body Stud Nut
101-2	13	First Stage Body Stud
101-3	8	*First Stage Body Gasket
102	1	Floating Bearing End Head
102-1	2	Floating Bearing End Gland Nut
102-2	2	Floating Bearing End Stud
103	1	Fixed Bearing End Head
103-1	2	Fixed Bearing End Gland Nut
103-2	2	Fixed Bearing End Gland Stud
104	1	Floating Bearing End Cone
104-1	8	Floating Bearing End Cone Screw
104-3	1	* Floating Bearing End Cone Gasket
105	1	Fixed Bearing End Cone
105-1	8	Fixed Bearing End Cone Screw
105-3	1	* Fixed Bearing End Cone Gasket
110	1	First Stage Rotor
111	1	Shaft
111-1	1	Shaft Key

*Minimum recommended spares

Table 2

LEGEND FOR FIGURE 7
†Used on pumps after September 15, 1981

LEGEND FOR FIGURE 49 (pounds)

Index No.	Qty.	Part Name (weight)
112	2	Packing Gland Assembly
115	1	Floating Bearing Outer Cap
115-1	3	Floating Bearing Outer Cap Screw
115-3	1	* Floating Bearing Outer Cap Gasket
115-4	3	Floating Bearing Outer Cap Bolt
116	1	Floating Bearing Inner Cap
116-3	1	* Floating Bearing Inner Cap Gasket
117	1	Fixed Bearing Outer Cap
117-1	3	Fixed Bearing Outer Cap Screw
117-2	3	Fixed Bearing Outer Cap Washer
117-4	3	Fixed Bearing Outer Cap Bolt
117-5	3	Fixed Bearing Outer Cap Washer
118	1	Fixed Bearing Outer Cap
118-1	1	*Fixed Bearing Outer Cap O-Ring
119	1	*Floating (Free) Bearing
120	1	*Floating (Locked) Bearing
120-1	1	Fixed Bearing Self-Locking Nut
529	1	Interstage Check Valve
529-1	8	Interstage Check Valve Nut
529-3	1	* Interstage Check Valve Gasket
601	1	Second Stage Lobe
601-1	16	Second Stage Lobe Stud Nut
601-2	16	Second Stage Lobe Stud
601-3	1	Second Stage Lobe Gasket
601-4	8	Second Stage Lobe Stud Nut
601-5	8	Second Stage Lobe Washer
605	1	Second Stage Cone
605-3	5	Second Stage Cone Gasket
605-5	8	Second Stage Cone/Lobe Stud
608	1	Bracket
608-1	2	Bracket Gland Stud Nut
608-2	2	Bracket Gland Stud
608-4	4	Bracket Screw
610	1	Second Stage Rotor
610-1	1	Second Stage Rotor Nut
610-2	1	†*Second Stage Rotor Lock Tab Washer
610-3	1	Second Stage Rotor Washer
610-4	1	Second Stage Rotor Key
613	1	Packing Gland Assembly
634	1	Second Stage Discharge Manifold
634-3	1	*Second Stage Discharge Manifold
639	1	Second Stage Discharge Manifold Cover
639-1	10	Manifold Cover Bolt
639-3	1	*Manifold Cover Gasket

*Minimum recommended spares

Table 2 (continuation)
LEGEND FOR FIGURE 7
†Used on pumps after September 15, 1981

8 Mechanical Data

8.1 Weights

Part Name	Weight in pounds (kg)				
	AT 404	AT 704/706	AT 1004/1006	AT 2004/2006	AT 3004/3006
First Stage Body (101)	158 (72)	200 (91)	307 (139)	690 (313)	1330 (603)
Floating Bearing End Head (102)	125 (57)	145 (66)	199 (90)	516 (234)	816 (370)
Fixed Bearing End Head (103)	125 (57)	145 (66)	235 (107)	516 (234)	816 (370)
Floating Bearing End Cone (104)	14 (6)	16 (7)	24 (11)	64 (29)	113 (51)
Fixed Bearing End Cone (105)	14 (6)	16 (7)	24 (11)	64 (29)	113 (51)
First Stage Rotor (110)	72 (33)	138 (63)	230 (104)	630 (286)	1034 (469)
Shaft (111)	40 (18)	60 (27)	120 (54)	300 (136)	400 (181)
Floating Bearing (119)	4 (2)	6 (3)	13 (6)	24 (11)	24 (11)
Fixed Bearing (120)	4 (2)	6 (3)	13 (6)	24 (11)	24 (11)
Bracket (301)	34 (15)	56 (25)	80 (36)	283 (128)	475 (215)
Second Stage Cone (605)	14 (6)	16 (7)	25 (11)	58 (26)	130 (59)
Second Stage Lobe (606)	43 (20)	68 (31)	123 (56)	143 (65)	530 (240)
Second Stage Rotor (610)	31 (14)	54 (24)	105 (48)	240 (109)	436 (198)
Second Stage Discharge Manifold (634)	63 (29)	91 (41)	150 (68)	210 (95)	380 (172)
Total Pump Weight	970 (440)	1420 (644)	2045 (928)	4600 (2087)	6621 (3003)

Table 3: Weights of Major Parts

Declaration of Clearance

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Declaration of clearance for the disassembly of vacuum pumps/compressors

When returning the pump-motor unit/the machine for repair and/or maintenance purposes, complete, sign and enclose this declaration.
The repair and/or maintenance of the returned pump-motor unit/machine in the workshop will only be carried out if this declaration has been completed, signed and enclosed. Each pump-motor unit/machine must be accompanied by a separate declaration.
The declaration must be attached to the outside of the packaging. In addition, prior to shipment a copy of the declaration should be forwarded to the workshop in charge, e.g. by fax.
This declaration may only be completed by authorized and qualified personnel of the operator.

Information on the operator:
Company/Department/
Institute: _____
Address: _____
Postal/Zip code, city: _____
Contact person: _____
Position: _____
Phone: _____
Fax: _____

Information on the pump-motor unit/machine:
Product designation: _____
Type: _____
Serial number (No N): _____
Reason for the return of the pump-motor unit/machine: _____

The pump-motor unit/machine designated above and returned by the undersigned *)
- ☐ has not come in contact with hazardous substances,
- ☐ materials and/or components containing asbestos were used, e.g. seals,
- ☐ was used for the following applications _____

and has come in contact with the following substances which are subject to compulsory marking or are detrimental to health:

Trade name:	Chemical designation:	Properties (e.g. toxic, flammable, corrosive, radioactive):

*) Check where applicable

☐ Prior to shipment the pump-motor unit/machine has been completely drained, purged and cleaned thoroughly both inside and outside according to the operating instructions.
☐ Special safety precautions are not necessary for further handling.
☐ The following safety precautions are required for further handling:

_____

_____

_____

_____

_____

☐ Safety data sheets in accordance with the relevant national and local codes and regulations are enclosed.

Legally binding declaration
We hereby affirm that the statements given in this declaration are correct and complete and that I, the undersigned, am capable of judging this. We are aware that we are liable to the contractor for any damage arising from incomplete or incorrect statements. We undertake to hold the contractor harmless from third party damage claims arising from incomplete or incorrect statements. We are aware that - irrespective of this declaration - we are directly liable to third parties, in particular to the personnel of the contractor in charge of the handling as well as the repair/maintenance of the unit.

Place, date: _____ Name: _____

Company stamp: _____ Signature: _____

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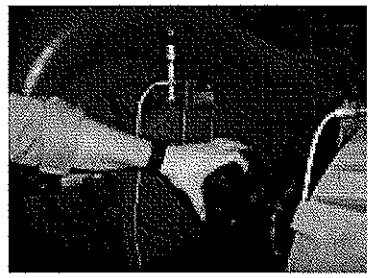
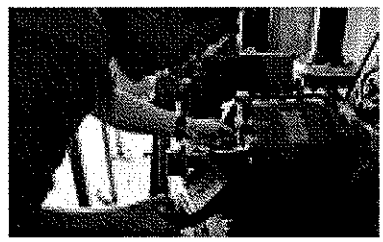
Service Locations

Australia	Wetherill Park Sydney, NSW
Brazil	Campinas-SP
China	Boshan, Zibo Shandong
France	Buc
Germany	Nuremberg Wetzlar
Netherlands	Assendelft
Singapore	Singapore
South Africa	Wadeville
South Korea	Seoul
Sweden / Scandinavia	Sollentuna
United Kingdom	Winsford, Cheshire
United States of America	Birmingham, AL Cleveland, OH Houston, TX St. Peters, MO Vancouver, WA

Detailed addresses can be found on our website:
www.GDNash.com → Sales & Service → Service Contacts





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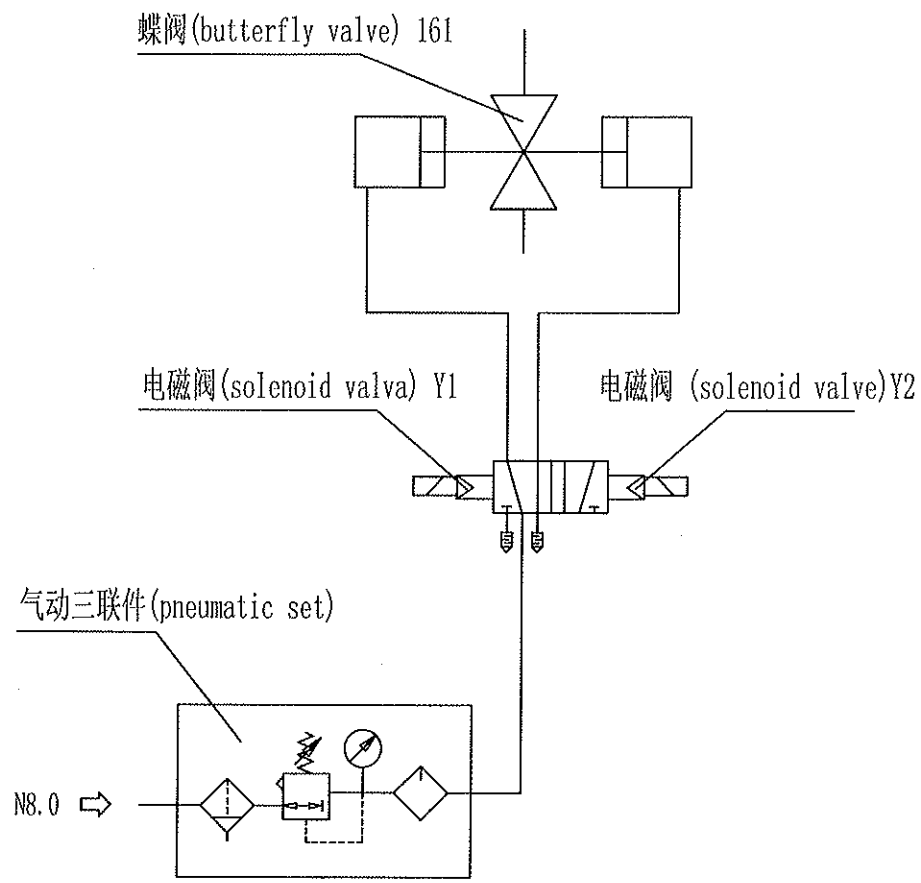

控 制 说 明
CONTROL DESCRIPTION

1. 电磁阀 Y1 通电.Y2 断电，蝶阀161开(Y1 turn on ,Y2 turn off,161 to open)
2. 电磁阀 Y2 通电.Y1 断电，蝶阀161关(Y2 turn on,Y1 turn off,161 to close)
3. 电磁阀 Y1.Y2 均断电，蝶阀保持在断电时的状态(Y1 and Y2 all turn off,161 remain as before)
4. 不允许电磁阀 Y1 .Y2 同时通电(Y1 and Y2 can not turn on at same time)

G	2012.11.04	FINAL				LKG
A	2011.11.04	PRE				LKG
版本	日期	状态	修改 说明			批准
编码 Doc.No.	工程 代码					

项目/Project	越南沿海燃煤电厂一期2×622MW		
比例/Scale		名称/Title	Condenser vacuum pump pneumatic system diagram 凝汽器真空泵气动原理图
重量/Weight			
材料/Material			
第 1 页/Page	共 1 页/Pages	型号/Type AT-3006E	图号/Drawing No. V326000
设计/Design	2013.02.22 11:50:59 +08'00'		
校核/Check	2013.02.25 14:28:01 +08'00'		
批准/Approval	2013.02.25 15:05:22 +08'00'		

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Gardner Denver Nash Machinery Ltd.

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NASH 佶缔纳士机械有限公司 Gardner Denver Nash Machinery Ltd					凝汽器真空泵DCS I/O 清单 CONDENSER VACUUM PUMP DCS I/O LIST	项目名称 PROJECT	越南沿海燃煤电厂一期2×622MW		
G	FINAL	LKG	HG	ZZX		分项名称 SUBPROJECT	凝汽器水环式真空泵 CONDENSER VACUUM PUMP		
A	PRE	LKG	HG	ZZX		专业名称 SPECIALITY	自控 AUTOMATIZATION		
版次 EDIT.	描述 DESCRIPTION	设计 DESD.	校核 CHKD.	审核 APPD.		设计阶段 STAGE	施工图 Shop drawing	第 1 张 共 1 张 Sheet 1 of 1	总张:1 第 1 张 Sheet 1 of 1

序号 Seri.No.	位号 Tag.No.	功能描述 Fuction Description	输入/输出 I/O	信号类型 Signal Type	电源 Power	量程 Range	单位 Unit	安全栅 Security-Bar	调节阀/Control			报警联锁要求 Interlock&Alarm						备注 Remark
									正反作用 ACTION	气开/气关 FO/FC	设定点 Setpoint	指示 Indication	调节 Control	低低 LL	低 L	高 H	高高 HH	
1	161-Y1	Signal to open inlet valve 开入口阀信号	DO	230VAC\50HZ	DCS	NA	NA											
2	161-Y2	Signal to close inlet valve 关入口阀信号	DO	230VAC\50HZ	DCS	NA	NA											
3	221	Signal to open make-up valve 开自动补水阀信号	DO	230VAC\50HZ	DCS	NA	NA											
4	161-open	Inlet valve "open" status 入口阀"开"状态	DI	Dry contact	NA	NA	NA					V						
5	161-closed	Inlet valve "closed" status 入口阀"关"状态	DI	Dry contact	NA	NA	NA					V						
6	470	Control the stand-by pump to start or stop 控制备用泵起停	DI	Dry contact	NA	NA	NA				80mbar.A 150mbar.A							
7	471	Control the inlet valve to open 控制入口阀打开	DI	Dry contact	NA	NA	NA				140mbar.A							
8	MCC		DI	Dry contact	NA	NA	NA											
9	231N	Seperator normal level 分离器正常液位	DI	Dry contact	NA	NA	NA				250mm							
10	231L	Seperator low level 分离器低液位	DI	Dry contact	NA	NA	NA								130mm			
11	MTE-030RA	Motor stator thermo-resistance 电机三相定子测温	AI	RTD		0-200	℃				<120℃	V				120℃	135℃	Detail seen :attached documents with MOTOR
12	MTE-030RB	Motor stator thermo-resistance 电机三相定子测温	AI	RTD		0-200	℃				<120℃	V				120℃	135℃	
13	MTE-030RC	Motor stator thermo-resistance 电机三相定子测温	AI	RTD		0-200	℃				<120℃	V				120℃	135℃	
14	MTE-030-B1	电机轴承测温电阻 Motor bearing thermo-resistance	AI	RTD		0-150	℃				<80℃	V				80℃	90℃	
15	MTE-030-B2	电机轴承测温电阻 Motor bearing thermo-resistance	AI	RTD		0-150	℃				<80℃	V				80℃	90℃	

NASH	依绅纳士机械有限公司 Gardner Denver Nash Machinery Ltd				凝汽器真空泵C&I定值表 LIST OF INSTRUMENT & CONTROL SETPOINTS FOR CONDENSER VACUUM PUMP	项目名称 PROJECT	福建福清核电厂一期工程专用		
G	FINAL	LKG	HG	ZZX		分项名称 SUBPROJECT	凝汽器真空泵 CONDENSER VACUUM PUMP		
A	PRE	LKG	HG	ZZX		专业名称 SPECIALITY	自控 AUTOMATIZATION		
版本 EDIT.	描述 DESCRIPTION	设计 DESIGNED	校核 CHECKED	审核 APPROVALED		设计阶段 STAGE	施工图 Shop drawing	第 1 张 共 1 张 Sheet 1 of 1	总张:1 第 1 张 Sheet 1 of 1

流程图编号 CODE IN P&ID	名称 NAME	量程 RANGE	单位 UNIT	定值 SETPOINT	+或—	说明 DESCRIPTIOM
PS471	真空压力开关 VACUUM SWITCH	0-1000	mbar.A	Set:140mbar.A		系统入口阀FV161后真空度>140mbar.A且电机运行时，打开入口阀FV161 The vacuum degree rises above 140mbar.A, open inlet valve FV161
PS470	真空压力开关 VACUUM SWITCH	0-1000	mbar.A	Set:80mbar.A Reset:150mbar.A		真空度上升到80mbar.A,停备用泵，真空度回落到150mbar.A,开备用泵 The vacuum degree rises above 80mbar.A，stop stand-by pump; The vacuum degree falls below 150mbar.A，start stand-by pump;
LS231N/L	正常/低液位开关 N/L LEVEL SWITCH	0-500	mm	L:180mm N:250mm		液位下降至180mm，DCS打开补液阀(221)；补液至正常点250mm，关闭补液阀 The level falls below 180mm，open make-up water valve 221;The level rises above 250mm，close make-up water valve
MTE-030RA/B/C	电机三相定子测温RTD MOTOR STATORS RTD	0-200	℃	H: 120 ℃ HH: 135℃		电机三相定子温度升至120℃，DCS报警；温度升至135℃，DCS联锁停电机 Motor stators temperature rises above 120℃，DCS alarm; If the temperature rises above 135℃，DCS interlock to stop the pump
MTE-030B1/B2	电机轴承测温RTD MOTOR BEARING RTD	0-150	℃	H: 80 ℃ HH: 90℃		电机轴承温度升至80℃，DCS报警；温度升至90℃，DCS联锁停电机 Motor bearing temperature rises above 80℃，DCS alarm; If the temperature rises above 90℃，DCS interlock to stop the pump

凝汽器真空泵机组控制说明

本真空机组的控制包括：真空泵电机和循环泵的启停控制；分离器液位监测与控制；系统入口阀门的开关控制；电机定子温度的监测与控制；备用泵启停控制。请结合凝汽器真空泵机组运行逻辑图使用。

具体控制描述如下：

系统初始状态：系统入口阀门（161）处于关闭状态，分离器液位补至正常液位，电机处于停机状态。

一、 真空泵电机和循环泵的启停控制

当电机启动指令存在而且分离器液位无报警信号，系统入口阀门（161）处于关闭状态，电机绕组温度正常时，启动真空泵电机(030)，同时联锁启动循环泵电机(090)。

当有停车指令或联锁指令时，停真空泵电机(030)，同时联锁停循环泵电机(090)。

真空泵电机(030)停，联锁关闭喷系统入口阀（161）。

二、 系统入口阀门的开关控制

系统入口蝶阀（161）的初始状态是处于关闭状态.

当真空泵电机(030)启动且系统入口蝶阀（161）后真空度>140mbar.A时，压力开关（471）动作，电磁阀（161-Y1）带电，开启入口蝶（161）。

当真空泵电机(030)停车，电磁阀（161-Y2）带电,关闭入口阀 （161）。

161-Y1/Y2为系统入口蝶阀（161）的气路控制电磁阀，两线圈不能同时带电，而且只需脉冲信号即可。

三、 分离器液位监测和控制

液位开关设定分离器液位的低点（130mm）和正常点（250mm）。

当分离器液位低时， DCS报警同时补液电磁阀（221）带电打开，补充液位到正常高度时停止补水。

当低液位持续5秒钟，DCS系统报警。
当低液位持续5分钟，DCS系统连锁停真空泵电机。

四、 电机绕组及轴承温度的监测与控制

电机电机三相绕组温度测量及控制，当温度高时(120 ℃)，DCS进行系统报警，当温度过高时(135 ℃)，DCS联锁停真空泵电机。

电机电机轴承温度测量及控制，当温度高时(80 ℃)，DCS进行系统报警，当温度过高时(90 ℃)，DCS联锁停真空泵电机。

五、 备用泵启停控制

系统在刚开始建立真空时，主泵和备用泵同时启动，以缩短抽空时间。

备用泵的启停由压力开关（470）控制，当真空上升到设定值（80mbar.A）时，压力开关（470）动作，联锁停备用泵。

当系统 真空度回降到150mbar..A时，压力开关（470）复位，重新启动备用泵。

当主运行真空泵因电气或其它参数联锁停车时，DCS联锁启动备用真空泵。

其他机组的控制完全一致

以上描述的功能，由用户DCS系统实现。

Control description for condenser vacuum pump

Controls for the pump include: control of the motors to stop or start; control of the separator level; control of the system inlet valve to open or close; motor stators temperature measuring; control of the standby pump. Please refer to the logic drawing to read the description.

The system initialization: systme inlet valve (161) "closed"; the separator level correct; the motor "stopped".

Ⅰ The motor to start or stop

While the system start command exists, if system inlet valve (161) "close d"; the separator level "not low"; the motor stators temperature "not high", Start the vacuum pump motor(030) and recirculating pump motor(090).

While the system stop command exists, stop the vacuum pump motor (030) and recirculating pump motor(090).

If the vacuum pump motor (030) is "stopped", the system inlet valve (161) will be closed.

Ⅱ The system inlet valve to open or close

The system inlet valve initialization is closed

While the vacuum pump motor (030) is "running", if the vacuum degree > 140mbar.A, pressure switch（471）action，solenoid valve（161-Y1）turn on to open inlet valve (161).

When the vacuum pump motor (030) stopped，solenoid valve（161-Y2）turn on to close inlet valve (161).

161-Y1 and 161-Y2 can not turn on at same time, and only impulse is enough.

161-Y1 and 161-Y2 all turn off, system inlet valve (161) remains as before

III. Separator level control

The level swiches set the low level (130mm) and the normal level (250mm).

When the level falls below 130mm，DCS control make-up water valve (221) to open to makeup water, and when the level rises above 250mm, DCS control make-up water valve (221) to close.

If the low level remains 5 seconds, DCS alarm.
If the low level remains 5 minites , DCS interlock to stop the motor.

V、 Motor stators /bearings temperature measuring and control

Motor stators temperature rises above 120℃，DCS alarm;
If the temperature rises above 135℃，DCS interlock to stop the pump.

Motor bearings temperature rises above 80℃，DCS alarm;
If the temperature rises above 90℃，DCS interlock to stop the pump.

VI、 Control of the standby pump

The main and standby pump operation is recommended for hogging condenser to operate vacuum

At the operating vacuum, set one pump to "standby" , When the vacuum degree rises above 80mbar.A, the pressure switch (470) act to stop the stand-by pump;

When the vacuum degree falls below 150mbar.A, the pressure switch (470) reset to restart stand-by pump.

When the main pump stopped because of fault or repair， the standby pump will start.

The logic for other pump system is the same.
The logic for control should be realized in customer's DCS system.

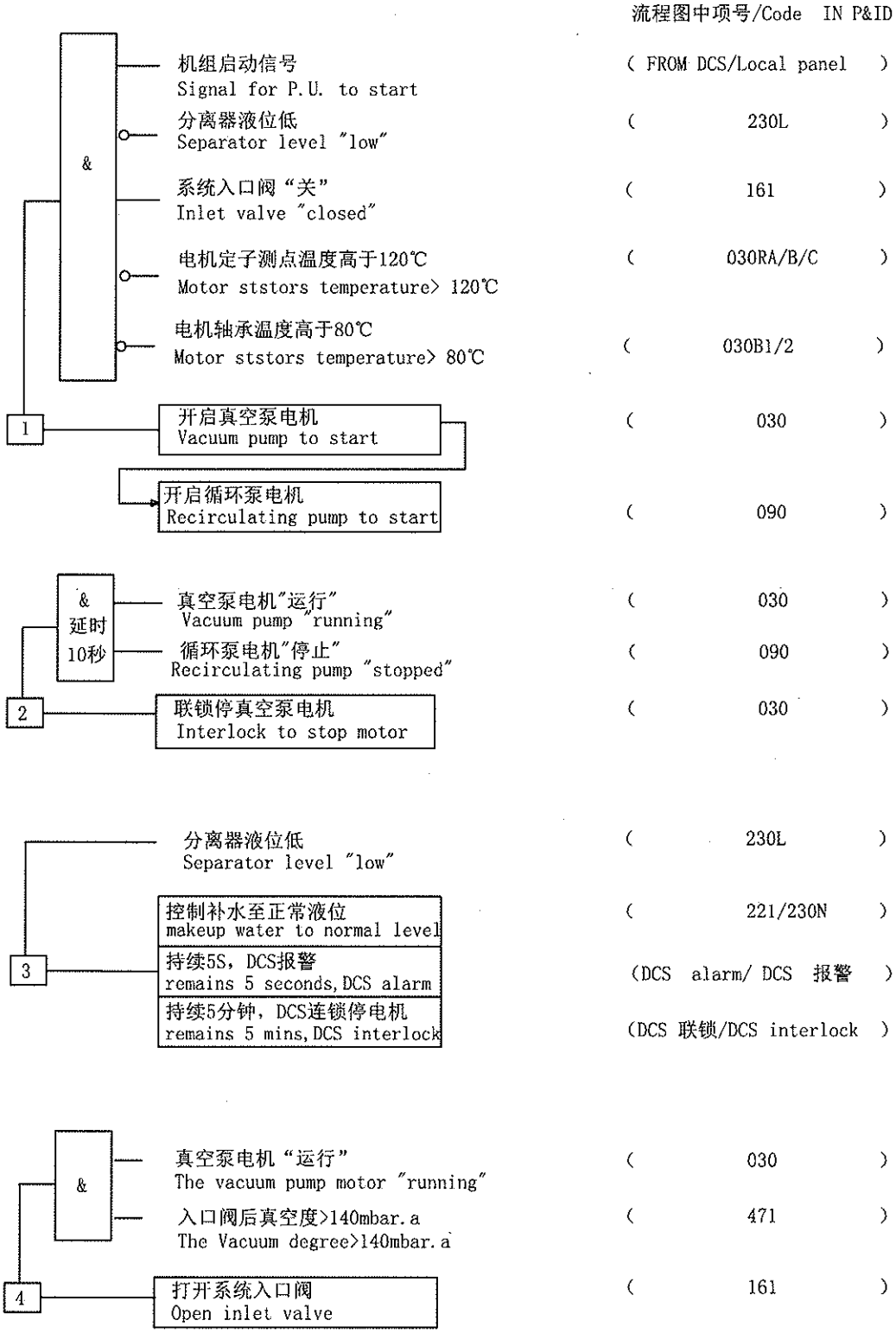
NASH A Gardner Denver Product	佶缔纳士机械有限公司 Gardner Denver Nash Machinery Ltd				真空泵机组电源消耗清单 **Power Consumption List for Pump Unit**			项目名称 PROJECT	越南沿海燃煤电厂一期2×622MW		
G	FINAL	LKG	HG	ZZX				分项名称 SUBPROJECT	凝汽器水环式真空泵 CONDENSER VACUUM PUMP		
A	PRE	LKG	HG	ZZX				专业名称 SPECIALITY	自控 AUTOMATIZATION		
修改 REV.	状态 STATUS	设计 DESIGN	校核 CHECK	审核 APPROVAL				设计阶段 STAGE	施工图 Shop drawing	第 1 张 共 1 张 Sheet 1 of 1	总张：1 第 1 张 Sheet 1 of 1

序号 Ser.No.	设备位号 Tag No.	仪表/设备名称 Instrument / equipment Name	电压等级 Voltage class	设备功率 Power	连接点 Junction Point	接线图图号 Wiring diagram	流程图图号 P&ID No.	每套机组用量 Quantity per P.U. Set	备注 Remark
1	221	Make-up water solenoid valve 补水电磁阀	230VAC 50HZ	17.1W	Instruments terminal box 仪表接线盒	V325999		One valve per P.U. 每套真空机组一台	
2	741-2	Instrument Air solenoid valve 气路电磁阀	230VAC 50HZ	3W	Instruments terminal box 仪表接线盒	V325999		One valve per P.U. 每套真空机组一台	
3	030	Motor 真空泵电机	400V 50HZ	160KW	Motor terminal box 电机接线盒	attached documents with Motor 电机所附资料		One valve per P.U. 每套真空机组一台	
4	030..01	Motor heater 电机加热器	230VAC 50HZ	200W	Motor terminal box 电机接线盒	attached documents with Motor 电机所附资料		One valve per P.U. 每套真空机组一台	
5	090.01	Motor 循环泵电机	400V 50HZ	2.2KW	Motor terminal box 电机接线盒	attached documents with Motor 电机所附资料		One valve per P.U. 每套真空机组一台	

NASH	佶缔纳士机械有限公司 Gardner Denver Nash Machinery Ltd				凝汽器真空泵仪表清单 CONDENSER VACUUM PUMP INSTRUMENT LIST						项目名称 PROJECT	越南沿海燃煤电厂一期2×622MW			
G	FINAL	LKG	HG	WZL							分项名称 SUBPROJECT	凝汽器水环式真空泵 CONDENSER VACUUM PUMP			
A	PRE	LKG	HG	WZL							专业名称 SPECIALITY	自控 AUTOMATIZATION			
版次 EDIT.	描述 DESCRIPTION	设计 DESD.	校核 CHKD.	审核 APPD.							设计阶段 STAGE	施工图 Shop drawing		第 1 张 共 1 张 Sheet 1 of 1	总张:1 第 1 张 Sheet 1 of 1
序号 Seria.No.	名称 Name	位号 Tag.No	量程/范围 Range		型号/规格 Model/Type	精度 Accuracy	输入 Input	输出 Output	控制点 Control	过程接口尺寸 Procc.Conn.	电缆接口 Elec.Conn.	气源接口 Air Conn.	防护等级 IP-Class	制造商 Manufacturer	备注 Remark
1	压力表 Vacuum-Pres.gauge	PG012	-0.1-0MPa		YTNF-100H -0.1-0MPa,316, M20X1.5,φ100,1.0级	±1.0				M20X1.5			IP65	BEIJING BRIGHTY INSTRUMENTS	
2	压力表 Vacuum-Pres.gauge	PG480	-0.1-0.3MPa		YTNF-100H -0.1-0.3MPa,316, M20X1.5,φ100,1.0级	±1.0				M20X1.5			IP65	BEIJING BRIGHTY INSTRUMENTS	
3	双金属温度计 Bimetallic Thermometer	TG420	0-100℃		WSSF-481,0-100℃,M27X2, 316, L=75,φ100,1.0级	±1.0	0-100℃			M27X2			IP65	BEIJING BRIGHTY INSTRUMENTS	
4	双金属温度计 Bimetallic Thermometer	TG440	0-100℃		WSSF-481,0-100℃,M27X2, 316, L=75,φ100,1.0级	±1.0	0-100℃			M27X2			IP65	BEIJING BRIGHTY INSTRUMENTS	
5	压力开关 Pressure switch	PS470	-0.1-0MPa		H100-218-1519-M201 SPDT 250VAC 5A	±1.0	-0.1-0MPa	Dry contact	H:80mbar(A) L:150mbar(A)	1/4"NPT(F)	1/2"NPT(F)		IP65	UE	
6	压力开关 Pressure switch	PS471	-0.1-0MPa		H100-218-1519-M201 SPDT 250VAC 5A	±1.0	-0.1-0MPa	Dry contact	140mbar(A)	1/4"NPT(F)	1/2"NPT(F)		IP65	UE	
7	气动蝶阀 Pneumatic butterfly valve	161	WHOLE CLOSE TO WHOLE OPEN		250-FAR1-805c/wF79U- 036DA/wCR-OB201BD00			Dry contact		DIN2501 DN250,PN10	M20X1.5	1/4"RC	IP66	KEYSTONE	
8	自动补水阀 Make-up water valve	SV221	WHOLE CLOSE TO WHOLE OPEN		8223G010,230VAC,17.1W		230VAC 50HZ			1/2"NPT(F)	1/2"NPT(F)		IP65	ASCO	
9	液位计/开关 Level indicator/ switch	LG230/ LS231	0-500mm		BM26/P/C/RR1,304,L=500mm, With two level switches			Dry contact		DIN2501 DN20,PN1.6	2XM20X1.5		IP65	KROHNE	
10	气动控制件 Pneumatic control set	741-1			AC30A-02DE-R		0-1MPa	0-1MPa	0.25MPa			Rc1/4"	IP65	SMC	
11	气路电磁阀组 Solenoid valve	741-2			VQ4201-4W-02, 230VAC,2.6W		230VAC 50HZ				1/2"NPT(F)	1/4"RC	IP65	SMC	
12	接线箱 Terminal box	151			V325998/V325999,IP56									GDNC	

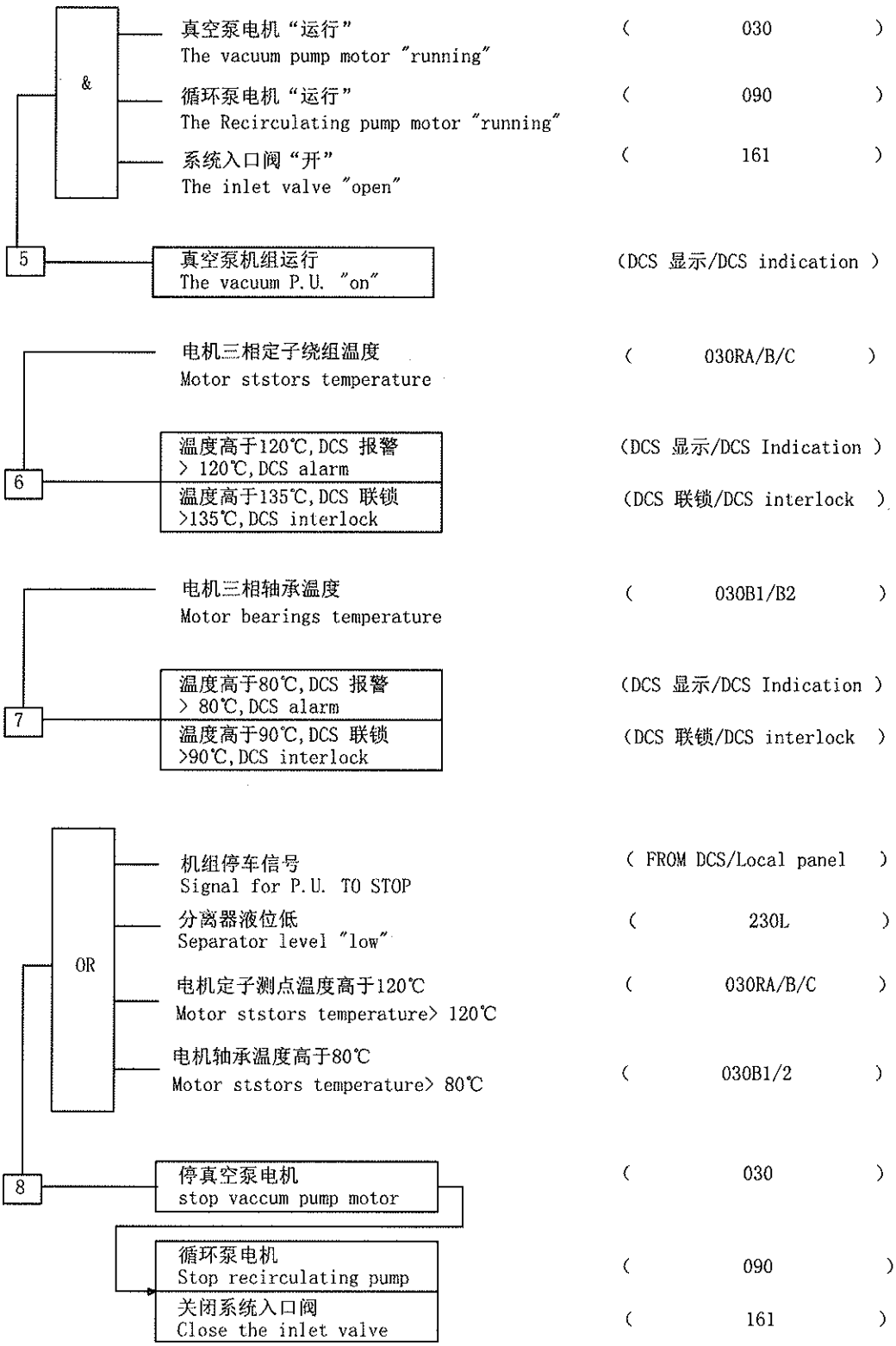
NASH	佶缔纳士机械有限公司 Gardner Denver Nash Machinery Ltd			凝汽器真空泵运行逻辑图 LOGIC DRAWING FOR CONDENSER VACUUM PUMP	项目名称 PROJECT	越南沿海燃煤电厂一期2×622MW	
G	FINAL	2013.02.25 13:19:15 +08'00'	2013.02.25 14:27:02 +08'00'	2013.02.25 15:06:32 +08'00'	分项名称 SUBPROJECT	凝汽器真空泵 CONDENSER VACUUM PUMP	
A	PRE	LKG	HG	ZZX	专业名称 SPECIALITY	自控 AUTOMATIZATION	
版次 EDIT.	状态 STAT.	设计 DESIGNED BY	校核 CHECKED BY	审核 APPROVALED BY	设计阶段 STAGE	施工图 SHOP DRAWING	页数：第1页共4页 Sheet 1 of 4

开一关一运行逻辑图(单机)
ON OFF LOGIC DRAWING(SINGLE PUMP)



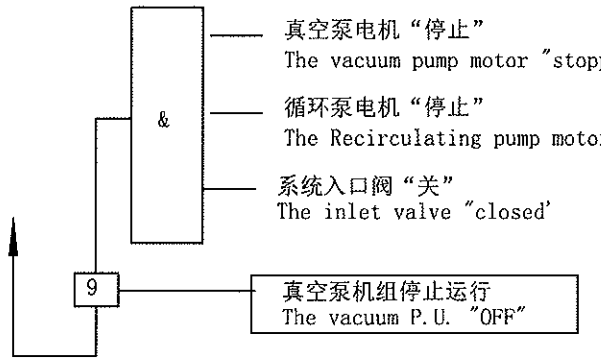
开一关一运行逻辑图(单机)
ON OFF LOGIC DRAWING(SINGLE PUMP)

流程图中项号/Code IN P&ID



开一关一运行逻辑图(单机)
ON OFF LOGIC DRAWING(SINGLE PUMP)

流程图中项号/Code IN P&ID



(030)

(090)

(161)

(DCS 显示/DCS Indication)

NASH	信缔纳士机械有限公司 Gardner Denver Nash Machinery Ltd				凝汽器真空泵运行逻辑图 LOGIC DRAWING FOR CONDENSER VACUUM PUMP	项目名称 PROJECT	越南沿海燃煤电厂一期2×622MW	
G	FINAL	LKG	HG	ZZX		分项名称 SUBPROJECT	凝汽器真空泵 CONDENSER VACUUM PUMP	
A	PRE	LKG	HG	ZZX		专业名称 SPECIALITY	自控 AUTOMATIZATION	
版次 EDIT.	状态 STAT.	设计 DESIGNED BY	校核 CHECKED BY	审核 APPROVALED BY		设计阶段 STAGE	施工图 SHOP DRAWING	页数：第4页共4页 Sheet 4 of 4

开一关一运行逻辑图(主备机)
ON OFF LOGIC DRAWING(main/standby pump)