FINISHED PLAN

DE014

COSFLYING LAKE

MAIN DIESEL ENGINE (3/5)

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DWG. NO. M-11 (3/5)

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DESIGN DEPARTMENT
DALIAN COSCO KHI
SHIP ENGINEERING CO., LTD.

DALIAN CHINA

SHEETS (INCL. COVER)

	Drawing No. 图号或型号	DESCRIPTION 名称
➢	GEA	CHARGER AIR COOLER 空冷器
➢	DALIAN JC	AUXILIARY BLOWER INSTRUCTION 辅助鼓风机说明书
➢	Chris Marine VGT	VALVE SPINDLE GRINDERS 排气阀磨机
➢	HPU2800-2	AIR DRIVEN HIGH PRESSURE PUMP INSTRUCTION 风动液压泵使用说明书
➢	VPUD1000	FUEL VALVE TEST PUMP UNIT 喷油器试验台说明书
➢	HP2000	HYDRAULIC PUMP INSTRUCTION 手动高压泵使用说明书
➢	VN215/93	OIL MIST DETECTOR 油雾探测器说明书
➢	NRT-7200MD1	TURNING GEAR INSTRUCTION 盘车机说明书
➢	ABB A270-L	OPERATION MANUAL FOR TURBOCHARGER 增压器说明说明书
➢	WEICHUAN	MAIN STARTING VALVE 主启动阀
➢	6.64.1	AUTOMATIC BACK FLUSHING FILTER 自清滤器
➢	FULINJIA	UPS FOR ECS ECS 系统电源
➢	LECHUN	AXIAL DAMPER MONITOR 轴向减振器检测仪
➢	HTC032B	HEATING TANK FOR CYLINDER OIL 注油器滑油加热柜

CONTENTS

- **DYDZ200 HEATING TANK FOR CYLINDER OIL**
  液压顶部支撑

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1、概 要

GEA 增压空冷器是一种管片式热交换器。其工作原理是：高温增压空气流经散热片，将热量通过对流作用传递给冷却管外壁，然后经过壁的导热作用传给管内壁，再由管内水的对流作用把热量带走，以完成换热。

空冷器传热元件有：椭圆管方片、圆管圆片及圆管方片等几种结构形式。管与片的连接方式通常有：钎焊式、整体轧制式和机械胀接式。

冷却管由胀管器将其两端紧紧地胀接到管板上。

侧板作为空冷器的一部分，与管板用螺栓连接紧固。

端盖（即进出水端盖和回流水端盖），作为循环水室，按设计的水流程数设置隔水筋。端盖上装有旋塞用于空冷器的放气和排水。端盖与管板间装有密封垫并用螺栓将其紧固。

端盖、管板和冷却管的材质是根据冷却水质和设计水流速来选择的。

增压空冷器安装在涡轮增压器和柴油机进气总管之间的风道中。其安装形式有两种：

1、空冷器可直接装在风道中（固定式空冷器），这时把空冷器的侧板和管板直接用螺栓安装到风道上，形成风道的一部分。

2、空冷器先装进箱体，然后把箱体用螺栓安装到风道上（可拆式空冷器）。用此法安装，在拆卸维修空冷器时可以不拆卸风道。

2. 固定式空冷器

2.1 概 述

固定式空冷器“Block Cooler”直接安装在发动机的风道中，正如第1部分所述，空冷器的侧板和管板用螺栓直接固定在风道中相应的位置上。

“固定式空冷器”有两种结构形式，即单回路和双回路。回路数即指流过空冷器冷却水的循环水回路数。

双回路空冷器有两个互不相通的循环水回路，各水路有其不同的目的。例如：高温水回路用于发动机缸套冷却，低温水回路用于油的预热。

2.2 空冷器的安装和拆卸

在安装空冷器前，应先拆卸下进、出气侧和水管连接法兰上的罩盖物；并用松香水洗去用于保护气侧和水侧密封面的保护物。

空冷器既可以直接安装在发动机上，也可以悬置安装在风道中。空冷器气侧连接孔与风道连接孔用螺栓联接坚固，同时加装发动机供应商提供的密封材料。

空冷器进出水法兰与冷却水管用螺栓联接坚固，同时加装发动机供应商提供的密封材料。

为避免空冷器在安装过程中变形和产生应力，所有的连接面都应该平行，公差越小越好。所有连接点都要做到气密和水密。

拆卸固定式空冷器时要按下列程序进行：

1. 排干冷却水

2. 用适当的升降装置支撑住空冷器

3. 拆开进出水管

4. 拆开气侧连接风罩，卸下空冷器。

安装时要使用如前所述新垫片。

拧紧力矩（Nm）

适用于标准公制螺纹、强度等级为8.8级的镀锌螺栓。螺纹、螺栓和螺帽的接触面上抹油

规格	不用密封或KLINGERSIL密封垫	不用密封或KLINGERSL密封垫用NORD-防松垫圈
M8	21	25
M10	42	51
M12	73	87
M14	115	138
M16	180	216
M18	256	307
M20	360	432

3. 可拆式空冷器

3.1 概　述

“可拆式管组空冷器（Removable Stack Cooler）”即可拆卸的管组连同其外壳一起安装到发动机的风道中。正如第1部分所述，用螺栓将空冷器的箱体固定在风道中，再把管组慢慢滑进箱体。用螺栓将管组上大管板（固定管板）固定在箱体上并加装垫片以气密。活动管板是通过一个O型橡胶圈和一个长方形密封法兰而形成密封，也可以使用平端盖。

要注意，所有的螺栓连接点都必须是气密的。

可拆式管组空冷器可设计为：单回路、多回路和多级空冷器。

回路数是指通过空冷器中水的回路数。双回路空冷器有两个互不相通的循环水回路，各水路有其不同的目的。例如，高温水回路用于发动机缸套冷却，低温水回路用于油的预热。

多回路空冷器可设计为整体管板式。如有必要的话也可以在活动端配置非整体的管板，以适用于微差膨胀。

多级空冷器由多组管组组成，这些管组都安装进同一个箱体内。

多级空冷器的级数是指串联在一个水回路的管组数，故级数不一定与回路数相同。

3.2 空冷器的安装和拆卸

在安装空冷器前，应先拆下进、出气侧和水管连接法兰上的罩盖物；并用松香水洗去用于保护气侧和水侧密封面的保护物。

空冷器既可以直接安装在发动机上，也可以悬置安装在风道中。空冷器气侧连接孔与风道连接孔用螺栓联接坚固，同时加装发动机供应商提供的密封材料。

空冷器进出水法兰与冷却水管用螺栓联接坚固，同时加装发动机供货商提供的密封材料。

为避免空冷器在安装过程中变形和产生应力，所有连接面都应该平行，公差越小越好。所有连接点都要做到气密和水密。

运输吊耳是用来提吊和搬运空冷器的，在管组侧板上也焊有起吊耳。

将空冷器箱体安装进风道之前，可先将管组拆下来。拆卸方法是:拧下把固定管板与箱体联接的螺栓，并拆下密封填料或活动管板上的盖板。在管组的固定端的端盖上钻有螺纹孔，该螺纹孔用于起吊和拆卸时安装吊耳或拆卸螺栓的。

箱体安装好后，用螺栓把管组的固定管板紧固到箱体上（加装新垫片），再安装密封填料或罩盖。

安装完毕后若要拆卸管组，可先将固定管板上的螺栓拧下，将活动端的密封填料或盖板，以及冷却水管卸下来（如有发动机系统的部件妨碍撤下管组，这些部件都应拆除）。最后用适当的起吊装置将管组

从箱体里抽出来。

为了使管组比较容易地从箱体内抽出，我们固定管板上钻有拆卸螺纹孔（孔径与箱体框架上的螺栓孔相同），该螺纹孔用于起吊和拆卸时安装吊耳或拆卸螺栓。

重新安装时应使用如前所述新密封垫。

4. 试运行

4.1 概 述

GEA空冷器在出厂前都进行了水压试验，并检验合格。然而，我们还是建议用户在安装前要按标定的测试压力对空冷器进行压力测试。

如果库存期或停用期超出了规定范围，端盖的密封垫可能会有渗漏现象。这时可通过拧紧螺栓来防止渗漏。倘若拧紧螺栓不能解决问题，就应考虑更换新密封垫。更换新密封垫后，要在规定的测试压力下再进行压力测试。

安装完毕后向空冷器内充水以排气，排气时将端盖上的放气塞卸下排气，排气完毕后再将其安装回原处。

空冷器投入使用后，要立即排气数次。把整个冷却系统的空气排出比只排出空冷器的空气效果要好些，因此最好是排出整个冷却系统的空气。

多回路或多级空冷器，每个回路和每级都要单独排气。

整个设备检测无渗漏，并保证冷却水畅流无阻后，空冷器便可投入使用。

在发动机加速到正常负载时，测量空冷器进气和出气温度，并根据性能数据表中的流量要求，调定冷却水达到正常流量。

4.2 冷却水流速

空冷器运行时，参照下表维持冷却水流速。

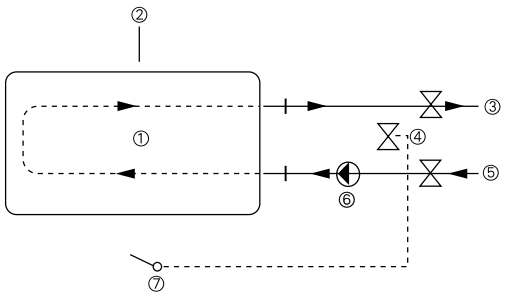
管 材	最小流速	最大流速
CuZn28Sn(SOMS71)	1.0m/s	2.0m/s
CuZn20Al(SOMS76)	1.0m/s	2.2m/s
CuNi30Fe(CuNi70/30)	1.5m/s	3.0m/s
CuNi10Fe(CuNi90/10)	1.5m/s	3.0m/s
Cu/SB or SF	1.0m/s	2.0m/s
Steel	2.0m/s	2.5m/s

空冷器决不能在最小水流速下长期工作，应按性能数据表中标定流量维持空冷器供水。

频繁改变水的流速不利于在空冷器内壁形成保护膜，而保护膜对于防腐蚀是至关重要的。如果水流速太小，容易产生沉积物；如果水流速太大，又容易产生侵蚀。管路的节流或进水口的位置不当，都容易产生易造成腐蚀的富氧水。为了在部分负载的情况下也保持均衡的水流量、流速，就必须安装控制装置。

4.3 冷却水流速的控制

现已证明，下图所示的旁通控制装置能满足控制水流速、流量的要求。旁通装置可以这样设置：即，空冷器的出水端与冷却水泵进水端旁通，由阀门及控制装置来调节空冷器进水的冷热度和流量，以保证增压空气出口温度的衡定。这样就能在各种负荷下使冷却水流量、流速和空冷器出气温度保持在推荐的范围内变动。



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旁管控制装置平面图

①增压空冷器

②增压空气进口

③冷却水出口

④流量控制阀

⑤冷却水进口

⑥泵

⑦感温器

5. 保护膜

确保形成结实、耐久保护膜的方法。

铜及铜合金所固有的耐腐蚀性能就在于：它们能够形成难以溶解的自然保护膜。

千万不要把污水用于未形成良好保护膜的新空冷器中，因为冷却管内表面的沉积附着物，不利于形成上述保护膜。

鉴于上述原因，空冷器进行水压测试时要用洁净的淡水。在试运行期间同样要避免使用污水。

我们建议在试运行期间往水中加入少量易溶的硫酸亚铁（$FeSO_4.7H_2O$），以便确保在可能使用污染水前，管子表面形成良好的保护膜。

在冷却水中加5mg/l硫酸亚铁，并保持每天有1小时的运行就足以形成良好的保护膜。如有可能，在正常运行期间也要反复加入硫酸亚铁，直到第一次进行维修检查。

在靠近空冷器进水口处的管路上安装适当的阀门，以用于添加硫酸亚铁。

6. 停　用

如果空冷器停用时，整个冷却水系统内的水未排放干净，那么对空冷器由铜、铜合金钢及铸铁等材料的部件来说是有危害的。

在保护膜形成之前，或是在诸如铵化合物和硫化氢等腐蚀性物质有可能沉积侵蚀的情况下，停用对于铜和铜合金来说是特别危险的。

如不能排干空冷器的水，那么在试运行后的头两个月内就尽量不要停止空冷器的运行。

如果由于冷却水供应出了问题导致停用，但停用不超过三天；且以后空冷器便能长期持续运行，那么停用时可以不排干空冷器的水。

一定要确保管内没有发生沉积现象。如果沉积已经发生，那么就要把空冷器的水排放干净后清洗管子，再用净水冲洗，然后吹干。我们建议用暖风或预干燥过的空气吹干管道，空冷器应保持良好通风。

假如冷却水是海水、咸水或盐水（氯化物含量≥500mg/l），那么冲洗就应使用含盐量低的水（饮用水质的水）。

两个月的试运行期内停用空冷器，且停用时间超过三天，为防止发生沉积现象，应排干空冷器的水，然后冲洗并吹干。

两个月的试运行期后停用空冷器，为避免停用造成的腐蚀，每次停用如期限超过两个星期都要按上述的清洗程序进行清洗。

空冷器试运行后的正常运行期间如果要停用空冷器，一定要限制停用期不排水超过三天的停用次数，并按我们建议的在试运行期的条件操作。

如停用期很短，空冷器可用低水速度来运行，假如在此条件下能有效防止管内形成沉积的话，用低水速运行要比冷却水滞留在空冷器中好，因为象铵化物和硫化氢等腐蚀成份能被冲走，不积留在管中。

冬季，霜冻会损坏空冷器，所以哪怕是最短暂的停用也要排干空冷器内的水。

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7. 运行控制

7.1 概　述

至于运行控制，需要在风道中及空冷器进出水管上安装温度计。我们建议在机器运行记录本上定期记下空气和水的温度。如有特殊要求，可以使用更复杂的控制装置。

如果在空冷器出气侧出现大量冷凝液，通过使用如前所述的冷却水旁管控制装置，来避免产生冷凝水或限制冷凝水的析出量。

必须保证冷凝水能及时排放掉。

7.2 性能试验

GEA 承诺的性能保证主要是指在正常运行时，冷水和冷空气之间的温差，必须要经常检测。

如在空冷器正常运行时观察到温度比保证温差高，这可能是空冷器中积存空气的原因，可用前文中所述的方法（给空冷器排气）来解决这个问题。

如按上述方法进行处理仍未能改进性能，且又没有发现其它故障的话，这台空冷器就需要清洗了。

可用压差表来检测空冷器的气侧或水侧是否需要清洗。因此我们建议在风道中和空冷器的进出水管上安装压差表。

8. 清　洗

8.1 概述

水侧和气侧热交换面的清洗，对于保障空冷器长期无故障运行是非常必要的。清洗周期要根据空冷器运行方式，冷却水质及吸入空气的物性来决定。

清洗方式有：机械清洗、水力清洗和化学清洗。

8.2 水侧的清洗

水侧清洗需定期进行，其周期由冷却水质来确定。

水侧清洗不仅是为了保持空冷器的热交换性能；也消除冷却管内因结垢造成的腐蚀、或因障碍物造成侵蚀的危险。

8.2.1 机械清洗

机械清洗是通过装在刷杆上的尼龙刷来进行的。刷杆的长短由冷却水管长度而定。要选择与散热管型号相应的刷子。每台空冷器在发货时都配有带柄的清洗刷。

机械清洗可以在不挪动空冷器的情况下进行，也可以把空冷器拆卸下来进行。在清洗时，至少要卸下一个端盖。为了卸下端盖，我们在端盖上钻有与端盖法兰螺栓直径相等的螺纹孔，用以拆卸端盖之用。管子需要逐根刷洗，冲去污物直到没有一点残留物。清洗完毕后，更换新密封垫并重新装上端盖，再注入冷却水排气。

8.2.2 水力清洗

水力清洗时要将空冷器卸下进行。用装有特别喷嘴的高压喷枪来清除冷却管内的沉积物。

8.2.3 化学清洗

化学清洗可以在不挪动空冷器的情况下进行，也可以把空冷器拆卸下来进行。

8.2.3.1 不挪动空冷器进行化学清洗

为了确保空冷器运行时管内没有结垢和污物，我们建议安装一个与空冷器配套的连续运行的化学清洗系统。

该清洗系统包括一个循环泵、一个洗涤槽、截流阀及相应的管路。清洗的水回路联接于冷却器的进出水管路上，该回路位于截流阀与端盖进出水法兰之间。

清洗之前要截断冷却水流，通过空冷器的出水管道将水排干。拧下排水螺塞排水。水排尽后，关闭冷却水阀。打开清洗水管的阀门，启动循环泵。排水完毕后要拧紧排水螺塞。

我们建议清洗水回路的水流方向与工作水回路流向相反。

清洗完毕后，将空冷器里的水排干，空冷器内不能留存清洗剂。关闭清洗水管的阀门，并打开冷却水阀门，用常规的冷却水冲洗。

最后空冷器需重新排气。

化学清洗也可以除去冷却水管道中的水垢沉积物。清除水垢沉积物需要用10%的盐酸加0.5%的抗氧化剂，这样清洗对有些管材特别适用。

清洗完毕后，要彻底冲洗空冷器，做到空冷器中没有一点清洁剂残留物。如果清洗以后空冷器要停用一段时间，这一点就更为重要。

如果对安装好的空冷器进行化学清洗，就不需要卸下端盖。我们建议用适当的工业洗涤剂进行化学清洗。

使用化学品清洗时，一定要按照清洗剂生产厂家提供的说明及用法指南进行。

8.2.3.2 拆下空冷器进行化学清洗

如果空冷器管路上没有安装化学清洗系统；或如果机械清洗和水压清洗都不成功的话，那么就要拆卸下空冷器进行化学清洗。

把端盖拆下后，将空冷器芯组放入洗池内浸泡清洗，浸泡的时间根据积垢程度而定。如果一次清洗效果不理想，那么就应反复清洗。

清洗程序及清洗剂见8.2.3.1条中的说明。

8.3 气侧的清洁

8.3.1 概 述

气侧的清洗应尽早进行，以避免散热片上聚集油烟（这些油烟在一段时间以后就会结一层很难清除的硬壳），以及其它腐蚀性的沉积物。如果这些腐蚀性的沉积物残留在管、片上一段时间以后，其中的一些物质就会与冷凝液化合，形成硫化物造成腐蚀。

8.3.2 水力清洗

空冷器被拆卸下后，用水力清洗是很有效的。在8.2.2节中讲到的高压喷射枪也可用于这一目的。我们建议用3mm喷嘴的喷枪，在距散热片2米处，用80～120bar的高压水垂直冲洗冷却水管（喷射水流与散热片平行）。

8.3.3 化学清洗

我们建议在空冷器拆卸下来后对空冷器气侧进行化学清洗。

清洗的程序是：拆下端盖后将空冷器管组浸入化学清洗槽中浸泡清洗（浸泡的时间根据积垢的程度而定），清洗完毕后用高压水枪冲洗空冷器。如效果不理想，那么就应反复清洗。

为了提高清洗槽的清洗效果并缩短清洗时间，我们建议：洗槽内的水应循环流动。也可用喷枪喷射清洗液来清洗。我们建议使用适当的工业洗涤剂对气侧进行清洗。

使用化学品清洗时，一定要按照该清洗剂生产厂家提供的说明及用法指南进行。

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9. 管　漏

9.1　概 述

腐蚀、侵蚀及错误的操作均可以导致管漏。如果发现空冷器渗漏，先必须查出渗漏的管子。如果目测发现不了，可以对空冷器进行压力测试、也可以对每根管子分别进行压力测试，以找出发生渗漏的管子。

9.2　单根管的压力测试

压力测试前要卸下空冷器前后端盖(如果空冷器周围有足够的空间就没有必要卸下空冷器)，用橡胶塞将接受测试的管子两端都塞住，其中必须有一个塞子上有空气或水的接头，然后通压力空气或水进行测试。

可以安装压力表来显示压损。施压后即使冷却水管上有很小的渗漏也会很快从表上显示出来。

如果不用压力表来检测空冷器，那么拆卸下空冷器，以便从散热片侧对渗漏进行目侧。

9.3　空冷器的压力测试

如果我们不拆端盖对空冷器进行水压测试，那么就得用手电筒在散热片侧寻找显示渗漏的湿点。为了避免邻近冷却水管上的湿点影响判断，应该在检测前通过吹风使气侧干燥。

9.4　在水下进行空气压力测试

如果没有安装压力表，那么空冷器压力测试应在水下进行。我们将空冷器浸没在一个水槽中，在不拆卸端盖的情况下对水侧施加0.5bar的空气压力来测试管子，如果有渗漏就会有气泡冒出来。

但应注意，积聚在散热片上的空气也会产生气泡，这些气泡并不表明管子渗漏。

9.5　堵管

一旦我们找到了出故障的管子，就应该把管子两端用坚硬的木头，橡胶塞或铜螺塞堵起来（交货时同时提供塞子），不能用钢螺塞，因为钢螺塞会损伤管板孔。所有型号的管子无一例外地都可以堵塞。

如果有几根管子同时渗漏，我们必需当场评估堵管后的空冷器性能是否能满足要求。

9.6　个别管子的更换

如果空冷器是单管片式，即椭圆管方片、或是圆管挤片，这时就可以更换渗漏的管子。如果是在管组中发现了渗漏管，这时要把周边邻近的管子也卸下来更换，以便能够接触到渗漏管。需要更换的管子卸下后，必须清洗管板上的孔。

用来更换的管子一端有一段光管(未装散热片)。更换时，先将管子的光管端插进一块管板的管孔内，然后回拉，再插进另一块管板相应的孔内，最后用胀管器把管子胀到管板上。

9.7　插入另一根芯管

如果是穿片、整体胀接式空冷器，要想更换一根管子是难以办到的。这时如发生渗漏现象，我们可以用直径小于渗漏管，管径全适的管子插入渗漏管中，然后内胀使替换管和渗漏管紧紧胀接在一起保证传热，再外胀把替换管胀接到管板上防止渗漏。

9.8　空冷器修理后的压力测试

空冷器修理完毕后，我们必须按规定的测试压力对空冷器进行压力测试。规定的测试压力标明在空冷器的侧板或箱体的标牌上。

修理管漏所需的芯管，工具以及其它材料都可以直接向基伊埃（芜湖）川崎机械制冷设备有限公司购买，或向德国GEA公司购买，也可以在我们世界各地的维修中心购买。

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1. General

The GEA charge air cooler is a finned tube heat exchanger. The hot air flows through the fins on the outside of the tubes and the cooling fluid flows through the tubes. The heat exchanger surface of the cooler consists of elliptical core tubes with rectangular threaded-on fins or round core tubes with either wound-on fins or continuous flat plate fins. The bond between fin and tube is achieved either by mechanical means or by soldering.

The core tubes are rolled into the tube sheets at each end of the tubes with roller.

Side wall form an integral part of the cooler and are bolted to tube sheets.

Water Headers (Namely connection and Return headers) are provided for water handling. The number of separation baffles conforms to the number of water passes. The headers are bolted to the tube sheets, gaskets interposed to form a seal. Plugs in the header are provided for cooler venting and draining.

The materials for headers, tube, sheets and core tubes are chosen in accordance with the specification of the cooling water to be used and the recommended water velocity in the tubes.

The charge air cooler is mounted in the air duct between the turbo charger and the diesel engine air inlet manifold. Mounting can be done as an integral part of the air duct (block cooler), the cooler side walls and tube sheets being bolted directly to the air duct. As an alternative the cooler can be mounted into casing which in turn is bolted to the air duct (Removable stack cooler), this method enables the cooler to be removed for repairing without dismantling air ducts.

2. Block cooler

2.1 General

The term, “Block cooler” refers to the design: mounted directly into the air duct of the engine. As already explained under part 1, the block cooler is bolted into the air duct at its side walls and tube sheets respectively.

There are two types of block coolers, namely single and double circuit coolers.

The number of circuits corresponds to the number of water flows passing the cooler.

The twin circuit cooler has two separate water flows which are independent from each other.

These two flows can be used for different purposes, i.e. for engine cooling, air or oil preheating etc.

2.2 Installation and removal of the cooler

Prior to installation the cooler, the transport covers at the air opening and the blanks on the water connection flanges are to be removed. The air and water side sealing surfaces, which are protected prior to shipping, must be cleaned with turpentine.

The cooler can either be mounted to the engine as a self supporting unit on a bracket, or alternatively it can be mounted in the air duct as a cantilever unit. The air side connections are bolted to the air ducts using gaskets or sealing compound provided by the engine builder.

The cooling water pipes are bolted to connection flanges on the connection header using gaskets also provided by the engine supplier.

To avoid deformation and stresses during installation all connecting surfaces must be parallel and the tolerances should be kept as small as possible.

All connections are to be air and water tight.

When removing the block cooler the following procedure should be used.

1. drain off cooling water.
2. Support cooler with suitable lifting gear.
3. Disconnect cooling water pipe.
4. Disconnect cooler form air side trunk and remove.

Installation is done by use of new gaskets as described above.

TIGHENING TORQUE(Nm)
FOR GALVANIZED SCREWS WITH CLASS OF STRENGTH8.8
WITH NORMAL METRICAL THREADS.
THREADS AND CONNECTING SURFACES FROM SCREWS AND NUTS ARE OILED

SIZE	WITHOUT GASKET ORKLINGERSIL-GASKET	WITHOUT GASKETOR KLINGERSIL-GASKET WITHNORD-LOCK-WASHER
M8	21	25
M10	42	51
M12	73	87
M14	115	138
M16	180	216
M18	256	307
M20	360	432

3. Removable stack cooler

3.1 General

The term “Removable stack cooler” refers to a design: where a cooler casing is fitted with a removable tube stack into the air duct of engine. As already explained under part 1, the cooler casing is bolted into the air duct. The tube stack is slid into the casing. The protruding tube sheet (fixed end) of the tube stack is bolted to the casing using a gasket to form an air seal. The extension end of tube sheet is seated by means of an rubber o-ring and a sealing frame which form a gland packing. Alternatively a cover plate header is used. All bolt connections are to be air tight.

Removable stack coolers are designed as single-circuit, multi-circuit and multi-stage coolers.

A multi-circuit cooler is designed with common tube sheets and if necessary can have a split tube sheet on the extension side to accommodate differential expansion. A multi-stage cooler consists of separate tube stacks which are mounted into a common casing.

The number of circuits refers to the water flows through the cooler. The twin-circuit cooler has two water flows which are independent from each other, these two flows can be used for different purposes, i.e. for engine cooling, air or oil preheating etc.

Since the tube stacks can be connected in series on the water side, the number of stages in a multi-stage cooler refers to the number of tube stacks fitted into the common casing, and need not to be identical with the number of water flows through the cooler.

3.2 Installation and removal of the cooler

Prior to installation of the cooler, the transport covers of the air side and the blanks on the water connection flanges are to be removed. The air and water side sealing surfaces, which are protected prior to shipping, must be cleaned by the use of turpentine.

The cooler can either be mounted to the engine as a self supporting unit on a bracket, or alternatively it can be mounted in the air duct as a cantilever unit. The air side connections are bolted to the air ducts using gaskets or sealing compound provided by the engine builder.

The cooling water pipes are bolted to connection flanges on the connection header using gaskets also provided by the engine builder.

To avoid deformation and stresses when installing the cooler all connecting surfaces must be parallel and the tolerances should be kept as small as possible.

All connections are to be air and water tight. Transport lugs are provided on the side walls for lifting and handling of the complete cooler. Lifting lugs are also welded to the tube stack side walls. Prior to installation of the cooler casing into the air duct the tube stack can be removed by means of unscrewing the bolts holding the protruding tube sheet to the casing frame and removal of the gland packing or cover plate at the extension end tube sheet. At the fixed end of tube stack threads are provided in the water header for eyebolts to be used when lifting and pulling out.

When the casing is installed the tube stack is fitted (new gaskets interposed) by bolting the protruding tube sheet to casing frame and mounting of the gland packing or hood.

When removing the tube stack after final installation the bolts holding the protruding tube sheet are unscrewed, the extension end gland packing or cover plate and cooling water pipes are removed and the tube stack is pulled out of the casing by the use of suitable lifting gear. To ease breaking the tube sheet from casing frame gasket seal, threaded holes with the same dimension as the bolts used for the

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casing frame are provided in the protruding tube sheet for jacking screws. The casing bolts may be used for this purpose.

Installation is done by use of new gasket as described above.

4. Commissioning

4.1 General

The cooler is subject to a hydraulic pressure test in our factory. It is however recommended to carry out a test with the specified test pressure before installation.

If after prolonged storage or extended standstill the geared gaskets are leaking, tightening of the geared bolts might prevent further leakage. If this is not sufficient the header gaskets must be replaced. A pressure test with specified test pressure should be carried out after replacement.

After assembly of the cooler is completed the cooler is circulated with the specified cooling water quantity prior to venting.

For cooler venting, the vent plugs in the headers are removed. After the air has escaped from the cooler the plugs are fitted again. Venting should be repeated shortly after cooler is taken into operation. Venting of the complete cooling system is better than venting only the cooler and should therefore be preferred.

With multi-circuit or multi-stage coolers, each circuit or stage should be vented separately.

After a leak test has been carried out on all plant components, and the water flow has been checked to ensure there are no restrictions, the cooler can be put into operation.

Upon accelerating the engine to the nominal load the air temperature should be measured before and after the cooler and the cooling water flows set in accordance with the nominal water flows stated in the performance data sheet for the cooler in question.

4.2 Cooling water velocity

The following water velocities should be maintained during operation:

Tube material	Min.	Max.
CuZn28Sn(SOMS71)	1.0m/s	2.0m/s
CuZn20Al(SOMS76)	1.0m/s	2.2m/s
CuNi30Fe(CuNi70/30)	1.5m/s	3.0m/s
CuNi10Fe(CuNi90/10)	1.5m/s	3.0m/s
Cu/SB or SF	1.0m/s	2.0m/s
Steel	2.0m/s	2.5m/s

Never operate at min. Velocity for a prolonged period of time. The nominal water flow stated in the performance data sheet for the cooler in question should be maintained. Frequent fluctuation of the water velocity impede the formation of a protective film on the tube inside, which are vital for corrosion protection. A too low water velocity encourages dirt deposits and a too high velocity causes erosion. To throttle the water flow or improper position of the water intake could lead to oxygen enriched water which favours corrosion. To keep the water flow, and so the water velocity, constant also during part load operation, control devices should be installed.

4.3 Control of cooling water velocity

The bypass control as shown below has proved suitable for this requirement. Bypassing can be done in such way that the discharged warm cooling water is mixed with the cold water at the suction side of the cooling water pump to assure operation at almost constant charge air outlet temperature. Subsequently water flow, velocity and charge air outlet temperature can be kept within the recommended range at all load conditions.

Layout of a bypass control system

① charge air cooler

② charge air inlet

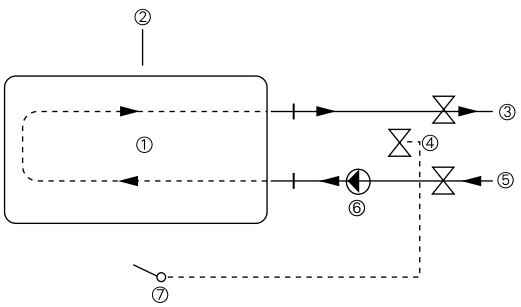
③ Cooling water outlet

④ Flow control valve

⑤ Cooling water inlet

⑥ Pump

⑦ Temperature sensor



5. Protection film

Measures to assure the formation of a strong and durable protective film.

The inherent good chemical corrosion-resistance of copper and copper alloys is due to their ability to form a natural protective film which is difficult to dissolve.

New cooler tubes lacking a sufficiently strong protective film should never be operated with contaminated water, as deposits on the material surface would prevent the formation of such a protective film.

For the above reason clean fresh water is used for the hydraulic test of the heat exchanger. The utilization of contaminated water should also be avoided during test runs.

During test runs it is recommended to add small quantity of easily soluble ferrous sulphate (FeSo4.7H2o) to the cooling water to make sure that a good protective film is formed before operating with contaminated water.

It is sufficient to add about 5mg/l to cooling water during a period of one hour every 24 hours. Adding of ferrous sulphate should, if possible, be repeated during normal operation until the first inspection is carried out.

An appropriate valve for adding ferrous sulphate should be provided in the piping close to the water inlet nozzle of the cooler.

6. Standstill

A standstill of the cooling water system, leaving the cooler undrained, is hazardous for cooler parts made of copper, copper alloys, steel and cast iron.

For copper and copper alloys standstills are especially hazardous prior to the formation of a protective film or in the case that the destruction of the same must be feared for reason of deposit attacked by putrefaction products such as ammonium compounds and hydrogen sulphide.

If possible, cooler operation should not be interrupted during the first 2 months after commissioning if the cooler can not be drained.

However, if there is a failure in cooling water supply and operation is resumed within 3 days and then for a prolonged period of time kept uninterrupted, the cooler may be left undrained.

It must be then guaranteed that the tubes are free from deposits. If deposits have formed, the cooler should be drained, the tubes cleaned and flushed with clean water prior to being dried. We recommend the use of warm or pre-dried air for blowing through the tubes. The coolers need to be vented adequately. If sea water, brackish or saline water(chloride content>500mg/l) is used as cooling water, water with low salinity (drinking water quality)should be used for flushing. In case of standstill within the start-up period of 2 months which is expected to last for more than 3 days, and where deposits must be feared, the cooler should be drained, flushed and dried.

To avoid standstill corrosion after the first 2 months of operation the above described cleaning procedure should be repeated by every standstill lasting longer than 2 weeks.

In case of permanent service interruptions after the start-up period it may be necessary to limit the standstill where the cooler is kept undrained to 3 days and operate the unit under conditions as recommended for the start-up period.

During short standstill the cooler can be operated at low cooling water velocity so formation of deposits in the tubes can be prevented. Operating with low water velocities is to be preferred to cooling water standstill in the tubes as putrefaction products, such as ammonium compounds and hydrogen sulphide are washed away from their point of origin.

During winter time standstill if frost injury to the cooler could occur the cooler should be drained also during the shortest standstill.

7.Service control

7.1 General

For service control, thermometers are to be installed in the air ducts and in the cooling water piping before and after the cooler, we recommend to keep record of the air and water temperatures in the machine log book periodically. Further control instruments can be provided in accordance with the individual requirement.

In case of the occurrence of a major amount of condensate after the cooler, further condensation can be prevented, or at least limited, by the use of a bypass control of the cooling water as previous described.

A possibility to drain the condensate must be assured.

7.2 Performance test

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The performance guarantee given by GEA is main expressed by the temperature difference between cold water and cold air during normal operation and should be checked from time to time.

In the event that a considerable increase of the guaranteed temperature difference observed during normal operation, this might be due to accumulation of air in the cooler. To remedy the above the cooler should be ventd by using the procedure previously described.

In case a performance increase cannot be achieved by proceeding as above and provided no other disturbance can be found, the cooler needs cleaning.

A differential pressure gauge can also be used to check whether or not cleaning of the air or water side of the cooler is necessary. We recommend to install differential pressure gauges in the air duct and water piping before and after the cooler.

8. Cleaning

8.1 General

Cleaning of the water and air side heat exchange surfaces is imperative for a long and trouble free operation of the cooler. The cleaning intervals vary with the mode of operation, cooling water quality, intake air characteristics etc.

Cleaning can be done by either mechanical, hydraulical or chemical means.

8.2 Cleaning of the water side

Regular cleaning is necessary. The cleaning intervals depend on the cooling water used. Cleaning of the water side is not only required to maintain the thermal performance of the cooler. Scaling increases the risk of biting corrosion and obstacles partly blocking the tubes favours erosion.

8.2.1 Mechanical cleaning

Mechanical cleaning is done by use of nylon brushes fitted to a rod. The length of the rod corresponds to the tube length of the cooler in question and the type of brush is chosen in accordance with the finned tube type. The brush with rod is part of each cooler delivery.

Mechanical cleaning can be done in-situ or with the cooler removed. At least one header needs to be removed when cleaning. For header removal threaded holes with the same dimension as the header bolts are provided in the header flange to serve as jacking screws. The wet tubes should be thoroughly brushed clean one after the other and the dirt flushed out until no residues are left. After the cleaning is completed the headers are refitted using new gaskets. Venting must be repeated after cooling water is refilled

8.2.2 Hydraulic cleaning

Hydraulic cleaning is carried out with the cooler removed using a high pressure spray gun with special nozzle to remove dirt deposits inside the tubes.

8.2.3 Chemical cleaning

Chemical cleaning can be carried out in-situ or with the cooler removed.

8.2.3.1 Chemical cleaning -In-situ

To ensure that the cooler is always operated without fouling or scaling in the tubes we recommend an integrated and continuously operating chemical cleaning system to be fitted.

Such cleaning system comprises of a circuiting pump and a detergent tank with the necessary piping and shut off valves. The detergent circuit is connected to the cooling water inlet and outlet piping between their shut off valves and the water header flanges.

Prior to cleaning, the cooling water flow is interrupted to allow the cooler to drain via the cooling water outlet piping. For draining the vent screw are removed. After draining, the cooling water valves are closed. The valves of the cleaning circuit are opened and the circulating pump switched on. The vent screws are fitted after venting completed.

It is recommended to connect the cleaning circuit to the cooling water outlet piping in such a way that the detergent flow is opposite to the normal cooling water flow.

When cleaning completed the cooler is drained leaving no detergent in the cooler. The valves of the cleaning circuit are closed and the cooling water valves opened. Flushing is done with normal cooling water. Reventing of the cooler

is necessary.

Scaling deposits in the cooling tubes can be removed by chemical cleaning as well. For removal, a 10% HCL hydrochloric, or muriatic acid is used and a 0.5% inhibitor (specifically suitable for the individual tube material)added. After cleaning, the cooler is to be flushed thoroughly, i.e. no detergent residues are allowed to be left in the cooler. This is most important in case the cooler is shut down for a short time after cleaning.

If the cooler is chemically cleaned in mounted position the headers need not be dismounted. For chemical cleaning we recommend to use suitble detergents to clean:

The instructions and handling guidelines provided by the manufacturer of the detergent in question should always be observed when using the chemical.

8.2.3.2 Chemical cleaning -Cooler removed

Chemical cleaning while the cooler is removed is required if neither mechanical or hydraulic cleaning proved successful and if the cooler is not connected to a continuously operating cleaning system.

The complete cooler with attached header will be connected by the use of blind flanges to an external cleaning circuit or filled with detergent on the water side. Time of saturation depends on the grade of deposit. If the result is not satisfying, cleaning should be repeated.

Cleaning procedure and detergents are described under 8.2. 3.1.

8.3 Cleaning of the air-side

8.3.1 General

Cleaning of the air-side should be done early enough to avoid accumulations of soot and oil on the fins, which after a period of time form a hard crust that is difficult to remove, as well as the deposition of other crack products as for instance residues that form a sulphuric acid (compound with condensate) when left on the fins and tubes for some time.

8.3.2 Hydraulic cleaning

Hydraulic cleaning is effected when the cooler is removed. A high pressure spray gun as described under 8.2.2 is suitable also for this requirement. We recommend a nozzle size of 3mm. If the water jet attacks the cooling tubes vertically, i.e. in parallel to the fins, a pressure of 120bar is suitable to be applied at a distance of 2m from the fin surface.

8.3.3 Chemical cleaning

We recommend chemical cleaning of the air side while the cooler is removed.

The water headers are detached from the cooler bundle. The tube bundle is then immersed into a chemical cleaning bath. The time of immersion is a function of the degree of fouling. When cleaning completed, the cooler is to be flushed by applying a powerful water jet. If the result is still not satisfying, cleaning should be repeated.

To intensify the cleaning effect of the bath and shorten the cleaning time, it is recommended to circulate the detergent. The chemical detergents can also be applied by spraying. The following detergents are recommended for air side cleaning.

The instructions and handling guidelines provided by the manufacturer of the detergent in question should always be observed when using the chemical.

9. Tube leaks

9.1 General

Tube leaks can be caused by corrosion, erosion or improper operation of the cooler.

If a leakage is observed, the defective tube of tubes must be identified. If this can not be done by a visual inspection, a pressure test of the cooler of an individual pressure test of each tube has to be carried out.

9.2 Pressure test of individual tubes.

Prior to pressure testing, the connection and return headers need to be removed. In case of ample free space around the cooler it is not necessary to remove the cooler. Rubber plugs can be used for pressure test. One of the plugs must have a connection for air or water supply. The tube to be tested is plugged at both ends and tested at low pressure applied via the plug having a pressure connection.

Pressure gauges can be installed to indicate a loss of pressure. Even-if there is only a small leak in the tube a pressure loss is indicated shortly after pressure application.

GEA (WUHU) KHI MACHINERY COOLING CO.,LTD

If the cooler is to be tested without the use of a pressure gauge it has to be dismounted to enable leakages to be found through visual control carried out from the fin side.

9.3 Pressure test of cooler

If pressure testing of the cooler is done by a hydraulic test, without removing the water headers, the fin side is searched with a flashlight for wet points indicating leaks. To avoid that damage rating being impaired by wet points on neighboring tubes, the air side should be dried by blowing with air prior to testing.

9.4 Pressure test with air under water

If no pressure gauges are installed pressure testing with air should be done under water.

The cooler is immersed into a water tank and tubes are tested by applying 0.5bar air pressure on the water-side without removing headers or by testing the tubes one by one as previous described. If a tube is defective bubbles will rise. However note that bubbles can from air accumlated on the cooling fins and that such bubbles do not indicate leaks.

9.5 Plugging of tubes

Once the defective tube is found it can be sealed with hard wood, rubber or brass plugs which are part of each delivery. On both sides steel plugs should not be used, due to damage of the tube sheet holes.

Plugging can be done on all tube types without exception. In the case that several tubes are leaking it must be decided at location whether or not the cooler performance will be satisfactory after plugging.

9.6 Replacement of single tubes

If the cooler has single fin tubes, i.e. elliptical tubes with threaded on rectangular fins or round tubes with wound-on fins, it is possible to replace single tubes. If the leaking tube is found in the middle of the tube bundle, the neighboring outer tubes must be also removed and replaced to gain access to the leaking tube. After the tubes to be replaced are removed the tube sheet holes must be cleaned. The replacement tubes are provided with an extended unfinned portion at one end. The tube is inserted into the tube hole in one tube sheet(long unfinned end first) then retracted and slid into the corresponding tube hole in the second tube sheet. Then the new tubes or then rolled into the tube sheets.

9.7 Insertion of a second core tube

Replacement of single tubes is not possible on coolers with compact fin tube system consisting of continuous fins with several inserted and expanded core tubes. To remedy tube leaks, plain tubes of smaller diameter than the defective tube can be inserted and expanded to form thermal contact with the latter and rolled into the tube sheets.

9.8 Pressure test after repair

After repair the cooler must undergo a pressure test with the specified test pressure which is stated on the name-plate fitted to the cooler side wall or casing. Replacement tubes, tools and other materials for leak remedy can be purchased directly from GEA (wuhu) KHI Machinery Cooling Co., Ltd or GEA Germany or from our service centers world wide.

关于中船三井 主机空冷器及防蚀锌块维护保养的补充说明

1. 维护保养内容

空冷器的日常维护主要工作就是对水侧、气侧热交换面的清洗和密封面处是否泄漏的检修，定期检查空冷器的运行状况，这对于保证空冷器长期无故障运行是非常必要的。

2. 水侧的清洗

2.1 闭路式冷却水回路情况下（例如中央冷却系统），所使用的水应为洁净的淡水，故在形成保护膜后，通常无需清洗，如果发生了水回路的污染，有必要立即清洗水侧，同时必须换水。

2.2 开放式冷却水回路情况下（例如弦外冷却系统），水侧的清洗周期根据使用的海水水质状况而定，GEA 推荐新空冷器使用 3 个月后要进行首次清洗，之后根据实际使用情况决定。

2.3 冷却管的清洗方法：机械清洗、水力清洗和化学清洗

2.3.1 机械清洗是通过与此型号相适应的带柄的尼龙清洗刷来进行的（每套主机空冷器均配备有清洗刷）。机械清洗可以在不挪动空冷器的情况下进行，也可以把空冷器拆卸下来进行。在清洗时，至少要卸下一个端盖。

2.3.2 管子需要逐根刷洗，冲去污物直到没有一点残留物。清洗完毕后，更换新密封垫并重新装上端盖，再注入洁净水排气。

2.3.3 水力清洗时要将空冷器卸下进行。建议用特别喷嘴（直径 φ3mm)的高压喷枪来清除冷却管内的沉积物，压力推荐用 6MPa～8MPa，注意冷却管两端均要敞开。

GEA Industrial Heat Exchanger Systems (China) Co., Ltd
No.8 Yangtian Road, Jiujiang Economic Development Area, 241007, Wuhu, Anhui, P.R.China
Tel. +86 553 5951222, Fax. +86 553 5842870, www.gea-ihe-china.geagroup.com

2.3.4 如果机械或水力清洗不成功，则要求进行化学清洗，化学清洗应由能胜任的公司进行，此方法要特别注意的是所使用的清洁剂应对冷却管材料无腐蚀性，并且冷却系统不得有任何清洗残留物，以利于形成新的保护膜。

3. 气侧的清洗

3.1 气侧的清洗应尽早进行，以避免散热翅片上聚集腐蚀的沉积物，如果这些腐蚀性的沉积物残留在管、片上一段时间以后，其中的一些物质就会与冷凝水反应，形成腐蚀性化合物，会对空冷器芯以及扫气箱产生腐蚀。

3.2 水力清洗：空冷器被拆卸下后，用水力清洗是很有效的。在距散热片 2 米处，用 0.2～0.4MPa 的水垂直冲洗冷却水管，喷射水流应与散热片平行，注意不得压倒翅片（散热片）。

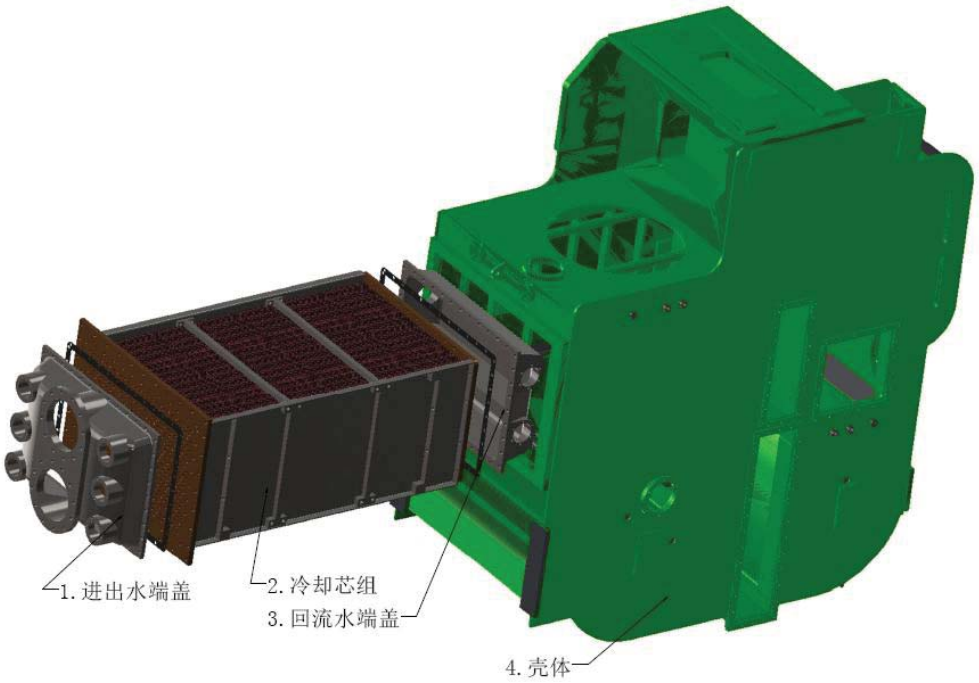
3.3 化学清洗：我们建议在空冷器拆卸下来后对空冷器气侧进行化学清洗。使用化学品清洗时，应由胜任的公司进行，此方法要特别注意的是所使用的清洁剂应对翅片材料无腐蚀性，必要时用压缩空气吹干翅片。

3.4 主机上一般都配有专门的清洗喷淋系统用于主机空冷器气侧的清洗。

4. 空冷器防蚀锌块的检查和维护

定期检查主机空冷器的运行状况对于日常船舶管理比较重要，因为空冷器的工作效率会直接影响主机工作效率。

4.1 空冷器的防蚀锌块的安装位置位于空冷器前、后端盖内部循环水室中。前端盖上的防蚀锌块盖板为矩形（或圆形），后端盖上的防蚀锌块盖板为圆形。防蚀锌块通过螺栓安装在盖板上，然后盖板通过螺栓安装在前、后端盖上，通过空冷器内部循环水室循环，作为阳极，可以保护铸件内腔，减轻海水对空冷器本体的腐蚀，尤其是铸件内腔的腐蚀。



主机空冷器拆解示意图

4.2 GEA 空冷器在设计时就已经考虑到防蚀锌块的用量，一般工况下，空冷器内部的防蚀锌块设计尺寸以及重量可以满足一年的防腐蚀要求。但是由于海水冷却环境复杂，各个海域的腐蚀情况不同，实际腐蚀情况可能和理论工况不一致。GEA 建议运行中的空冷器每半年（6 个月）检查一次防蚀锌块的腐蚀情况，必要时进行更换（每台空冷器均配有用于更换的备件锌块）。

4.2.1 如果防蚀锌块被腐蚀的速度较快，一般可通过加大锌块使用量来解决。具体解决方案应根据实际不同的工况、不同的空冷器型号，建议咨询厂家已得到更好的解决方案。

4.2.2 如果防蚀锌块被腐蚀速度较慢，则建议适当延长锌块的检查周期，具体可由实际情况判断，但最好不要超过一年（12 个月）。

4.2.3 对于防蚀锌块被海水腐蚀速度较快的工况，在检查锌块腐蚀情况的同时，建议同时检查冷却海水输送管道以及其他直接与海水接触的部件是否被腐蚀，做到提前预防与处理，确保整个冷却系统的稳定运行。

4.3 防蚀锌块的拆检方法及注意事项

4.3.1 拆检防蚀锌块时，通过拆卸前后端盖上面的防蚀盖板来观察防蚀锌块的被腐蚀状况，如果目测防蚀锌块被腐蚀面积超过 2/3，建议更换新的防蚀锌块，以确保其他部件不被腐蚀。

4.3.2 拆检防蚀锌块时应注意防蚀盖板上螺栓的拆解和拧紧都应缓慢进行，防止过于用力造成铸件上螺纹孔的损坏或者螺纹磨损，进而影响水腔密封。GEA 建议防蚀盖板上螺栓的拆解和拧紧时都避免使用气动或电动扳手等，防止力量过大引起部件损伤。安装防蚀盖板上的螺栓时，应先用手将螺栓拧入螺纹孔并手动旋转几圈，确保螺纹之间正确咬合，然后逐步拧紧。拧紧时应注意对称原则进行。

4.3.3 建议拆检防蚀锌块盖板的同时，应观察空冷器端盖水腔内部是否有异物、杂物进入，防止异物堵塞冷却管，以及损害空冷器工作效率。如果发现空冷器端盖水腔内部有异物，及应立即检查弦外冷却水进水口的过滤装置是否完好。

4.3.4 在维护保养空冷器的过程中，请穿戴好必要的防护用具。

金船

JC 辅助鼓风机
AUXILIARY BLOWER

大连金船空调风机有限公司
DALIAN JINCHUAN AIR-CONDITIONER BLOWER CO., LTD.

简 介

大连金船空调风机有限公司地处辽东半岛之峰，东靠黄海，哈大公路，西临渤海，沈大高速公路。距沈大高速公路只有100米左右。

大连金船空调风机有限公司建于1980年，厂区占地面积8000平方米，建筑面积6000平方米。

我厂是为沪东造船集团、大连船用柴油机厂、上海船厂、宜昌船舶柴油机厂制造的出口万吨轮和舰艇配套的风机专业厂，其主要产品：船用辅助鼓风机、船用排气阀研磨机、船用翻转工具、船用操纵台，因制作工艺先进，产品质量过硬，成为中国船舶工业集团和中国船舶重工集团定点配套厂，获英国劳氏船级社的质量认可，因此在国际、国内的造船行业的风机配套上，有一定的知名度。

我厂的宗旨是，重合同，守信用，售后服务保证用户满意。让我们携手合作，共图繁荣，共同进步。

BRIEF INTRODUCTION

Dalian Jinchuan Air-conditioner Blower Co., Ltd. located to Liaoning eastern peninsula, it stands by Yellow Sea and Hada high speed way at east, Bohai and Shenda high speed way at west. The plant has only about 100 meters apart from the Shenda high speed way.

Dalian Jinchuan Air-conditioner Blower Co., Ltd. establised in 1980, it occupies 8000m^2 and has 6000m^2 of building area.

Our plant is special works for manufactureing the marine fans. Which installed them on various export ocean-ship and naval vessels built by Shanghai hudong Heavy Machinery, Dalian Marine Diesel Works, Shang Chuan Diesel Co., Ltd., Yichang Marine Diesel Engine Plant. The major products as following: marine auxiliary blowers, marine exhaust valve granding mechanes, marine turning tools, marine control consele. Our plant become the appointed equipment plant by CSSC and CSIC due to the advanced processing workmanship and perfect product quality, and the product already approved by LR Society. Therefore, our plant has some well-known at fans equiped of shipbuilding in home and abroad.

Obide by contract, attach importance to trustworthiness, guarantee the customer satisfactory in after-sale service area. Which is our plant purpose.

Let's corporation hand in hand, flourishing and progress together.

JC A TYPE AUXILIARY BLOWER MAINTENANCE INSTRUCTION

The auxiliary blower type JC developed by our plant is a fully welded centrifugal fan designed for the capactities and pressures required for operation in connection with discharge scavenge air for B&W and SULZER constant pressure main diesel engines and are to be fufill the requirements of various classification society.

Description:

JC type auxiliary blower can be specially adapted for all installtion requirements and operation condition of main engine.

There are two forms to be made, namely.

Form A: provided with a single discharge opening of scroll casing.

Form B: provided with three discharge opening of scroll casing.

See Fig 1

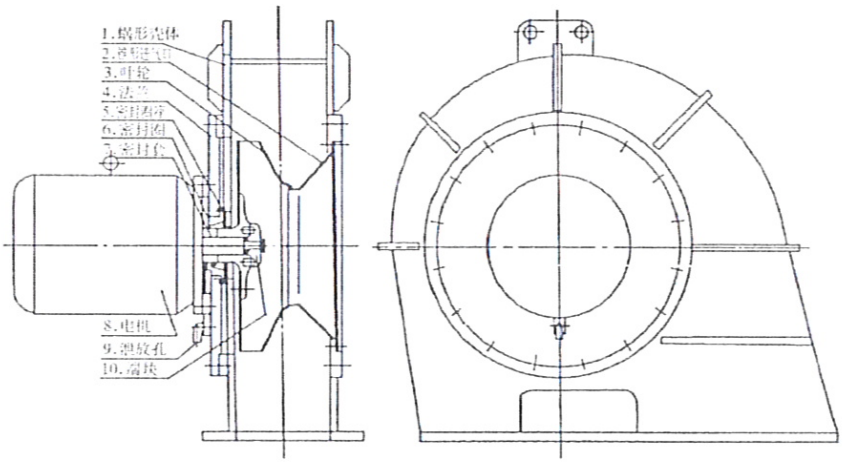


Fig 1 JC A Type Auxiliary Blower

Key to Fig. 1,2and3 .

1. Scroll Casing
2.Inlet Cone
3. Impeller
4. Flange
5. Seal Seat
6. P/S Seal ring
7. Seal sleeve
8. Motor
9. Leakage Hole
10. End piece

From our delivery program, the auxiliary blower type JC are to be graded on impeller out diameter with 60,57,55,53cm. In each grade the width of impeller from size 40 to 90mm with dividing rate in 5mm.

It all size will be met requirements capacity of main engine from cyl. size 80mm to 35mm.

The designation of an auxiliary blower is marked in a name plate JCXX/XXA(B).
Where numerator XX designates the impeller diameter in cm, and denominator XX designate the width in mm. A or B denotes form of the auxiliary blower.

For example, an auxiliary blower is denoted JC 57/60 B on name plate that means the auxiliary blower impeller dia. is 57cm, and width is 60mm, and provided with three discharge openings scroll casing.

The impeller is made from low carbon steel plate and has a backward blades ensuring better efficiency, short starting time and the power consumption curve has a level line on the outer piece. Correspondingly, motor size can be selected with only minimum addition of safety for the capacity.

The motor size are also to be met when the running engine scavenge air density is up to 2.1kg/m^3 or 1.6kg/m^3 according to the engine type.

The driving motor type B5 is to be used and coupled directly to the flange 3 of auxiliary blower. The impeller is to be mounted on the motor shaft. See fig. 1.

Seals

The blower seal construction as shown fig. 2

The special element P/S seal may be permitted a little air and oil to leak. The leakage hole 9 will be acted as a inspect hole to see the P/S seal whether in working or assuring that even a destruction of the P/S seal occurred, and the blower still can continue working.

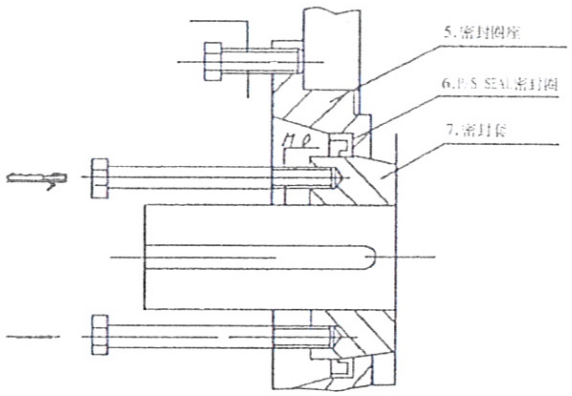


Fig 2 P/S-Seal Construction

Maintenance

The Blower must be stopped when vibration occurred, otherwise it will be influenced the life of motor. Remove the impeller from motor shaft by means of special tool delivered with owns blower, check the dynamic balance of impeller, see fig. 3

The auxiliary blower motor maintenance based on demand of electric motor.

The inspection should be carried out often whether the oil or air leaked out from the hole G3/8".

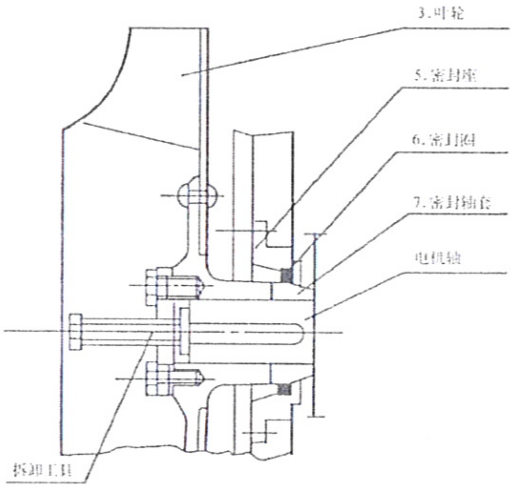


Fig 3 Withdrawing Impeller

Change of p/s seal

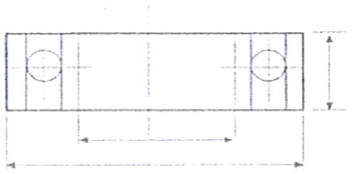
When the p/s seal damaged, the change process is to remove the impeller from motor shaft by means of special tool delivered with auxiliary blower, two M10 × 50 bolts is to be screwed on the shaft sleeve 12 for withdrawing, to screw out the seal seat 11 by means of two M10 bolts.

The new p/s seal ring must be carefully and evenly to press in the seat.

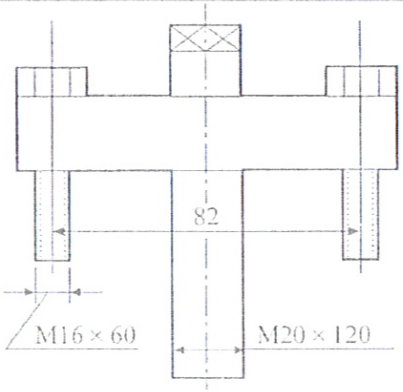
The seal seat 11 should be gone to the flange 3 prior to mounting of shaft sleeve.

备件和工具
Spare part and Tool

A、备件
Spare part

备件名称 Article	外形图 Outline	数量 Quantity	备件用于鼓风机电机 Spare part for Aux. Blower Elec. Motor
滚珠轴承 Ball bearing		1/Motor	注：主机厂提供 Supplied by engine plant

B.工具
Tool

备件名称 Article	外形图 Outline	数量 Quantity	备注 Remarks
风机叶轮 拆卸工具 Impeller dismantling Tool		1	

JC型辅助鼓风机
维护保养说明

JC型辅助鼓风机是本厂设计的一种全焊接结构的离心式鼓风机。它的工作流量及压力的设计，完全满足各B&W和SULZER型低速二冲程柴油机主机定压扫气系统的要求，并符合各船级社的要求。

JC型鼓风机的规格、种类及结构简介

JC型鼓风机共有二种基本形式：一种为A型，其蜗壳为单出口的，见图1；另一种为B型，其蜗壳为三出口的，见图2

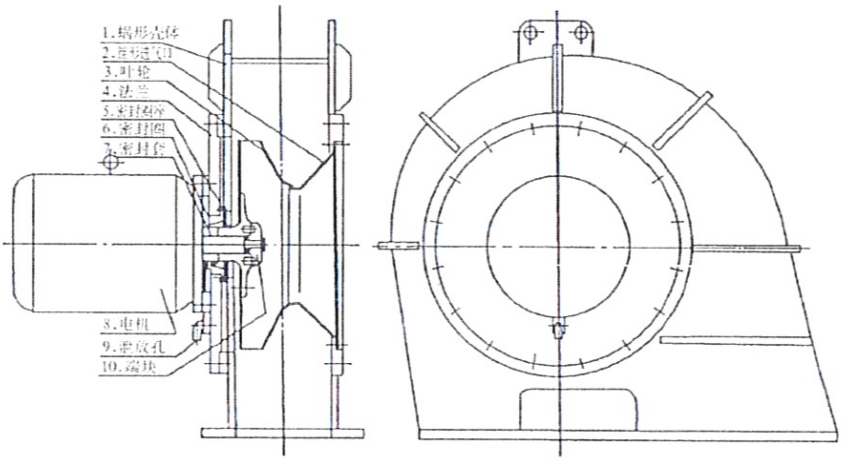


图1 JC A型辅助鼓风机图

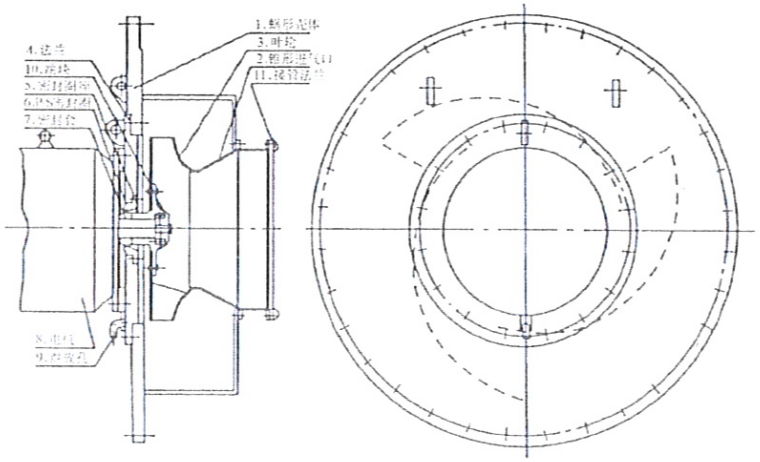


图2 JC B型辅助鼓风机图

JC型系列鼓风机的规格，从外径上分有60、57、55、53四档。每档叶轮直径其出口宽度，从40mm至90mm，每隔5mm有一分档。因此，JC型系列主机辅助鼓风机完全可以满足从80至35mm缸径以内的各种主机的要求。

JC型风机的典型标志为JCXX／XXA(B)；分子为叶轮直径标识，分母为叶轮出口宽度，A标示该风机蜗壳为单出口，如标B则该风机的蜗壳为三出口。其安装尺寸完全符合主机的要求。

例如：一辅助鼓风机在其铭牌上型号处标有JC 57／60B，则该辅助鼓风机叶轮直径为570mm，出口宽度为60mm，蜗壳为三出口的。

蜗壳为三出口的辅助鼓风机，端部有一块较厚的圆钢板，它亦作为扫气箱的端盖用。单出口的辅助鼓风机，在出口处有一厚法兰，它将整台辅助风机牢靠地安装于主机上。

叶轮是用低碳钢焊接而成，叶片为后倾式板状叶片，以保证有较高的效率及功率消耗曲线的倾斜。叶轮功率的吸收能满足于主机扫气箱内空气密度为2.1kg／m^3(B&W型主机)和1.6kg／m^3(SULZER 型主机)对电机功率的配置。风机叶轮的设计有较小的转动惯量及优良的气动性能。具有起动电流小，起动快等特点。

辅助鼓风机的电动机，一律采用B5型。它直接装于辅助风机的法兰上，见图1、图2；叶轮则直接装于电机轴上。

风机的密封

JC型辅助鼓风机的密封结构见图3其中的密封为P/S型特种密封圈，允许少量空气和油的泄漏。件号9为检查孔检查密封圈是否损坏。密封圈损坏后在更换前鼓风机依然可以正常运转。

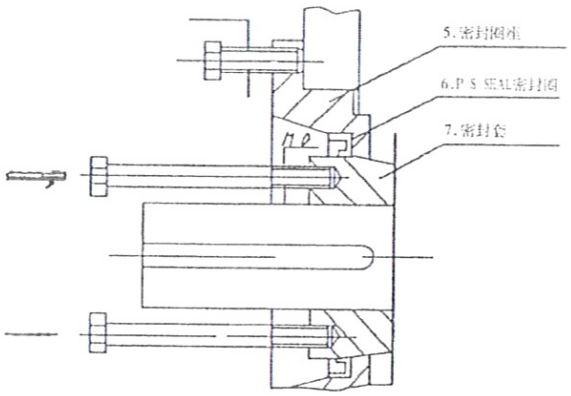


图3　密封结构图

使用与维修

在鼓风机运转时若产生震动，必须立即停止工作并对叶轮进行检查，否则会影响电机的轴承寿命。叶轮的拆卸请使用本厂提供的专用工具，使用方法见图4。经过修理后的叶轮，必须进行动平衡以保证风机的平衡工作。

电动机的使用与维护请按照电机的要求执行。

辅助鼓风机在使用过程中应经常地从在电机法兰上的G3／8″孔中检查有无空气及油泄漏出。

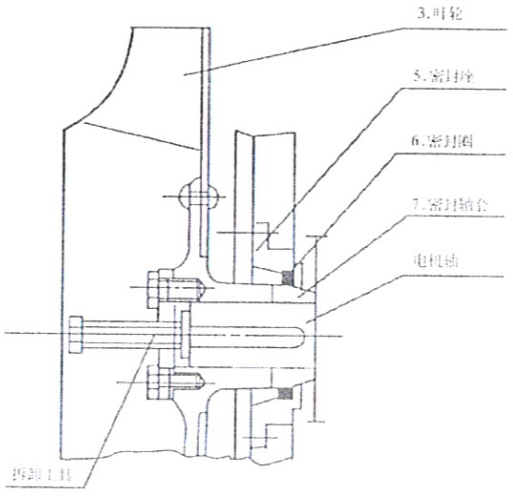
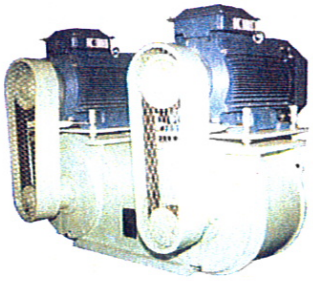
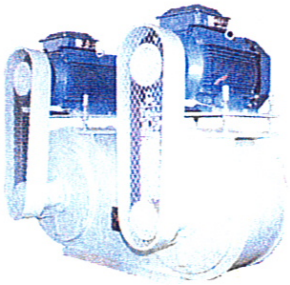
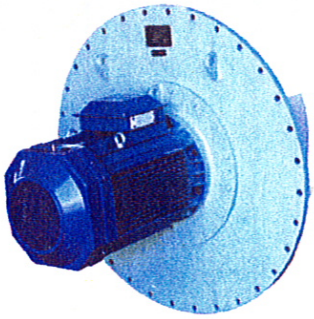
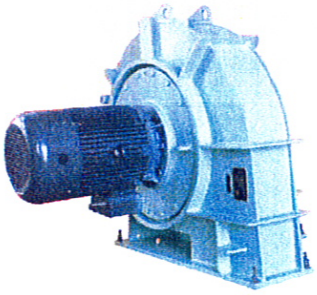
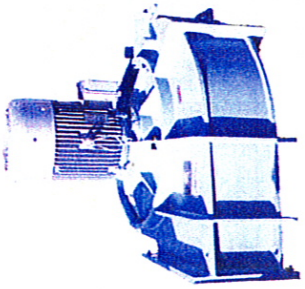
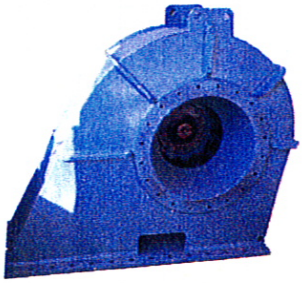
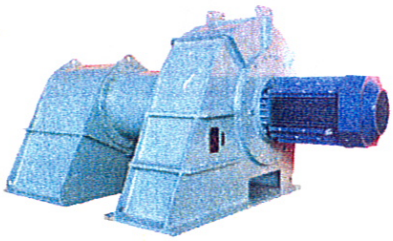
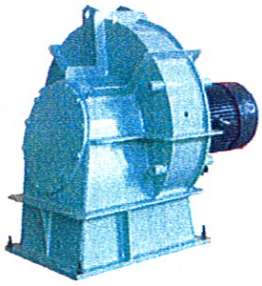


图4　叶轮拆卸图

密封圈的更换

密封圈在使用过程中不要随意拆卸，这样很容易使密封圈损坏。更换密封圈时，首先用随机提供的拆卸叶轮的工具将叶轮取下，然后用 2 个M10×50的螺栓拧在密封轴套12上将密封轴套轻轻取出。最后，再用 2 个M10螺栓拧入密封圈座的顶螺栓孔内，将密封圈座顶出座孔取下。新的密封圈装入圈座必须在四周很均匀压入，因此建议用外径为109×5的钢管放在密封圈上，再用锤均匀敲入。密封圈座必须首先装到鼓风机上，然后再装入密封轴套及叶轮。

 6S50MC-C	 7S42MC-C	7S60MC-C
 7S80MC-C	6S35MC-C	6S60MC
5S50MC	 6RTA48	 6RTA48TB、58TB、68TB
 6RTA52	 6RTA62U	 MU60-37/21M

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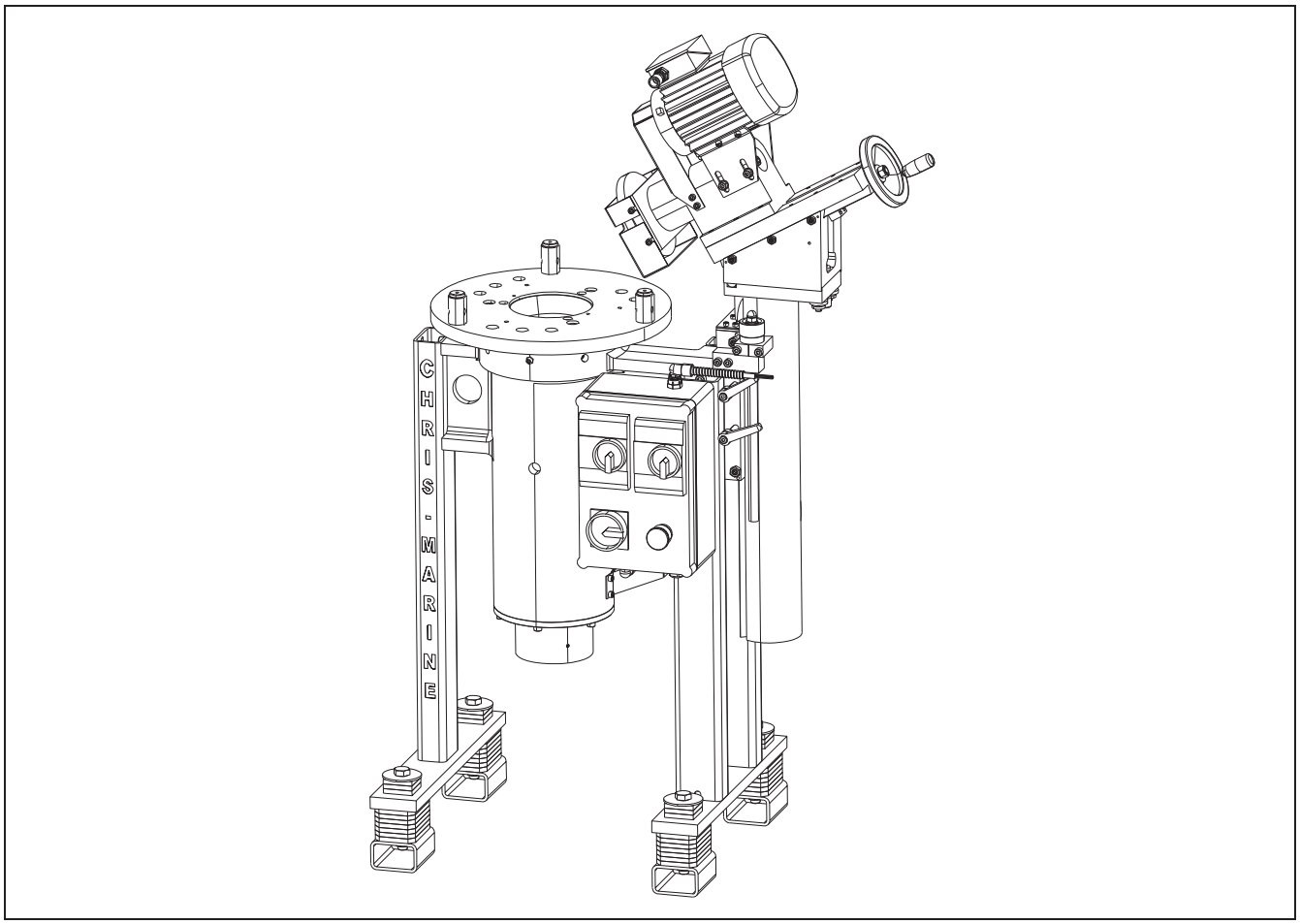
EXHAUST VALVE AND VALVE SEAT GRINDING MACHINE TYPE VGT

INSTRUCTION MANUAL for MAN-B&W 2-STROKE DIESEL ENGINES



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Doc. No.: I-140-01-E

Rev. d

2013-06-28

Preface

The equipment described within this manual is designed and manufactured by CHRIS-MARINE AB, Malmö, Sweden.

The companies principal activities are in the development and production of grinding machines and tools for use in maintenance of diesel engines in the marine, off-shore, power generation and allied industries.

Today's machines are the product of experience and R&D since 1962. All Chris-Marine machines have of proven performance and are continuously updated to meet the lastest standards and new demands of diesel technology.

Chris-Marine reserve the right to make improvements and all necessary changes to the equipment and it's technical documentation. Drawings and diagrams contained within this manual are intended for illustrative purposes only and are not to scale.

Chris-Marine's liability for damages will only be considered, and are strictly limited to use of the equipment and grinding wheels are operated in accordance and compliance with the appropriate Chris-Marine instruction manual.

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1. GENERAL INFORMATION

1.1 EU declaration of conformity

CHRIS-MARINE AB	Dokument/ ID: dc-vgt	
	Datum/ Date: 00-12-07	Rev: 0
	Sida/ Page: 1	av/of: 1

Declaration of Conformity

According to the Machinery Directive 89/392/EEC, Annex II A

The Manufacturer:

Chris-Marine AB
Box 9025
S-200 39 MALMÖ
Sweden

Phone: +46 40 671 2600
Fax: +46 40 671 2699

declare that the following machinery:

Valve Grinding Machine type VGT electric driven
Serial No.1

Manufacturing No.

a/ is manufactured in conformity with the Svenska Arbetarskyddsstyrelsens Författningssamling AFS1993:10. This law conforms with the COUNCIL DIRECTIVE of 14 June 1989 regarding harmonisation of member states legislative system concerning machinery (Machinery Directive 89/392/EEC, and amending Directives 91/368/EEC and 93/44/EEC when applicable), with particular reference to Annex 1 concerning the essential health and safety requirements relating to the design and construction of the machinery.

b/ is besides the provision under a/ manufactured according to following directives and harmonized standards:

93/68/EEC

Place: MALMÖ, Sweden

Date:

Signed on behalf of:

.....
enpowered signature and Name in block letters
Per Svensson

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BOX 9025
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Sweden
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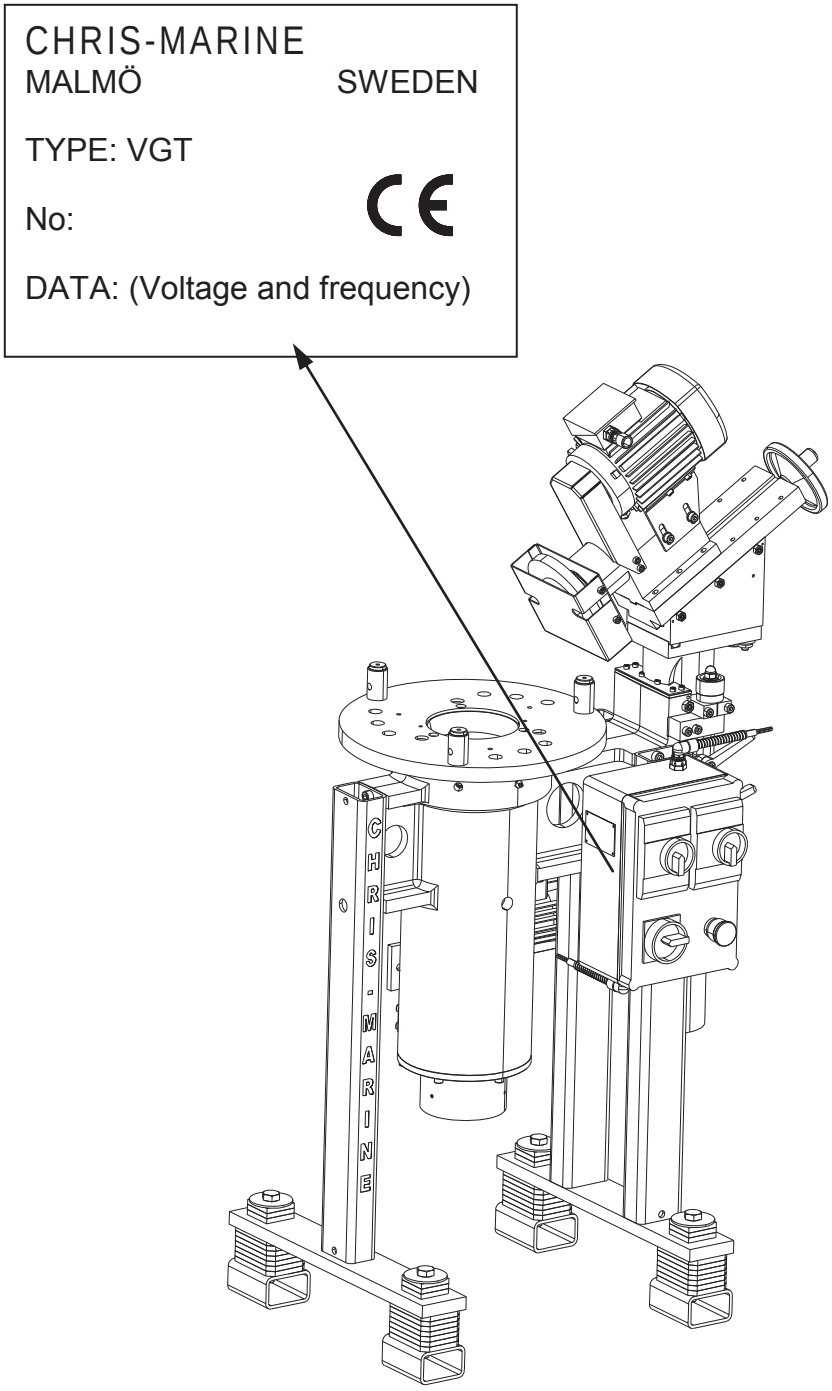
1.2 Location of Nameplate

This instruction applies to machinery with details as shown in the nameplate illustrated below.

In communication with Chris-Marine and their representatives, always state machine type and serial No of the machinery.



Location of nameplate for the VGT valve spindle and valve seat grinding machine

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1.3 Safety information

1.3.1 Manual topics

This manual must be carefully studied before using the equipment. It will help you to use the equipment to its full capacity and avoid costly mistakes. All safety instructions must be complied with. Failure to do so may result in personal injury or damage to equipment and the environment.

The Instruction Manual is intended primarily for the operator of the valve spindle and valve seat grinding machine and describes the using it.

The manual is divided into four sections, 1) Introduction with general information (this section), 2) a descriptive section, 3) an instructive section and 4) list of parts.

- **Introduction:**

  These pages consisting of *General Information* introduce Chris-Marine equipment, with its nameplate and safety information. It emphasises precautionary measures and describes the safe working practices as described in the instructive section of the manual.

- **Descriptive information:**

  The descriptive information consists of the section *Description*. It provides an overall description of the equipment, its technical data and performance, as well as its principal technical functions.

- **Instructive information:**

  The section *Main Parts and Controls*, *Installation, Grinding Preparations* , *Valve Spindle Grinding and Valve Seat Grinding* provide instructions and information on handling and use of the equipment. The sections *Trouble Shooting, Maintenance* and *Reminders* provides information on the efficient use, and servicing of the equipment ensuring it's long and trouble free operation

- **List of parts:**

  This section consists of a reference sheet and a list of parts. The reference sheet includes the serial number of the machine and should always be used when ordering parts. Addresses of Chris-Marine representatives can be found at the end of list of parts.

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1.3.2 Safety Measures

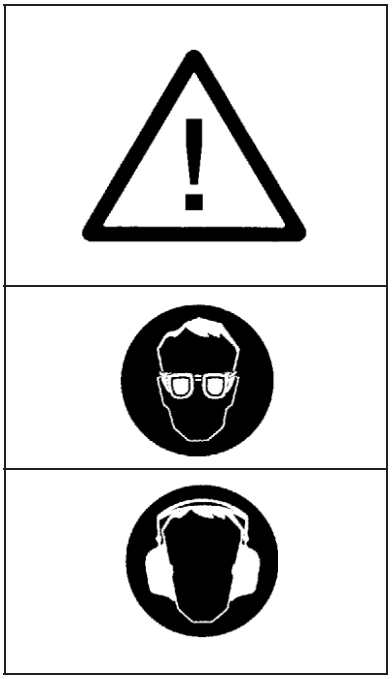
Transportation and Installation

- Ensure that the equipment is transported safely, and never lift loads above people.
- Only use undamaged and correctly sized lifting equipment.

Use of the machine

- Take all necessary steps to prevent and protect against grinding wheel breakage or damage.
- Make sure the correct type of grinding wheel is used. For part no., see Reference Sheet.
- Make sure the grinding wheel is not cracked by performing the ring test: use a non-metallic implement, gently tap the wheel at each side while holding the wheel in the centre. An undamaged wheel will omit a clear tone. If cracked, there will be a dead tone.
- When idle, or stored, all grinding wheels should be protected from the effects of moisture, humidity and fluids, as these may be absorbed and cause the grinding wheel to become unbalanced.
- Grinding wheels must not be subjected to freezing temperatures.

- Always use safety goggles, breathing filter and hearing protection when the grinding machine is in operation and while dressing the grinding wheel.
- Keep away from the rotating grinding wheel.
- Keep away from the extended radius of the rotating grinding wheel during starting.
- Do not wear loose fitting clothing i.e. sleeves, ties etc. or hair styles which may become entangled in the machine.
- Use proper protection against glowing grinding particles whilst grinding and keep inflammable materials at safe distance at all times.
- Keep away from rotating parts while the machine is in operation.



Other warnings

- Always turn off the electric power supply when the operation is completed.
- Disconnect the main electric supply from the machine during maintenance.
- Protect the machine by using 16A time fuse only.
- Do not clean or spray internal parts of the machine with water.

IN CASE OF ANY DOUBT, CONTACT YOUR CHRIS-MARINE REPRESENTATIVE

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1.3.3 Safety Instruction Labels

The safety instruction labels below contain important information concerning risks associated with particular aspects of operation the machine. Chris-Marine strongly recommends that the operator familiarize themselves with the signs.

- Three different levels of safety instructions, as shown below, may be used in the Chris-Marine Instruction Manuals:

Danger!

Risk of serious or fatal injury to personnel

Safety instructions in this group indicate when there is a risk of serious injury or injury that could cause death as a consequence of misuse.

Warning!

Risk of injury to personnel and/or damage of property

Safety instructions in this group indicate when there is a risk of injury or damage to property or the environment.

Caution!

Use the equipment correctly

Safety instructions in the group indicate that there is a risk of injury or damage if the instruction is not obeyed.

FAILURE TO OBEY THE SAFETY INSTRUCTIONS IN THIS MANUAL CAN CAUSE ACCIDENTS, WHICH CAN RESULT IN SEVERE INJURY TO PERSONNEL OR DAMAGE TO PROPERTY OR TO THE ENVIRONMENT.

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2. DESCRIPTION

2.1 Application

The Chris-Marine VGT-type grinding machine is available in a number of versions intended for use on crosshead engine exhaust valves.

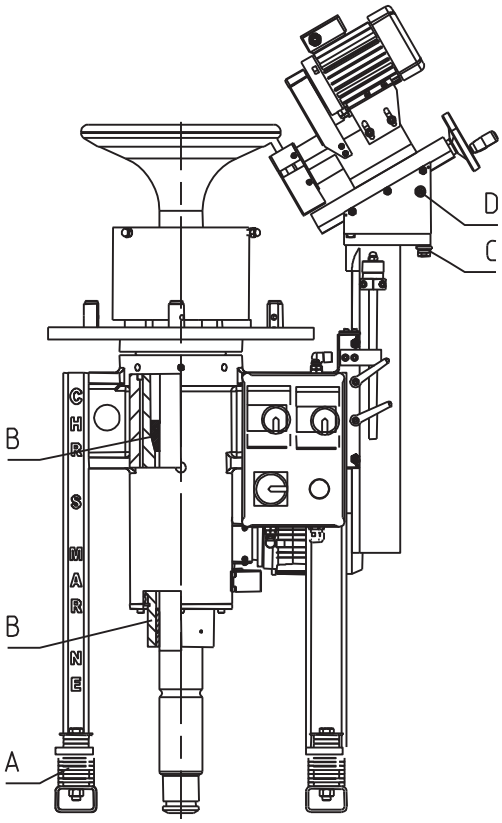
2.2 Features

The grinding machine is electric driven and easy to operate. It is of robust construction and designed as a professional tool for grinding valve spindles and valve seats both onboard and ashore. A high precision grinding spindle, automatic centring and insensibility to vibrations assures a high quality grinding result.

The Chris-Marine VGT features:

- Anti vibration mounts (A).
- Self-centring system for valve spindle and valve seat (B).
- Grinding angles (C) locked in accurate position according to engine builder's requirement.
- Balancing apparatus included (D).
- Diamond dresser for grinding wheel and full set of tools included.

Due to sturdy design and incorporated features, a high quality grinding result is achieved, also under the most demanding operating conditions, as on a ship in service at sea.



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2.3 Technical information

2.3.1 Grinding accuracy

Angle accuracy	±1 minutes
Eccentricity	max 0,02 mm
Ovality	max 0,003 mm
Surface fineness	N5 = Ra 0,5 µm

2.3.2 Technical data

Machine capacity	up to 96 mm valve stem diameter.
Grinding wheel size	Ø 152 x 15 mm.
Normal grinding time	10 - 20 minutes / sealing surface
Weight	250 KGs
Size	H: 1370 - 1700 mm / L: 925 mm / W: 550 mm
Power supply	3ph 220-260 V 50/60 Hz
	3ph 380-440 V 50/60 Hz
Power requirement:	1.3Kw

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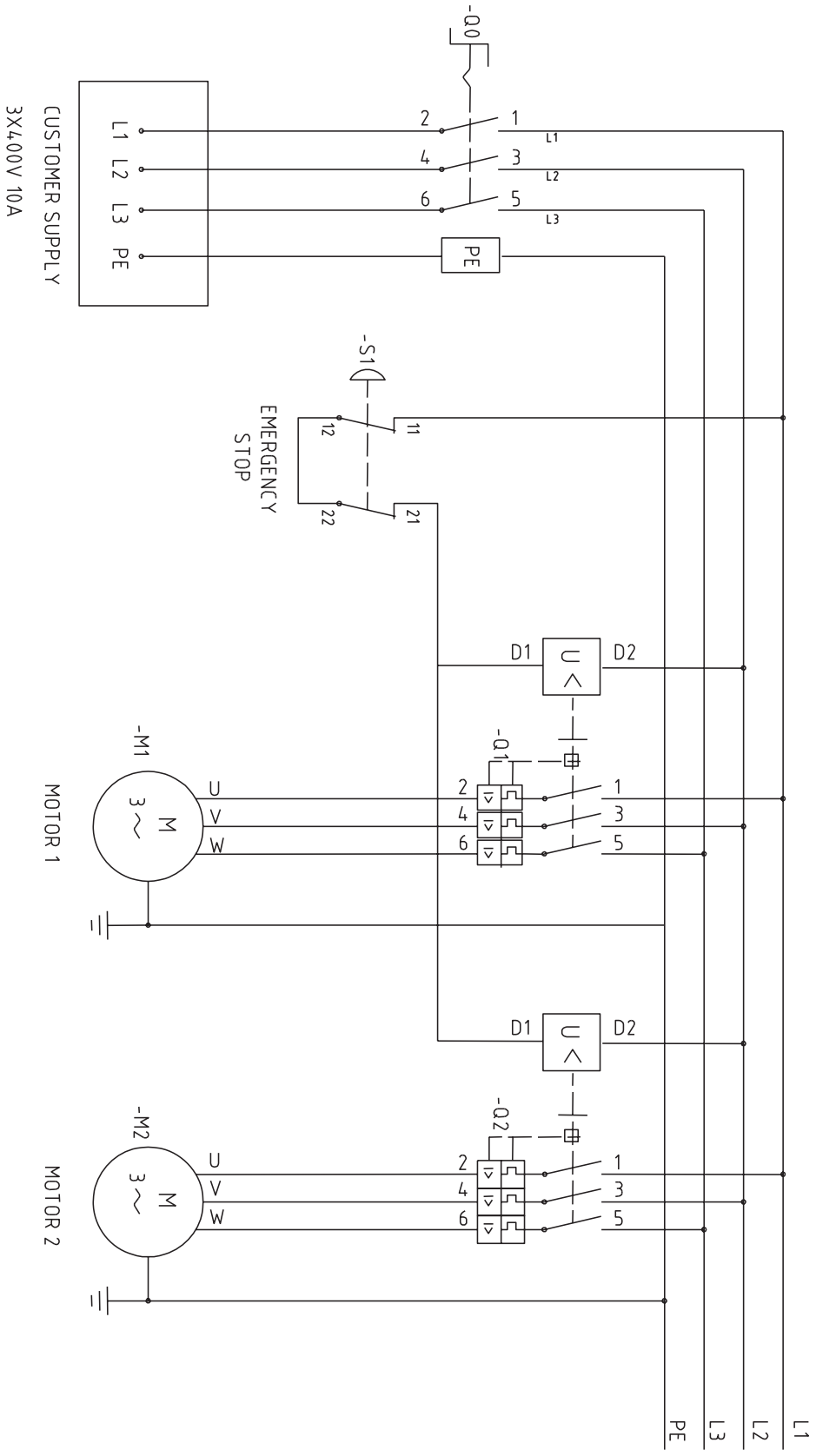
2.3.3 Circuit Diagram



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3 MAIN DIMENSIONS

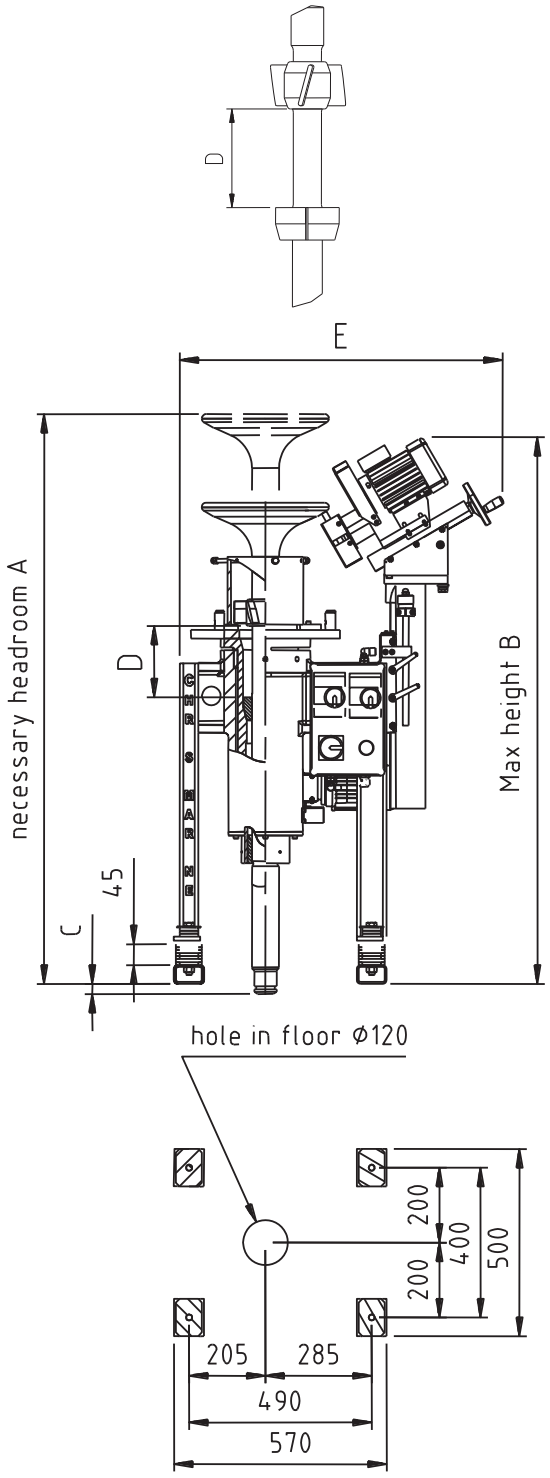
Machine dimensions for different engine types

Engine type	Dimensions (mm)				
MAN B&W	*A*	*B*	*C*	*D**	*E*
L/S 35MC	1795	1476	--	80	844
L/S 42MC	2020	1506	--	129	823
S 46MC-C	2010	1511	--	205	823
L/S 50MC/-C	2135	1523	--	203	840
S 50 ME-B	2260	1525	--	340	850
L/S 60MC/-C	2298	1563	--	185	861
S 60ME-C	2490	1579	70	185	850
S65ME-C	2535	1538	127	188	874
L/S 70MC/-C	2483	1579	3	198	850
S 70ME-C	2660	1579	190	185	850
K/L/S 80MC/-C	2672	1598	110	245	867
S 80ME-C	2852	1598	280	235	867

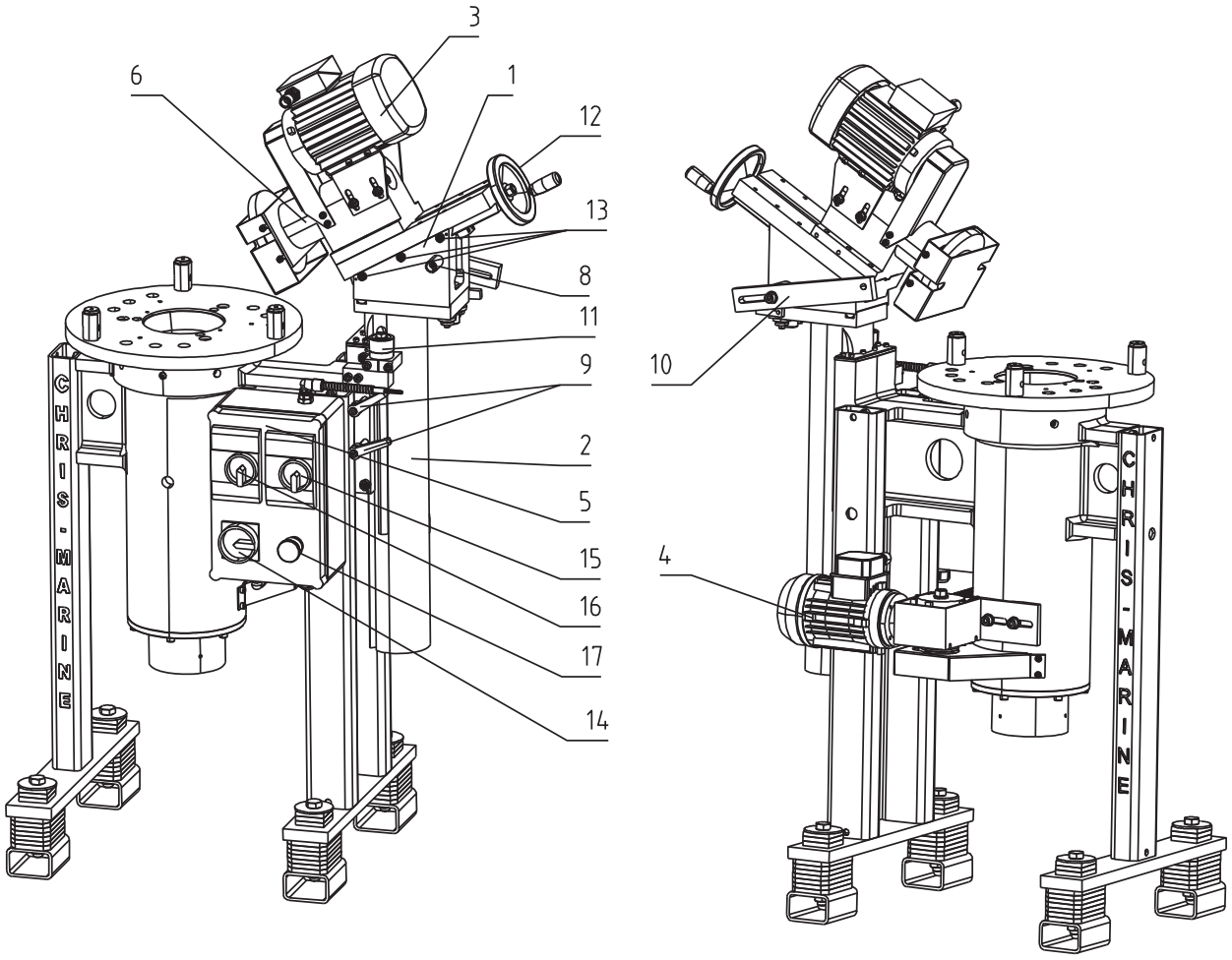
*Distance from valve vane to mounting position of centring cone.

The four damping pads should initially be compressed to a thickness of 45 mm.

Suggested working area 1800 x 1800 mm.



4. MAIN PARTS AND CONTROLS



1 *Grinding head*
2 *Grinding column*
3 *Grinding motor*
4 *Table driving motor*
5 *Control panel*
6 *Grinding spindle*
7 *Tool box*
8 *Balancing apparatus*
9 *Locking handles for height adjustment*
10 *Holder for grinding wheel dresser*
11 *Height adjustment wheel*
12 *Directional feed wheel*
13 *Adjusting screws for grinding head*
14 *Main switch*
15 *Grinding motor switch*
16 *Driving motor switch*
17 *Emergency stop*

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5. INSTALLATION

At delivery, metal parts are coated to prevent corrosion. Before assembling and using the equipment, clean it carefully with a suitable solvent.

5.1 Location of the equipment

Carefully consider where to locate the VGT grinding machine for the most effective and economical use.

- Avoid any area with excessive vibrations.
- Ensure availability of lifting facilities and necessary headroom clearance.
- Cut holes in deck according to dimensions in section 3, or mount the machine on a suitable foundation.
- Mount the grinding machine on the damping pads supplied.
- The supplied mounting brackets can be welded directly to the floor.

5.2 Power connection

1. The machine can before delivery be adapted to different voltages according to customers specification. Available options are:

- 3phase 220 – 250 V 50/60 Hz.
- 3phase 380 – 440 V 50/60 Hz.

With an optional transformer other voltages can also be used.

The power requirement is 1.3 kW.

Note
If the direction of rotation is to be changed on the grinding motor, this must be done by switching two of the phases in the incoming mains wire.
Do not only switch the phases to the grinding motor, as the relationship between the rotation of the grinding motor and table rotation motor must be kept.

CAUTION!

Unintentional start up!

Shut off grinding motor and driving motor (switches 15, 16) in order to avoid unexpected start when the machine is connected to mains.

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6 GRINDING PREPARATIONS

6.1 Replacing the grinding wheel

The Chris-Marine exhaust valve grinding machine is equipped with a pre-balanced grinding wheel mounted on the grinding motor when delivered.

1. Remove screw (28) at the outer end of the grinding motor shaft.
2. Remove the complete assembly of grinding wheel and grinding wheel hub by pulling it by hand from the grinding motor shaft.
3. Split the grinding wheel hub into two halves using pin keys from tool set.

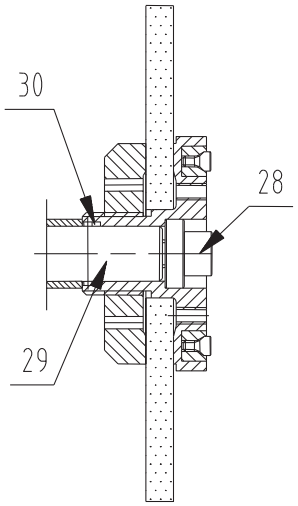
IMPORTANT
The grinding wheel hub is left hand threaded.

4. Fit the new grinding wheel and tighten the hub.

IMPORTANT
The grinding wheel assembly must be firmly tightened.

Before mounting the grinding wheel assembly on the grinding motor shaft, it must be balanced. See chapter 6.2

5. Mount the grinding wheel assembly on the grinding motor shaft (29). Make sure the drive pin (30) in the shaft is aligned with the slot in the grinding wheel hub.
   Use the hexagon nut in the shaft end to counteract when turning the wheel assembly.
6. Tighten the center bolt (28). Do not knock with a hammer on the hub.



Fitting or replacing of grinding wheel

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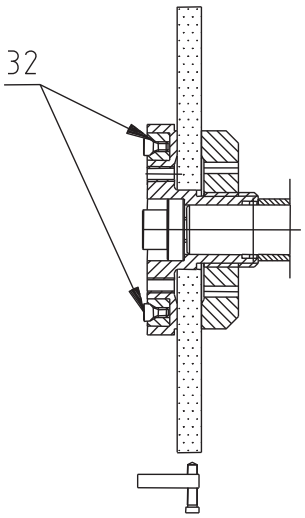
6.2 Balancing and dressing of grinding wheel

IMPORTANT!

When replacing the grinding wheel, or whenever need arises, always balance the grinding wheel.

A new grinding wheel should be dressed until concentric before balancing.



6.2.1 Dressing.

1 Start the grinding motor.

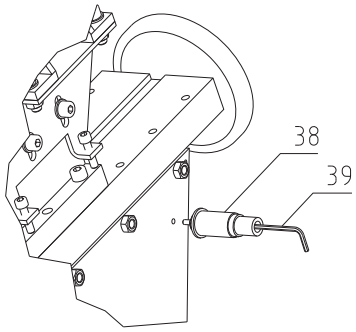
2 Adjust the diamond cutting point. Each cut should be maximum 0.1 mm, which corresponds to 1/8 of a turn of the dresser.

3 Dress the wheel by slowly moving the grinding wheel back and forth over the diamond cutting point.

4 New grinding wheels are slightly off centre, and dressing should be continued until the wheel is concentric.

6.2.2 Balancing equipment

When mounting the balancing equipment (38), which is stored in the tool box, it is important to use an Allen key (39) as shown beside.



6.2.3 Balancing.

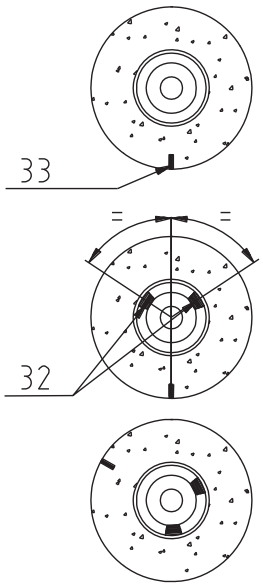
1 Remove the balancing weights (32) and place the grinding wheel on the balancing apparatus.

2 Let the wheel swing back and forth until it stays with its heaviest point downward.

3 Mark this point with a felt tipped pen.

4 Mount both weights symmetrically above the horizontal centreline of the wheel.

5 Adjust both weights symmetrically up or downward until the wheel stays put when placed in any angular position.



The grinding wheel is now balanced.

IMPORTANT!

Vibrations and poor cutting performance could be caused either by a grinding wheel clogged with dirt and residue, or by an unbalanced grinding wheel. Truing and balancing should therefore be done regularly.

7. VALVE SPINDLE GRINDING

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Before commencing work, check the valve spindle according to the instruction from the engine manufacturer.

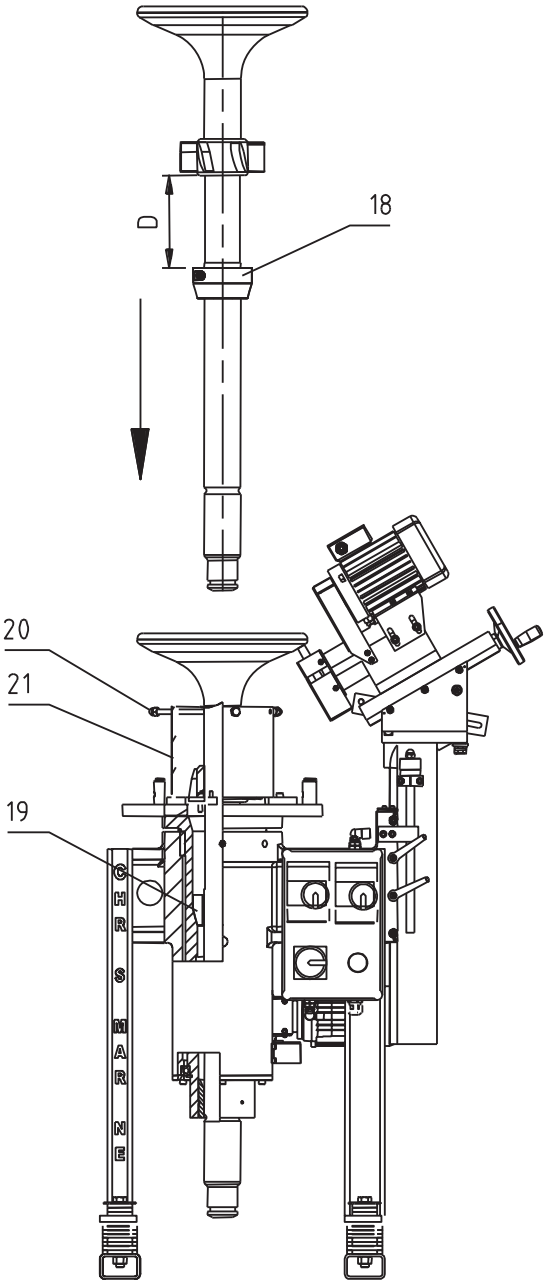
7.1 Centring

The grinding machine has a self-centring system. It is important that surfaces to which the centring relates are undamaged and clean.

1. Fit the centring cone (18) at a position (D) shown in section 3.
2. Lower the valve stem slowly into the hole in the machine until the centring cone lands gently on the centring ring (19).

The valve is now centred.

3. Check with a dial gauge on an undamaged surface on the seat face if the valve is bent.
4. If the engine manufacturer's instructions prescribe a correction of a bent valve, use the stabilising screws (20) on the stabilising support (21) to adjust this. Tighten with a spanner.
5. If a correction not is prescribed, tighten stabilising screws (20) with a spanner without changing the valve position.



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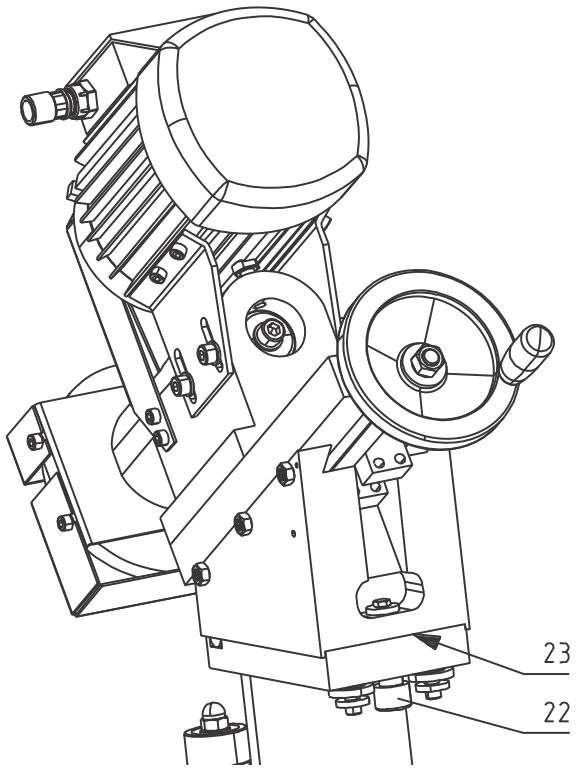
7.2 Grinding head position

At delivery the machine is preset with the angles necessary to grind the valve spindle, and if applicable the valve seat.

For engine types where the valve seat is ground in the machine, the grinding head can be adjusted to the required angles for valve and seat.

- For valve spindle grinding: Turn adjusting screw (22) clockwise until end stop, and tighten slightly. A small clearance between parts at position (23) can be seen.
- For valve seat grinding: Turn adjusting screw (22) anticlockwise until end stop, and tighten slightly. No clearance between part at position (23) can be seen.



7.3 Grinding

WARNING!

Protective accessories.

Always use safety goggles, breathing filter and hearing protection when the grinding machine is in operation.

The grinding procedure described below is especially developed for Nimonic valve spindles When other types of materials are ground, the lubrication with oil described in section 7.3.1, is not necessary.

- Use grinding wheel according to reference sheet in list of parts section. Dress and balance according to section 6.2.

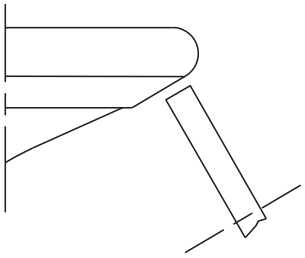
The grinding process is performed in two steps: Coarse grinding to remove material, and fine grinding to provide the required surface finish.

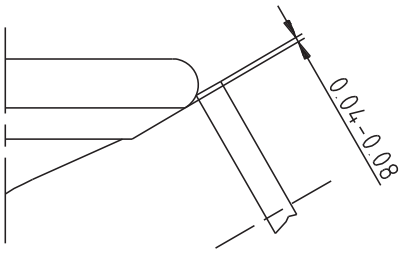
7.3.1 Coarse grinding

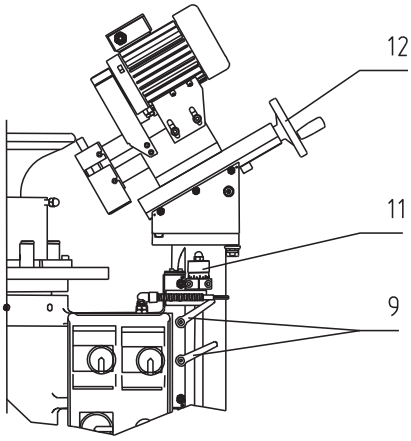
1. Adjust the grinding wheel to a position as close as possible to the valve surface. Unlock handles (9) before feeding. While rotating the valve, find the position where the distance between the surface to be ground and the grinding wheel is smallest. Use a dial gauge if necessary.
2. While rotating the grinding wheel by hand, use the feeding wheel (11) to guide the grinding wheel towards the seat surface. Use a spanner from tool set. One scale division on wheel (11) corresponds to 0.04 mm feeding depth.
3. Upon contact, stop the feed and retract the grinding wheel with the hand wheel (12).
4. When the grinding wheel is away from the seat surface, feed upwards 0.04 - 0.08 mm (1-2 scale divisions), and lock with handles (9).
5. Start the drive motor.
6. Start the grinding motor.
7. Lubricate the valve surface to be ground by brushing with Chris-Marine oil Part no. 99P01. (Only necessary on Nimonic spindles).
8. Feed slowly with the hand wheel (12), approximately 1/8 turn per revolution of the valve, and frequently apply oil with the brush to the valve surface. (Only necessary on Nimonic spindles).
9. Use cutting depths of 0.04 - 0.08 mm. Grinding can be done in both the inward and outward directions.
10. If necessary dress the grinding wheel before grinding. Dressing several times during coarse grinding might also be necessary.

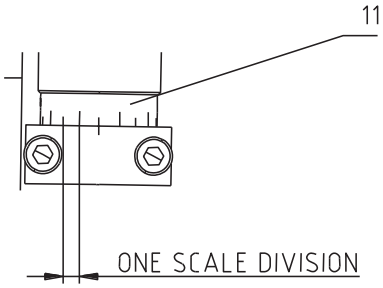
IMPORTANT!

Continuously lubricate the seat face during grinding Nimonic valve spindles.









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7.3.2 Fine grinding

1. Dress the grinding wheel carefully until no deposits can be seen. The final cut should be made in an inward direction.
2. Set the grinding depth to approx. 0.01 mm and lock with handles (9).
3. Lubricate the valve surface in the same way as during the coarse cut.
4. Feed slowly with the hand wheel (12) while frequently lubricating the valve surface. (Only necessary on Nimonic spindles).
5. Grind until the entire valve face is clean and free from spot marks, or as specified by the engine manufacturer. (Only necessary on Nimonic spindles).
6. After grinding, clean the valve.

IMPORTANT!

Continuously lubricate the seat face during grinding Nimonic valve spindles.

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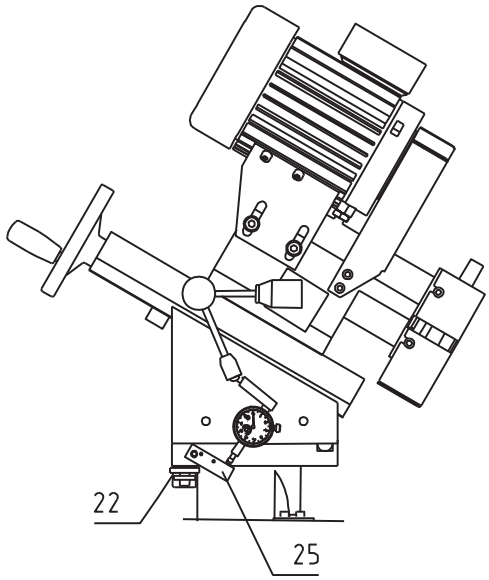
7.4 Valve angle control

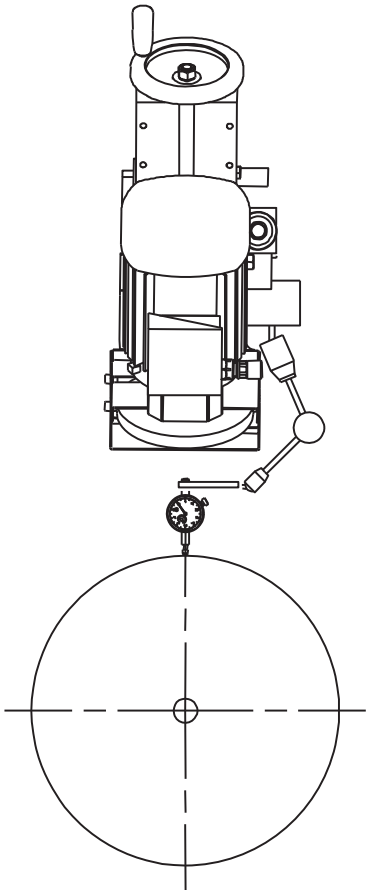
After the valve spindle has been ground, a check of the attained angle is recommended. The procedure for this is described below. The basic angle setting for seat grinding is 30°. If for some reason, this should be checked, a template (25) with the angle 30° ± 0.03° is located on the grinding head.

1. Turn the adjusting screw (22) anticlockwise to valve seat position for the grinding head.
2. Put a dial gauge with magnetic foot holder on the grinding motor or spindle housing.
3. While moving the grinding motor up or down with wheel (12), let the dial gauge follow the surface on the template. The deflection of the gauge should be zero or close to zero for correct angle setting.



The valve angle control is made immediately, after the grinding, with the valve spindle still in the machine.

1. Turn the adjusting screw (22) anticlockwise to valve seat position for the grinding head.
2. Put the dial gauge holder on the grinding motor or spindle housing and the dial gauge on the upper or lower end of the ground surface. It is important that the dial gauge tip is located in the centreline between the valve spindle centre and the grinding motor centre.
3. To avoid influences from clearances in the gauge, move the grinding motor 1-2 mm with wheel (12).
4. Take a reference measurement “A” between the grinding motor slide and a fix point on the machine. (See page 23)
5. Move the grinding motor with wheel (12) until the dial gauge has the deflection stated in table below. (See page 23)
6. Take a measurement “B” and make a calculation “C”=”B”-“A” (or “C”=”A”-“B” if “A” is larger then “B”). (See page 23)
7. If the “C” value is between the max and min values in the table, the valve angle is within limits. (See page 23)



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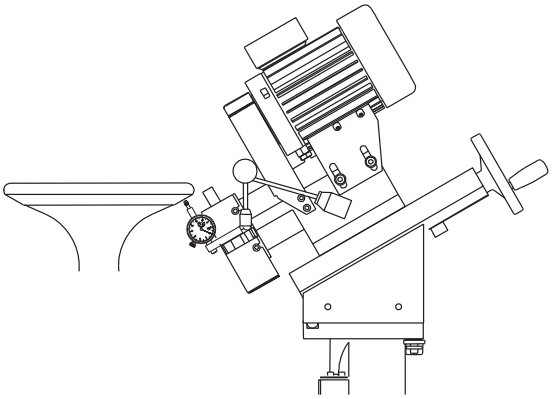
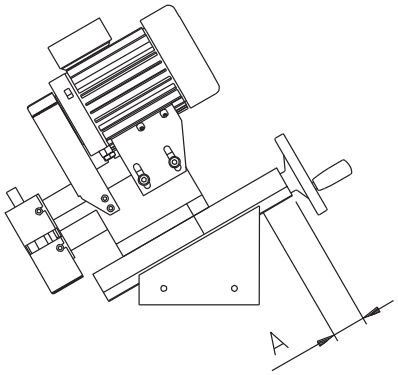
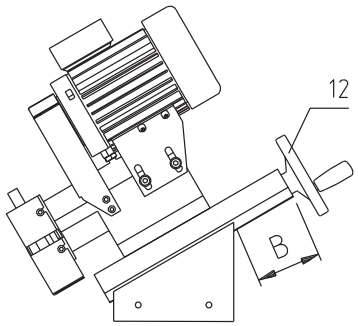
Engine type	Valve spindle angle	Dial gauge deflection	Measuring length “C” Min	Max
35MC	30.3° +0.1’ 0’	0.1 mm	14.3 mm	19.1 mm
42MC	30.3° +0.1’ 0’	0.1 mm	14.3 mm	19.1 mm
46MC	30.4° +0.1’ 0’	0.1 mm	11.4 mm	14.3 mm
50MC Nimonic	30.4° +0.1’ 0’	0.1 mm	11.4 mm	14.3 mm
50MC Steel	30.5° +0.1’ 0’	0.15 mm	14.3 mm	17.2 mm
60MC	30.3° +0.1’ 0’	0.1 mm	14.3 mm	19.1 mm
70MC	30.4° +0.1’ 0’	0.1 mm	11.4 mm	14.3 mm
80MC	30.5° +0.1’ 0’	0.15 mm	14.3 mm	17.2 mm
90MC	30.7° +0.1’ 0’	0.2 mm	14.3 mm	16.4 mm





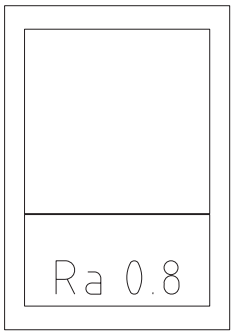


If a change in the specified valve spindle angle is made by the engine manufacturer later on, this new angle can be ground with a change in the grinding head position. For information about how to change the grinding head position, contact Chris-Marine in Sweden.

7.5 Surface roughness

The surface roughness requirement on the ground surfaces of both spindle and seat is max Ra 0.8 (N6).

To make a check without having a complicated instrument, a template with a specified surface roughness is included in the machine tool set.



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8. VALVE SEAT GRINDING

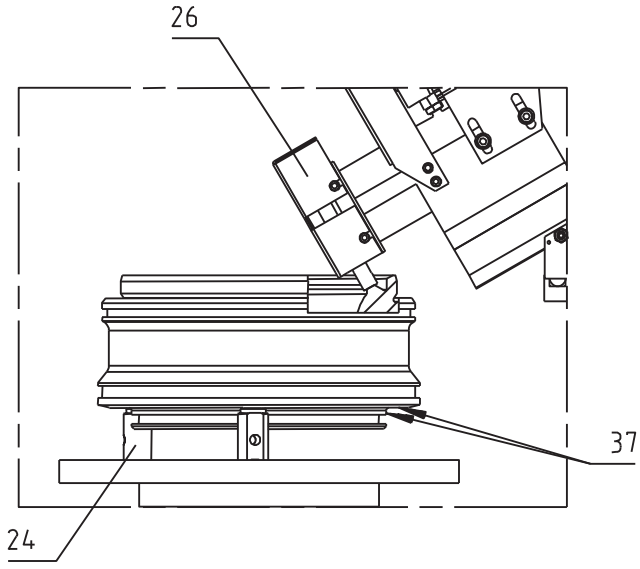
Before commencing work, check the valve seat according to the instruction from the engine manufacturer.

8.1 Centring

The grinding machine has a self-centring system. It is important that surfaces (37) to which the centring relates are undamaged and clean.

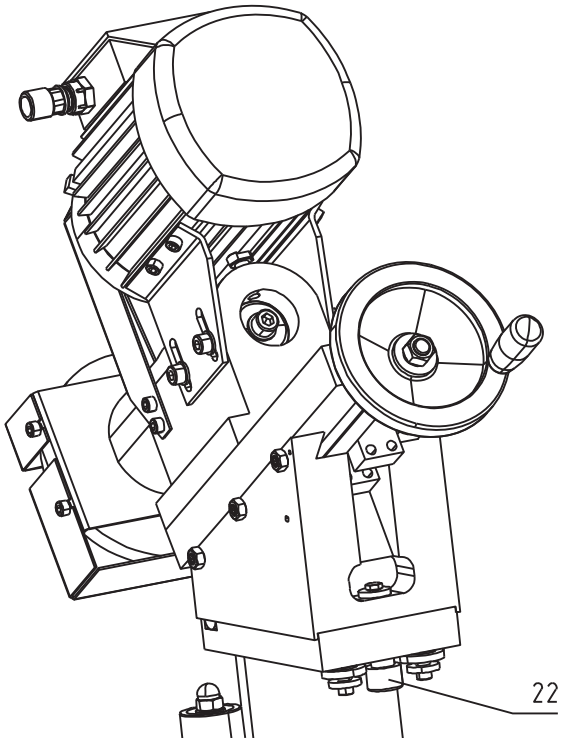
1. Turn the grinding wheel protection (26) 180°, and remove the valve stabilising support (21) shown in section 7.1.
2. The centring pins (24) are either mounted on the circular table or stored in the tool box. A digit (1, 2, 3) is marked on the pins and on the table. Mount the pins in the hole which corresponds to the digit on the pin.
3. Turn the flat surface of the centring pins towards the center of the circular table. The centring pin positions are marked on the circular table.
4. Place the bottom piece on top of the pins (24). Turn the pins so that the cylindrical surface of the pin is facing the valve seat.

The valve seat is now centred.



8.2 Grinding head position

Before starting grinding operation, turn the adjusting screw (22) anticlockwise until end stop.



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8.3 Grinding

WARNING!

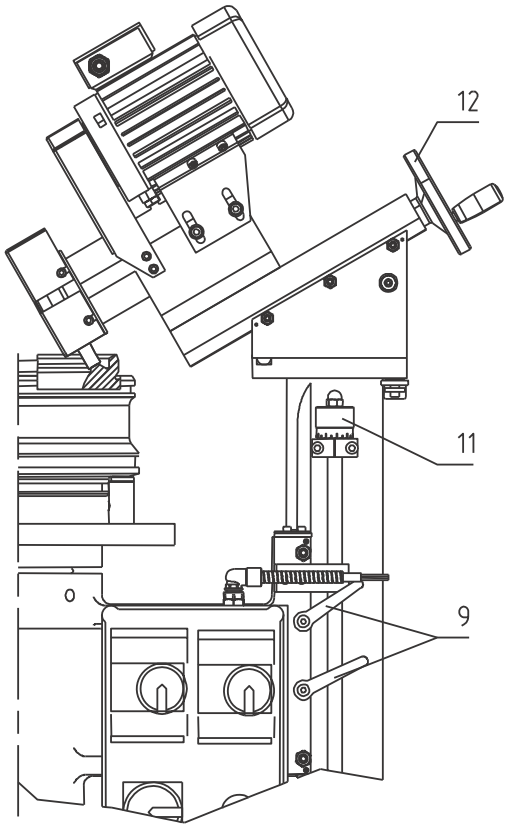
Protective accessories.

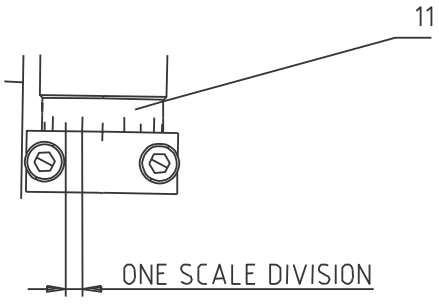
Always use safety goggles, breathing filter and hearing protection when the grinding machine is in operation.

- Use grinding wheel according to reference sheet in list of parts section. Dress and balance according to section 6.2.

1. Adjust the grinding wheel to a position as close as possible to the valve seat surface. Unlock handles (9) before feeding. While rotating the valve seat, find the position where the distance between the surface to be ground and the grinding wheel is smallest. Use a dial gauge if necessary
2. While rotating the grinding wheel by hand, use the feeding wheel (11) to guide the grinding wheel towards the seat surface. Use a spanner from tool set. One scale division on wheel (11) corresponds to 0.04 mm feeding depth.
3. Upon contact, stop the feed and retract the grinding wheel with the hand wheel (12).
4. When the grinding wheel is away from the seat surface, feed downwards 0.05 - 0.1 mm and lock with handles (9).
5. Start the drive motor.
6. Start the grinding motor.
7. Feed slowly with the hand wheel (12), approximately 1/8 turn per revolution of the valve seat.
8. Continue grinding with cutting depths of 0.05-0.1 mm until the surface is clean. Grinding can be done in both inward and outward directions.
9. The final cut should be done in an inward direction with a cutting depth of about 0.01 mm.

Check the recess gap according to engine manufacturer's instruction and grind that surface if necessary.



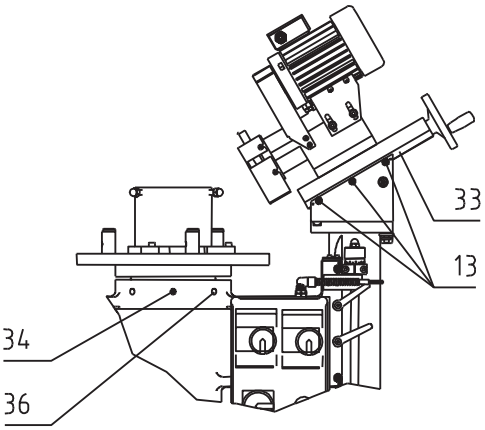


9. MAINTENANCE

9.1 Care and lubrication

Check the following regularly to ensure good grinding result and a safe operation.

- Keep the sliding surfaces (33) well lubricated.
- Lubricate the top bearing with grease at least once a year at the lubrication nipple (34)
- Keep the grinding machine clean and protected with a thin layer of oil.



9.2 Maintenance and adjustment

9.2.1 Upper end bearing clearance

The upper end bearing clearance should be adjusted if necessary as follows:

1 The clearance is adjusted by tightening the four Allen screws equally. Allen screws (36) are located at the upper end of the center part of the headstock.

2 The clearance is correctly adjusted when a slight resistance is felt

9.2.2 Top slide

The top slide is pre-adjusted before leaving Chris-Marine factory. Should any clearance be noticed, reset with screws (13).

10. REMINDERS

10.1 For best results

- Apply a suitable vertical and directional feed. (Section 7.3, 8.3).
- Dress the grinding wheel periodically to restore the cutting efficiency. (Section 6.2)
- Always maintain the balance of the grinding wheel. (Section 6.2)
- Reduce the cutting depth on the final cut.

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11. TROUBLE SHOOTING

Fault or problems	Cause	Action
Uneven ”wavy” surface	1. Grinding wheel not dressed.	Dress grinding wheel when clogged and especially before the final cut. See section 6.2.1, 7.3 and 8.3.
	2. Grinding wheel not balanced.	Balance grinding wheel when vibrations are noticeable during grinding motor running without load. See section 6.2.2
	3. Valve seats not lubricated.	Lubricate seat face continuously during grinding. See section 7.3
	4. Stabilising screws not set.	Set screws. See section 7.1
	5. Slack in the top slide guide.	Reset with screws (13). See section 9.2.2.
	6. Loose levers, screws etc.	Check following components: Locking levers (9). See section 4 and 7.3. Adjusting screw (22) Screws (13) on grinding head. See section 4.
Incorrect angle difference between valve spindle and seat.	1. Final grinding not done in an inward direction.	See section 7.3.2 and 8.3
	2. Grinding head position incorrect adjusted.	Adjust according to instruction in section 7.2.

12. AFTER USE

Clean the machine from dirt and clogging residue and apply an anti-corrosion fluid on the metal parts.
It is also recommended to protect the machine from dust and dampness using a waterproof cover.

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13. SAFETY

Always use safety goggles, breathing filter and hearing protection when the grinding machine is in operation.

Make sure the grinding wheel isn't cracked.

Beware of accidental grinding wheel breakage:
Keep away from the extended radius of the rotating grinding wheel.

Service and assistance

In choosing Chris-Marine equipment, you have made an investment in quality and accuracy. Therefore it is important that you also use genuine Chris-Marine spare parts and grinding wheels.

Chris-Marine grinding wheels have been especially developed, tested and proven through many years of experience producing the very highest grinding quality for the benefit of your engines.

Therefore always make sure that the grinding wheels used are of original Chris-Marine make.

For supply of Chris-Marine grinding equipment, and for any assistance, please contact our head office or Chris-Marine service workshops and agents.

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List of Parts

for Valve Grinding Machine type VGT

		Page
1.0 REFERENCE SHEET		**1**
1.01 BASIC MACHINE	**24432-00-00**	**3**
Basic stand	**24428-00-00**	**4**
Vibration damper kit	24719-03-00	5
Grinding spindle	**24430-00-00**	**6**
Prisma	**24431-00-00**	**7**
1.11 GRINDING WHEEL HUB	**13098-01-00**	**8**
1.13 BALANCING EQUIPMENT	**24475-01-00**	**9**
1.71.01 SET OF TOOLS	**11551-57-00**	**10**
1.71.02 SET OF SCREWS	**24719-05-00**	**11**

When ordering spare parts please state machine serial No……..

Doc. No.: S-140-E

Rev. b

2013-06-14

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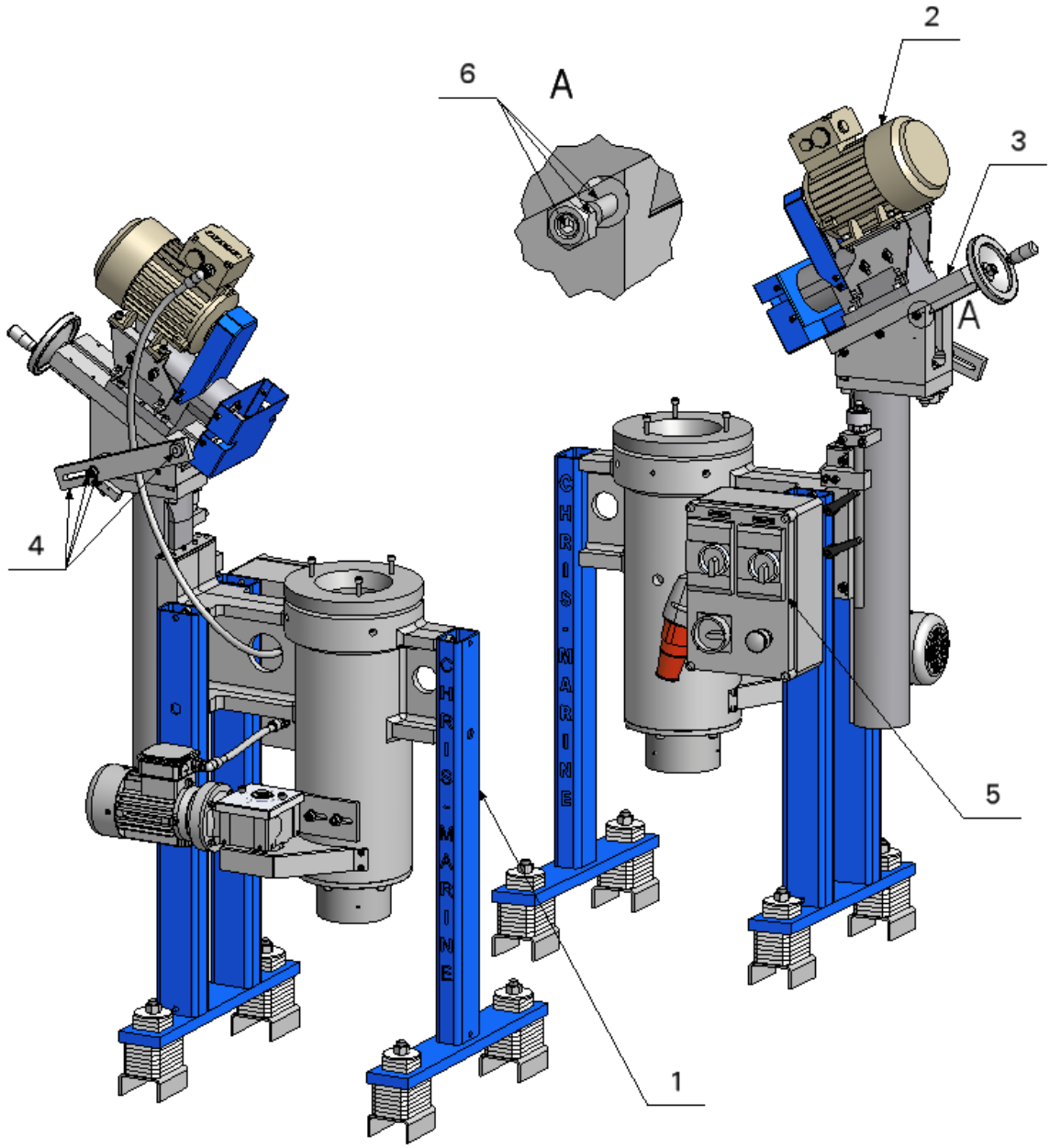
Valve Grinding Machine type VGT
BASIC MACHINE No 24432-00-00



Item	Name	Part No	Qty
1	Basic stand	24428-00-00	1
2	Grinding spindle	24430-00-00	1
3	Prisma	24431-00-00	1
4	Holder f. grinding wheel dresser	24476-00-00	1
5	Control device	24486-00-00	1
6	Plunge kit	24719-00-00	6

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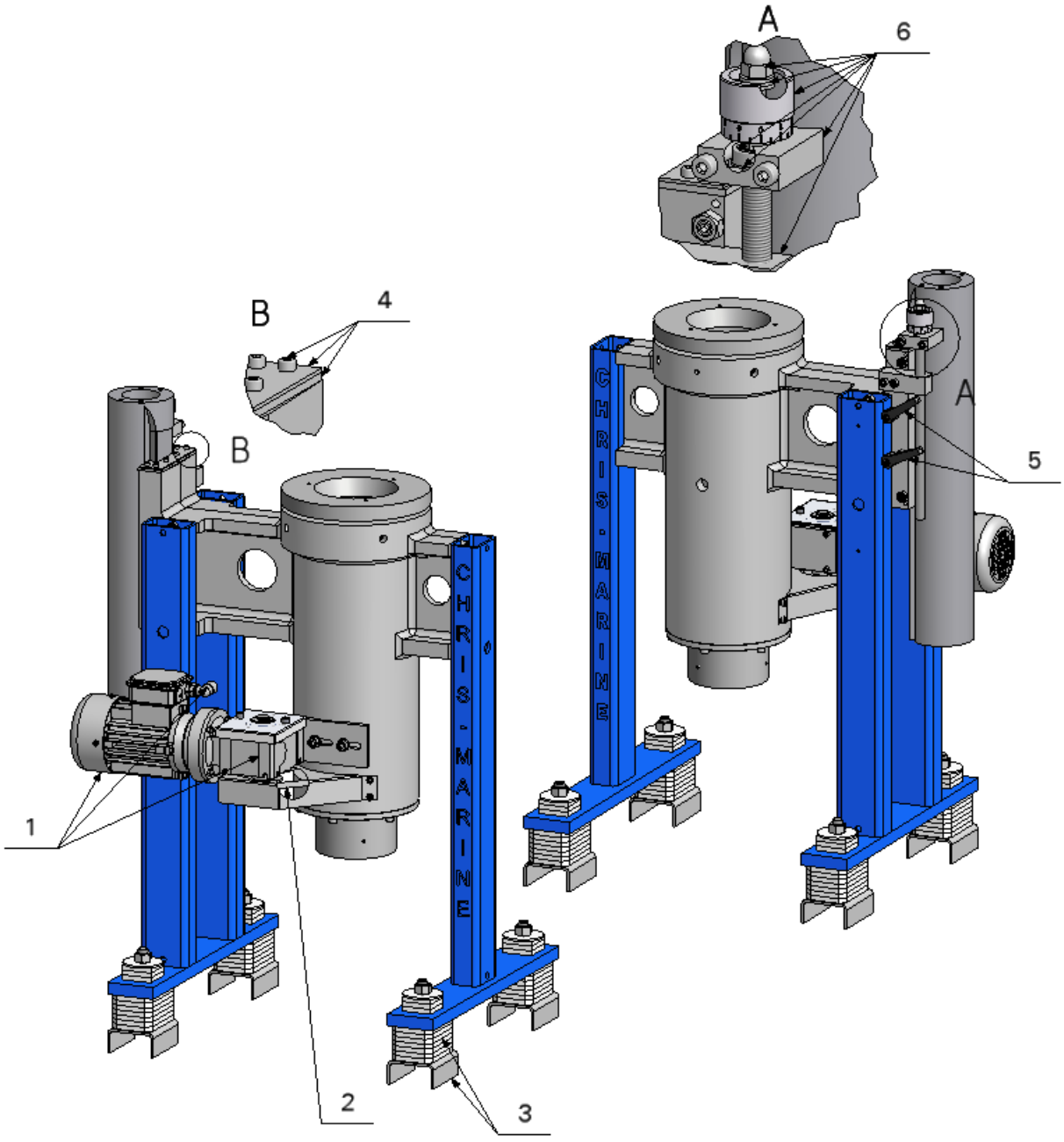
List of Parts

Valve Grinding Machine type VGT
Basic stand No 24428-00-00



Item	Name	Part No	Qty
1	Driving motor w. worm gear kit	24719-02-00	1
2	V-belt	B062B005	1
3	Vibration damper kit	24719-03-00	4
4	Scraper kit	24719-04-00	5
5	Set of screws	24719-05-00	1
6	Knob kit	24719-06-00	1

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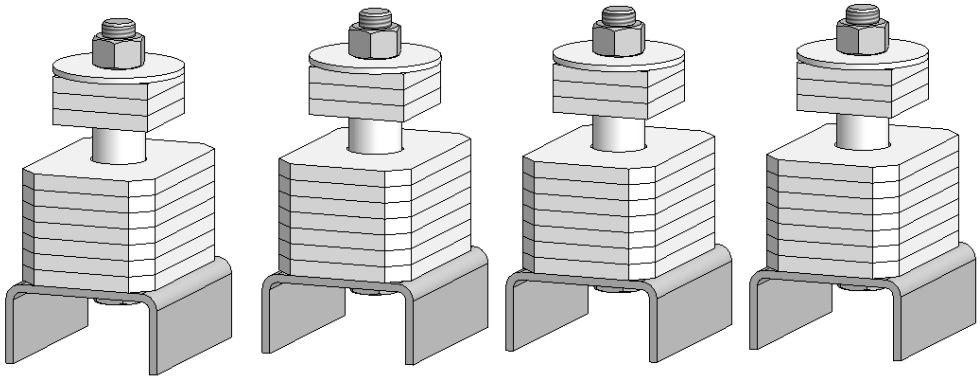
Valve Grinding Machine type VGT
Vibration damper kit No 24719-03-00



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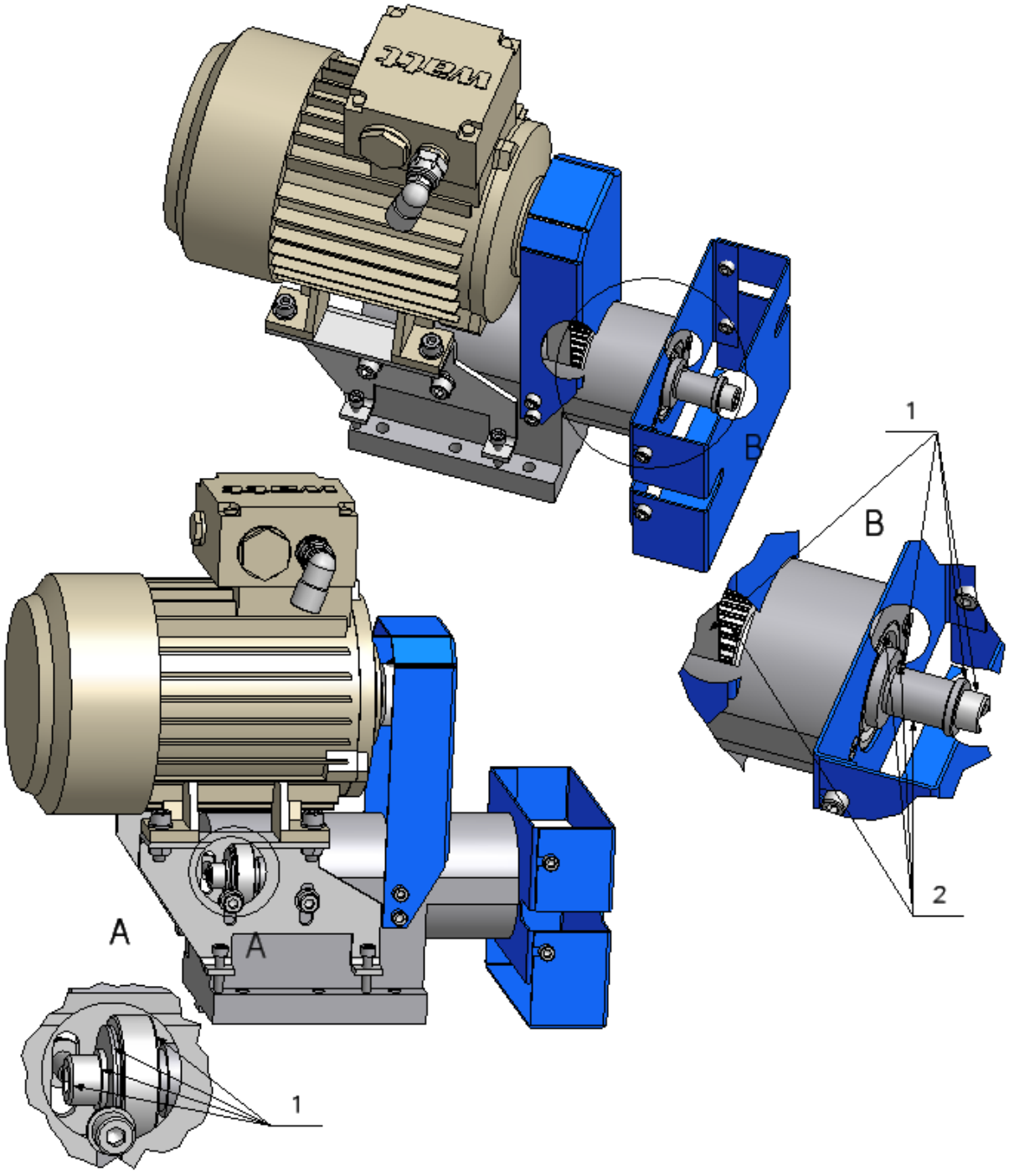
List of Parts

Valve Grinding Machine type VGT
Grinding spindle No 24430-00-00



Item	Name	Part No	Qty
1	Drive belt kit	24719-07-00	1
2	Shaft kit	24719-08-00	1

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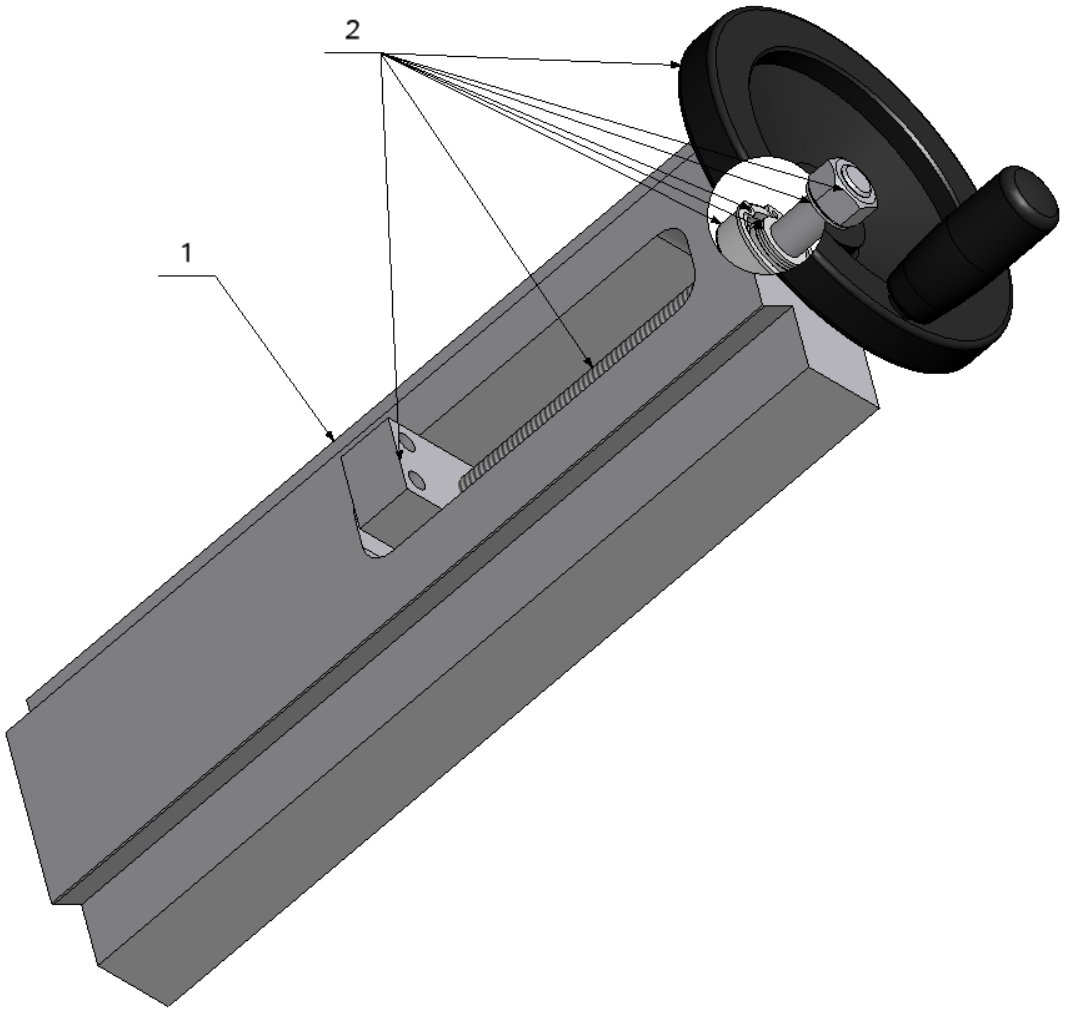
Valve Grinding Machine type VGT
Prisma No 24431-00-00



Item	Name	Part No	Qty
1	Prisma	24411-00-00	1
2	Repair kit	24719-09-00	1

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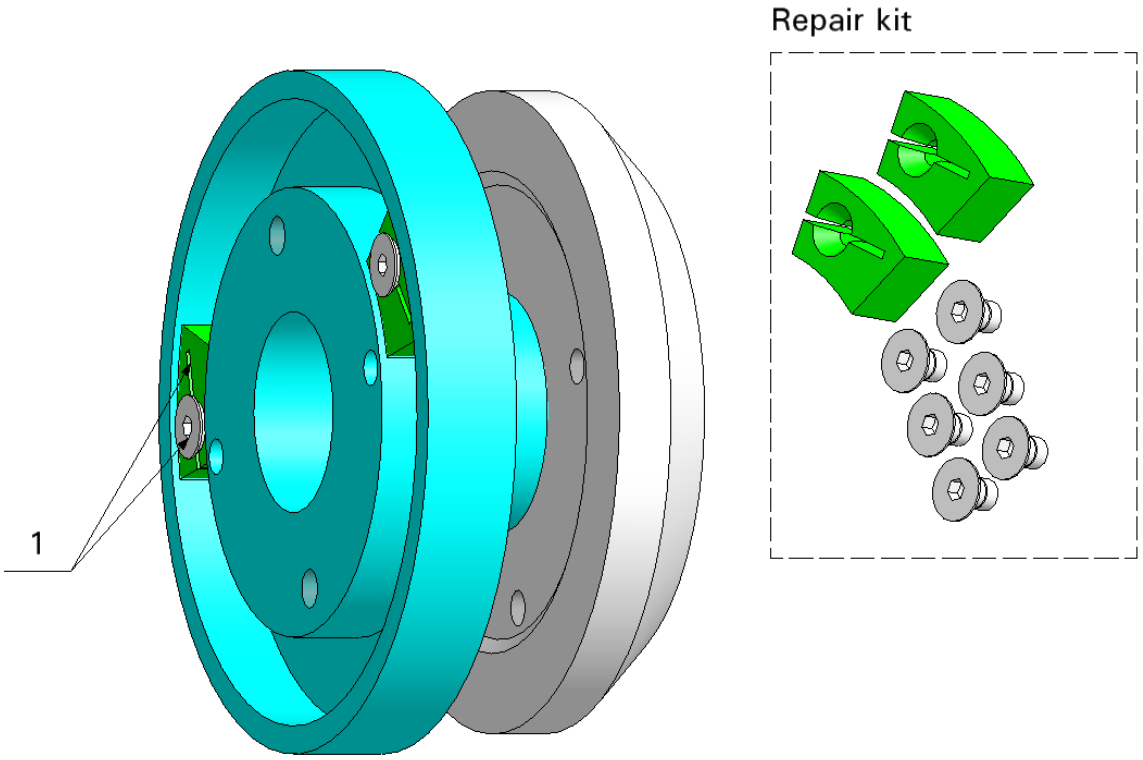
Valve Grinding Machine type VGT
GRINDING WHEEL HUB No 13098-01-00



Item	Name	Part No	Qty
1	Repair kit	24719-10-00	1

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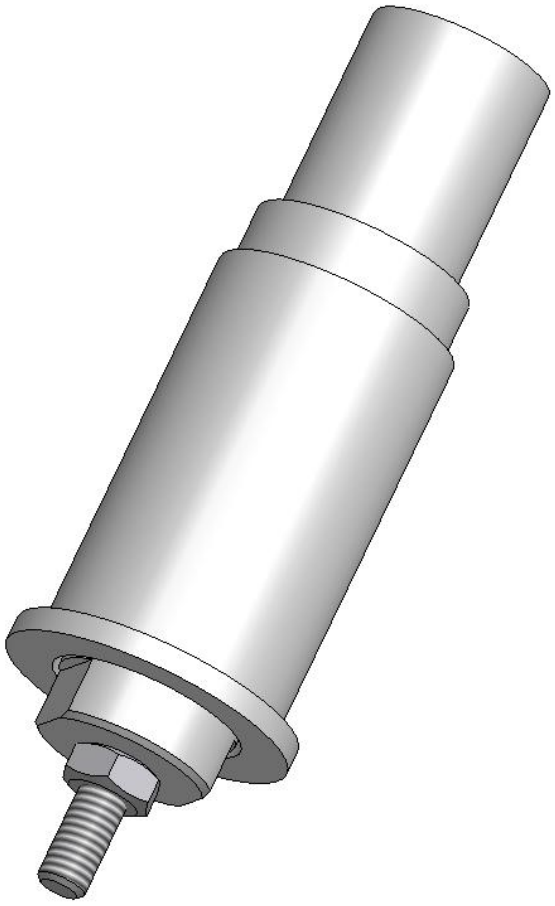
Valve Grinding Machine type VGT
BALANCING EQUIPMENT No 24475-01-00



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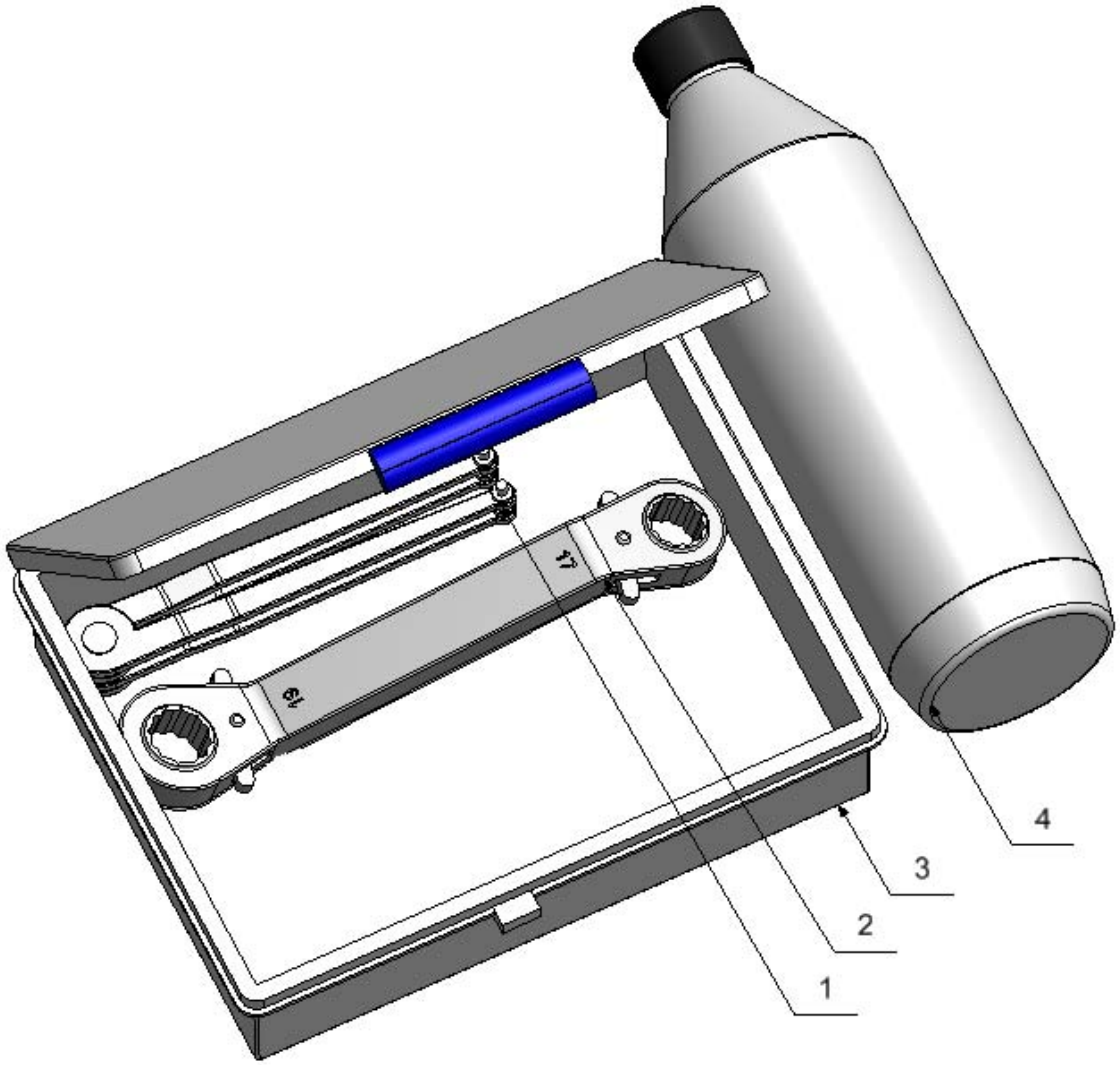
Valve Grinding Machine type VGT
SET OF TOOLS No 11551-57-00



Item	Name	Part No	Qty
1	Pin spanner		2
2	Ratchet wrench		1
3	Box		1
4	Cutting oil	18834-00-00	1

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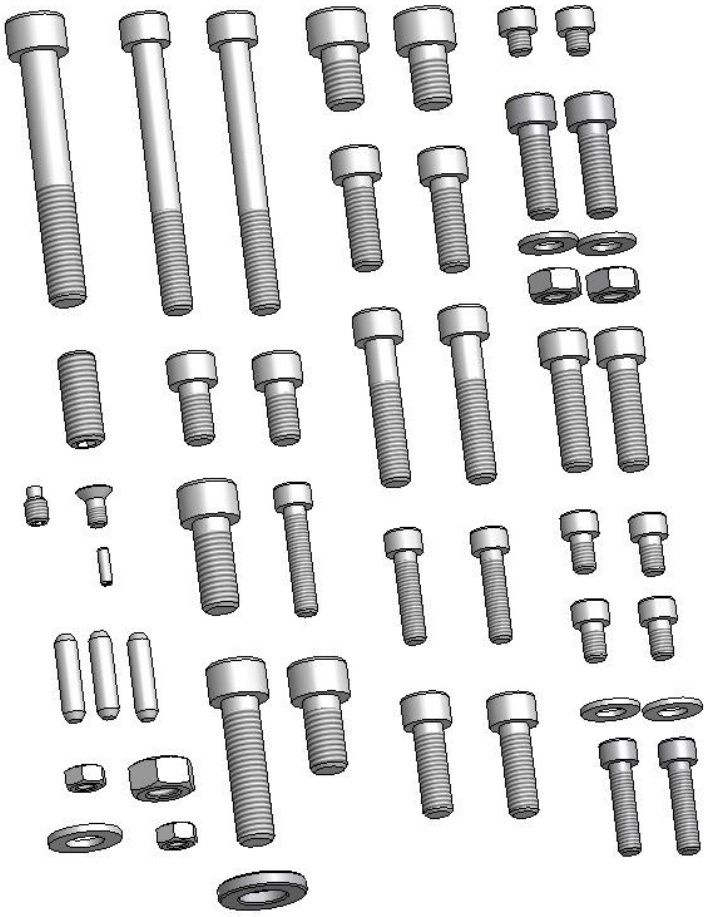
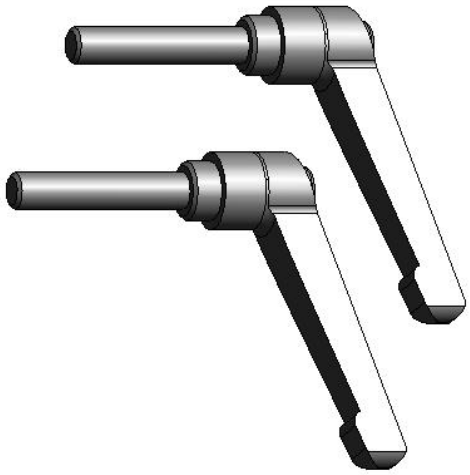
E-mail: info@chris-marine.com Website: www.chris-marine.com

Valve Grinding Machine type VGT
SET OF SCREWS No 24719-05-00





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IOP MARINE
OBEL-P PRODUCTS

High Pressure Unit
Type HPU 3500-2

IOP Marine A/S
Obel-P-Products
Engager 7 • DK-2605 Brondby • Denmark
Tel: +45 44 98 38 33 • Fax: +45 44 98 11 25 • www.obel-p.com/marine

Hydraulic Power Unit - Type HPU 3500-2

Twin-pump hydraulic power supply designed for fast operation of MAN B&W's new 2200 bar tool series, providing a high hydraulic pressure even at low air inlet pressure.

Approved for all MAN B&W engine types. Also operates all other maritime hydraulic tool series from other vendors.

Output pressure	2450 bar / 245 MPA 2000 bar / 200 MPA	@ 6 bar air input @ 5 bar air input
Max. air inlet pressure	10 bar (safety valve activates @ 6 bar)	
Max. flow @ 0 bar (g)	1,7 l/min	
Displacement per cycle	3,8 cm^3	
Cycle frequency	450 cycles/min	@ 5 bar air input
Air consumption	300-1050 litres per min	
Tank capacity	6 l	
Classification	Gauges: MPA / BAR scale, analogue; class 1,0	
Liquid outlet	1/4" BSP Female (ISO-228-1-G-1/4)	
Air inlet	1/2" BSP Female (ISO-228-1-G-1/2)	
Weight (excl. oil)	30 kg	
Dimensions (L x W x H)	440 x 330 x 540 mm	

Approved & recommended by MAN Diesel A/S

MAN B&W Diesel

IOP Marine A/S, Engager 7, DK-2605 Brondby, Denmark,
Phone: +45 4498 3833, Fax: +45 4498 1125, E-mail: marine@obel-p.com - homepage: www.obel-p.com/marine

OPERATING INSTRUCTION FOR HIGH PRESSURE PUMP UNIT TYPE HPU 3500-2

This instruction has been made to facilitate the understanding of the working principles of the pump unit.

The HPU 3500-2 features the IOP Marine A/S twin-pump system which ensures high performance and high reliability. Operation of this unit is slightly different from operation of traditional IOP Marine HPU's.

The various control instruments and manoeuvring handles are fitted with a number. These numbers are mentioned in this instruction and are also referring to the numbers found on the drawings showing the complete pump unit.

Furthermore, these numbers are found on the instrument panel of the pump unit. Please, read this direction of use carefully before using the pump unit and follow the instructions given very carefully.

Before connecting the pump unit:

The tank is filled with oil through the filler cap (6) in the right side of the top panel.

Oil: Hydraulic oil (rust preventing) with a viscosity of between 7 and 10 cSt at 50º C.

a) Open oil return valve (1) by turning anti-clockwise.

b) The handle of the regulator valve (3) should be turned 4-5 turns anti-clockwise.
This is done to avoid the pump starting at a too high pressure level.

c) Stop valve (2) should be turned clockwise, to close the valve. This is done to ensure that the pump will not work at will when the primary pneumatic system is connected.

Connection of pump:
Note: Make sure the "Cycling Valve" (2) is in "Off" position when connection of air takes place.

Compressed air is led through a flexible hose and is connected to the stud marked "air inlet" (7) on the back side of the cabinet. This stud has 1/2" B.S.P. female thread with a 1/4" B.S.P. reduction, accepting either 1/2" or 1/4" hose. To avoid contamination of the pump, it is essential that an effective airfilter and water separator is inserted in the air line. A lubro unit should however be avoided – see lubrication instruction on page 2. The hydraulic system is connected to the stud marked "high pressure outlet" (8) found on the back side of the cabinet. This stud has a m 16 x 1,5. female thread. The pump is now ready for use.

Start of job:

a) The "Cycling Valve" (2) turns pump unit on/off. When connecting air, this valve should be in "off" position.

b) Turn "Cycling Valve" (2) to open – the low-pressure pump unit automatically builds up a pressure to 500 bar.

c) The "Pressure Control Valve" (3) is used for adjusting the outlet pressure of the high-pressure pump unit is now turned clockwise and the hydraulic pressure may now be read on the manometer for pressure control (4). This manometer shows the hydraulic high pressure in bar.

d) The "Oil Return Valve" (1) is closed by turning the knob clockwise and the oil will then run from the oil tank into the hydraulic system. When the hydraulic system has been filled, and the pump has stopped operating, the working pressure reached can be read on the large manometer (5). The pump stops automatically, when the required working pressure has been established and holds it infinitely. The pump starts automatically again if a pressure drop occurs in the hydraulic system.

Ending of job:

To avoid oil spillage, precautions should be taken to see that the oil is taken back into the oil tank before the connections on the high pressure side are disconnected. This is done by

e) Turning the oil return valve (1) anti-clockwise. Simultaneously the pump should be stopped by turning the stop valve (2) clockwise, and when this valve has been closed, the air hose may be removed and the pump transferred to another job.

Data for high pressure:

The pump unit can deliver a maximum pressure of 2800 bar with a 7 bar air inlet. At an air pressure of 6 bar, a safety release valve is in the B&W standard version adjusted to release at a maximum pressure of 2400 bar.

This preset pressure maximum (which is preset by the factory) secures against overload of the connected hydraulic tool set and the built-in gauges.

Cleaning of oil filter:

The filter in the filler cap (6) is removed and cleaned when by re-filling the oil starts running through slowly.

Lubrication instruction:

WARNING: AVOID AIRLINE LUBRICATION. The pump has been pre-lubricated and a lubro unit will decrease the efficiency of the pump.

Air valves should be lubricated periodically. Remove exhaust fittings and valve spool and apply a thin coat of Obel-P grease no. 3000010.

If primary airdrive section is dismantled, always apply a thin coat of Obel-P grease to entire inner surface of cylinder tube and plunger O-rings.

Spare parts:

Even though the pump unit is a robust and reliable piece of equipment, there may be a need - after a long time of operation - for changing various wearing parts like o-rings, seals and springs - specially in the pressure transformer.

Spare part lists can be acquired from IOP Marine – kindly contact us and

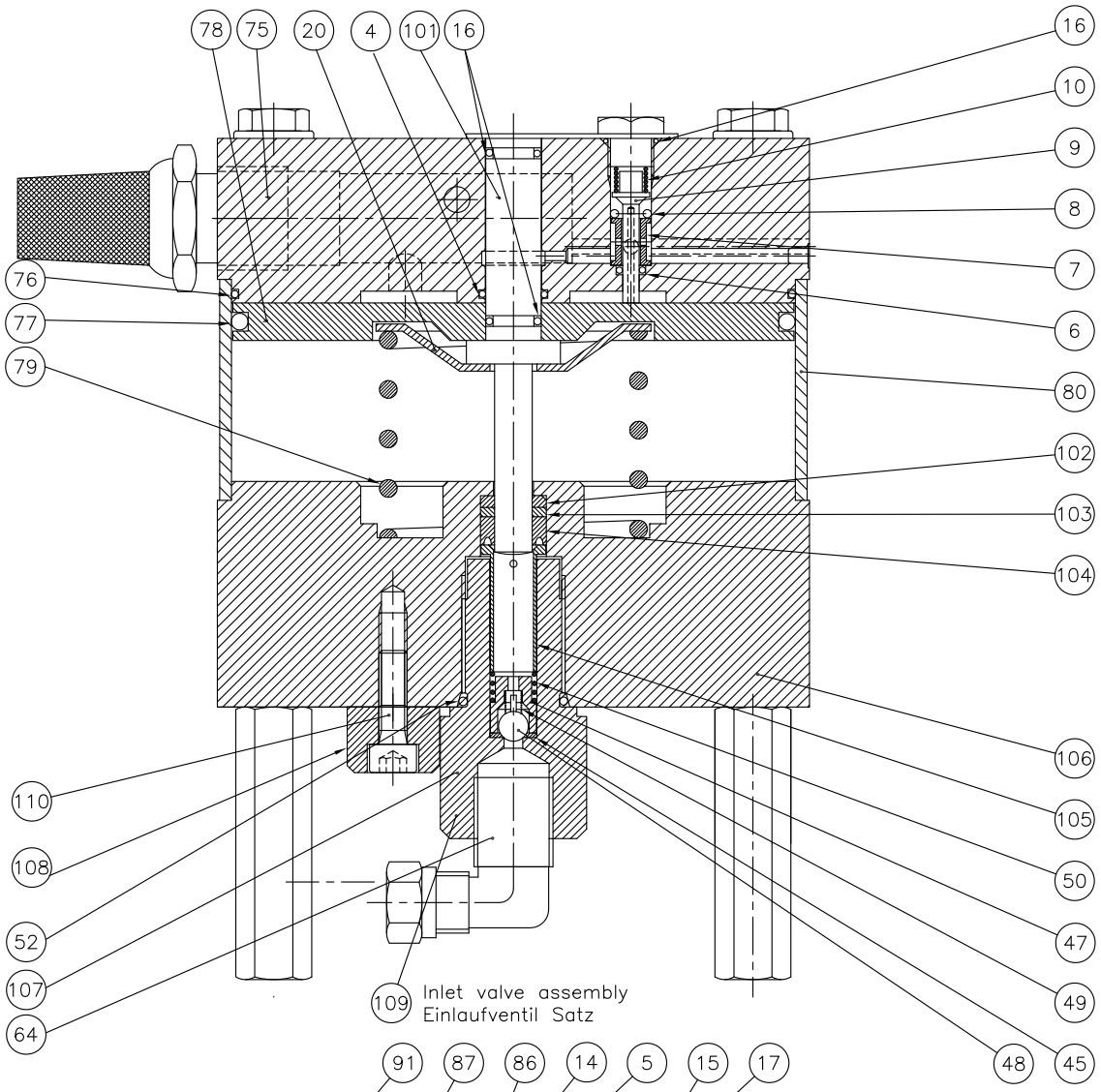
Spares can be purchased directly from IOP Marine A/S (email: marine@obel-p.com - fax +45 44 98 11 25) or ordered through most resellers. Please remember to inform of unit type number and serial number. This information is available on the small “name plate”, near the air inlet.

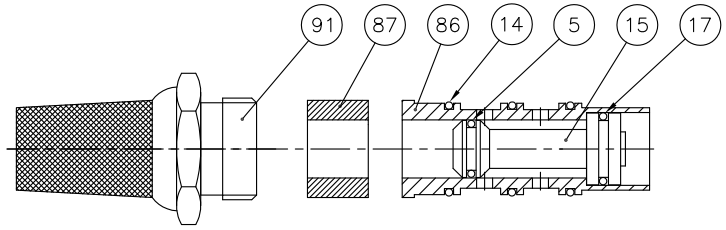
Authorised maintenance is carried out by approved workshops worldwide. Please see

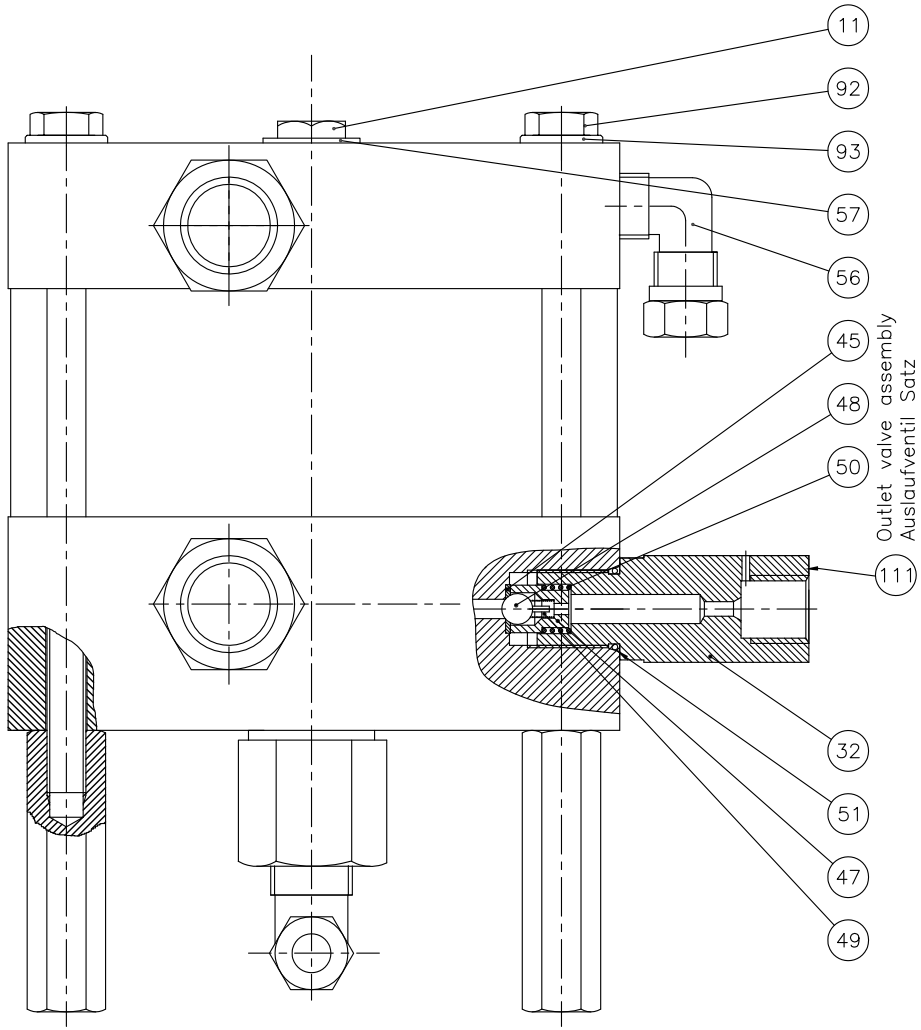
http://www.obel-p.com/marine

for an up-to-date list of approved workshops.

Benyttelse af denne tegning i erhvervsøjemed uden skriftlig tilladelse af IB OBEL PEDERSEN personlig, er ulovlig og vil medføre ansvar i henhold til lov om uretmæssig konkurrence







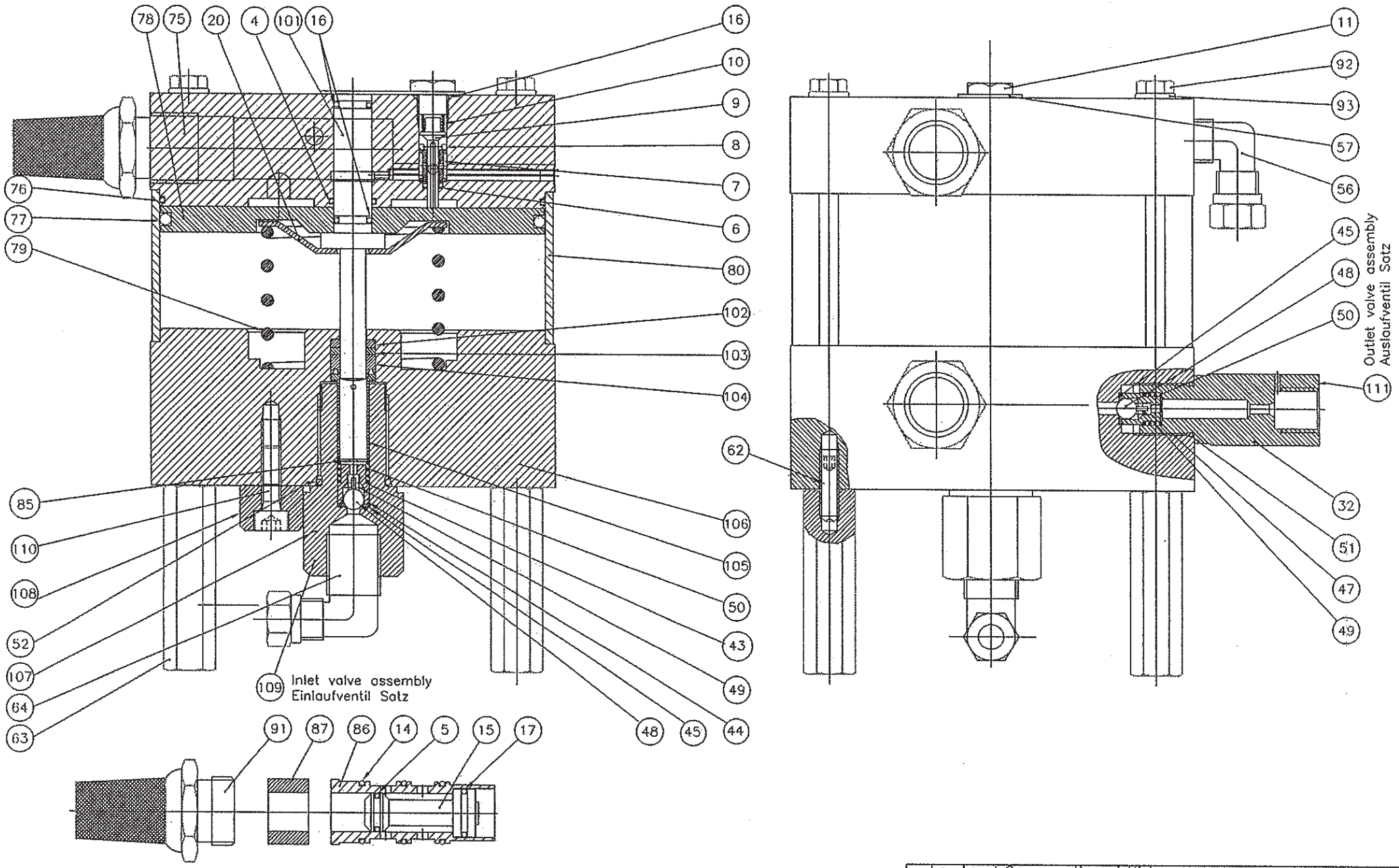
	Dato	Navn	Cross section of High pressure pump	IB OBEL PEDERSEN Obel-P-Products DK-2880 Bagsværd · Denmark
Tegn.	25-1-06	LB		
Konstr.		BA	Hochdruck Pumpeneinheit	
Målest.	1.25:1		A2800	Tegn.Nr. 8601-05-080
EDB	2111295			

SPARE PARTS LIST FOR CROSS SECTION 8601-05-080/2111295 A 2800

POS.	INCL. IN KIT			DESCRIPTION	IOP NO.	PCS.
4.			△	O-ring	3325001	1
5.			△	O-ring	3168010	1
6.			△	O-ring	3168022	1
7.				Tube	3222010	1
8.			△	O-ring	3168009	1
9.				Pilot valve	3222009	1
10.			△	Spring	3149010	1
11.				Plug	3190090	1
14.			△	O-ring	3168013	3
15.				Spool	3013012	1
16.			△	O-ring	3168056	3
17.			△	O-ring	3168011	1
20.				Spring support	2112188	1
32.		■		Fitting oil out	3222017	1
45.	□	■	○	Seat	3013015	2
47.	□	■		Cage	3222005	2
48.	□	■	○	Ball	3210017	2
49.	□	■	○	Spring	3149008	2
50.	□	■	○	Spring	3149012	2
51.		■	○	O-ring	3168014	1
52.	□		○	O-ring	3168057	1
56.				Stud air in	3786052	1
57.				Cover	2112192	1
64.				Fitting	3786053	1

POS.	INCL. IN KIT			DESCRIPTION	IOP NO.	PCS.
75.				Top cap	2112407	1
76.			△	O-ring	3275085	1
77.			△	O-ring	3275084	1
78.				Air piston	2112409	1
79.				Spring	3149038	1
80.				Cylinder tube	3754003	1
86.				Sleeve	3222035	1
87.				Spacer	2112406	1
91.				Silencer	3060030	2
92.				Bolt	3048674	4
93.				Washer	3049277	4
101.				Plunger	1111152	1
102.			○	Support ring	3222064	1
103.			○	Back-up ring	3013084	1
104.			○	Seal	3275119	1
105.				Spacer	2111566	1
106.				Bottom cap	2111563	1
107.			□	Fitting oil in	3222045	1
108.				Tightening bush	2111232	1
110.				Screw	3049959	1
			△	Silicon grease	3000010	1
94.			○	Seal kit hydraulic	2112952	1
95.			△	Seal kit pneumatic	2112727	1
109.			□	Inlet valve assembly	1111129	1
111.			■	Outlet valve assembly	1113025	1

Pos. 94, 95, 109 and 111: The symbols indicate the contents in different maintenance kits.



	Date	Navn	Cross section of High pressure pump	IB OBEL PEDERSEN Obel-P-Products DK-2880 Bagsværd · Denmark
Tegn.	15.05.2006	BHK		
Konstr.		BHK	Hochdruck Pumpeneinheit	
Målest.	2111260		A500	Tegn.Nr. 8601-05-072

SPARE PARTS LIST FOR CROSS SECTION 8601-05-072/2111260 A500

POS.	INCL. IN KIT	DESCRIPTION	IOP NO.	PCS.
4.	△	O-ring	3325001	1
5.	△	O-ring	3168010	1
6.	△	O-ring	3168022	1
7.		Tube	3222010	1
8.	△	O-ring	3168009	1
9.		Pilot valve	3222009	1
10.	△	Spring	3149010	1
11.		Plug	3190090	1
14.	△	O-ring	3168013	3
15.		Spool	3013012	1
16.	△	O-ring	3168056	3
17.	△	O-ring	3168011	1
20.		Spring support	2112188	1
32.	■	Fitting oil out	3222017	1
43.	□	Cage	2111243	1
44.	□	Ring	2111247	1
45.	□ ■ ○	Seat	3013015	2
47.	■	Cage	3222005	1
48.	□ ■ ○	Ball	3210017	2
49.	□ ■ ○	Spring	3149008	2
50.	□ ■ ○	Spring	3149012	2
51.	■ ○	O-ring	3168014	1
52.	□ ○	O-ring	3275095	1
56.		Stud air in	3786052	1
57.		Cover	2112192	1
62.		Screw	3048009	4
63.		Supporter	2112701	4
64.		Fitting	3786053	1

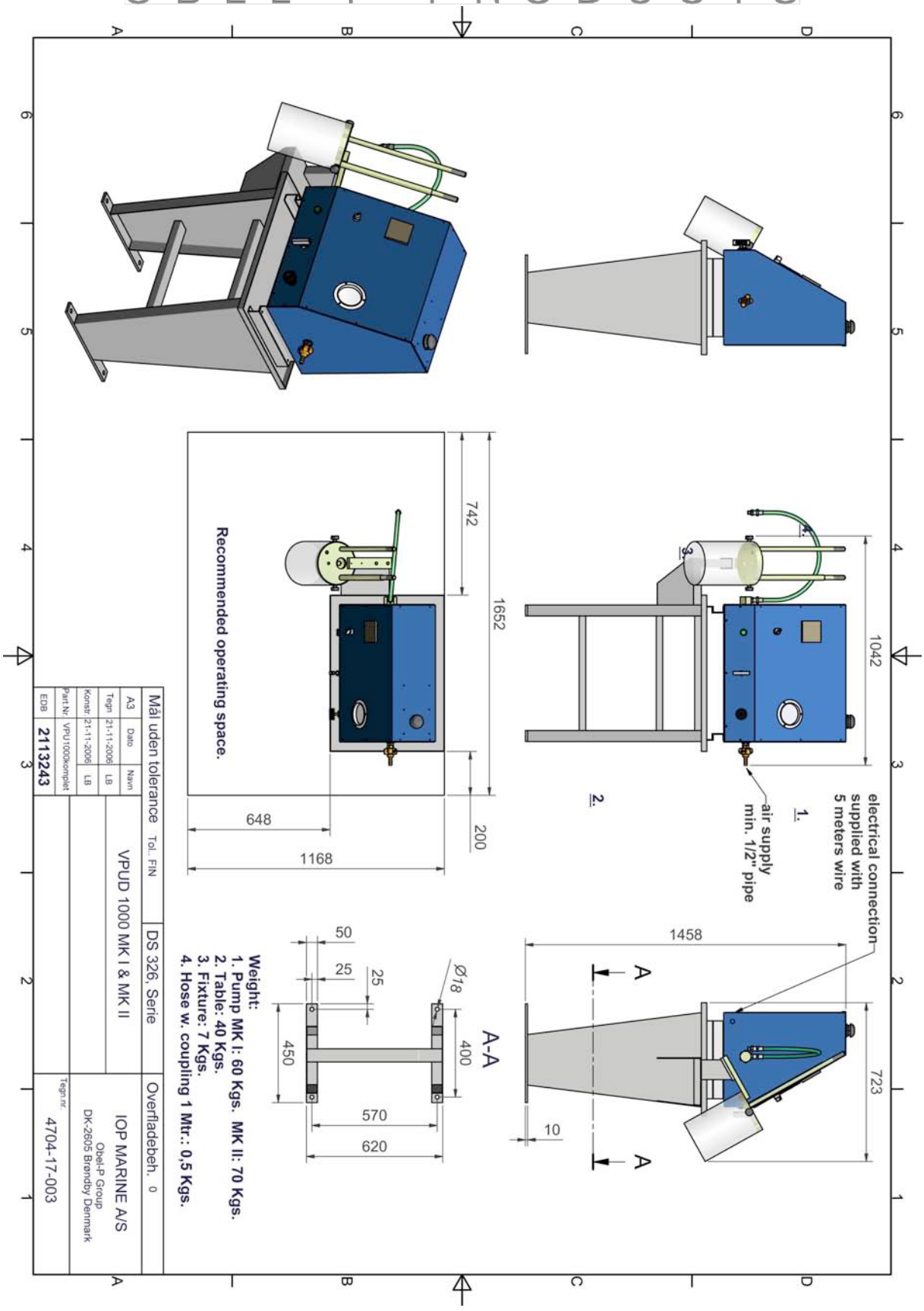
POS.	INCL. IN KIT	DESCRIPTION	IOP NO.	PCS.
75.		Top cap	2112407	1
76.	△	O-ring	3275085	1
77.	△	O-ring	3275084	1
78.		Air piston	2112409	1
79.		Spring	3149038	1
80.		Cylinder tube	3754003	1
85.		Washer	2112545	1
86.		Sleeve	3222035	1
87.		Spacer	2112406	1
91.		Silencer	3060030	2
92.		Bolt	3019011	4
93.		Washer	3049277	4
94.		Nut	3048322	4
101.		Plunger	1111154	1
102.	○	Support ring	2112547	1
103.	○	Back-up ring	3013010	1
104.	○	Seal	3168070	1
105.		Spacer	2112541	1
106.		Bottom cap	2112546	1
107.	□	Fitting oil in	2112542	1
108.		Tightening bush	2111232	1
110.		Screw	3044350	1
	△	Silicon grease	3000010	1
94.	○	Seal kit hydraulic	2110003	1
95.	△	Seal kit pneumatic	2112727	1
109.	□	Inlet valve assembly	1111178	1
111.	■	Outlet valve assembly	1113025	1

IOP MARINE
OBEL-P PRODUCTS

Fuel Injector Test Unit
Type: VPUD 1000

(Patent Pending)

IOP Marine A/S
Obel-P-Products
Engager 7 • DK-2605 Brondby • Denmark
Tel: +45 44 98 38 33 • Fax: +45 44 98 11 25 • www.iopmarine.dk



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Phone: +45 4498 3833, Fax: +45 4498 1125, e-mail: contact@iopmarine.dk, web: www.iopmarine.dk

1. Technical specifications:

FUEL VALVE TEST RIG
TYPE: VPUD 1000

Featuring:
IOP SafeTest Technology
(patent pending)

- For test of 2- and 4-stroke fuel injectors.

The only recommended pneumatic-hydraulic solution for testing of slide valve fuel injectors from

MAN B&W Diesel A/S

Output pressure:	Max. 1100 bar Max. 800 bar	@ 10 bar air @ 7 bar air
Air consumption:	50 l/cycle 36 l/cucle	@ 10 bar air @ 7 bar air
Max flow at no pressure:	1,2 l/min	@ 7 bar air
Displacement pr. cycle:	20 cm^3	
Cycle frequency:	60 cycles/min	@ 7 bar air
Tank capacity:	6 l	
Classification:	Gauge: class 1,0. Display: class 0,5	
Weight:	100 kg	
Dimensions:	560x950x1525 mm	
Power supply:	Single Phase 115/230 V AC	

IOP Marine A/S, Engager 7, DK-2605 Brondby, Denmark,
Phone: +45 4498 3833, Fax: +45 4498 1125, e-mail: contact@iopmarine.dk, web: www.iopmarine.dk

Unit Layout

(1) FULL STROKE push button
(2) Pressure relief valve
(3) Pressure control valve
(5) Switch (OPENING PRESSURE / VENTING PRESSURE /RESET)
(6) Manometer for primary air pressure 0-10 bar
(7) Digital instrument: WORKING PRESSURE
(8) Digital instrument: VENTING+OPENING PRESSURE

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Phone: +45 4498 3833, Fax: +45 4498 1125, e-mail: contact@iopmarine.dk, web: www.iopmarine.dk

2. Installation and maintenance instructions

The VPUD 1000 *(patent pending*) ensures correct testing of MAN B&W Diesel slide fuel valves. Before initiation of testing, the unit should be properly installed and prepared for testing.

Installation and preparation of VPUD 1000 unit for testing of fuel injectors:

- Fill tank with hydraulic oil (viscosity 7-10 cSt at 50°c) through filler cap (11). The tank will hold 6 l.
- Close pressure control valve (3) by turning it counter-clockwise
- Connect compressed air (0-10 bar) to stud marked "AIR INLET" (9). To avoid contamination consider installation of a water separator (not included). Avoid the use of a lubro unit
- Insert and connect a fuel injector.
- Open pressure relief valve (2) by turning counter-clockwise
- Switch knob (5) to position **OPENING PRESSURE**

The preparation procedure should be carried out every time the oil tank runs empty.

Cleaning of Oil Filters:

The mesh filter, which is found in the filter cap (11) is removed and cleaned when the fuel oil has a tendency of slow flow. The oil filter (12), which is found in the outlet from the oil vessel, is of the "throw-away" type, which should be removed and substituted by a new filter, when the old one has clogged, and the filter should under all circumstances be changed at least once every 6 months. Please note that before removing this filter the oil tank should be emptied completely, which is easily done by operating the pump unit without a fuel valve.

Lubrication Instruction (WARNING - Avoid Airline Lubrication):

The pump B 1100 (diagram ref. 14) has been pre-lubricated and a lubro unit will decrease the efficiency of the pump. Air valves of the B 1100 should be lubricated periodically. Remove exhaust fittings and valve spool and apply a thin coat of Obel-P grease 8601-07-030 (item 3000010). If primary air drive section is dismantled, always apply a thin coat of Obel-P grease to entire inner surface of cylinder tube and plunger O-rings.

Spare Parts:

Although the test unit is a robust and reliable piece of equipment it might be necessary to change certain parts, which are particularly exposed to wear (O-rings, springs etc. in the pump itself, and when such worn components are changed, it will also be necessary to install new seals. A cross-section drawing and related spare part numbers can be found at the end of this manual

For info about nearest authorised IOP Marine A/S service center and/or ordering of spares, call us or visit http://www.obel-p.com/marine

Unit Layout

(1) FULL STROKE push button
(2) Pressure relief valve
(3) Pressure control valve
(5) Switch (OPENING PRESSURE / VENTING PRESSURE /RESET)
(6) Manometer for primary air pressure 0-10 bar
(7) Digital instrument: WORKING PRESSURE
(8) Digital instrument: VENTING+OPENING PRESSURE

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Phone: +45 4498 3833, Fax: +45 4498 1125, e-mail: contact@iopmarine.dk, web: www.iopmarine.dk

3. Operation instructions

The VPUD 1000 *(patent pending*) ensures correct testing of MAN B&W Diesel slide fuel valves.

The below procedure for fuel-valve testing is in compliance with the MAN B&W Diesel A/S' guidelines for testing of fuel-injection valves. Please refer to the B&W manual for general fuel valve maintenance as well as possible derivations from the below procedure. All numbers in the text refers to numbers found on the VPUD 1000 front panel (see also section 2 - unit layout).

If the test unit runs out of hydraulic oil during testing, please consult section 2 of this manual.

Pre-testing preparations (to be carried out with every inserted injector):

Before performing any of the tests, the slide-valve must be completely filled with test-oil:

- Switch knob (5) to position **OPENING PRESSURE**
- Close pressure relief valve (2) by turning clockwise
- Turn pressure control valve (3) clockwise, until the WORKING PRESSURE display (8) shows a pressure above zero*
- *The valve is now filled with oil. When clear oil without air-bubbles tickles from the venting hole through the breathing-pipe, the valve is full*
- Turn pressure control valve (3) counter-clockwise to switch off air supply
- Open pressure relief valve (2) by turning counter-clockwise

* Note: The IOP SafeTest Technology may be activated during this process, which stop operation. Switch knob (5) to **RESET** and back to **OPENING PRESSURE** to resume pre-testing preparations

Test A: Opening Pressure

- Switch knob (5) to **RESET** position.
- Close pressure relief valve (2)
- Switch knob (5) to **OPENING PRESSURE** position
- Adjust pressure control valve (3) until WORKING PRESSURE (8) is between 100 and 140 bar
- Press FULL STROKE Push button (1)
- Increase pressure using the regulator valve (3) until opening pressure is reached
- *The opening pressure is shown on the lower part of the OPENING+VENTING PRESSURE display (7).* The pump stops automatically
- Close pressure control valve (3) – turn it counter-clockwise
- Open pressure relief valve (2) – turn it counter-clockwise

Repeat test A a few times, until two similar results (+/- 10 bar) have been obtained one after the other. Note that the first result measured after valve dis-/reassembly may differ from the following results.

Unit Layout

(1) FULL STROKE push button
(2) Pressure relief valve
(3) Pressure control valve
(5) Switch (OPENING PRESSURE / VENTING PRESSURE /RESET)
(6) Manometer for primary air pressure 0-10 bar
(7) Digital instrument: WORKING PRESSURE
(8) Digital instrument: VENTING+OPENING PRESSURE

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Test B: Leak Test

- Switch knob (5) to **RESET** position
- Close pressure relief valve (2)
- Switch knob (5) to **OPENING PRESSURE** position
- Adjust pressure control valve (3) until WORKING PRESSURE (8) is between 100 and 140 bar
- Press FULL STROKE Push button (1)
- Adjust pressure using the regulator valve (3) until displayed WORKING PRESSURE (8) is 10-20 bar below the opening pressure measured in Test A
- *Maintain pressure and check that there is no leak at the valve nozzle*
- Close pressure control valve (3) – turn it counter-clockwise
- Open pressure relief valve (2) – turn it counter-clockwise

Test C: Venting function

Before performing any of the tests, the slide-valve must be completely filled with test-oil, as described in the section “Pre-testing preparations”.

- Switch knob (5) to **RESET** position
- Close pressure relief valve (2)
- Switch knob (5) to **VENTING PRESSURE** position
- Adjust pressure control valve (3) until the system automatic turns off the VPU pump ≈ 150 bar
- The pressure will slowly decrease on the WORKING PRESSURE display (8). *When the internal leak slide valve opens, the venting pressure is shown on OPENING+VENTING PRESSURE display (7).*
- Close pressure control valve (3) – turn it counter-clockwise
- Open pressure relief valve (2) – turn it counter-clockwise

Test D: O-ring Seal Test

- Switch knob (5) to **RESET** position
- Close pressure relief valve (2)
- Dismantle breathing pipe from the venting hole in the fuel-injection valve head/fixture
- Plug venting hole with plug supplied with the valve holder
- Switch knob (5) to **VENTING PRESSURE** position
- Adjust pressure control valve (3) until WORKING PRESSURE (8) is ≈ 100 bar
- Decrease air pressure using the regulator valve (3) until manometer 6 reads 0 bar
- Read pressure from WORKING PRESSURE display (8). *The displayed pressure should remain stable for a few minutes*
- Open pressure relief valve (2) – turn it counter-clockwise

4. Troubleshooting the VPUD 1000 Test Rig

Problem:	No tests can be performed. Inlet pressure reads 0 bar at all times (manometer 6) although air supply is working
Possible solution:	Switch knob (5) to position “RESET” and start test over.
Explanation:	When the electronic blocking system in the VPUD 1000 is activated, air supply to the unit is blocked. The magnet valve is “released” by resetting the unit.

Problem:	Air supply is turned off almost immediately after test is initiated
Possible solution:	Make sure that the valve is filled with oil (clear oil is tickling from venting hole when PRESSURE CONTROL VALVE (3) is turned a few times clockwise) before attempting to run a test. Remember to execute pretest preparation for each injector, as described in section 3
Explanation A	Air inside the fuel valve results in malfunction of the electronic pressure transmitter. In special cases early shutdown can be a result
Explanation B:	Shutdown may also occur if pump is ending a cycle in the early stage of the venting function testing. In this case – start test over, follow instructions carefully.

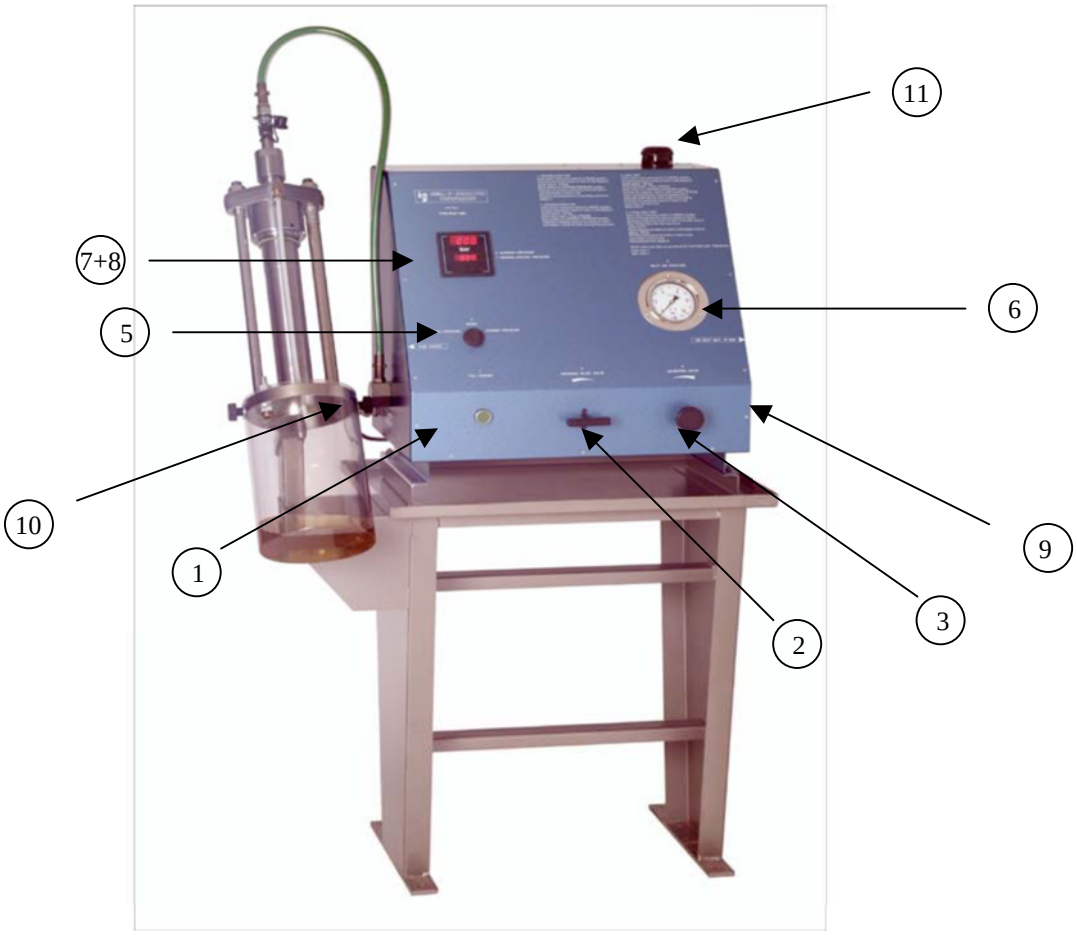
Problem:	Air supply is turned off when full stroke button is pressed
Solution:	Reset the unit, and start the test again. Press the “FULL STROKE” button (1) before working pressure reaches 150 bars.

Problem:	The VPUD 1000 is plugged in and turned on, but air supply is never blocked during testing.
Possible explanation	If the turn-button is pointing at either “OPENING PRESSURE” or “VENTING FUNCTION”, and a sudden oil pressure drop does not result in a blocking of the air inlet, the unit needs further troubleshooting.
Solution:	Consult IOP Marine for maintenance advice.

Problem:	The display on the VPUD 1000 is not working
Possible solution:	Check power supply.
Explanation:	Unlike standard VPU units, the VPUD 1000 requires 110V/230V power-supply.

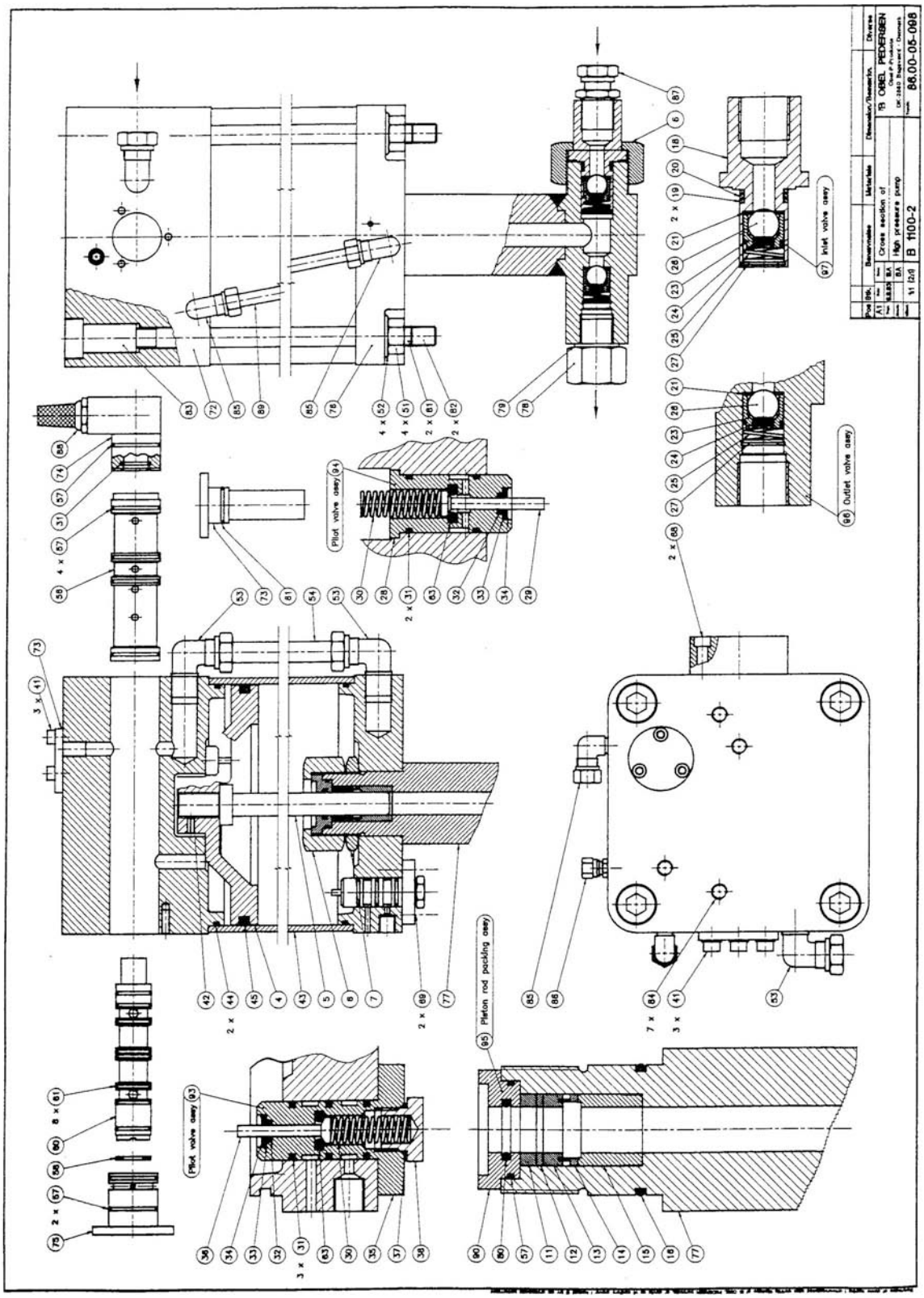
For a more detailed trouble-shooting guide, please contact IOP Marine A/S
For general maintenance instructions, please consult section 2.

5. Spare Parts



Pos. 1	Full stroke valve (push button)	(IOP no. 31904-46/-47/-48)
Pos. 2	Pressure relief valve	(IOP no. 1111032)
Pos. 3	Pressure control valve / pneumatic reducing valve	(IOP no. 3788003)
Pos. 4	Transducer (inside VPU unit)	(IOP no. 3865030)
Pos. 5	Switch (OPENING PRESSURE/VENTING PRESSURE/RESET)	(IOP no. 3304612)
Pos. 6	Manometer for “Inlet air pressure” (0-10 bar)	(IOP no. 3805003)
Pos. 7+8	Digital instrument with two displays	(IOP no. 3303061)
Pos. 9	Stud “air inlet” / air inlet with claw coupling or M42x2	(as ordered)
Pos. 10	Stud “fuel outlet” / high pressure outlet	(IOP no. 2112005)
Pos. 11	Filler cap with strainer	(IOP no. 3787001)
Pos. 12	Oil filter (inside oil tank)	(IOP no. 3332002)
Pos. 13	2-Way pneumatic valve	(IOP no. 3190629)
Pos. 14	Pump B1100-2 (inside VPU unit) *For spares for the main pump, please check the cross-section diagram and the B1100-2 spare part list on the following pages*	(IOP no. 1113021)

Main pump, cross section (IOP 1113021)



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Main Pump, Spare Parts List

SPARE PARTS LIST FOR CROSS SECTION 8600-05-098/2112628 B1100-2/1113021

POS.	INCL. IN KIT	DESCRIPTION	IOP NO.	PCS.
4.		Air piston	2112237	1
5.		HP Piston	2112238	1
6.		Gland nut	3330005	2
7.		Nut	3330006	1
11.	○	Spacer	3222026	1
12.	○	Back-up-ring	3013010	1
13.	○	Seal	3168070	1
14.	○	Support ring	3222025	1
15.	●	Bearing	3013011	1
16.	●	O-ring	3168055	1
18.		Fitting inlet	3330003	1
19.	○	Back-up-ring	3013007	2
20.	○	O-ring	3168015	1
21.	○	Seal	3013008	2
23.		Retainer	3222024	2
24.	○	Spring	3149005	2
25.	○	Spring	3149006	2
26.	○	Ball	3210018	2
27.	○	Retainer	3169008	2
28.	■	Valve body	3330007	1
29.	■	Valve	3222030	1
30.	■	Spring	3149007	2
31.	△	O-ring	3168013	6
32.	△	O-ring	3168054	2
33.	△	Washer	3049275	2
34.	△	Retainer	3169001	2
35.	□	Valve body	3330008	1
36.		Valve	3222029	1
37.	△	O-ring	3168056	1
38.		Plug	3190091	1
41.		Screw	3049116	6
42.		Screw	3049887	1
43.		Tube	3754002	1
44.	△	O-ring	3168017	2
45.	△	O-ring	3168067	1
51.		Nut	3049321	4
52.		Washer	3049274	4
53.		Fitting	3786059	3
54.		Air tube	3170002	1
56.		Sleeve	3331002	1
57.	△	O-ring	3168068	8
58.		Seal	3153004	1
60.		Spool	3331001	1
61.	△	O-ring	3168100	9
63.	△	O-ring	3168099	2
67.	△	Lubricant	3000010	1
68.		Screw	3049876	2
69.		Screw	3049271	2
72.		Top cap	2112570	1
73.		Plug	2112576	1
74.		Plug	2112575	1
75.		Plug	2112574	1
76.		Bottom cap	3213012	1
77.		Cylinder head	2112594	1
78.		Adaptor	2112082	1
79.	○	Seal	3168061	1
80.	○	O-ring	3275057	1
81.		Pinbolt	2112573	2
82.		Pinbolt	2112577	2
83.		Nut	3330020	4
84.		Plug	3049793	7
85.		Fitting	3786051	3
86.		Fitting	3786032	1
87.		Fitting	3786044	1
88.		Silencer	3060003	1
89.		Air tube	3170004	1
90.	●	Bearing	3222037	1
91.	△	Seal kit pneumatic	2001006	1
92.	○	Seal kit hydraulic	2001005	1
93.	□	Pilot valve assy.	2111064	1
94.	■	Pilot valve assy.	2111065	1
95.	●	Piston rod packing assy.	2111066	1
96.	✚	Outlet valve assy.	2111067	1
97.	▲	Inlet valve assy.	2111068	1

Pos. 91-97: The symbols indicate the contents in the different kits.

03.09.2003

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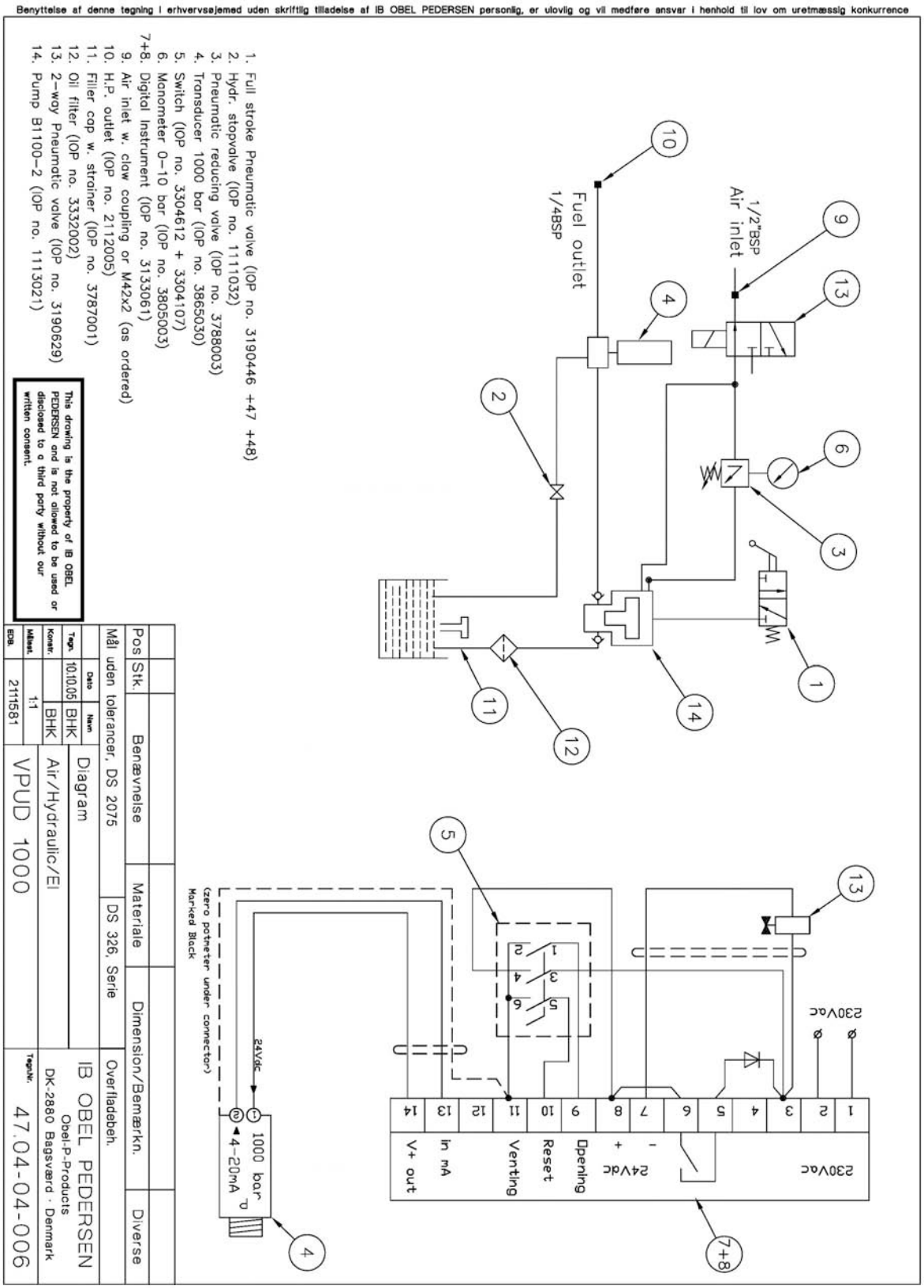
VPUD 1000 – Mechanic/Electric Diagram



手动高压泵 使用说明

Hydraulic Pump INSTRUCTIONS FOR USE

常州市陆氏船舶机械有限公司

CHANGZHOU LU SHI MARINE MECHANICAL CO.,LTD

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Technology Leader Industry Pioneer

科技创导　行业先锋

天高任鸟飞,海阔凭鱼跃;
经济浪潮的冲击,
成就了陆氏的飞速发展.
市场的竞争激烈,
彰显出陆氏的诚信与服务.
风高浪急,唯我英勇无惧!
山高水长,友情万古常青!
携手陆氏船舶机械,
我们和您风雨同舟,共创辉煌!

安全劝告

由于高压下存在着安全危险，必须遵守下列指南：

——此装置必须由经过训练的人员操作。
——使用前仔细检查泵及所有附件，切勿使用,即使是极小损坏之部件。
——泵升压前，确认液压系统中所有空气均已放尽。
——必须使用压力表。
——避免装工作、工具在没有保护情况下，快速释放压力（即要用保持螺母）。
——本装置切勿使用超过规定的压力。
——切勿调节安全阀，使工作时超过最高工作压力。
——切勿延长手柄，企图减少用力来达到最高压力，只能用手的力量。
——不能将低于本泵最高压力的附件与本泵同时使用。
——使用防护目镜。
——切勿改动本装置。
——只使用原装零件。
——使用干净液压油。

Safety recommendations

As high pressures constitute a potential safety risk , the following instructions must be considered:

— The equipment should only be operated by trained personnel.
— Check the pump and all accessories carefully before use.
— Never use even slightly damaged components.
— Make sure all air has been removed from the hydraulic system , before pressurizing the pump.
— Always use a pressure gauge.
— Always prevent the workpiece/tool from being projected upon sudden release of pressure(e.g.by use of retaining nut).
— Never use the equipment above the stated maximum pressure.
— Never adjust safety valves to work at pressures above the maximum working pressure.
— Do not extend the handle in order to reduce the required force to reach maximum pressure .Use hand pressure only.
— Never use the pump together with accessories which are rated below the maximum pressure of the pump.
— Use protective goggles.
— Never modify the unit.
— Use original parts only.
— Only use clean , recommended hydraulic oils.

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1、简介

手动滚压泵是二级泵，在到达开关压力前具有高流量（每行程17.5cm³），到达压力后流量自动降至每行程1.25cm³。

本泵的双柱塞缸具有二个不同的出口及一个额外的通向油池的返还接口，当泵的油池的容量不够时，此接口还可用于与额外的油容器连接。

1. Description

The pump is a two-stage pump giving a high flow(17.5cm³ per stroke) until switching pressure is reached . from then on the flow is automatically reduced to 1.25 cm³ per stroke.

The pump has two different outlets for double jacking and an extra return connection into the oil container . this return can also be used for connection of an extra oil reservoir when the oil container capacity is insufficient.

2. 技术参数 Technical data

型　号	工作压力（bar）		每冲程油量（CC）		输　出	压力表	油箱容积	外型尺寸	重量
	一级	二级	一级	二级	接口	接口	（cc）	（mm）	（kg）
HP -1800	20	1500	32	1.6	1/4BSP	1/2BSP	2200	585×120×170	9
HP -2000	20	2000	32	1.3	1/4BSP	1/2BSP	2200	585×120×170	11
HP -2800	20	2800	32	0.9	3/4”-16UNF	3/4”-16UNF	2200	585×120×170	11

3. 操作指南

a. 旋开手柄下部的油池螺塞来检查油位高低，确认已有足够油量来进行操作。当使用手动高压泵安装轴承或安装液压螺母时，我们推荐油粘度为300mm²/s，当拆缸轴承时，我们推荐操作温度下的油粘度为900mm²/s。

b. 保持泵在水平位置或稍稍向前倾斜，以利充油。

c. 随手将泵右边的释放阀关闭。

d. 将快速连接乳头（G1/4”）旋入工作。

e. 松开快速连接头上的卡环，将高压管与乳头连接，用同样方法拆下高压管。

f. 将泵打到使用所需压力，最高压力为150Mpa达到此压力值时安全阀打开。

g. 缓慢打开和释放阀，让多余的油返还到油池。

3.Operating instructions

a) Check oil level by unthreading the container plug under the pump handle . Make sure there is enough oil for your complete operation . For mounting bearings with the Pump Oil Injection Method or by means of an hydraulic nut . we recommend an oil viscosity of approximately 300mm²/s(1.400sus) at operating temperature. For dismounting bearings . we recommend an oil with a viscosity of 900mm²/s(4.100sus) at operating temperature.

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b) Hold the pump horizontally or slightly tilted forwards in order to secure oil supply.

c) Close the release valve on the right hand side of the pump without using force.

d) Screw the quick connection nipple (1/4"G) into the workpiece.

e) Connect the hose to the nipple by withdrawing the snap-ring on the quick connector , the hose is disconnected in the same manner.

f) Continue pumping until necessary pressure is reached for your application. Maximum pressure is 150Mpa(21.750psi) at which pressure the safety valve will open.

g) Open the release valve , letting superfluous oil return to the oil container.

4. 保养

4.1换油

当需换油或在维护保养后，确定系统中空气残留时，在将高压管接上前，必须确认在泵油时，高压管中没有带气的油泵出，只使用清洁的液压油。

4.2清洁

保持泵的清洁，不让灰尘及金属颗粒污染以避免过度磨损。

4. Maintenance

4.1 Replacing the oil

when replacing the oil or after maintenance make sure no air is trapped in the system .this should be checked before attaching the hose to the application , by making sure only airfree oil comes out of the hose when pumping.Only ues clean ,recommended hydraulic oils.

4.2 cleanliness

keep the pump clean from dirt and metal particles in order to avoid excessive wear.

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Pc:213024

Version 2.0, 07/2008

VISATRON®

Oil Mist Detectors

VN115/93
VN116/93
VN215/93

Operation Manual

Part-No. 10980

IACS UR M67 type approved

SCHALLER AUTOMATION

About this Manual

This operation manual was designed to answer your questions concerning the handling, operation and maintenance of the Oil Mist Detector (OMD) VISATRON® series VN93. It contains no details about repairs.

The operating instructions are applicable for:

VN115/93
VN116/93
VN215/93

Should you encounter any interruptions or breakdowns during operation, please contact SCHALLER AUTOMATION Industrielle Automationstechnik GmbH & Co. KG. You can expect a safe and reliable operation of the series VN93 devices only when the device is operated in accordance with this operation manual.

Please note the following rules:

- Installations of the VISATRON® series VN93 devices have to be in accordance to the IACS UR M10 if applicable.
- Please acquaint yourself with the operation manual.
- Read the operation manual carefully and take note of the given advice.
- Use the VISATRON® series VN93 devices only for the purpose described in the operation manual.
- Incorrect maintenance and handling errors may cause failures and accidents!
- The VISATRON® series VN93 devices may be used by authorised specialised staff only.
- This operation manual must be available at the place of installation at all times.

The manufacturer does not accept any guarantees resulting from improper handling or insufficient maintenance and service.

SCHALLER AUTOMATION Industrielle Automationstechnik GmbH & Co. KG precludes all guarantees for the case that incorrect device combinations are operated with devices not certified to be compatible or not admitted by the manufacturer.

Conditions of Sale

The standard conditions of sale of SCHALLER AUTOMATION (current version) shall apply to all sales of VISATRON® and connected products to any of our customers.

Safety instructions

The series VN93 devices are manufactured according to the high quality standard of SCHALLER AUTOMATION and pass the stringent factory tests. In order to keep the device in a smooth and problem free operation, the user has to take note of the safety hints and warnings. In the instruction manual and at the device they are marked with the following symbols.

Used symbols	
	CAUTION! Do not ignore the warnings. The safety of persons can be endangered or the device can be damaged.
	WARNING! The marked text contains important information.
	The marked text contains only a hint for faster processing.

	CAUTION! Unplug the OMD during welding processes on the engine.

Reset of Oil Mist Alarms

Ensure, that the oil mist concentration inside the engine has fallen under the Lower Explosion Level (LEL) before acknowledging an oil mist alarm by pressing the Oil-Mist-Alarm button. Otherwise you risk an oil mist explosion!

Follow the instructions of the engine builder, ship yard and ship owner.

Use a monitoring device at a safe location to read off the current oil mist concentration. SAB recommends to wait until more than the half of the indication LED's are switched off (VISATRON®-device and Remote Indicator II) or the oil mist alarm level has to reduce below 50 % (ReCon DS23).

Declaration of Conformity

We, the manufacturer

SCHALLER AUTOMATION
Industrielle Automationstechnik GmbH & Co. KG
Industriering 14
D-66440 Blieskastel
Tel.: 06842 / 508-0
Fax: 06842 / 508-260

declare on our own responsibility, that the product:

Kind of equipment: **Oil Mist Detector**

Type-designation: **VISATRON® VN115/93**
VISATRON® VN116/93
VISATRON® VN215/93

is in compliance with following standards :

EN 61000-4-2
EN 61000-4-3
EN 61000-4-4
EN 61000-4-5
EN 61000-4-6
CISPR 16-1
CISPR 16-2
IACS UR M67

D-66440 Blieskastel, 2007/07/25

Stephan Schaller
- Managing Director -

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1 Introduction and functional overview

The VISATRON® series VN93 Oil Mist Detector (OMD) from SCHALLER AUTOMATION protects large diesel engines against oil mist explosion, caused by spontaneously occurring oil mist. It is part of a safety system that secures the life and health of the operating staff and prevents heavy damages to the engine.

This device is conform to the IACS UR M10 which is valid since January 2006.

It is not possible to monitor directly all potential sources of oil mist inside a large diesel engine. There are main bearings, large end bearings, pistons, liners, sliders, pumps, camshaft bearings, chains, gears or forgotten mounting tools – all of these parts could produce oil mist e.g. in case of lubrication problems. Therefore SCHALLER AUTOMATION philosophy is that only OMD-systems can securely prevent oil mist explosions by detecting the primary origin of danger: the oil mist itself.

The VISATRON® series VN93 OMD-system uses the approved wear-free suction system to continuously extract the atmosphere of the crankcase compartments and other engine locations. The system works actively and is not waiting for oil mist clouds. This ensures proper reaction times from the beginning of oil mist generation to an oil mist alarm.

To avoid false alarms caused by splash oil the suction system makes use of Schaller's special suction funnels working independent of the rotation sense of the engine. Additional draining components ensure correct working under all operating conditions. This includes the application in power plants as well as on vessels with their static or dynamic inclinations. False alarms initiated by condensing water vapour are prevented by an integrated heater inside the measuring head housing.

The OMD-system consists of following parts:

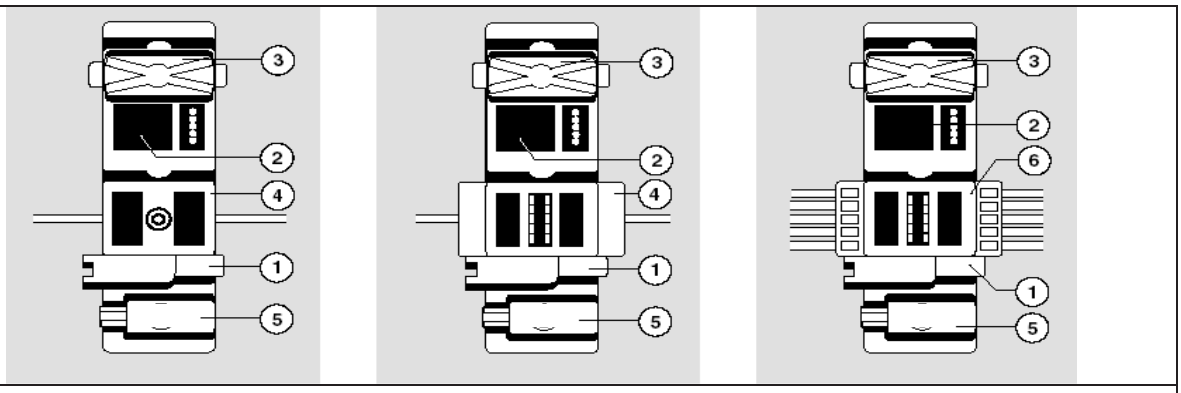
- VISATRON® series VN93 oil mist detector
- Protection cover
- Suction system including pressure regulator
- Monitoring device

Three different types of the VISATRON® series VN93 oil mist detectors are available (see Figure 1):

- VN115/93
- VN116/93
- VN215/93

All devices have a measuring head (2) which includes the optical measuring track under the control cover (3), a label on the front side and a display to give the user all important information for normal operations conditions. The measuring head is mounted on a vibration protected base plate.

The negative pressure for the suction system is generated by an air jet pump (1) working with the Venturi principle. The electrical interface is integrated within a socket housing (5). The device can be connected directly to the engine safety system. The interface includes two Oil-Mist-Alarm outputs, a Pre-Alarm output and a Ready signal.



VN115/93 VN116/93 VN215/93

Figure 1: Types of VISATRON® series VN93

VN115/93
The suction system is connected to the common "Connecting Box" (4). This type of oil mist detector is able to detect an oil mist alarm, without identifying the location of the oil mist source inside the engine.

VN116/93
The suction system is connected to the "Valve Box 116" (4). This type of oil mist detector is able to detect an oil mist alarm, indicating in the valve box window the left or right side of the detector with the highest oil mist concentration.

VN215/93
The suction system is connected to the "Valve Box 215" (6). This type of oil mist detector is able to detect an oil mist alarm, indicating in the valve box window the compartment with the highest oil mist concentration.

In normal operation mode all models are sampling in parallel the atmosphere of the engine at all suction points through the suction system to the measuring head. On detection of an oil mist alarm the models VN116 and VN215 start an additional search run to determine the location of the highest oil mist concentration. The reaction time to an alarm is totally independent of the search run.

The devices offer two alarm levels: Main-Alarm and Pre-Alarm. They can be adjusted by the light buttons (see chapter 4).

To keep the optical track clean all models using clean scavenging air in front of the filter glasses. This air is derived from the compressed air driving the air jet pump.

The devices can be ordered as single OMD device or integrated in a mounting unit. In this case the scope of supply includes an additional pressure reducer and a protection cover.

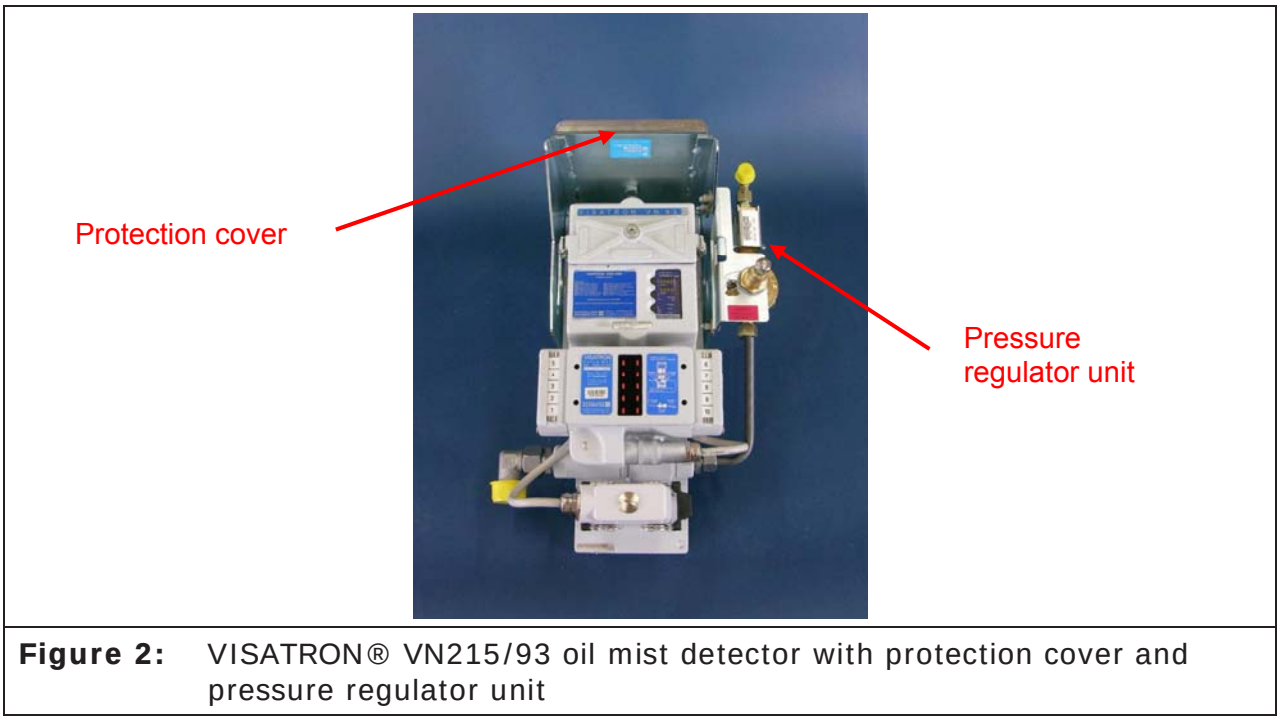


Figure 2: VISATRON® VN215/93 oil mist detector with protection cover and pressure regulator unit

The suction system always requires a so called 'suction funnel' at each suction point. This prevents the system against incoming splash oil. During normal operation mode of an engine the OMD sucks out a small concentration of oil mist which was generated by blow-by or mechanical spraying. This oil mist intercepts in the suction pipes and must be drained back to the crankcase.

Figure 3:
siphon block VN180 siphon block VN280plus pipe siphon

The best method on a VN115/93 and VN116/93 installation to drain the system is to use pipe siphons. Also recommended is the use of siphon blocks.

On 2-stroke engines the crankcase and the combustion chambers are separated by stuffing boxes, which let the crankcase be nearly free of blow-by. Therefore it's also possible to use the suction funnel as draining device. In this case it is necessary to mount the suction pipes with an inclination of greater than 6°.

To become independent from fast changes of the engine room air pressure, it is recommended that the output of the air jet pump is blown back into the crankcase. If the air is blown into the engine room, SCHALLER AUTOMATION offers an optional oil separator which should be mounted directly to the output of the pump.

Figure 4: Oil separator for air outlet

The OMD device can be connected to Schaller's monitoring devices Remote Indicator II or ReCon DS23 to monitor the oil mist concentration and the status of the OMD device from a safe location as requested by IACS UR M10. The connection to the monitoring devices is realized by a RS485 two-wire bus.

Figure 5: Remote Indicator II

Figure 6: ReCon DS23

Thus, the series VN93 is a further contribution to safety at sea. Our goal is to avert lasting damage to real assets, the individuals and environment.

2 Installation instructions

2.1 Mechanical installation

2.1.1 Basics

There are multiple potential sources of oil mist inside an engine. These are for example defective main bearings, connecting rod bearings as well as piston seizures, chains and covers of pumps. For each of these individual sources you could determine the "optimum" suction point. The result would be a vast number of holes to be distributed over the entire engine. To find out a safe and economic solution to monitor oil mist SCHALLER AUTOMATION recommends the OMDEA-test (Oil Mist Detection Efficiency Approval). In each case the following rules are recommended.

	CAUTION! Do not ignore the warnings. The safety of persons can be endangered

Following rules are recommended by SCHALLER AUTOMATION:

- Use at least one suction point per compartment.
- Use always the long version of the suction funnels. This makes the installation independent from the rotation sense of the engine.
- At least one suction point per chain drive or gear drive is necessary.
- Avoid the splash oil disk of the crankshaft bearings.
- Select points in the upper area of the crankcase, as oil mist tends to rise upwards!
- The detection unit has to be placed above the suction points.
- Installation Rules: in general avoid U-bends or kinks in the tubing system.
    - VN115/116 with pipe siphons: Mount one pipe siphons at each end of the horizontal header pipes, place the pipes a little bit above the suction points and connect the pipes and the engine wall connections with flexible tubes.
    - VN115/116 with siphon blocks: Use one siphon block at each compartment.
    - VN215 with siphon block: Use one siphon per compartment. If a suction point is placed above the detection unit e.g. at the camshaft use a pipe siphon at the lowest point of the pipe to avoid an oil pocket, which could clog the pipe.
    - VN215 without draining components: The pipes have to be mounted with an angle greater than 6° inclination.

- If possible mount the device on the engine side opposite to the crankcase relief valves, to reduce danger to the crew during a damage situation.
- If possible place the VISATRON® detection unit in the center of the engine to avoid long pipe runs.
- Select only suction points which allow the use of long suction funnels. In this case the installation side is independent from the rotation sense of the engine. Installations without any suction funnels are not allowed.
- If recommended by engine builder, determine an additional suction point at the camshaft bed.

SCHALLER AUTOMATION recommends a final test procedure per engine type called OMDEA (Oil Mist Detection Efficiency Approval).

According to the IACS unified requirement M10 the installation drawings have to be approved from engine builder and SCHALLER AUTOMATION. The installations have to be executed in compliance with these drawings and the contents of this manual.

The following figures show typical installation arrangement on a 6 cylinder engine.

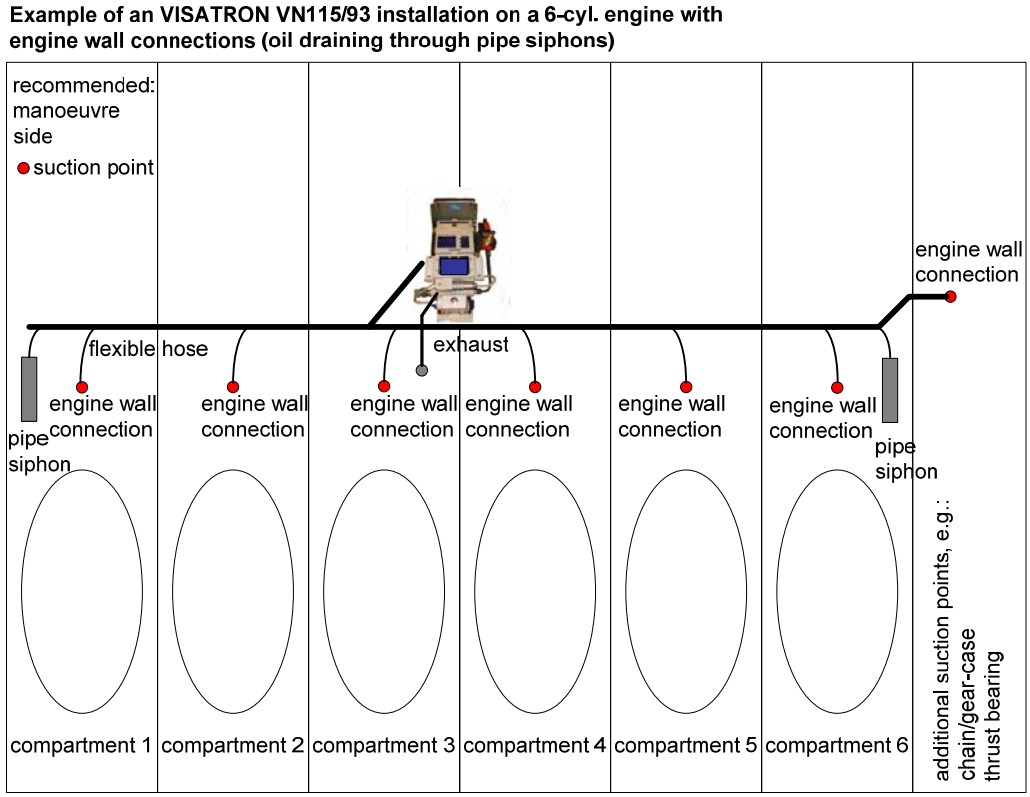


Figure 7: Recommendation for best VN115/93 OMD installation

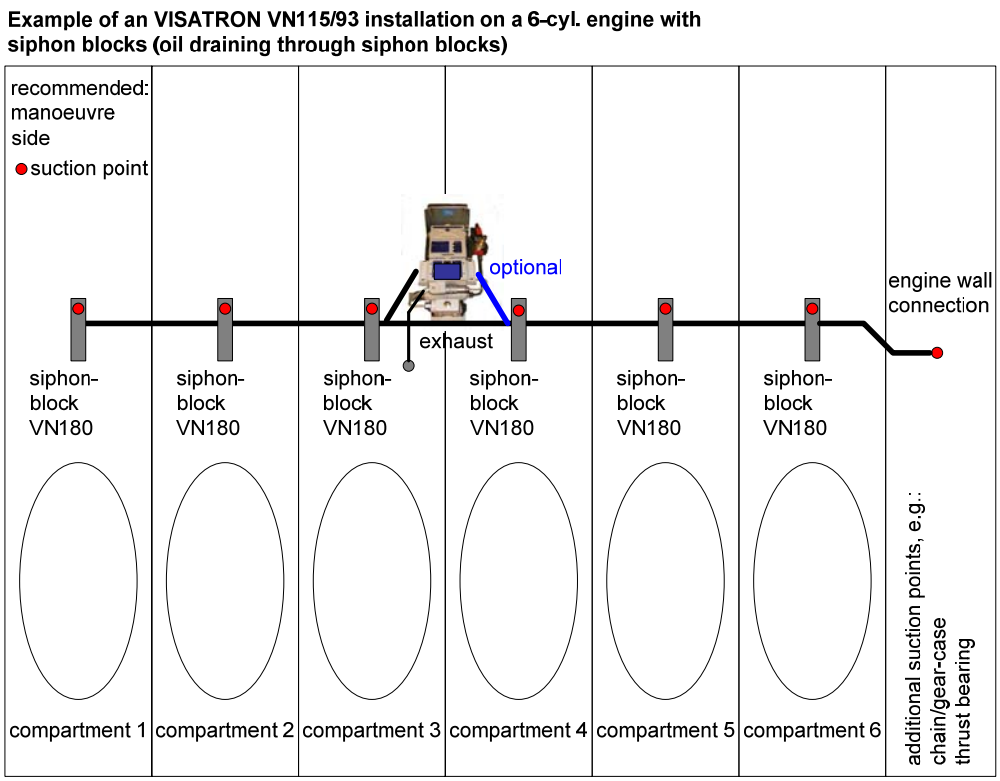


Figure 8: Alternative installation of VN115/93 OMD

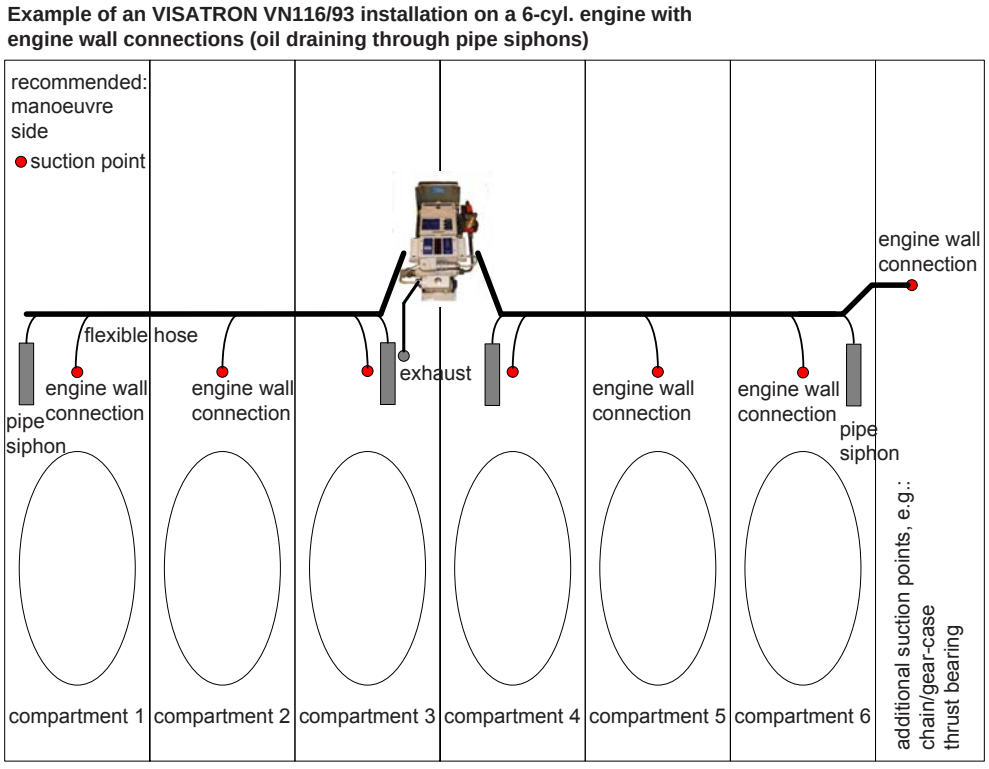


Figure 9: Recommendation for best VN116/93 OMD installation

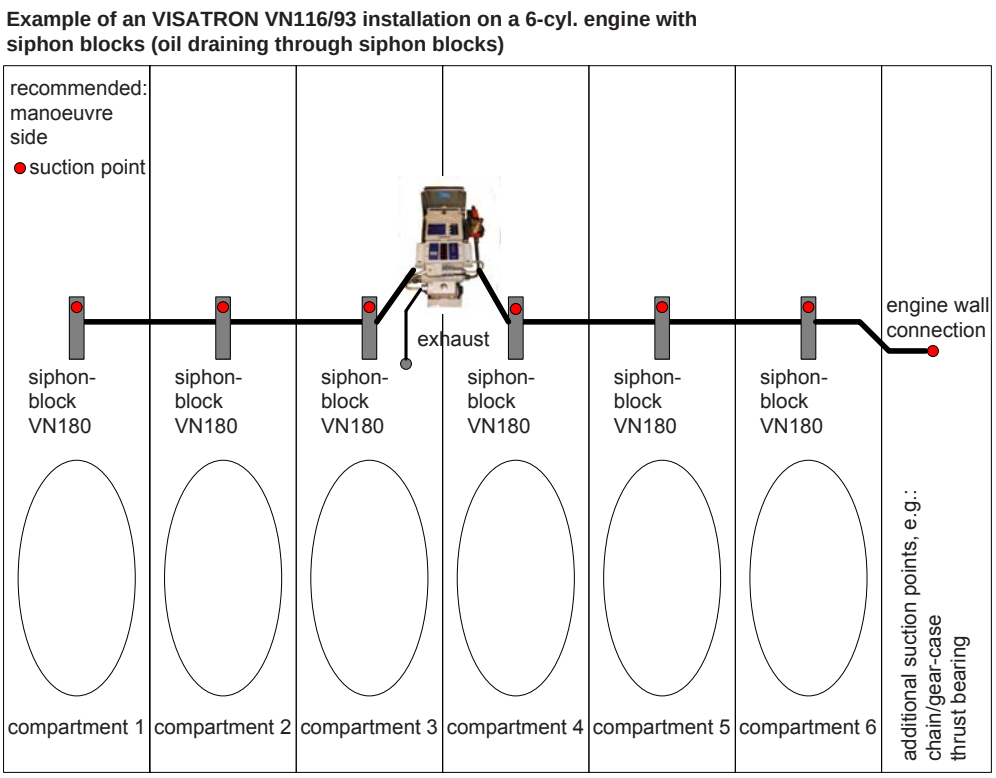


Figure 10: Alternative installation of VN116/93 OMD

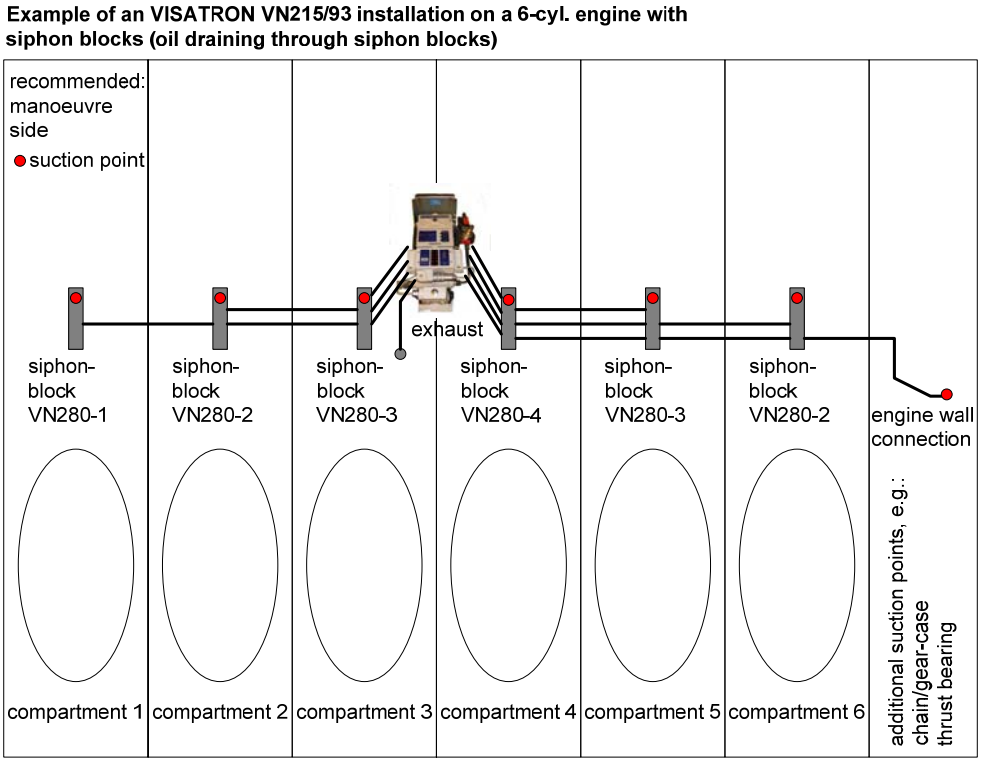


Figure 11: Recommendation for best VN215/93 OMD installation

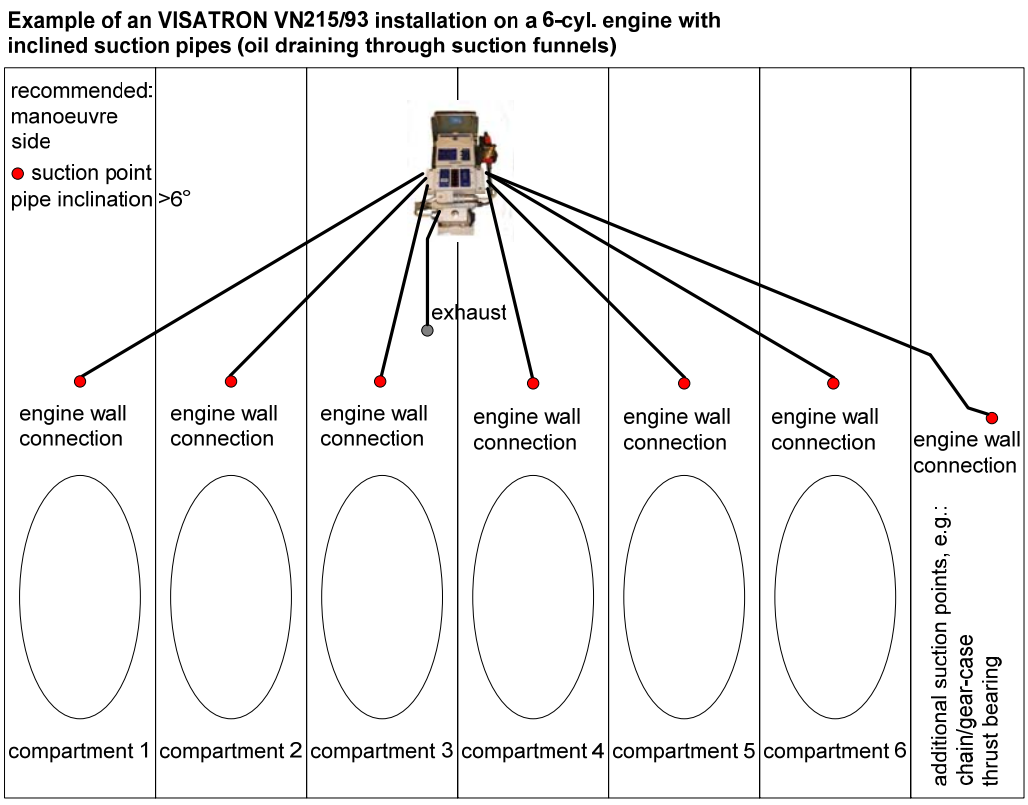


Figure 12: Alternative installation of VN215/93 OMD

2.1.2 Pipe dimensions

- For VN115 and VN116 standard applications:
  - Seamless steel Pipes: 22 mm outer diameter, 2 mm wall thickness
  - Flexible hoses: inner diameter not less than 6 mm

- For VN215 standard applications:
  - Seamless steel Pipes: 14 mm outer diameter, 2 mm wall thickness

  or, if 14 mm is not available

  - Seamless steel Pipes: 13,71 mm (known as1 /4-inch pipes, schedule no. 40, 0.540 inch outer diameter, 0.088 inch wall thickness)

The length of the exhaust pipe (outlet of the venturi injector) is restricted to max. 2m. The inner diameter has to be ≥ 18 mm. Pointed elbows are forbidden.

Other installation solutions must have written agreements by SCHALLER AUTOMATION as required by IACS UR M10.

2.1.3 Installation of pipe siphons

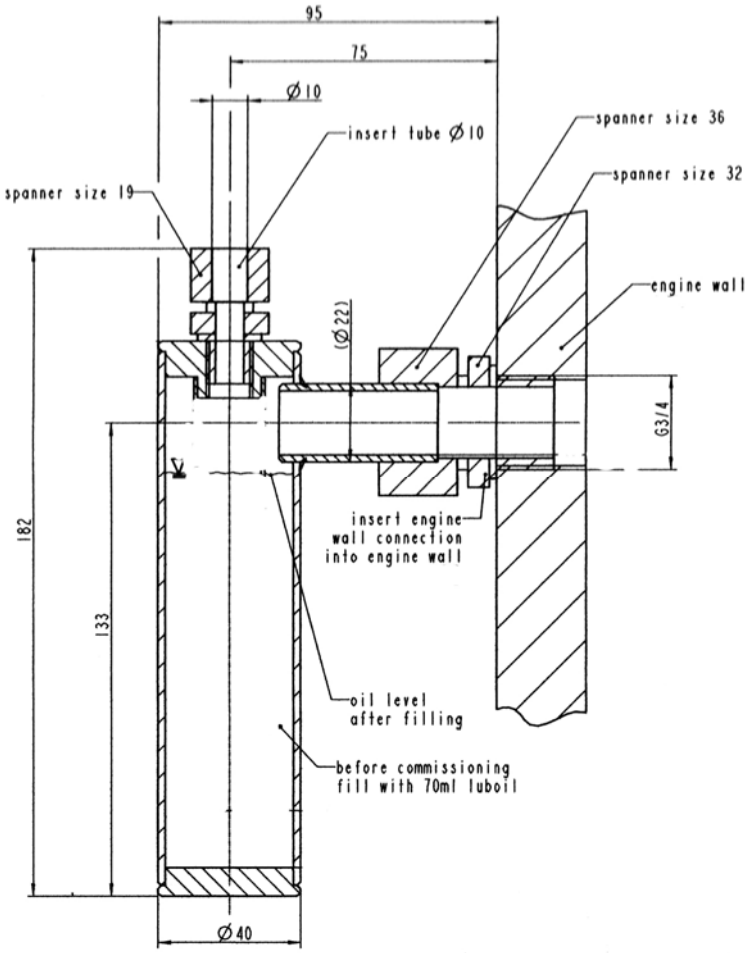


Figure 13: Pipe siphon

- Mount the engine wall connection into the G3/4" thread with 110 Nm torque
- Put the pipe siphon in the hole
- Fix the clamping nut
- Fill the pipe siphon with oil (see chapter 'commissioning')
- Fix the flexible tube on the top fitting

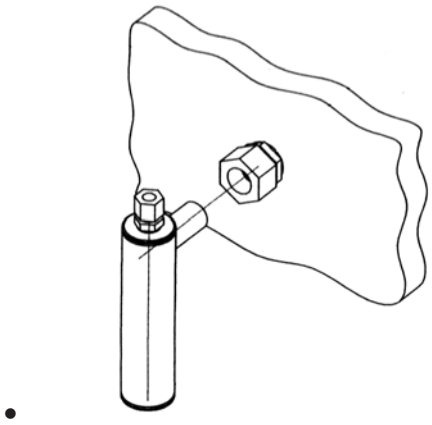


Figure 14: Pipe siphon at engine wall

Figure 15: Image of pipe siphon

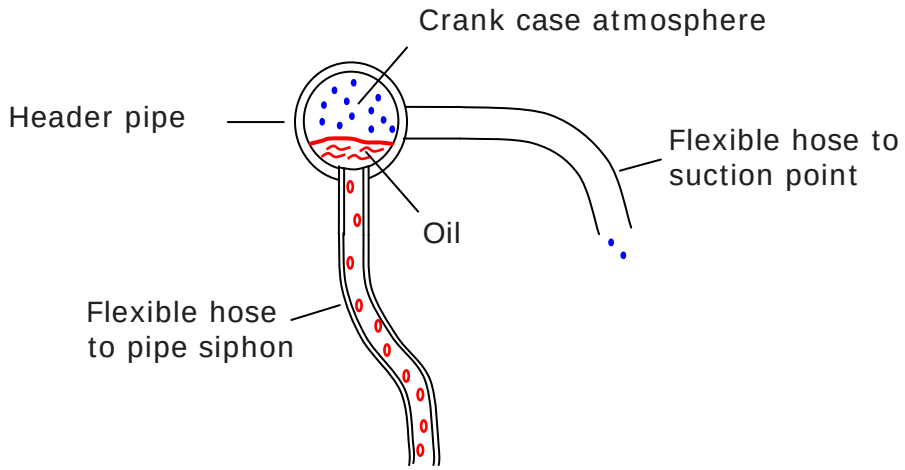


Figure 16: Oil draining principle

2.1.4 Installation of the siphon block connection units

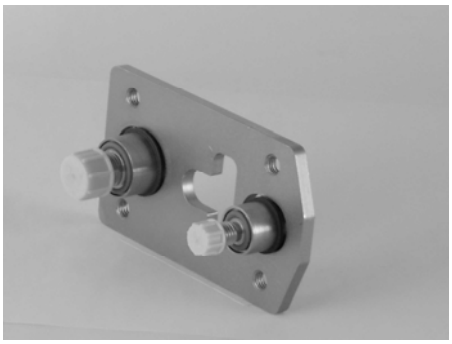


Figure 17: Connection unit

Consider the following points:

- Take note of the drilling template (made of paper, included with the connection units)
- Drill through
- Seal all threads with 'Loctite 572'
- Max. torque = 30 Nm

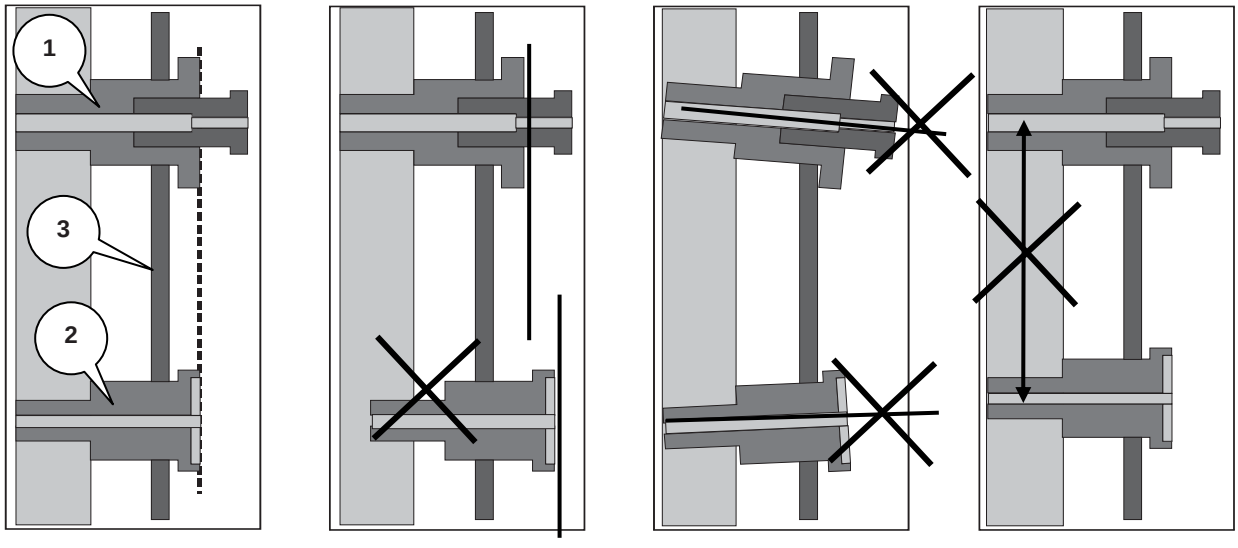


Figure 18: Side view

- Avoid wrong alignment, wrong angles and incorrect distances (see Figure 18)

- Insert the suction funnel from the crankcase side into the siphon block, align it in a vertical position (see Figure 19) **with the opening at the bottom** and fix the small clamping nut.

2.1.5 Suction funnels in the crankcase compartment

The suction funnels have to be fitted in such a way that flooding by splashing bearing oil or returning piston cooling oil is avoided (see Figure 19).

	CAUTION! Make sure funnels do not interfere with rotating or moving parts of the engine.

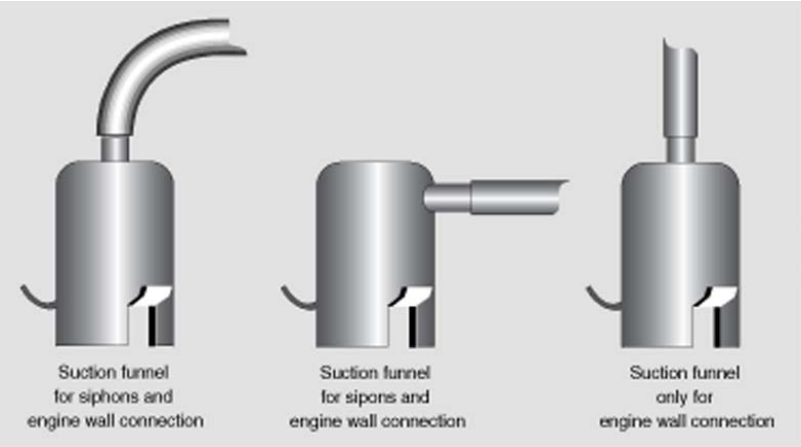


Figure 19: Different types of suction funnels

2.1.6 Pipe arrangement at valve box (VN215/93 system only)

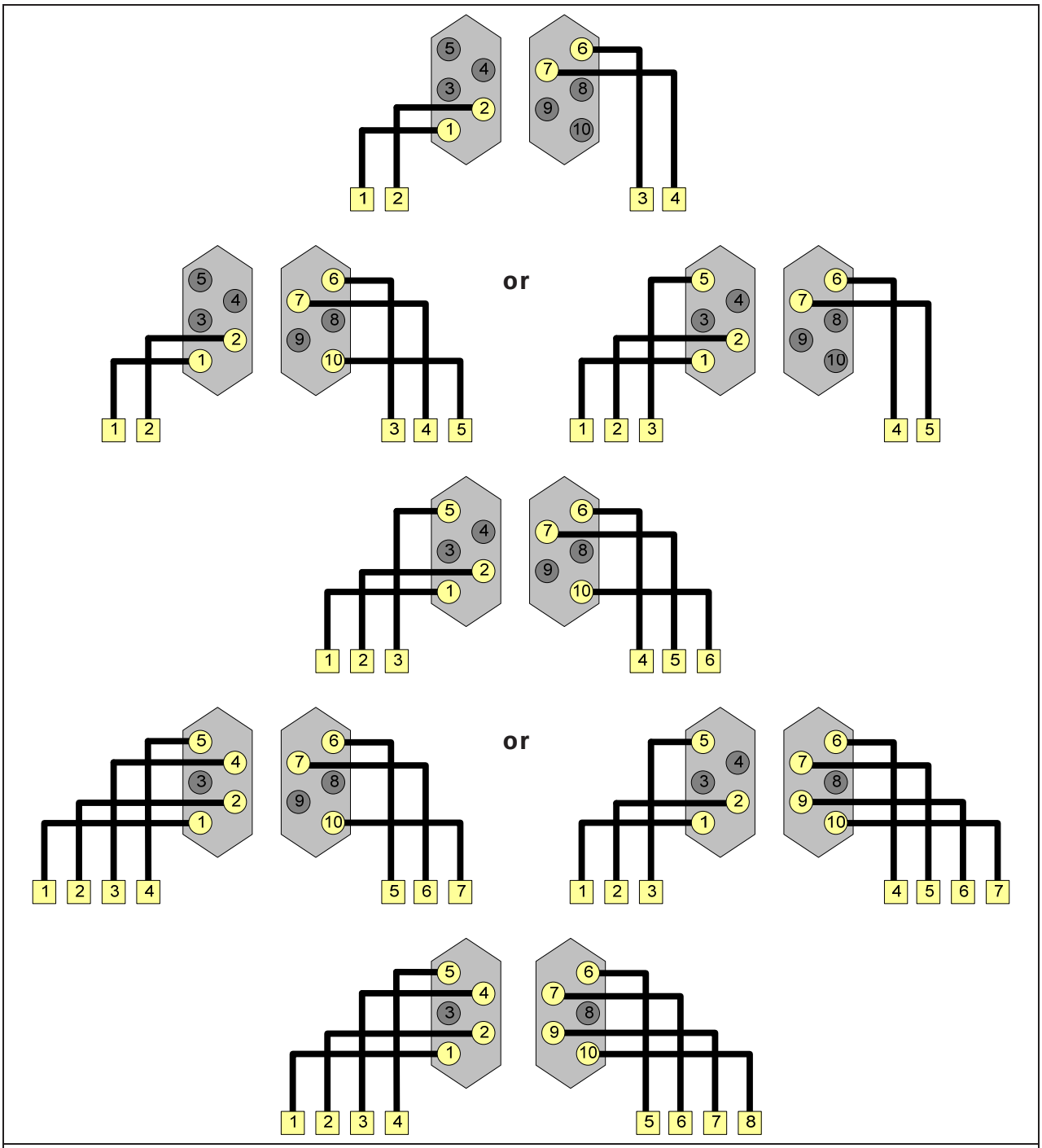


Figure 20: Pipe arrangement for 4 to 8 suction points

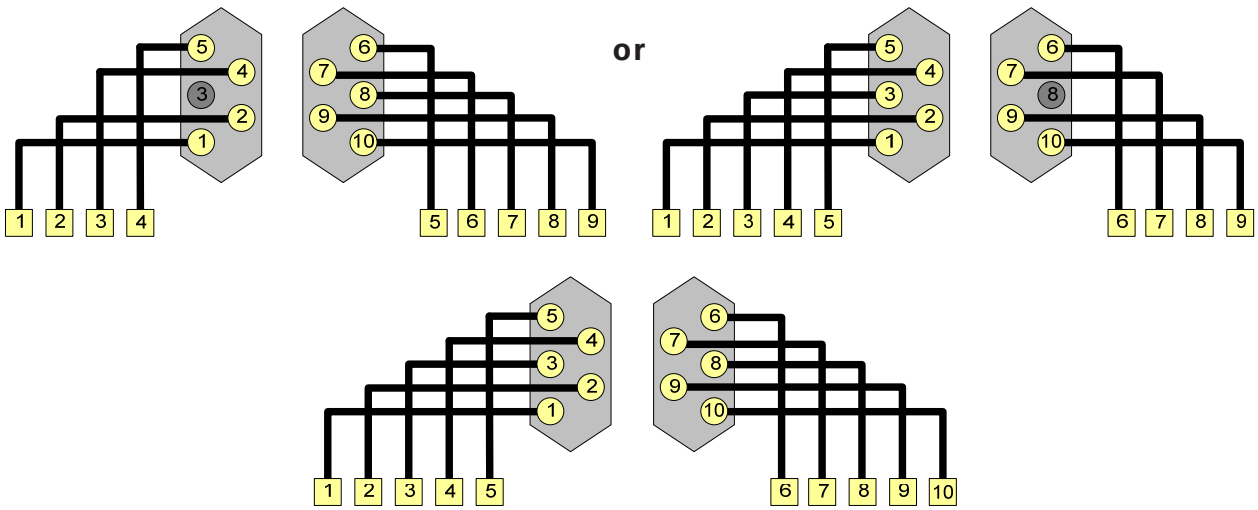


Figure 21: Pipe arrangement for 9 and 10 suction points

	CAUTION! Other arrangements are not valid. Unused connection points (see Figure 20 and Figure 21, marked dark grey) have to be closed by supplied rubber plugs.

2.1.7 Compressed air connection

If the SAB pressure regulator (see Figure 22) is used connect the compressed air supply at the NTP/BSP/G1/4A fitting. Use only **dry** and **clean** compressed air within a range of 2 - 15bar.

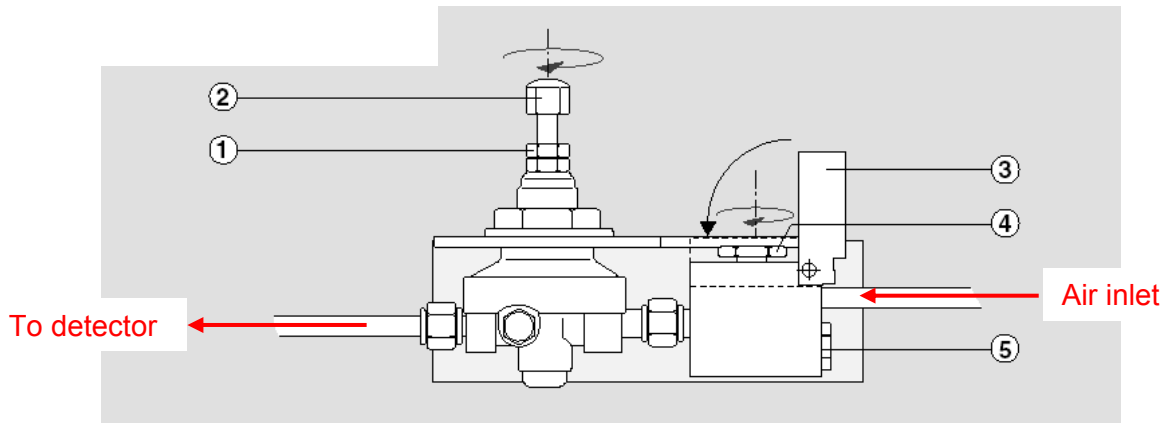


Figure 22: SAB pressure regulator unit

2.2 Electrical installation

2.2.1 VISATRON® series VN93 device

The electrical terminal is inside the socket housing (see Figure 23) on the base plate of the VISATRON® device. The pin assignment is specified in Figure 26. The cable entries are on the small sides.

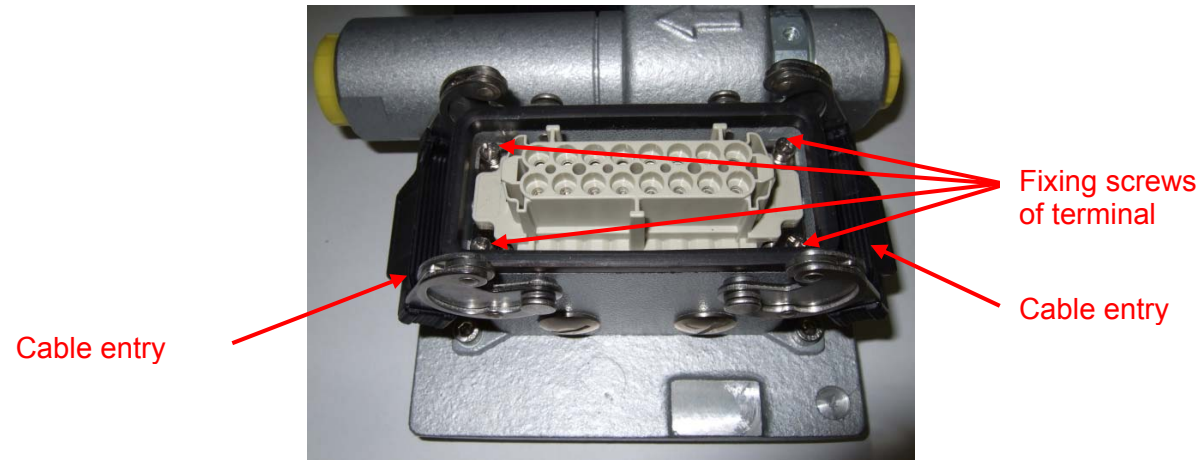


Figure 23: Socket housing

According to the pin assignment of Figure 26 connect the VISATRON® device to the 24 Volts power supply. The supply voltage can be potential free or not. The earth connection between the OMD and the engine is carried out by the fixings screw of the base plate or protection cover.

Additionally connect one alarm relay output to the safety system of the engine. As specified by the classification societies the 'Alarm' relay must be connected either to the shutdown or to the slow-down input.

During normal operation the alarm relay is switched off. In case of an oil mist alarm the relay is switched on. To monitor this output, a wire break resistor is installed (between pin 7 and 8 and between 15 and 16 as shown in Figure 26).

To replace the wire break resistors the measuring head has to be dismounted. The resistors (see Figure 25) are located at the rear side under the plastic cover (see Figure 24). The plastic cover can be removed be opening the screws. Do not forget to write the resistor value on the plastic cover with a permanent marker.

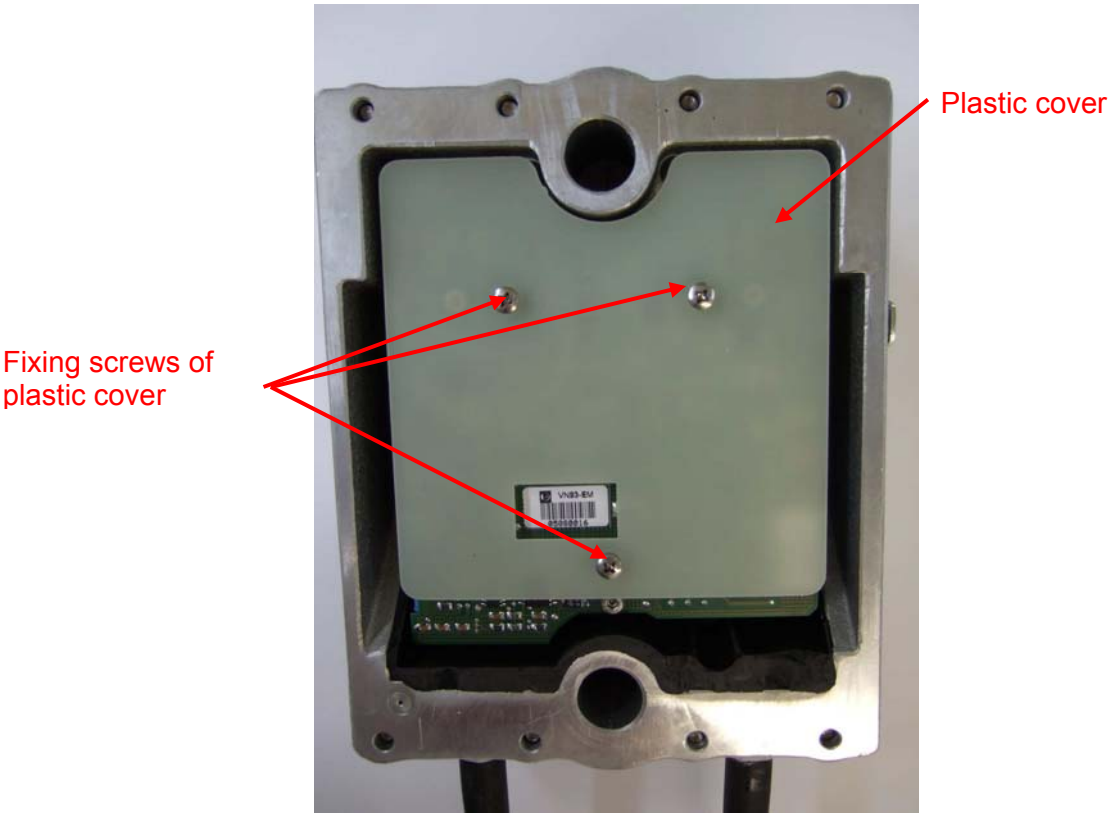


Figure 24: Rear side of measuring head

The second 'Alarm' output must be connected to separate channels on alarm monitoring system of the vessel or power plant and the 'Ready' output. The 'Ready' relay is switched on when the OMD is in correct operation (see Figure 26).

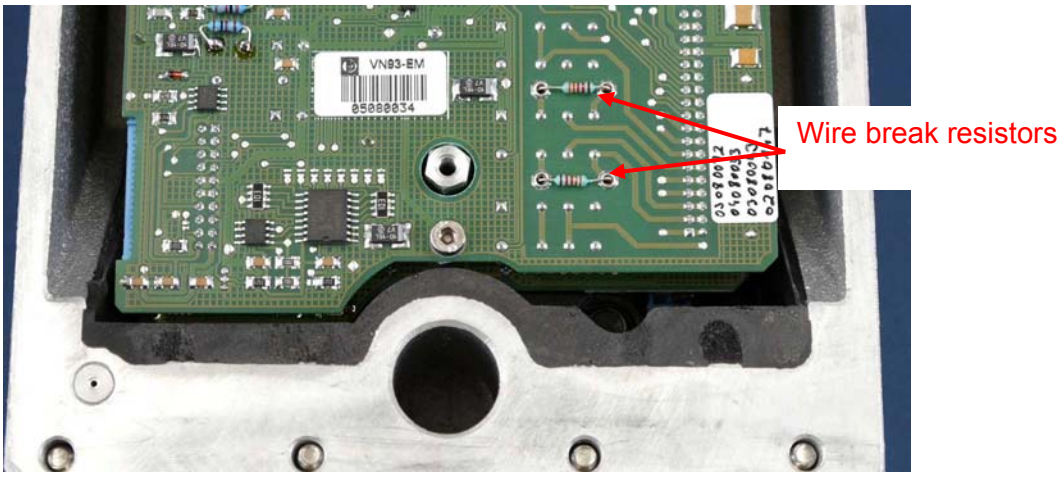


Figure 25: Wire break resistors

The optional pre-alarm output can be used to initiate either a pre-warning signal or slow-down signal. The pre-alarm relay is switched on when the oil mist concentration is rises up to the adjusted level. Depending on the characteristics of an oil mist occurrence the time between 'Pre-alarm' and 'Alarm' could be only a fraction of a second.

Description	Pin		Description
24 Volts DC	1	9	'Pre-alarm' relay
24 Volts DC GND	2	10	'Pre-alarm' relay
'Ready' relay closed	3	11	RS485 B
'Ready' relay open	4	12	Reserved, do not use
'Ready' relay common	5	13	RS485 A
'Alarm' 1 relay closed	6	14	'Alarm' 2 relay closed
'Alarm' 1 relay open	7	15	'Alarm' 2 relay open
'Alarm' 1 relay common	8	16	'Alarm' 2 relay common

Figure 26: Pin assignment

The relay outputs are potential-free.

Power supply	18 – 31.2 Volts DC, max. 3 A
Nominal voltage	24 Volts DC
Relay Outputs	Max. 60 Volts DC/AC, 60W, 125VA, 2A
Internal fuse	3.15 A semi time lag

Table 1: Electrical specification

2.2.2 Connection of monitoring devices

As required by IACS UR M10 the OMD device can be connected to Schaller's remote monitoring devices Remote Indicator II or ReCon DS23 to monitor the oil mist concentration and the OMD status from a safe location.

The connection to the monitoring devices is realized by a RS485 two-wire bus. In case of a Remote Indicator II or a standard ReCon DS23 installation the connection is only a two point link. The bus system at the OMD device must be terminated by the resistor. It is integrated in the terminator (see Figure 27), which is supplied with the monitoring device.

The used communication cable must be twisted pair and shielded. We recommend LAPPKABEL UNITRONIC-FD CP (TP) plus UL-CSA, AWG20. The total bus length is limited to 400 m. The VISATRON® device cable entry (see Figure 27) at the VISATRON device is designed for cable diameter between 7.5 and 10.0 mm.

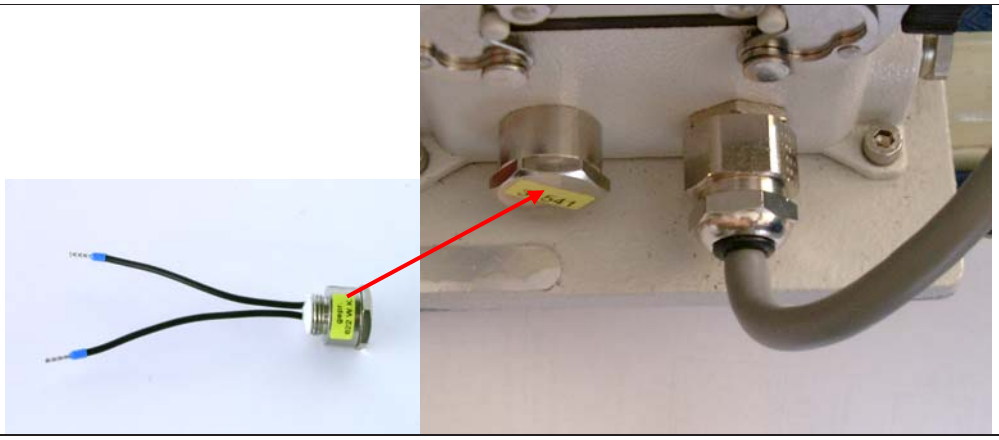


Figure 27: Cable entry and bus-terminator on the bottom side of the VISATRON® device

The connection between the OMD device and the monitoring device for standard application is shown in the following wiring diagram (see Figure 28). If more than one OMD device is connected to a ReCon DS23 unit following the installation instructions in the ReCon DS23 manual.

	WARNING! The shield must be connected directly at the cable grommet.

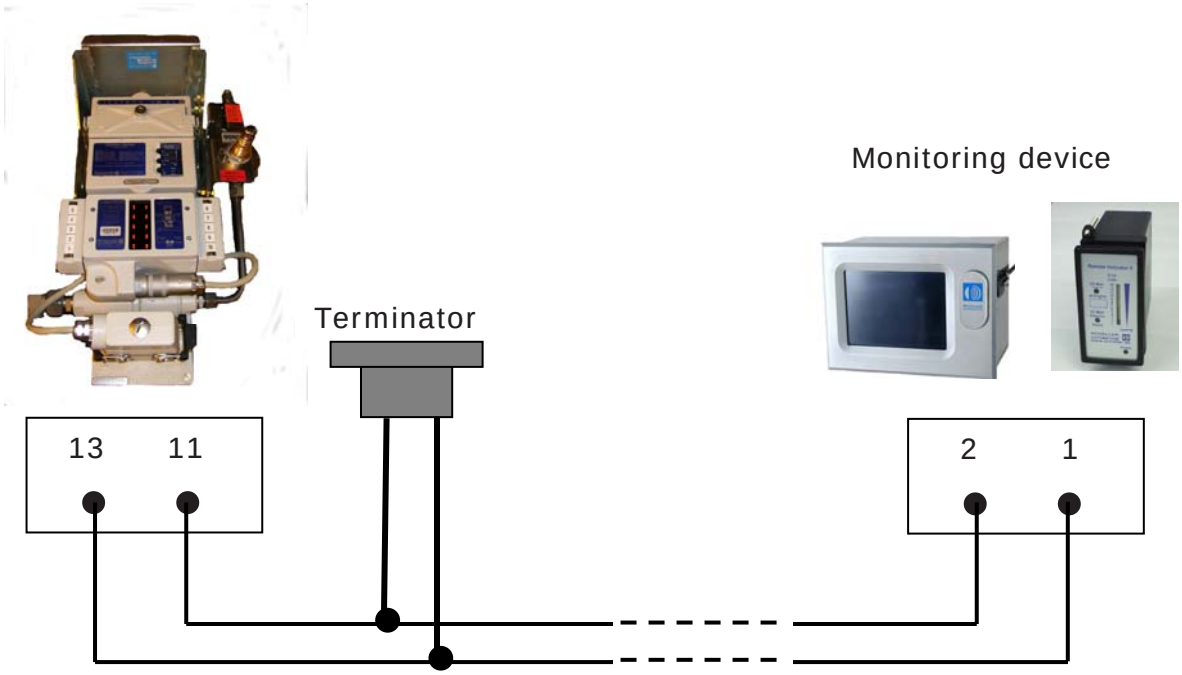
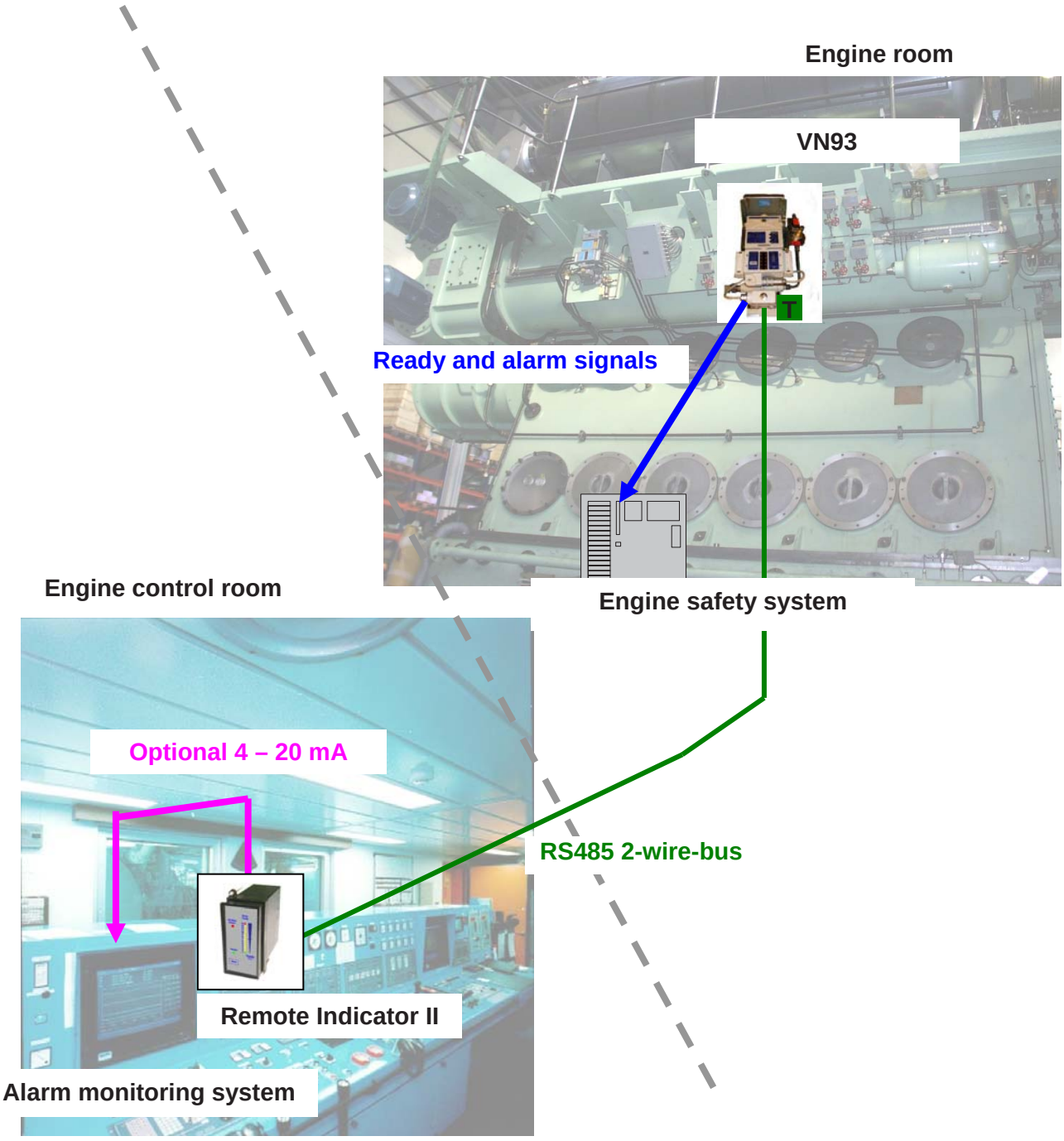


Figure 28: Wiring diagram to connect Remote Indicator II or ReCon DS23

⚠	WARNING! Install only 1 terminator at the end of the bus system, if multiple VISATRON® VN93 devices are connected to 1 ReCon DS23 unit.

The monitoring device is the bus master and the OMD devices are the slaves. It's necessary to adjust different bus addresses at each slave device. Normally the first OMD device gets the address '1' and so on. The address can be adjusted by the light buttons (see chapter 4).

2.2.3 Schematic electrical wiring diagram



3 Commissioning

3.1 Adjusting or checking the suction pressure

The suction pressure must be set by adjusting the pressure regulator when the engine is at standstill. Make sure ventilation of the engine room is in operation.

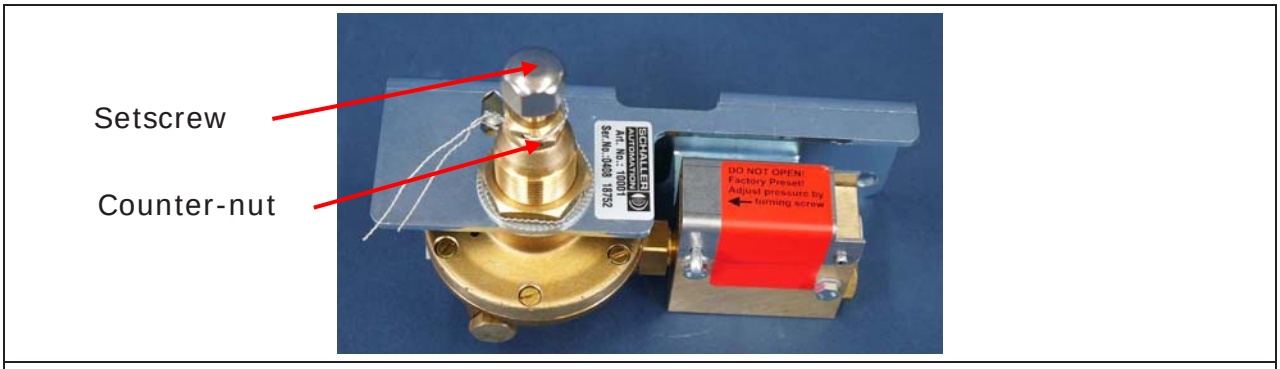


Figure 29: Pressure regulator unit

	WARNING! **Adjust 60 mm WC negative pressure.** After adjustment, remove U-tube pressure gauge and screw in the previously removed plug.

	CAUTION! A pressure setting much higher than 60 mm WC negative pressure may cause a change in detecting sensitivity.

- Connect U-tube manometer at inspection cover (see Figure 30). (U-tube manometer is included in the service box, available as an option).
- Switch on compressed air supply with inlet pressure in a range from **2 to 15 bar (before connecting the OMD the first time check the pressure).**
- If the negative suction pressure is already adjusted to 60 mm WC within a tolerance of ±5 mm remove the U-tube manometer and finish the procedure.
- Otherwise loosen counter-nut.
- Turn setscrew until the negative pressure is only 60 mm WC.
- Tighten counter-nut.

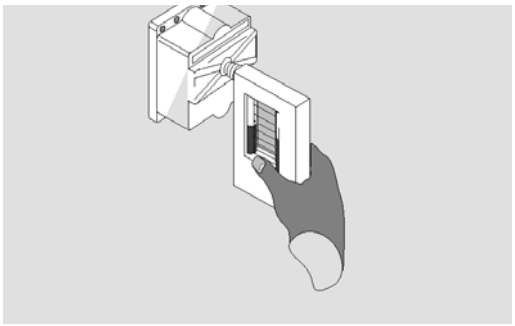


Figure 30: U-tube manometer connected to OMD control cover

- Remove U-tube manometer

3.2 Filling of siphon blocks VN280plus of VN215/93 system with oil

- Press the pump lever of the filling pump (see Figure 32) as many times until first oil drops are coming out.
- Unscrew the lower siphon block plug (see Figure 31).
- Insert filling pump nozzle.

Figure 31: Siphon block VN280plus

Figure 32: Filling pump

- Press the black nipple into the opening of the block.

- Push the nozzle to the first mark (see Figure 33).

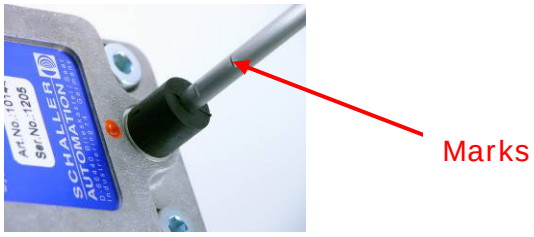


Figure 33: Marks on the nozzle

- Fill the siphon with 12 strokes, push the nozzle to the next mark and repeat the procedure until the nozzle reaches the rear plate.

	CAUTION! Do not fill with more than 12 strokes, waste oil flow in the tubes and could suck out of the block internal siphons.

- Close the threaded hole with the plug (a small amount of oil coming out does not impact the functionality.
- Clean the siphon block.
- Continue with the next block.

3.3 Filling of siphon blocks VN180 for VN115/93 and VN116/93 system with oil

- Press the pump lever of the filling pump (see Figure 35) as many times until first oil drops are coming out.
- Unscrew the lower siphon block plug (see Figure 34).
- Insert filling pump nozzle (see Figure 36).

Figure 34: Siphon block VN180

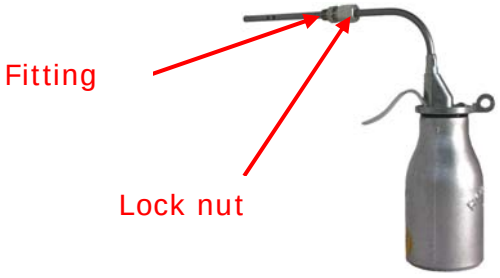


Figure 35: Filling pump

- Screw in the fitting of the filling pump.
- Press the nozzle to stop position.
- Tighten the lock nut.
- Fill the siphon with 8 strokes.

	CAUTION! Do not fill with more than 8 strokes, waste oil flow in the tubes can cause a malfunction of the siphon block.

Figure 36: Filling pump inserted and fixed in the siphon block

- Remove the filling pump.
- Close the threaded hole with the plug (a small amount oil coming out does not impact the functionality.
- Clean the siphon block.
- Continue with the next block.

3.4 Filling of pipe siphons for VN115/93 and VN116/93 system with oil

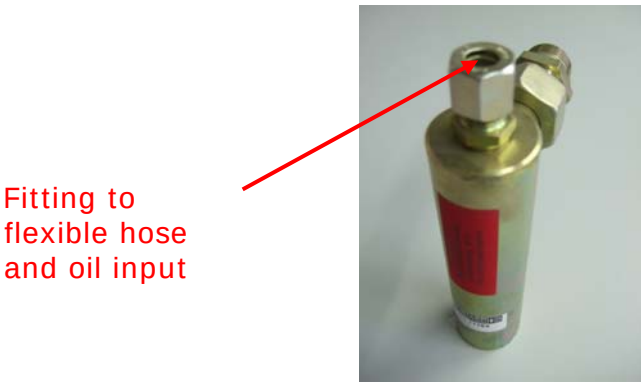


Figure 37: Pipe siphon

- Remove flexible hose
- Fill in 70ml lubrication oil
- Fix flexible hose again

	CAUTION! Do not fill in more than 70ml, waste oil could suck out the pipe internal siphon.

3.5 Adjusting the sensitivity of the OMD

The detector determines the oil mist concentration by an optical measurement. The calculated values have the unit 'relative opacity', a Schaller specific definition. 100% relative opacity means that no light is transmitted through the oil mist sample. This is equivalent to a complete white wall.

The IACS UR 67 requires an oil mist alarm at 5% of the Lower Explosion Level (LEL). The LEL is equal to 47mg/l oil mist concentration in air at a temperature of 25 °C, which means that the OMD is required to indicate an oil mist alarm at approx. 2.5mg/l.

Position	VN115 alarm level in relative opacity	VN116/VN215 alarm level in relative opacity
3	1.5%	1.6%
4	2.0%	2.4%
5	3.0%	3.7%
6	5.0%	5.5%

Table 2: Sensitivity switch position and corresponding oil mist alarm level

Inside the measuring head 2.5mg/l oil mist concentration is approx. 23% absolute opacity compared to the full measuring range.

The number of suction points, the different oil mist concentration in the compartments and the progress of oil mist occurrence can influence the amount of oil mist be sucked out of the engine to the measurement head and be detected.

	CAUTION! Use only level 3 or 4 for normal diesel engines. Level 5 and 6 must be confirmed in writing by SCHALLER AUTOMATION.

The sensitivity of the VISATRON® oil mist detector can be adjusted by the light buttons (see chapter 4).

3.6 Commissioning check list

Mechanical check	
Are all suction pipes installed as specified in the installation drawing?	□ yes / □ no
Are all fittings fastened and tight?	□ yes / □ no
On VN215/93 installation: Is the arrangement of the pipes at the valve box correct?	□ yes / □ no
On VN215/93 installation: Are all un-used openings at the valve box closed?	□ yes / □ no
On installations with siphon blocks: Are all siphon blocks filled with oil and all un-used openings closed?	□ yes / □ no
On installations with pipe siphon: Are all siphons filled with oil?	□ yes / □ no
On installations with oil separator: Is the separator filled with oil?	□ yes / □ no
Is the negative pressure at the measuring head adjusted to 60 mmWC?	□ yes / □ no
Adjusted negative pressure	mmWC

Electrical check	
Is the power supply connected to the terminal and is the voltage within the specified range?	□ yes / □ no
Measured supply voltage	Volts
Is the monitoring device installed?	□ yes / □ no
Are the ‘Alarm’ and ‘Ready’ signals connected to the engine control and safety system?	□ yes / □ no
Are the correct wire break resistors installed	□ yes / □ no
Value of wire break resistor	kOhm
Is the correct interface mode at pin 11 and 13 selected?	□ yes / □ no

Functional check	
On vessels perform the on-board test with test plate. Test positive?	□ yes / □ no
At engine factory perform smoke test. Test positive?	□ yes / □ no
On VN115/93 installations, as an alternative to the smoke test, measure the negative pressure at the end of the suction pipes. Values as specified?	□ yes / □ no

4 Operating instructions

4.1 Display

After power-on the VISATRON® device starts a 30 seconds count down before the device enters the normal display mode. The device type appears in the upper 'Code' window and the current opacity in the 'Value' window. The 'Ready' LED indicates, that the device is running well.

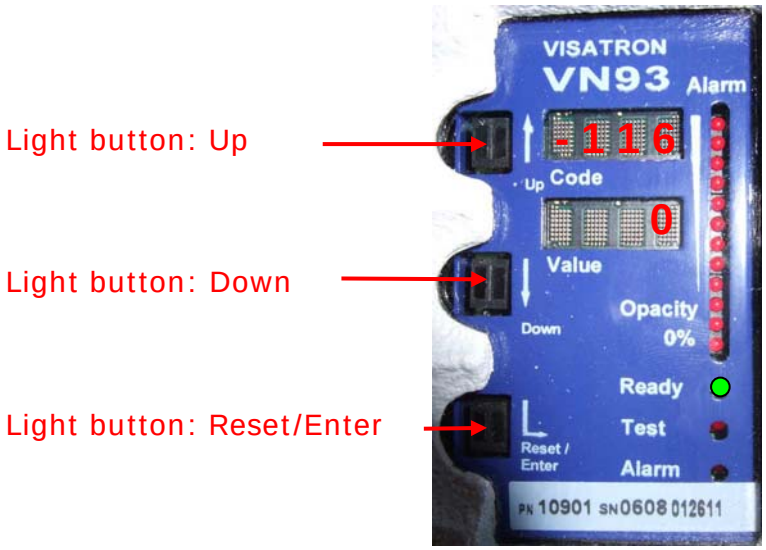


Figure 38: Normal display mode (VN116/93 as example)

The device offers a user interface to display and to adjust some parameters. The handling happens by three light buttons (see Figure 38). By touching the glass plate the infrared light from the transmitter is reflected to the optical receiver which generates a signal for the micro-controller.

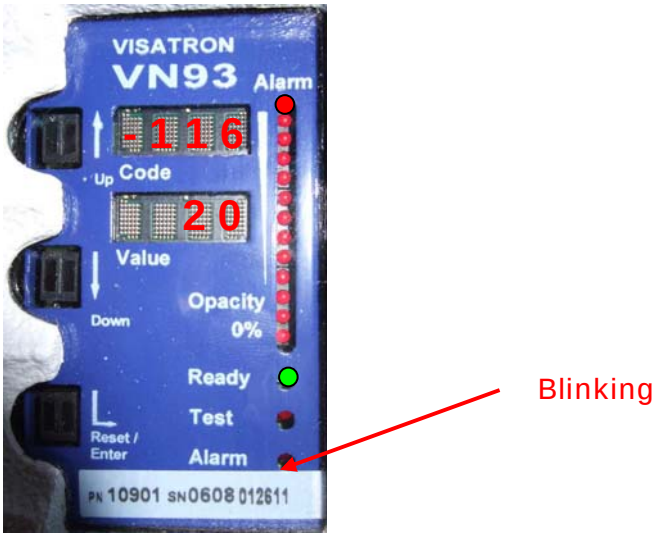


Figure 39: Example of an oil mist alarm state with 20% opacity

In case of a high oil mist concentration the LED bar goes up. At 100% opacity, compared to the alarm level, the 'Oil-Mist Alarm' LED starts blinking. If the opacity later goes down, the alarm condition will be stored. The opacity is shown in the right LED bar. If the highest LED is switched on the opacity is equal or higher, compared to the alarm level.

By touching the light button ‘Up’ for longer than 3 seconds the ‘Parameter display mode’ is activated. The available parameters are listed in Table 3. The ‘Up’ and ‘Down’ button can be used to navigate within this list.

If no button is touched for one minute the ‘Parameter display mode’ will be left.

Code	Description	Unit / Format
-215/-116/-115	Opacity	%
-001	Oil mist alarm level	%
-002	Opacity relative to alarm level	%
-003	Not used	
-004	Not used	
-005	Negative pressure inside measuring head	mmWC
-006	Ambient temperature	°C
-007	Electronic temperature	°C
-008	Time	hh.mm
-009	Date	dd.mm
-010	Alarm level (see chapter 3.5)	
-011	Oil mist pre-alarm level relative to the main alarm level (40 -100)	%
-012	Not used	
-020	A/D converter: opacity	
-021	A/D converter: air flow sensor	
-022	A/D converter: ambient temperature	
-023	A/D converter: electronic temperature	
-024	For internal use	
-025	For internal use	
-026	For internal use	
-027	Up-Counter	s

Table 3: Parameters

4.2 Parameter Adjustment

By touching the light button ‘Up’ and the light button ‘Down’ for longer than 3 seconds simultaneously the ‘Parameter adjustment mode’ is activated. The ‘Up’ and ‘Down’ button can also be used for navigation.

	WARNING! The engine is **not** monitored In the ‘Parameter adjustment mode’.

To enable the setting of all parameters, a password must be entered in parameter P000 first. Otherwise the parameters are only readable.

The value of the password is **4711** and is not changeable. To enter the password touch the ‘Enter’ button first and select than the number digit for digit using the ‘Up’ and ‘Down’ button. To step to the next digit touch ‘Enter’.

By touching the light button ‘Up’ and the light button ‘Down’ for longer than 3 seconds simultaneously again the ‘Parameter adjustment mode’ is left or if no button is touched for one minute.

Code	Description	Range	Factory presetting	Unit / Format
P001	Oil mist alarm level	3-6	4	
P002	Used for service purpose, must be always 0			
P003	Used for service purpose, must be always 0			
P004	Oil mist pre-alarm level relative to the main alarm level	40 - 100	100	%
P005	RS485 bus-address	1 - 16	1	
P006	Restore presetting by enter ‘1’	0 or 1	0	
P050	Date	01.01 – 31.12		dd.mm
P051	Date	1990 -		yyyy
P052	Time	00.00 – 23.59		hh.mm

Table 4: Adjustable Parameters

4.3 Diagnostics

If a device internal error or a system failure occurs the diagnostics system displays the failure condition in the ‘Code’ window and the ‘Ready’ LED is off. The error codes are shown in Table 5.

Error Codes	Value	Series VN93 device failures
E018		Voltage of internal battery too low
E017		Electronic module defective
E016		Electronic module defective
E015	% of max.	Optical sensor very dirty
E014	mm WC	Negative pressure/airflow too low
E013	% of max.	Optical sensor dirty
E012		Checksum error
E011	Temperature	Ambient temperature too low (<0°C)
E010	Temperature	Ambient temperature too high (>70°C)
E009	Temperature	Electronics temperature too low (<0°C)
E008	Temperature	Electronics temperature too high (>75°C)
E007		Light button defective
E006	Voltage	Supply voltage too high
E005		Not used
E004	Digital value	Optical sensor defective
E003	Digital value	Airflow-sensor defective
E002	Digital value	Airflow-sensor defective

Table 5: Error codes

A detected oil mist alarm is displayed at this time with the 'Test' LED. In this case the alarm relay or shutdown relay is not switched on.

Figure 40: Device not ready, example of 'Negative pressure too low'

4.4 Reset of Oil Mist Alarms

	Ensure, that the oil mist concentration inside the engine has fallen under the Lower Explosion Level (LEL) before acknowledging an oil mist alarm by pressing the Oil-Mist-Alarm button. Otherwise you risk an oil mist explosion! **Follow the instructions of the engine builder, ship yard and ship owner.** **Use a monitoring device at a safe location to read off the current oil mist concentration. SAB recommends to wait until more than the half of the indication LED's are switched off (VISATRON®-device and Remote Indicator II) or the oil mist alarm level has to reduce below 50% (ReCon DS23).**

The alarm condition can be reset only by pressing the Oil-Mist-Alarm reset light button.

Figure 41: Oil-Mist-Alarm reset light button

5 Troubleshooting

Error	Description	Measure	Chapter
18	Voltage of internal battery too low	1. Exchange measuring head	5.5 page 44
17	Electronic module defective	1. Exchange measuring head	5.5 page 44
16	Electronic module defective	1. Exchange measuring head	5.5 page 44
15	Optical sensor dirty	1. Clean infrared filter	5.2 page 42
14	Negative pressure / airflow too low	1. Exchange air filters 2. Clean fresh air bores 3. Check suction system 4. Adjust suction pressure 5. Adjust suction pressure 6. Exchange measuring head	5.3 page 43 5.1 page 42 3.1 page 28 3.1 page 28 5.5 page 44
13	Optical sensor dirty	1. Clean infrared filter	5.2 page 42
12	Checksum Error	1. Repeat parameter setting	
11	Ambient temperature too low (<0°C)	1. Remove ambient cooling components	
10	Ambient temperature too high (>70°C)	1. Remove or turn away ambient heating components 2. Install metal heat shields against radiation 3. Install vortex coolers	
9	Electronics temperature too low (<0°C)	1. Remove ambient cooling components	
8	Electronics temperature too high (>75°C)	1. Remove or turn away ambient heating components 2. Install metal heat shields against radiation 3. Install vortex coolers	
7	Light button defective	1. Clean glass plate 2. Exchange Measuring head	 5.5 page 44
6	Supply voltage too high	1. Measure supply voltage 2. Exchange measuring head	 5.5 page 44
4	Optical sensor defective	1. Clean infrared filter 2. Exchange measuring head	5.2 page 42 5.5 page 44
3	Airflow-sensor defective	1. Exchange measuring head	5.5 page 44
2	Airflow-sensor defective	1. Exchange measuring head	5.5 page 44
	All LED off	1. Measure supply voltage 2. Activate Self-repair of Polyfuse 3. Replace measuring head fuse 4. Exchange measuring head	 5.6 page 41 5.6 page 41 5.5 page 44

5.1 Clean scavenging air bores

Figure 42: Cleaning of scavenging air bore in the left and the right chamber

5.2 Clean infrared filter

	CAUTION! Dirty optical filter glass can also cause a non detected high oil mist concentration (e.g. when the device was switched off for a long period).

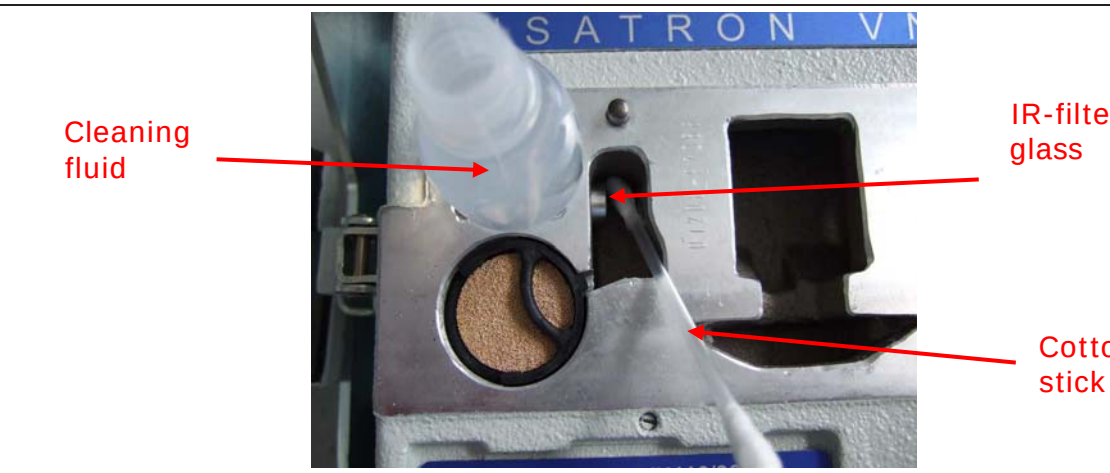


Figure 43: Cleaning of IR-Filter glass in the left and the right chamber

	WARNING! Use only cleaning fluids for optical components as delivered in the service box.

5.3 Exchange air filters in the measuring head

Figure 44: Exchange of the air filters

⚠	WARNING! Do not try to clean the filters, use always new ones.

5.4 Exchange air filter in pressure regulator unit

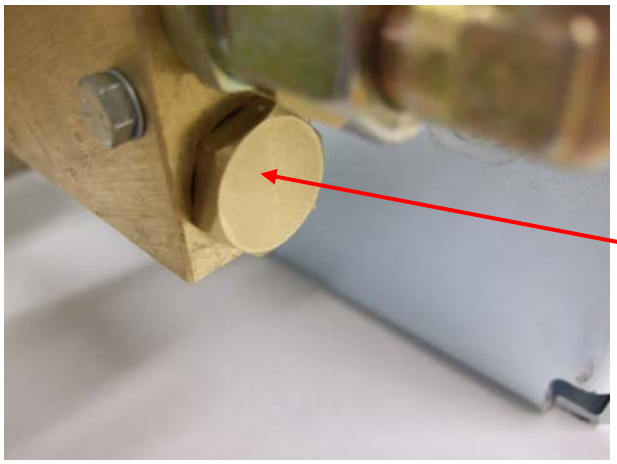


Figure 45: The air filter is behind the lock screw of the throttle block

⚠	WARNING! Switch off the compressed air supply during the maintenance work. After the exchange re-check the negative suction pressure.

5.5 Exchange measuring head

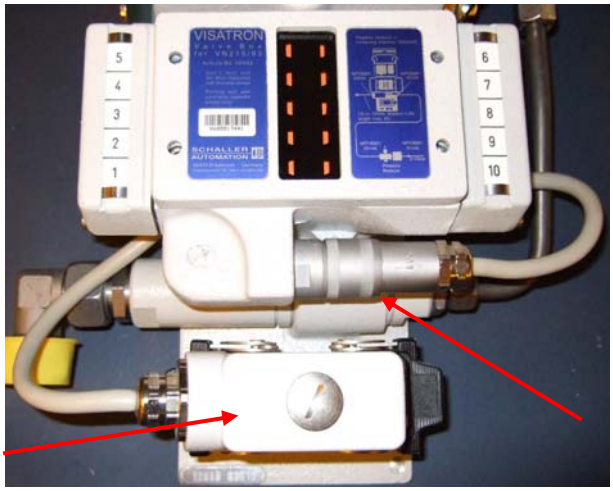


Figure 46: **Step 1** is to unplug the connectors

Figure 47: **Step 2** is to unscrew the measuring head

To mount the new measuring head execute the 2 steps in reverse order.

⚠	WARNING! Check the values of the wire break resistors or in case of doubt use the old ones.

5.6 Measuring head fuses

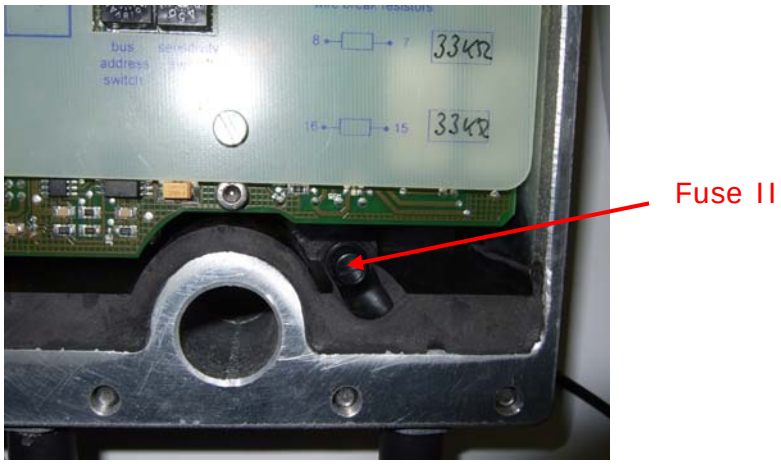


Figure 48 Fuse on the rear side of the measuring head

The device has two internal fuses. The first is located in the main connector of the measuring head. This is a 'self-repairing' fuse which protects the filter circuit in the connector.

To reset this fuse, unplug the main connector and **wait 5 minutes** before you plug it again.

⚠	WARNING! Unplug the main connector during the exchange of the fuse.

If all LED's remain dark exchange the 3.15 A semi lag fuse II at the rear side of the measuring head (see Figure 48).

6 Maintenance procedures

	CAUTION! Maintenance work has to be done when engine stopped.

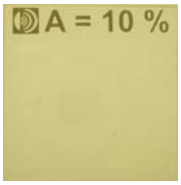
Quarterly		
1	Check negative pressure in the measuring head: under 55 mmWC → adjust pressure between 55 mmWC and 65 mmWC → okay between 65 mmWC and 85 mmWC → adjust pressure over 85 mmWC → check pressure regulator unit	See chapter 3.1 page 28
2	Clean infrared filters in the measuring head	See chapter 5.2 page 42
3	Clean fresh air bores in the measuring head	See chapter 5.1 page 42
4	Exchange air filters in the measuring head	See chapter 5.3 page 43
Half-yearly		
5	Perform quarterly maintenance procedure 1 - 4	
6	Exchange air filter in pressure regulator unit	See chapter 5.4 page 43
Yearly		
7	Perform half-yearly maintenance procedure 5 - 6	
8	Clean suction system with compressed air. **ATTENTION, do not forget to refill the siphons!**	See chapter 3 page 28
9	Check the bellows and the suspension-system between measuring head and base plate, check the scavenging air outlet behind the control cover (see Figure 43) by feeling the air stream to control scavenging air system	
10	Perform functional test	See chapter 7 page 47
Additional every 5 years		
11	Exchange bellows	Use services of our partners (see chapter 10)

7 Functional test

7.1 On board test

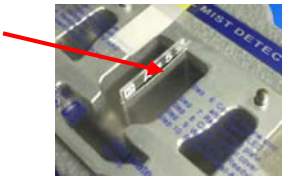
⚠	Attention: Before starting the on board test execute the procedures as specified in the maintenance schedule. The pipe system has to be clean and if used all siphons have to be filled with oil (regarding chapter 2.1.3.)

Using the test plate set, included in this manual folder, you can easily test the functionality of the VISATRON® oil mist detectors and their connection to the safety system of the engine. The set can also be ordered separately under Part.-No. 11072. It consists of the following parts:

• Test plate (A) • Test glass (B) • Working instruction	**A**	**B** 

⚠	**Attention: You will stop or slow down the engine**.

Test procedure step by step:

Step 1	Open the **bolts** of the OMD control cover and turn the cover to the left side.	
Step 2	Press the test plate onto the **openings**. Ensure that the openings are completely covered. Now the device starts to create the negative suction pressure again.	
Step 3	Waiting for the 'Ready'-LED on the display.	
Step 4	Insert the **test glass into the slot** of the test plate. The glass simulates oil mist and generates an oil mist alarm.	

Step 5	Waiting for the 'Alarm'-LED. At this comes on, the engine has to stop or to enter the slow down mode.	
Step 6	Remove the test plate and put it together with the test glass back into the bag.	
Step 7	Close the control cover carefully.	
Step 8	Wait for the 'Ready'-LED.	
Step 9	Press the **Oil-Mist-Alarm RESET button** to acknowledge the alarm state and enter the normal monitoring mode.	

If applicable perform an additional pressure measurement to check the tightness of the suction system as described in chapter 7.3. Instead of an electronic gauge you can use the U-pipe manometer of the service box.

7.2 Factory test with smoke generator on VN115/93, VN116/93 and VN215/93 installations

All installations can be proved by a smoke test. Due to vessels not normally having the equipment and the increasing world wide ban of smoking cigarettes SCHALLER AUTOMATION recommend this procedure only for the factory test by using the SCHALLER smoke generator (see Figure 49). If a smoke generator is available on a vessel this test can be performed, however, in this case observe the following warning.

⚠	Attention: Before starting the on board test execute the procedures as specified in the maintenance schedule. The pipe system has to be clean and if used all siphons have to be filled with oil regarding chapter 2.1.3.

A complete test can be done only at standstill of the engine. The crankcase service covers must be opened first. Then fill in a small amount of smoke fluid (see Chapter 'Accessories') into the reservoir and switch on the generator for a few seconds until the storage tank is completely filled with smoke. This is important so that the tank can provide sufficient smoke to complete the search run of a VN215/93 installation to determine the right compartment. The last step is to hold the flexible hose directly under the suction funnel until an oil mist alarm is indicated.

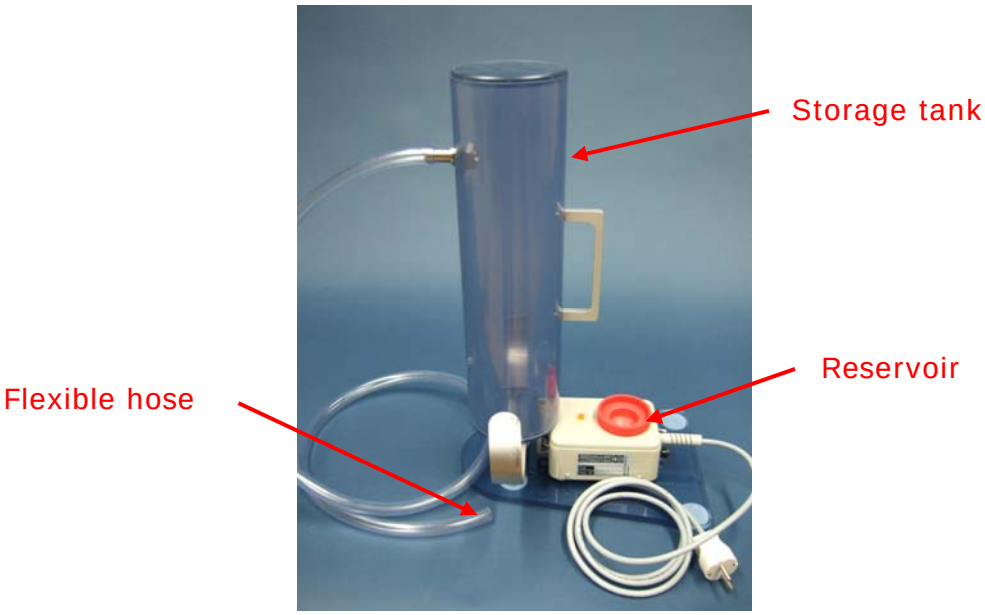


Figure 49: SCHALLER AUTOMATION smoke generator, see 'Accessories'

If it's not possible to open the service covers a functional test can be preformed without testing the suction funnels.

In this case the flexible hose has to be positioned over the openings under the lock screws of the siphon blocks as seen in Figure 50 or has to be pressed over the open tube at T-engine-wall connection.

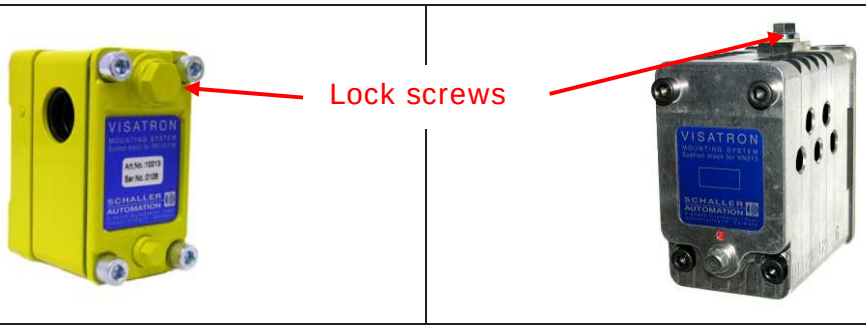


Figure 50: Test inlet on the siphon blocks

7.3 Additional pressure measurement on VN115/93 and VN116/93 installations

Perform the functional and smoke test as shown in the previous chapters 'On board test' and 'Factory test with smoke generator'.

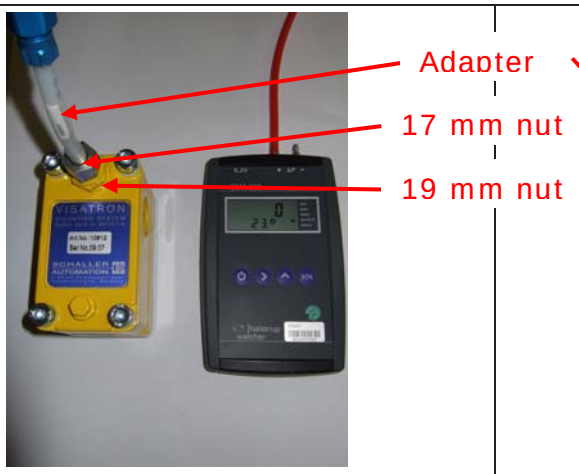


Figure 51: Manometer connected to siphon block VN180

Figure 52: Manometer connected to header pipe

Then carry out a pressure measurement at the end of the suction system. The engine including the oil pump must be at stillstand.

⚠	Attention: You will only measure correct values at standstill of the engine and the luboil pump.

On a VN115/93 and VN116/93 installation the tightness of the suction system can be determined by a pressure measurement at the outer siphon blocks or at the end of the header pipes.

This siphon block has an additional fitting for a manometer (see Figure 51). To remove the 17mm lock nut you have to counter the 19 mm nut with a jaw wrench.

The pressure measurement procedure can also performed at the end of the 22 mm diameter suction pipes which are delivered from SCHALLER AUTOMATION. These pipes have also fittings for the manometer at the pipe end (see Figure 52).

Use only a digital manometer with a differential measuring method. On completion do not forget to lock all openings.

The minimal negative pressure values are defined in Table 6. They are only valid if a negative pressure of **60 mm WC** is adjusted at the measuring head.

VN115/93	6.5 mm WC
VN116/93	1.5 mm WC

Table 6: Minimal pressure values **at the end** of the suction system

8 Spare Parts and Accessories

Part-No.	Description
11201	Measuring head VN115/93; 33k; sensitivity level 4
11401	Measuring head VN116/93; 33k; sensitivity level 4
10901	Measuring head VN215/93; 33k; sensitivity level 4
10969	Measuring head seal
11233	Base plate VN115/93
10904	Base plate VN116/93 and VN215/97plus
11432	Valve box VN116/93
10902	Valve box VN215/93
10993	Pipe connection for valve box VN116/93
10995	Pipe connection for valve box VN215/93 right
10994	Pipe connection for valve box VN215/93 left
10411	Rubber insert for valve box pipe connection VN215
11232	Connection box VN115/93
10023	Bellow of suction channel
10990	Bellow of scavenging air channel
10042	Scavenging air filter
10002	Air filter for pressure regulator unit
10727	Control cover measuring head series VN93 devices
10973	Semi lag fuses 3.15 A
10087	Fuse cap

Table 7: Spare parts

The listed measuring heads are the standard units. Other versions are also available on enquiry.

Part-No.	Description
10950	Service box series VN93
10189	Maintenance kit series VN93
10980	Manual series VN93
10001	Pressure regulator unit with input throttle
10753	Protection cover
11163	Oil separator for air outlet
11164	Pipe siphon
10140	Siphon block VN280 1 connection
10142	Siphon block VN280 2 connection
10143	Siphon block VN280 3 connection
10144	Siphon block VN280 4 connection
10145	Siphon block VN280 5 connection
10141	Siphon block VN280 1 connection with manometer fitting
10160	Mounting plate VN280
11062	Oil pump VN280
10013	Siphon block VN180
10612	Siphon block VN180 with manometer fitting
10089	Mounting plate VN180
10062	Oil pump VN180
10813	Sampling funnel STD
10353	Smoke generator 230 Volts
11072	Test-plate kit
10046	U-pipe manometer
11073	G1/4 engine wall T-connection for 14 mm pipes
11506	Monitoring device Remote Indicator II
11500	Monitoring device ReCon DS23
11503	Bus-cable 10m for monitoring devices

Table 8: Accessories

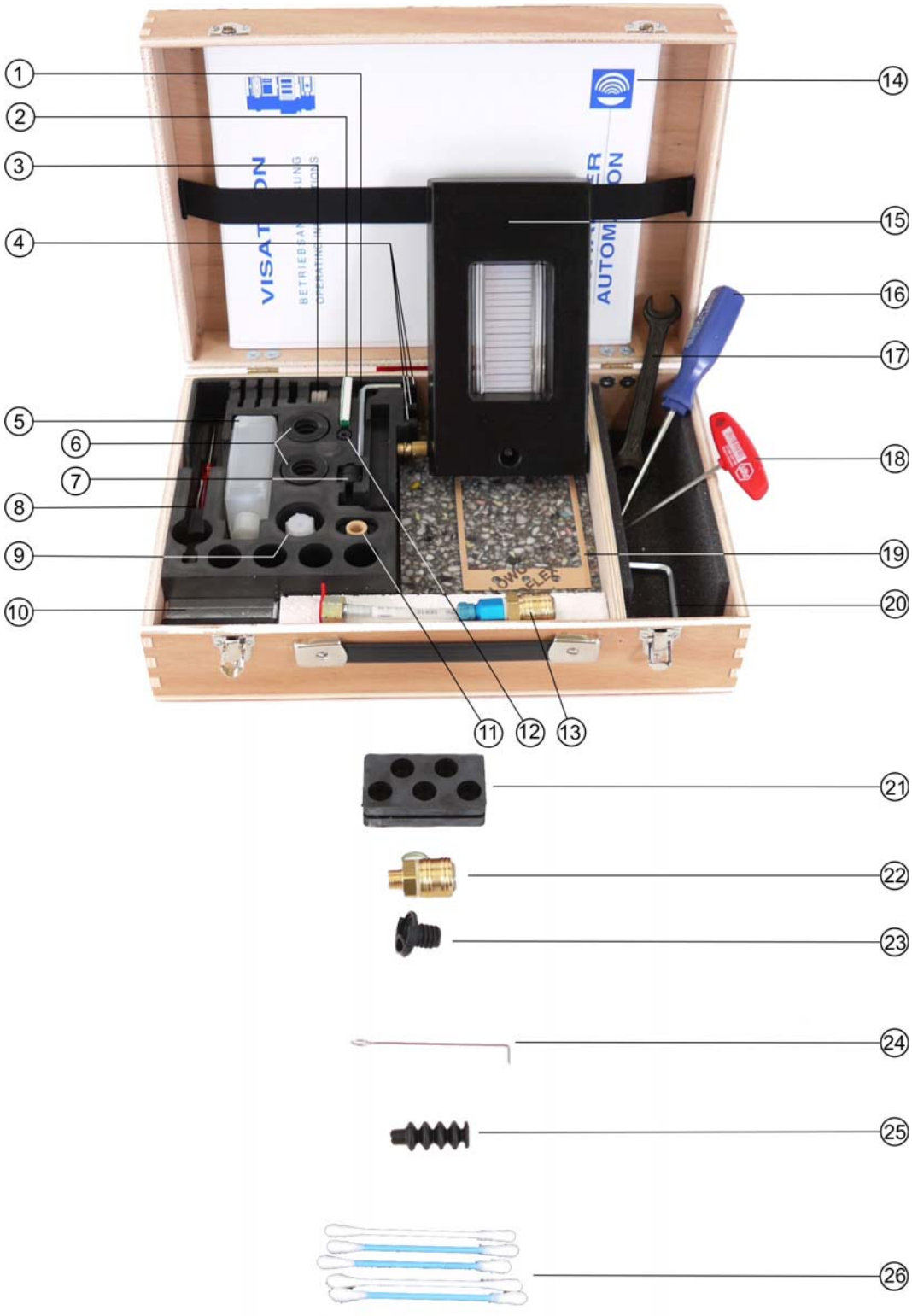


Figure 53: Service box

Item	Part-No.	Description	Quantity
01	10044	Hex key 5 mm L-shape	1
02	10973	Fuse 3.15 A semi time lag	10
03	10042	Scavenging air filters	6
04	10412	Rubber plugs for unused valve box connections	3
05	10040	Bottle with slacked water	1
06	10023	Bellows of suction channel	2
07	10407	Sealing for suction channel in valve box	2
08	10038	Screwdriver 3 mm	1
09	10035	Bottle with cleaning fluid	1
10	10409	Clamp plate VN215 valve box connection	2
11	10002	Air filter for pressure regulator unit	1
12	10406	Sealing for oil draining valve box	1
13	11080	Manometer adapter for siphon block VN180	1
14	10980	Manual series VN93 in English	1
15	10046	U-pipe manometer	1
16	10354	Philips screwdriver	1
17	10356	Double jaw wrench 14/17 mm	1
18	10355	Hex key 4 mm with handle bar	1
19	10405	Gasket for valve box	1
20	10047	Hex key 6 mm L-shape	1
21	10411	Rubber plate for VN215 valve box connection	2
22	10053	Manometer adapter for control cover	1
23	10975	Scavenging air inserts	2
24	10135	Cleaning needle	1
25	10990	Bellow of scavenging air channel	1
26	10036	Cotton buds to clean IR-filters	5

Table 9: Contents of service box series VN93

Item	Part-No.	Description	Quantity
01	10046	U-pipe manometer	1
02	10053	Manometer adapter for control cover	1
03	10040	Bottle with slacked water	1
04	10405	Gasket for valve box	1
05	10042	Scavenging air filters	6
06	10975	Scavenging air inserts	2
07	10002	Air filter for pressure regulator unit	2
08	10973	Fuse 3.15 A semi time lag	5

Table 10: Contents of maintenance kit series VN93

9 Technical data

Mechanical data	
Dimensions	See drawings (Figure 54 to Figure 59)
Weight	VN115/93 9 kg VN116/93 11 kg VN215/93 11 kg
Display	LED-bar with 14 LED's 1 green Ready LED 1 red Alarm LED 1 red Test LED 2 x 4 alpha-numerical displays
Suction pipes	VN115/93 ø 22 x 2 x max. 9m VN116/93 ø 22 x 2 x max. 9m VN215/93 ø 14 x 2 x max. 9m
Pipe connections	VN115/93 2 x G1/2 or G3/4 VN116/93 2 x G1/2 or G3/4 VN215/93 10 x ø 14
Venturi injector connections	In NTP/BSP/G1/2A Out NTP/BSP/G3/4A
Pressure reducer connections	In NTP/BSP/G1/4A Out NTP/BSP/G1/4A
Air pressure	Before pressure reducer 2 – 15 bar Before air jet pump max. 500 mbar
Negative pressure in measuring head	- 60 mm WC or – 6 mbar
Air consumption	Depends on the suction system (about. 1 m^3/h)
Electrical data	
Power supply	18 Volts – 31.2 Volts DC, max. 3 A
Nominal voltage	24 Volts DC
Relay Outputs	2 x 'Alarm' 1 x 'Ready' 1 x 'Pre-Alarm' (max. 60 Volts DC/AC, 60W, 125VA, 2A)
Cable entry	2 x M25
Communication interface to monitoring device	2 wire RS485, galvanic separated

Communication cable recommendation	LAPPKABEL UNITRONIC-FD CP (TP) plus UL-CSA, 2 x 2 x AWG20, max 400 m length, 7.5-10.0mm Ø
Environmental conditions	
Operating temperature	0 - 70 °C
Storage temperature	-25 – 80 °C
Max. vibrations	4 g (25-100Hz)
Relative humidity	up to 95%
Protection class	IP54
Approval of classes	
	Type approved for closed areas, designed for installation on combustion engines, environmental category D (GL), IACS UR M67 conform, list of type approvals see www.schaller.de

Table 11: Technical data

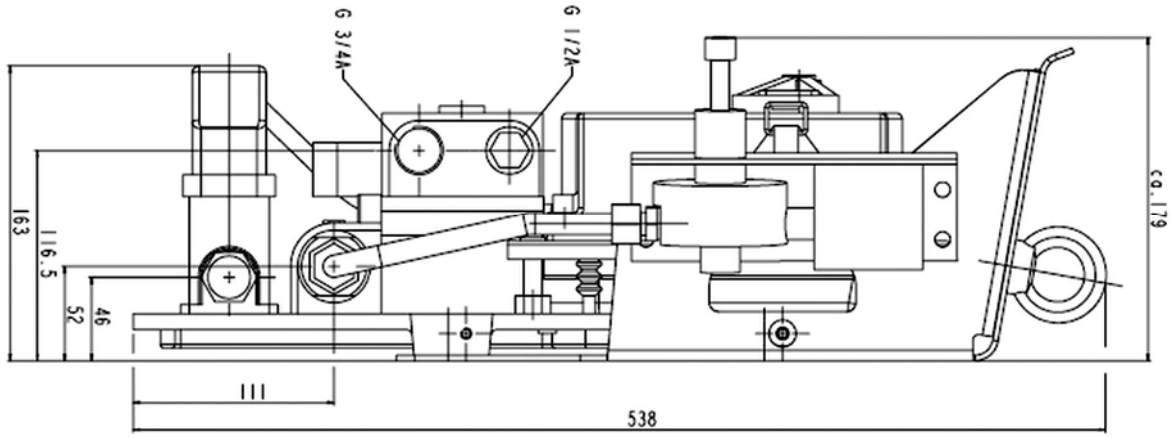


Figure 54: Mechanical dimensions of VN115/93: side view

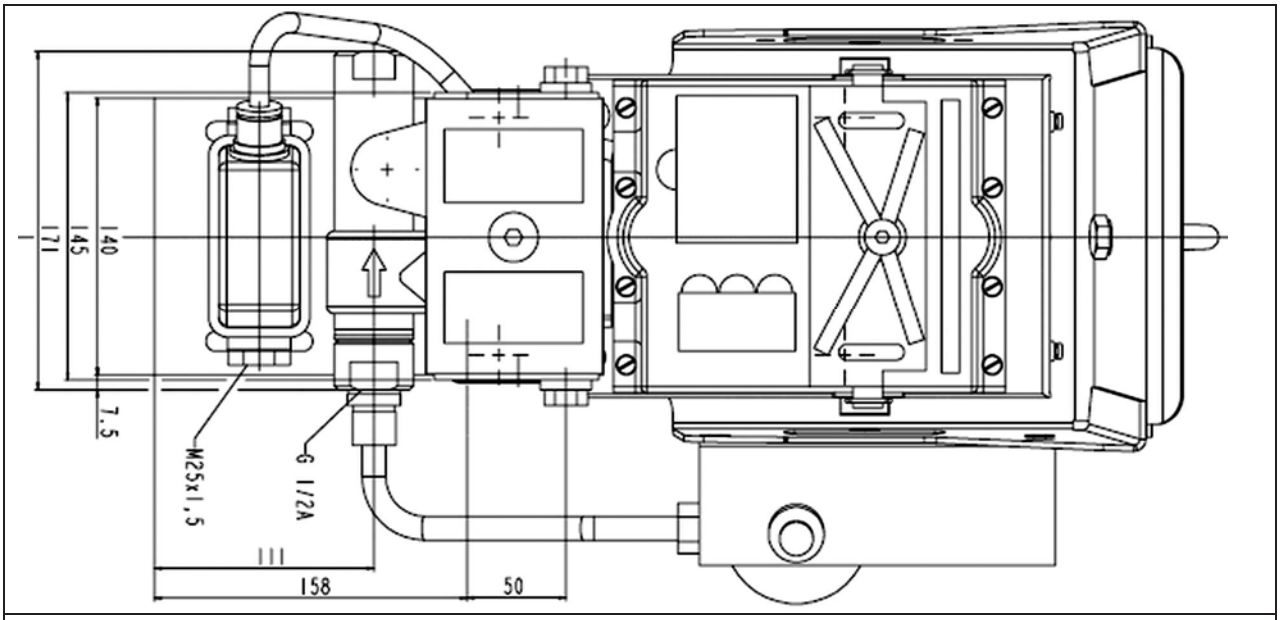


Figure 55: Mechanical dimensions of VN115/93: top view

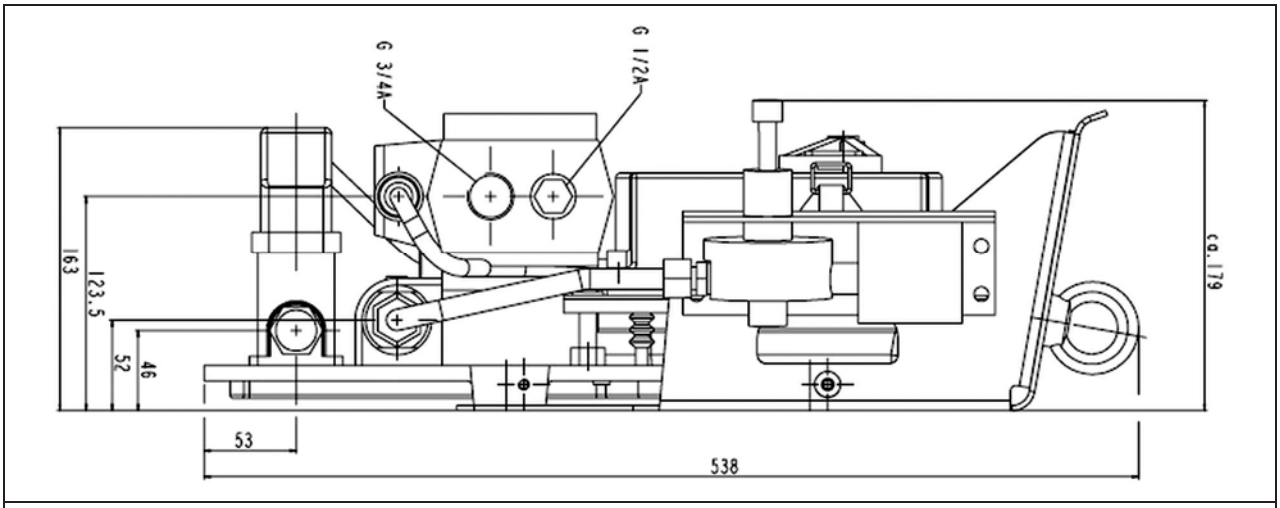


Figure 56: Mechanical dimensions of VN116/93: side view

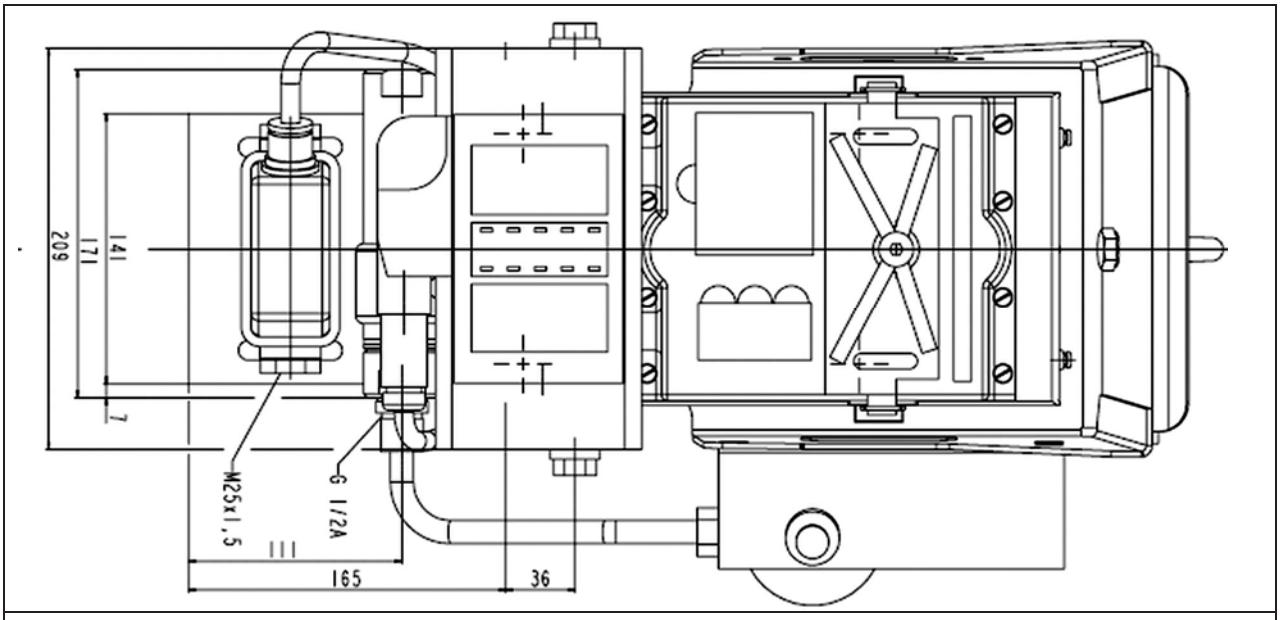


Figure 57: Mechanical dimensions of VN116/93: top view

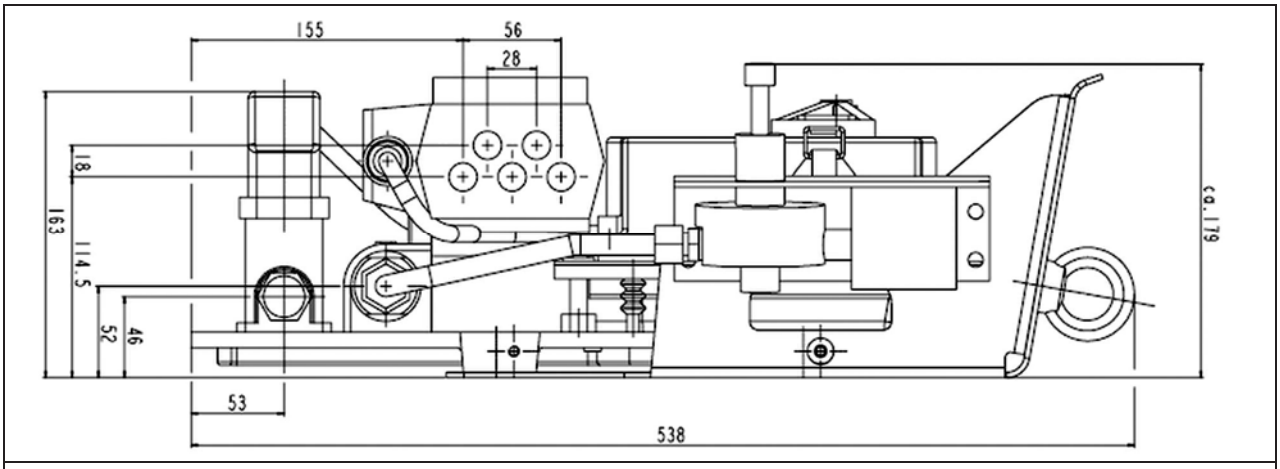


Figure 58: Mechanical dimensions of VN215/93: side view

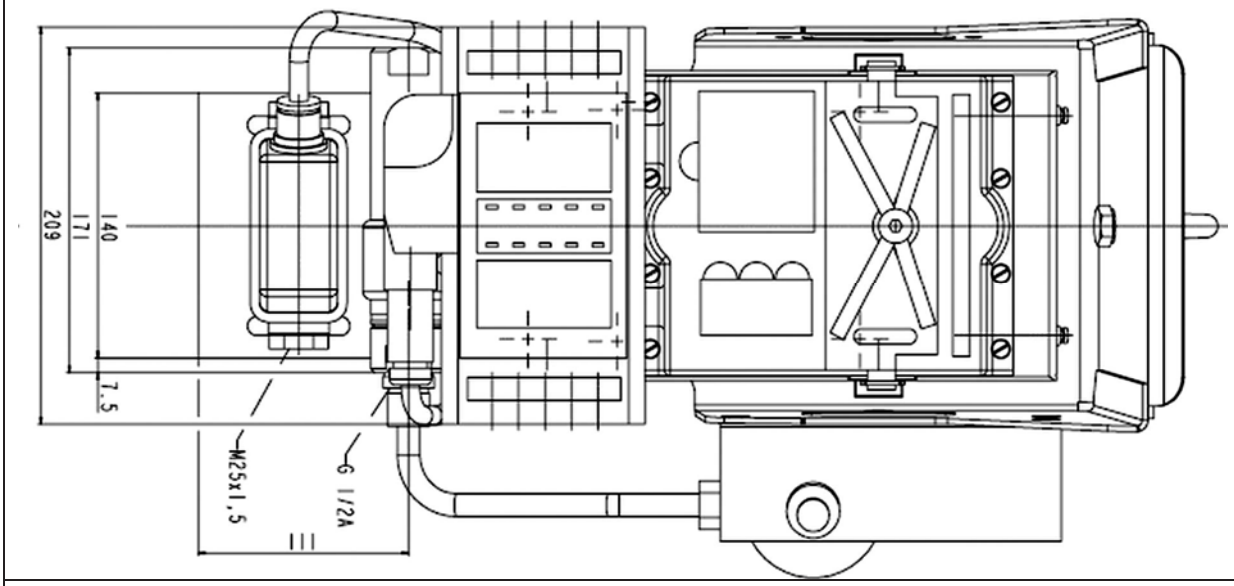


Figure 59: Mechanical dimensions of VN215/93: top view

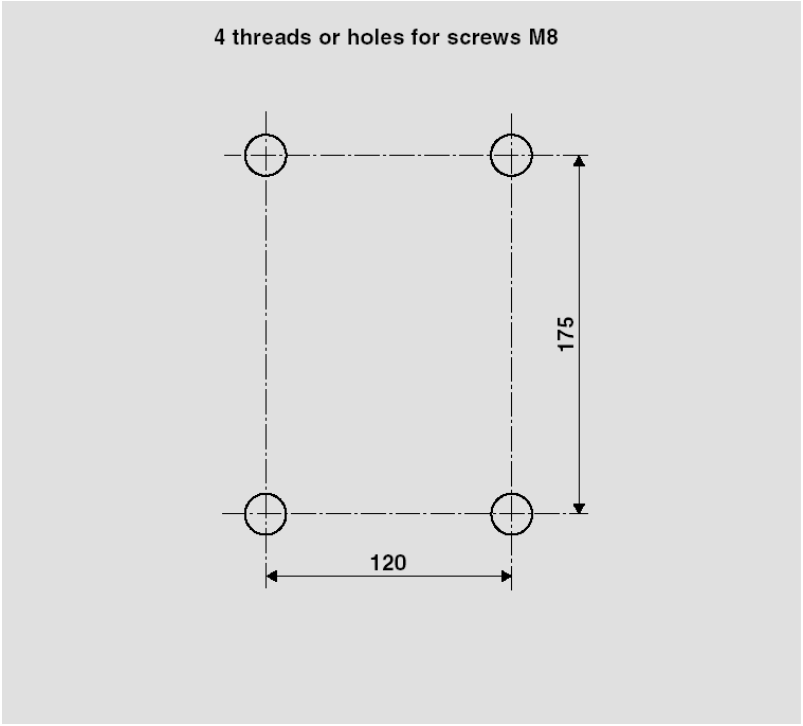


Figure 60: Drilling template of the OMD base plate

10 Service Partners

Schaller Automation maintains a worldwide network of service partners in following countries:

Australia
Brazil
China
Denmark
Germany
Greece
Italy
Japan
South Korea
Netherlands
Norway
Poland
Singapore
Spain
United Arabian Emirates
United Kingdom
United States of America

As details in relevant addresses are supposed to change, please find actual addresses of the relevant service partner under

www.schaller.de

or call our technical support center at the German headquarter:

Tel. +49 6842 508 0

OPERATION AND MAINTENANCE MANUAL
FOR TURNING GEAR WITH MOTOR

NRT – 7200 MD1

==========

MANUAL

				2
				1
2014. 03. 22.	조동욱	고성욱	First issued	0
Date	Prepared by	Approved by	Description	Rev.

NARA CORPORATION

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2. TRANSPORTATION AND INSTALLATION

3. OPERATION

4. LUBRICATION

5. INSPECTION AND MAINTENANCE

6. DISASSEMBLY AND REASSEMBLY

7. MOTOR

8. BRAKE

NARA Corporation

#1500-11, Dadae-Dong, Saha-gu, Busan, Korea,
Tel:82-(51)-264-3100, Fax:82-(51)-264-1947

1. General

The Turning Gears with Motor("Turning gear" here in after) are designed, manufactured and tested in accordance with KS, AGMA or etc, and have high strength. Even an unskilled operator can handle it easily. However, as improper handling may cause unexpected troubles, read this manual carefully. Normal torque applied to an output shaft should be kept below the rated torque. Continuous operation exceeding normal torque may shorten the service life of gears and bearings, and sometimes cause damage to them.

2. Transportation and Installation.

2-1. Transportation

When lifting Turning gear for transportation, use the eye bolt or lug attached at the top of the casing. In this case, Turning gear should be in the parallel position. The following table shows the weights of Turning gears.

Model	Weight
NRT – 7200 MD1	1650 kgf

2-2. Installation

All the Turning gears should be installed in clean, dry place. If there is any excessive dust or moisture around the Turning gears, please consult us. Install Turning gear on a rigid foundation board and fasten fitting bolts and nuts tightly. Improper installation may cause abnormal noise or vibration and shorten the service life of Turning gears and other machinery.

3. Operation

3-1. Prior to initial start

Check the connections whether they are still tight enough, and make sure that none of them have loosened during transportation or storage.

Before starting the Turning gear, check whether the gear unit is properly filled with oil. (Center of oil gauge)

3-2. Initial start

- Check the operation of brake and the running direction of motor.

- When the Turning gear is started up for the first time, it should, if possible, run without load at least for two hours, checking abnormal noise, abnormal vibration and any other possible problems. If no irregularities are noticed, increase the load gradually.

- As testing drive, operate it with rated load for 30 minutes. Meanwhile, any abnormal noise and abnormal vibration should not be noticed.
  Check exceeding heat of bearing(below 90℃).

- Turning gear out of operation for a long time should, if possible, be operated without load for an hour every 3 weeks. If it is impossible, the turning gear must be protected against corrosion.

- If you want to make the Turning gear run in the opposite direction, at first you should stop operating so that the turning gear is not overloaded.

4. Lubrication

4-1. Lubrication system

The general lubrication method of Turning gears is oil bath system, i.e. all components in the gear units are lubricated by splashed oil during operation.

4-2. Oil filling

- Before starting up, all gear units except grease-lubricated types must be filled with oil to the correct level. (Center of oil gauge.)
- The gear oil should be poured into the gear unit through the oil filler plug hole or air vent hole. Only fresh, clean, unspoilt oil must be used.

- The selection of oil depends on oil viscosity according to the normal operating condition with ambient temperatures between -10℃ and +50℃.(refer to Table - Ⅰ.) If ambient temperatures below -10℃ and above +50℃ or extreme fluctuations of temperatures or external heat sources, please consult us.

- It is permissible to use the equivalent oils of others manufacturers provided in Table - Ⅰ.

- Lubricant selection table (Table - Ⅰ.)

Viscosity ISO-VG (㎟/s)	Ambient temperature (℃)	MAKER						
		ARAL	B. P	EXXON	MOBIL	SHELL	FAMM	SK
VG 320	-10℃ ~ +50℃	Aral Degol BG 320 BMB 320	BP Energol GR-XP 320	SPARTAN EP 320	Mobilgear 632	Shell Omala Oil 320	Meropa 320	SUPER GEAR EP 320
VG 220	-10℃ ~ +50℃	Aral Degol BG 220 BMB220	BP Energol GR-XP 220	SPARTAN EP 220	Mobilgear 630	Shell Omala Oil 220	Meropa 220	SUPER GEAR EP 220
GREASE		Aralub HL 3	BP Ener-Grease L33 LS 2	BEACON 3	Mobolux 2	Shell Alvania Grease R 2	Multifak 2	Y.KCrown Grease EP2

- Model and Quantity of oil (Type for standard)

MODEL	OIL Q'TY IN REDUCER (ℓ)	GREASE Q'TY IN END SUPPORT(gf)
NRT – 7200 MD1	APPROX. 19	APPROX. 250

4-3. Oil change

- It is commonly recommended to change the lubricating oil after 50 operating hours for the first time. Subsequent oil changes must be made once a year, depending on working conditions or ambient temperatures.

- **By oil changing, the gear unit should be refilled with the same grade of oil used previously. In that case, previous oil should be removed completely.**

- The gear unit is initially filled with FAMM 「Meropa 320」 from the company.

5. Inspection and maintenance

It is recommended that a general inspection routine be established to check periodically the following items.

1) Cleanliness
2) Lubrication
3) Noise and vibration

5-1. Cleanliness

- The exterior of the Turning gear should be kept free from such foreign materials as dirt, oil and grease, or etc. They may build up on the exterior of the Turning gear and impair oil seal, leading to oil leakage.

- The dusty air breather(or air vent) may cause pressure rise inside of gear unit while running. It must be always cleaned and checked whether the filter of it is free of dust and pollutions.

5-2. Lubrication

- Oil filling and change must be carried out in accordance with section 4-3. If it is not kept, the life of Turning gear as well as the life of bearing may be shorten.

- Make sure that the oil level is at the correct height. (Center of oil gauge.)

5-3. Noise and vibration

- When any abnormal noise or vibration happens, please consult us.

6. Disassembly and reassembly

6-1. Disassembly

- Disassemble Turning gear after full comprehension of it's construction in accordance with the attached assembly section drawing.

- Make clear the purpose of disassembly in order to minimize parts to be disassembled.

- If there is no match mark on a part to be disassembled, disassemble Turning gear after marking.

- Never strike parts strongly nor pull them by force.

- If problems occur during disassembly, do not continue disassembly forcibly. Repeat disassembly after careful inspection or consulting us.

6-2. Reassembly

- Carry out reassembling normally in the reverse order of disassembling.

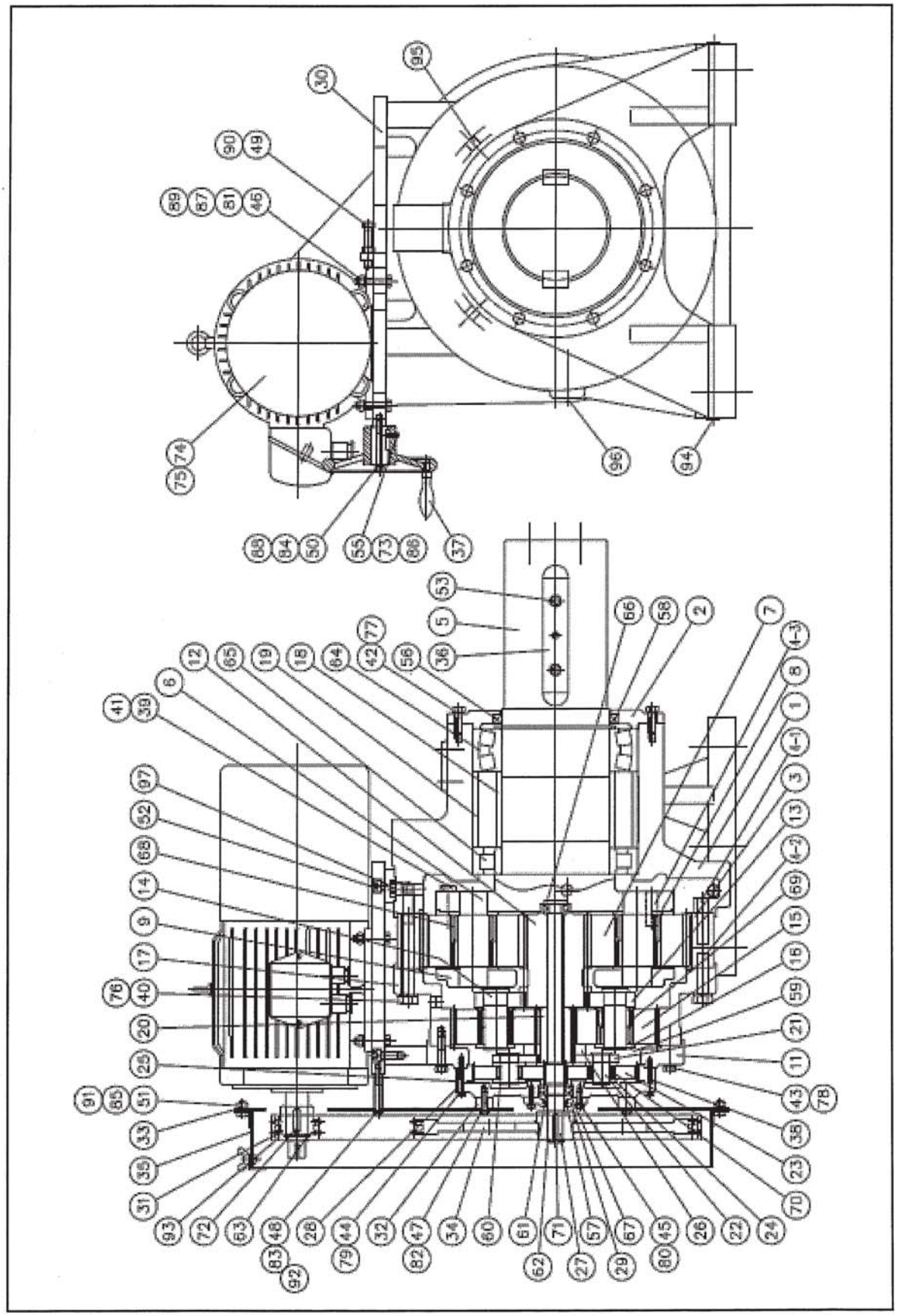
- Reassemble parts after washing them carefully with cleaning oil and applying machine oil or lubrication oil.

- When fitting a new bearing to the shaft, heat it in oil bath maintained of 100℃~120℃ and then set.

- Special care is required when fitting oil seals in order to avoid damage to the sealing lips. Damaged oil seals are the cause of leakage. When inserting an oil seal, apply grease to the shaft for smooth installation of seal. If possible, it is recommended to replace the oil seals with new ones.

- After reassembly, make certain whether the motor shaft can be rotated by hand smoothly.

Assembly Drawing (NRT – 7200 MD1)

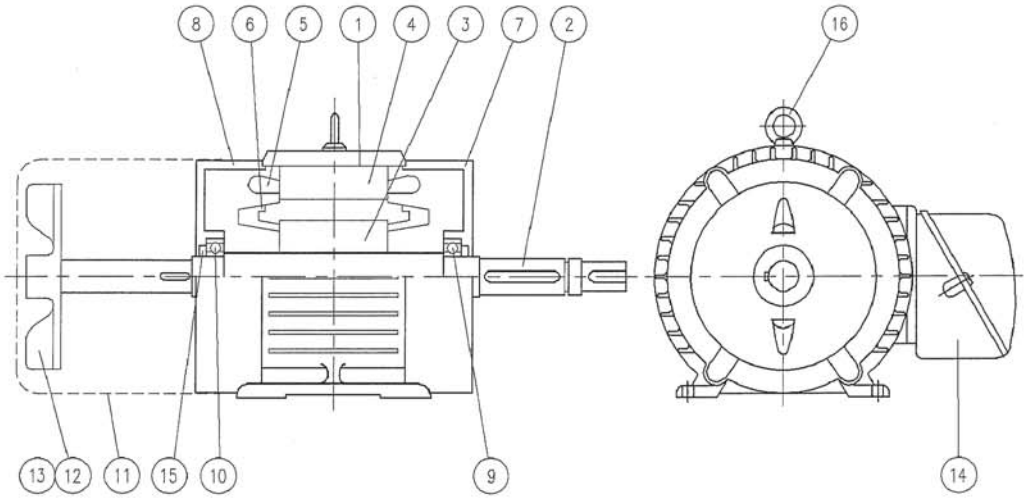


Parts list (NRT – 7200 MD1)

Part No.	NAME OF PARTS	Part No.	NAME OF PARTS	Part No.	NAME OF PARTS
1	CASE	33	COVER PLATE	67	BALL BEARING
2	BEARING COVER (大)	34	SPROCKET (大)	68-1	3RD NEEDLE BEARING
3	3RD INTERNAL GEAR	35	CHAIN COVER	68-2	3RD NEEDLE BEARING
4-1	DOWEL-PIN	36	KEY	69	2ND NEEDLE BEARING
4-2	DOWEL-PIN	37	HANDLE SET	70	1ST NEEDLE BEARING
4-3	DOWEL-PIN	38	SPRING PIN	71	KEY
5	OUTPUT SHAFT	39	LOCK WASHER	72	KEY
6	3RD PIN	40	HEX' BOLT	73	KEY
7	3RD IDLE GEAR	41	HEX' BOLT	74	MOTOR
8	3RD COLLAR	42	HEX' BOLT	75	DISC BRAKE
9	3RD CARRIER	43	HEX' BOLT	76	SPRING WASHER
10	SPACER	44	HEX' BOLT	77	SPRING WASHER
11	GEAR CASE	45	HEX' BOLT	78	SPRING WASHER
12	3RD SUN GEAR	46	HEX' BOLT	79	SPRING WASHER
13	2ND CARRIER	47	HEX' BOLT	80	SPRING WASHER
14	2ND PIN	48	HEX' BOLT	81	SPRING WASHER
15	2ND IDLE GEAR	49	HEX' BOLT	82	SPRING WASHER
16	2ND COLLAR	50	HEX' BOLT	83	SPRING WASHER
17	2ND INTERNAL GEAR	51	HEX' BOLT	84	SPRING WASHER
18	INNER RING	52	WRENCH BOLT	85	SPRING WASHER
19	OUTER RING	53	WRENCH BOLT	86	SPRING WASHER
20	2ND SUN GEAR	54	-	87	PLAIN WASHER
21	1ST CARRIER	55	SCREW	88	PLAIN WASHER
22	1ST PIN	56	OIL SEAL	89	NUT
23	1ST IDLE GEAR	57	OIL SEAL	90	NUT
24	1ST COLLAR	58	SNAP RING	91	NUT
25	1ST INTERNAL GEAR	59	SNAP RING	92	PIPE
26	SPACER	60	SNAP RING	93	CHAIN
27	1ST SUN GEAR	61	SNAP RING	94	DRAIN PLUG
28	FRONT COVER	62	SNAP RING	95	FILLER PLUG
29	BEARING COVER (小)	63	SNAP RING	96	OIL GAUGE
30	MOTOR BED	64	ROLLER BEARING	97	AIR VENT
31	SPROCKET (小)	65	ROLLER BEARING		
32	SPACER	66	BALL BEARING		

7. Motor

7-1. Structure



PART NO.	MANE OF PARTS	PART NO.	MANE OF PARTS
1	FRAME	9	BEARING (D.E)
2	SHAFT	10	BEARING (O.D.E)
3	ROTOR CORE	11	SAFETY COVER
4	STATOR CORE	12	FAN
5	STATOR COIL	13	FAN CLAMP
6	END-RING	14	CONDUIT BOX
7	END SHIELD (D.E)	15	WAVE SPRING
8	END SHIELD (O.D.E)	16	EYE BOLT

7-2. Operation

- Before operation, check correct installation, electrical connections and earthing connections with satisfactory conditions.

- Check running direction at the initial start.

7-3. Maintenance

- The work required for electric power installation must be carried out by skilled personnel only.

- Check and note results according to following chart.

Periodical Maintenance Chart

Interval	Inspection	Inspection procedure	Counter measure.
Monthly	Motor and starter	Rotate the motor by hand and check for abnormality.	If abnormality is noticed, investigate the cause and repair.
		Measure insulation resistance.	If insulation is deteriorated, investigate the cause and repair.
		Check surface.	Clean contaminated area.
		Check terminals for loosened connection.	Retighten loosened connection.
3-monthly	Electrical circuit	Measure insulation resistance.	If the measurement is less than the minimum value (1 MΩ), dry or correct.
6-monthly	Apparatus associated with motor	Check operation of starter and accessory apparatus.	If operation is abnormal. Investigate the cause and repair. Repair defective or burnt part.
		Check contact part, terminal and connections.	If necessary, replace. Retighten loosened connection.
	Motor	Check for loosened bolt or nut in the base mounting part, joint cover mounting part, etc., and for correction.	Retighten loosened bolt or nut. Renew defective bolt or nut with a new one.
Yearly	Motor	Measure air gap between stator and rotor Check for abnormality in bearing part.	Renew defective bearing with a spare part. Clean shaft and bearing.
	Spare part	(1) Check the quantities (2) Measure insulation resistance.	(1) Check with parts list. (2) If insulation is deteriorated, investigate the cause and dry or correct.

- The ball bearing requires replacement if it produces abnormal during operation.

- **The procedure for bearing replacement** is as following.

1) After disassembling the motor, remove the defective bearing from the rotor shaft by use of a bearing puller.
2) Anti-rust grease on the surface of the replacement bearing should be removed with a cloth.
3) Install the new bearing on the rotor.

- Smear grease to the chain sprocket of motor shaft periodically.
(As continuous operation : Every 3 month, As intermittent operation : Every 6 month)

7-4. Disassembly and reassembly

- **Caution**

1) The vertical type should be disassembled in a horizontal position.
2) Assembly or disassembly should be carried out by two or more qualified personnel.
3) Disassemble according to exact sequence and be arranged to prevent mixed up of the parts and to improve the work efficiency.
4) The disassembled parts are covered, to protect from dust or foreign materials, etc.

- **Disassembly procedure**

1) Remove all external cables connected to the motor and brake.
2) Remove the bolts connected the motor with base plate.
3) Take to the place of disassembly.
4) In case of vertical type motor, lay down the motor horizontally.
5) Remove the chain sprocket connected with the motor.
6) Remove the brake in accordance with the section 8-2.
7) Remove each-end shields since it may cause the damage of coil.
Please handle carefully.
8) Pull out the rotor from the stator.

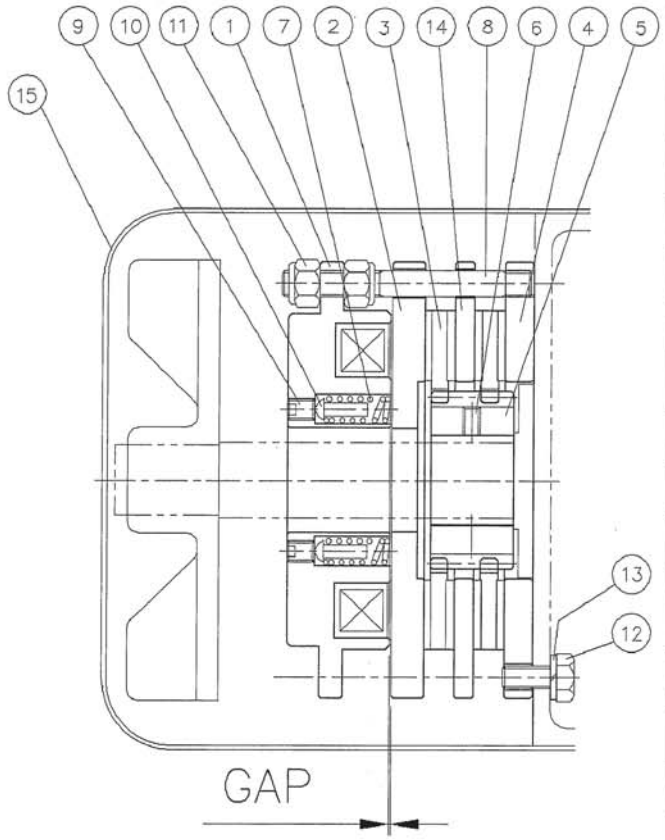
- **Assembly procedure**

1) Carry out assembling normally in the reverse sequence of disassembling.
2) Before assembling, remove the dust, oil and etc. from the parts.

8. Brake

8-1. Structure

This brake is the dry disc electric magnetic type.



PART NO.	NAME OF PARTS
1	MAGNET
2	MAGNET FLANGE
3	LINING
4	FLANGE
5	GEAR
6	SET SCREW
7	SPRING
8	STUD BOLT
9	SET SCREW
10	RIVET
11	SELF LOCKING NUT
12	HEX. BOLT
13	SPRING WASHER
14	DISC FLANGE
15	SAFETY COVER

(Table - Ⅱ.)

BRAKE SIZE	STATIC TORQUE	CHARACTER				GAP (㎜)
		VOLTAGE	AMPERE	RESISTANCE	WATT	
DB - 30	21 ㎏ f.m	D.C 90V	0.82A	110Ω (20℃)	73.8W	0.5-0.6

8-2. Disassembly procedure

- Remove all external cables connected to the brake.

- Remove the motor cover and the fan.

- Remove the outside self locking nut.

- Remove the magnet, at this time, please take care of spring not to be lost.

- Remove the inside self locking nut.

- Remove the magnet flange, the lining and the disc flange.

- Remove the stud-bolt.

- Remove set screw of upper gear.

- Remove the gear from motor shaft.

8-3. Assembly procedure

- Carry out assembling normally in the reverse sequence of disassembling.

- Before assembling, remove the dust, oil and etc. from the parts.

8-4. Gap adjustment method

- Measure the gap with a filler gauge to see if the brake is loose.

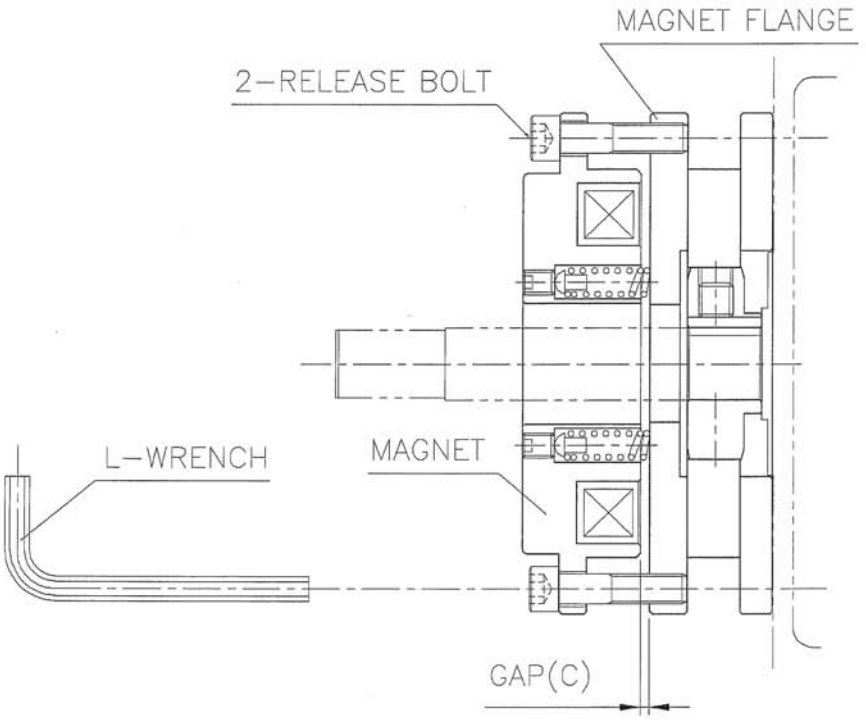
- Loosen the gap adjusting nut(inside self locking nut) and adjust the gap between the magnet and the magnet flange with the nut(use the gap gauge).

- The brake is adjusted at "Table - Ⅱ." upon release from the factory.
  The inspection and gap adjustment is required per 6 months at least.

8-5. Manual opening method

- When opening the brake manually, use the furnished release bolts.

- Refer to the following process.



1) Remove the motor cover and the motor fan.
2) Using an "L-Wrench", tighten two release bolts until magnet flange is separated from lining. (Tighten the release bolts until the gap reaches "0".)
3) Don't forget to remove "Release-bolt" after use it.

⚠CAUTION.

1. Brake.

1-1. Gap adjustment is required every 6 months at least.
(Gap amount is shown on the "Table-Ⅱ".)

1-2. Make sure to remove "Release-bolt" after using it to loose manually.

2. Check and tension adjustment for Roller Chain.
(Inspect per 6 months.)

2-1. Check of Roller Chain.

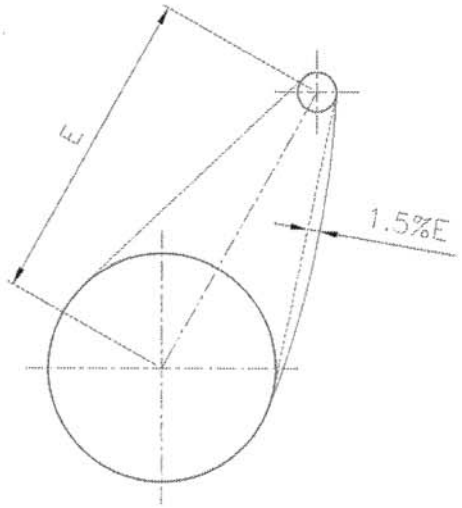
2-1-1. If the noise occurred to the roller chain, Inspect the roller chain after removing the chain cover.
If a heavy noise is still not disappeared, rearrange the sprockets of motor and reducer.

2-1-2. Inspect a failure of each link of chain.

2-2. Adjustment of Roller chain.

2-2-1. Roller chain has to be tensile-loaded until chain's roller contacts to the root of teeth.

2-2-2. The amount of slack should not be exceeded 1.5% of the center to center distance of sprockets.

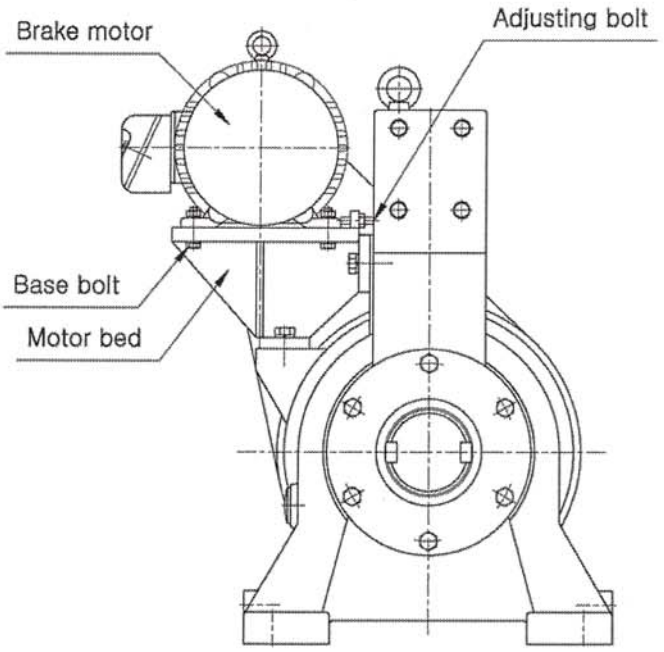


Model	1.5%E [mm]
NRT-7200 MD1	7

2-2-3. Adjustment for the looseness of chain tension.

- To adjust chain tension, Release base bolts of Motor and adjust chain tension with lateral adjusting bolt.

- Fasten base bolts of Motor.



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1 Preliminary remarks

1.1 Purpose of the manual

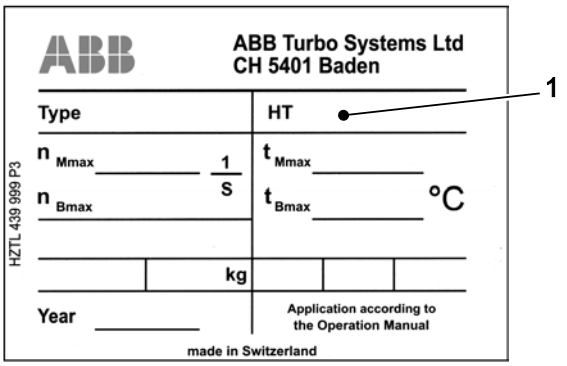

Figure 1

This Operation Manual belongs to the turbocharger with the identical HT number (1), see the Operation Manual cover sheet and the turbocharger rating plate.

Operation Manual

This Operation Manual will familiarise you with the turbocharger of ABB Turbo Systems and provides information on how to use it in compliance with its intended purpose.

The Operation Manual explains what is important to know in order to operate the turbocharger safely, appropriately and profitably.

The Operation Manual is a complement to and expansion of existing national regulations for occupational safety and accident prevention.

Target group

The Operation Manual is aimed at engineers and trained mechanics responsible for the proper operation of the engine and for the turbocharger connected to it.

Availability of the operation manual

An operation manual must be available where the turbocharger is used.

All persons operating or working on the turbocharger must have read and fully understood the operation manual.

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1.2 Symbols, definitions, contact address

Symbols

The following symbols are used in the documents:

▶ Step of a procedure

- List, first level
  - List, second level

[→] see page

Definition of Note

NOTICE

Note
The note provides advice to facilitate working with the product.

Definition of Caution / Warning

Caution and warning signs are described in chapter Safety.

ABB Turbo Systems

ABB Turbo Systems Ltd is identified as ABB Turbo Systems in this document.

Official service stations of ABB Turbo Systems

Official service stations are identified in this document as ABB Turbocharging Service Stations. They are regularly audited and certified by ABB Turbo Systems.

Contact address

ABB Turbo Systems AG
Bruggerstrasse 71a
CH-5401 Baden
Switzerland

www.abb.com/turbocharging

Customer service

The Contact Information brochure includes a global overview of the official ABB Turbocharging Service Stations.

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2 Safety

2.1 Introduction

Turbochargers manufactured by ABB Turbo Systems are state of the art and comply with the respective health and safety standards in effect at the time the turbocharger was built. This ensures safe operation of the turbocharger. Nevertheless, there may be some residual risks during operation of and work on the turbocharger which:

- Are caused by the turbocharger itself or its accessories.
- Are caused by the operating equipment used or supplies and materials.
- Are a consequence of insufficient compliance with safety instructions.
- Are a consequence of insufficient or inappropriate performance of maintenance and inspection work.

The operating company is responsible for the organisational measures that regulate the safe handling of the turbocharger by its personnel.

All instructions contained in this chapter must be observed for safe and trouble-free operation of the turbocharger and during all work on the turbocharger.

All further safety instructions contained and specifically identified in every chapter of this manual (Definition of safety instructions [➞ 8]) must also be observed.

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2.2 Definition of safety instructions

The following symbols and nomenclature are used in this manual, referring to safety or indicating potential hazards:

WARNING

Definition of Warning

Non-compliance or inaccurate compliance with working or operating instructions indicated by this symbol and the word **WARNING** can lead to serious injuries to personnel and even to fatal accidents.

▶ **Warning signs must always be observed.**

CAUTION

Definition of Caution

Non-compliance or inaccurate compliance with working or operating instructions indicated by this symbol and the word **CAUTION** can lead to serious damage to engine or property with grave consequences.

▶ **Caution signs must always be observed.**

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2.3 Warning plates on the turbocharger

Warning plates are affixed at the following locations on the turbocharger:

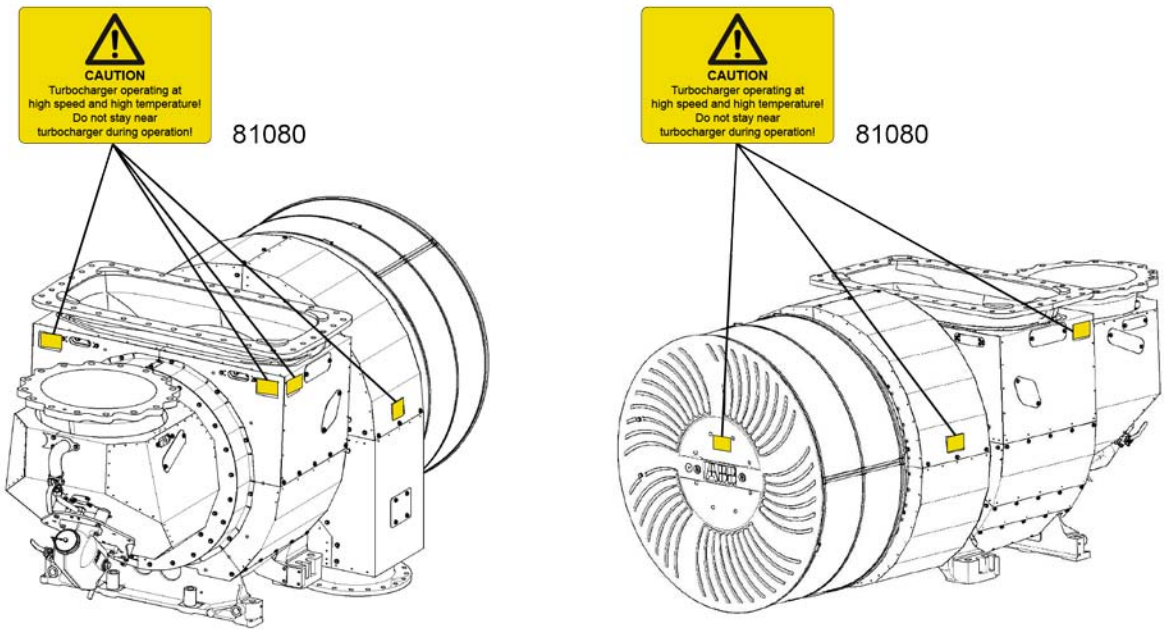

Figure 2: A…-L

If warning plates are not present in the designated locations or not readable, proceed as follows:

- ▶ Order new warning plates from ABB Turbocharging Service Stations.
- ▶ Remove any warning plates that have become unreadable.
- ▶ Clean and degrease the areas designated for the warning plates.
- ▶ Attach the new warning plates.

Non-insulated turbochargers

Turbochargers supplied to the enginebuilder without insulation must be equipped later with warning plates to be attached to the insulation. This is the responsibility of the enginebuilder.

2.4 Safe operation and maintenance

The instructions specified in this section are for the safety of personnel. Together with the instructions in section "Hazards during operation and maintenance" of this chapter, they allow the user to safely use the turbocharger.

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Occupational safety and safety at the workplace

WARNING

Risk of falling

When working on the turbocharger, there is a risk of falling.

- ▶ Do not climb onto the turbocharger or onto attached parts and do not use them as climbing aids.
- ▶ Use suitable climbing aids and working platforms for work above body height.

- ▶ Comply with the general accident prevention regulations.
- ▶ Only perform work on the turbocharger when you are in a physically and psychologically stable condition.
- ▶ Wear appropriate protective equipment, such as:
  - Helmet
  - Hearing protection
  - Safety goggles
  - Safety gloves
  - Safety boots
  - Protective clothing
  - Hair net (for long hair)
  - Respirator mask
- ▶ Only work with suitable tools and with equipment and appliances that function properly.
- ▶ Power tools must be properly earthed and cables must be undamaged.
- ▶ Keep the workplace clean; clear away any loose objects and obstacles on the floor.
- ▶ Keep the floor, equipment, and turbocharger clean.
- ▶ Have oil binding agents ready and provide or keep oil pans at hand.
- ▶ Clean up any spills.
- ▶ Have fire protection means and extinguishing agents available.

Welding work

- ▶ When performing welding work above the turbocharger, always cover the filter silencer to prevent the filter mat from being damaged.
- ▶ Keep flammable objects and substances out of the vicinity of flying sparks.
- ▶ Cover all connections on the turbocharger so that no foreign objects can enter the turbocharger.

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Safety during commissioning and operation

- ▶ Visually inspect your working environment before starting work.
- ▶ Remove any obstacles and objects littering the workplace.
- ▶ Check all pipes to and from the turbocharger for damage and leaks before commissioning.
- ▶ Avoid all operational practice which could negatively affect safety at the turbocharger.
- ▶ Check turbocharger for recognisable damage or defects approximately every 12 hours of operation or at least once a day.
- ▶ Report any damage and any alterations of operational characteristics to the responsible department immediately.
- ▶ In case of damage, take the turbocharger out of operation immediately and safeguard against accidental/unauthorised use.
- ▶ When switching on operating energy supplies (hydraulics, pneumatics, electricity, water), pay attention to the risks that may occur as a consequence of this energy input.

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Safety during cleaning

It is possible that detergents or solvents are used for cleaning. In this case, the safety instructions in section "Hazards due to operating materials and supplies" must always be observed.

- ▶ Protect the floor against unintentional penetration of detergents or solvents before starting cleaning operations.
- ▶ Wear appropriate protective clothing.
- ▶ Inspect the electric cables for abrasion and damage before and after your cleaning work.

Safety during disassembly, assembly, maintenance and repair

- ▶ Observe the procedures for set-up, maintenance and inspection work and the inspection intervals.
- ▶ Inform the operating staff before starting any maintenance or repair work.
- ▶ Before taking off any cover or removing any guard from the turbocharger, switch off the engine and wait until the turbocharger has come to a standstill.
- ▶ Make sure that the oil supply is interrupted, especially with an external oil supply.
- ▶ Only restart the engine after all parts have been properly fitted again and oil supply is ensured.

CAUTION

Mechanical operations on the turbocharger

Components of the turbocharger can be damaged or destroyed.

- ▶ Only perform operations that are described in this manual.
- ▶ Only perform operations for which you have previously received instruction or training.

Safety when taking out of operation at short notice or preparing for mothballing

- ▶ Secure rotor against turning. The rotor can rotate due to the stack draught alone.
- ▶ Clean the turbocharger prior to mothballing.
- ▶ Wear appropriate protective clothing.

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2.5 Hazards during operation and maintenance

Mechanical hazards during operation

During standard operation, no mechanical hazards are caused by the turbocharger itself if it has been properly installed.

WARNING

Physical hazards due to rotating parts

Contact with rotating parts can cause severe injury. The turbocharger must never be used without the air-inlet casing or filter silencer, respectively. With the engine stopped, the rotor can rotate due to the stack draught alone.

▶ Operate the turbocharger in compliance with the specifications.

Mechanical hazards when working on the turbocharger

During maintenance, various risks may arise due to improper handling of components, non-compliance with safety and health standards, carelessness, or as a consequence of inadequate qualification.

WARNING

Mechanical hazards

Severe injuries to personnel or fatal accidents can be caused by mechanical influences as a consequence of hazardous and inadequate operational procedures.

▶ Secure rotor against turning.
▶ Observe the general rules for occupational safety and prevention of accidents.
▶ Ensure workplace safety.
▶ Only perform operations that are described in this manual.
▶ Only perform operations for which you have previously received instruction or training.

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Noise hazards

The noise emission during operation is influenced by its installation and operating conditions. A noise level exceeding 85 dB(A) is harmful.

WARNING

Danger due to noise

Exposure to noise can harm the hearing system. It can impair health and the psychological state and may lead to irritation and lack of attention.

- ▶ When the engine is running, always wear hearing protection.
- ▶ Always wear hearing protection if the noise level exceeds 85 dB(A).

Standard values for the maximum duration of exposure to areas of noise emission (source: Unfallverhütungsvorschriften für Unternehmen der Seefahrt (UVV See) [Accident Prevention Regulations for Enterprises engaged in Seafaring]):

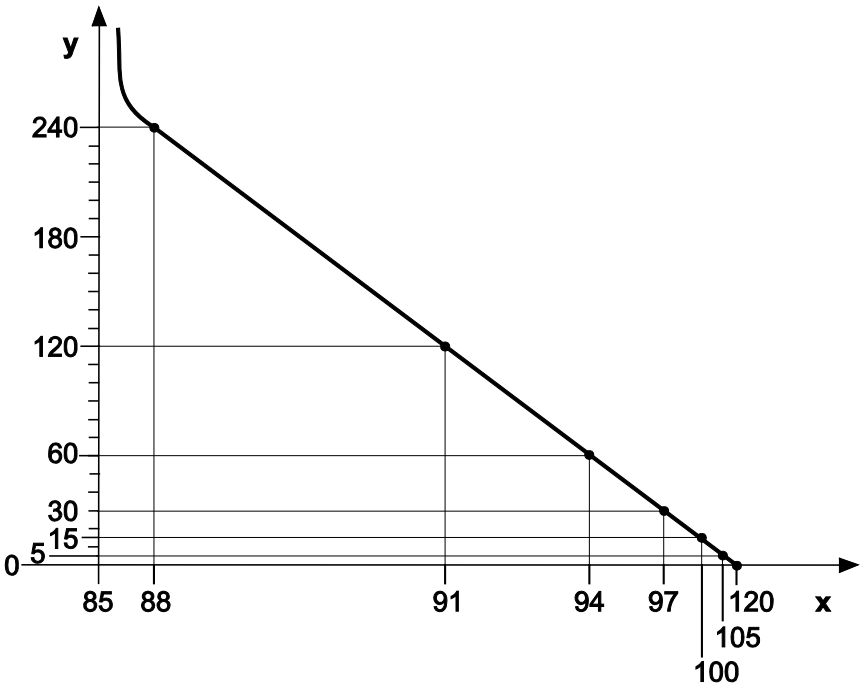

Figure 3

x Noise level [dB(A)]
y Maximum duration of exposure [min] per working day

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Hazards due to hot surfaces and substances

Surfaces of the turbocharger, attached parts and operating fluids (lubricating oil) get hot during operation. The surface temperature depends on the efficacy of the existing insulation. The temperature may rise to a level that can cause burns.

WARNING

Danger of burns

Touching hot surfaces or contact with hot operating fluids can cause severe burns.

- ▶ Do not touch hot surfaces. Observe the warning plate on the turbocharger.
- ▶ Wear heat-resistant safety gloves and protective clothing.
- ▶ Wait for the turbocharger to cool down before carrying out any work.

WARNING

Hot surfaces on the non-insulated turbocharger

Non-insulated turbochargers can cause serious injuries to personnel (burns).
ABB Turbo Systems supplies the turbocharger with or without insulation in accordance with the purchase order received from the enginebuilder. If supply is without insulation, the enginebuilder is responsible for providing the turbocharger with proper insulation and for providing protection against contact with hot surfaces.

- ▶ Compliance with the instructions and specifications given by the enginebuilder to protect against hot surfaces is compulsory.

Hazards due to operating materials and supplies

Operating materials and supplies are substances required for the operation or for the performance of maintenance work. Oils, greases, coolants, detergents and solvents, acids and similar substances can be classified as hazardous substances. Operating materials and supplies can be flammable and combustible.

WARNING

Danger of poisoning or acid burns

Swallowing of or skin contact with toxic or caustic operating materials and supplies or breathing of any such vapours can be harmful to health.

- ▶ Do not breathe in these substances and avoid contact with the skin.
- ▶ Wear protective clothing and a breathing mask.

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WARNING

Danger of fire or explosion

Flammable and combustible operating materials and supplies can catch fire or resulting vapours can lead to an explosion.

- ▶ Open flames are forbidden when carrying out cleaning work.
- ▶ Carry out cleaning in the open or provide sufficient ventilation.

CAUTION

Danger of environmental damage

The emission of operating materials and supplies into the atmosphere or the contamination of ground or water systems as a result of improper disposal can cause damage to the environment.

- ▶ Handle operating materials and supplies with care.

- ▶ Observe all instructions for use, material safety data sheets and the hazard information provided on the containers of the operating materials and supplies.
- ▶ Wear appropriate protective clothing.
- ▶ Do not breathe in these substances and avoid contact with the skin.
- ▶ Ensure sufficient ventilation of the workspace.
- ▶ After use, close containers hermetically and put them away.
- ▶ Collect used operating materials and supplies safely, store them separately in suitable containers and dispose of them properly and in an environmentally compatible manner in compliance with the legal regulations.
- ▶ In the event of leaks or spillage, spread binding agents immediately and dispose of them properly and in an environmentally compatible manner in compliance with the legal regulations.

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Hazards due to the handling of insulation materials

WARNING

Danger from insulation materials

Dust or fibres from insulation materials can have adverse effects on the health or cause irritations. Unsuitable and combustible insulation materials are a fire hazard.

▶ Handle insulation materials with care.

- ▶ Only use suitable and non-combustible insulation materials.
- ▶ Ensure good ventilation at the workplace.
- ▶ Wear suitable work clothing (safety goggles, dust mask).
- ▶ Avoid whirling up dust.
- ▶ Use dust-free tools and working methods.
- ▶ Remove package at the workplace only.
- ▶ Proceed with particular care when removing old insulation materials.
- ▶ Dispose of insulation materials properly and in an environmentally compatible manner in compliance with the legal regulations.

Hazards due to electrical components

WARNING

Danger due to electrical components

Electrical components work with electrical voltages that can be a danger to humans.

▶ Any work on or with electrical components must only be performed by specifically qualified electricians.

▶ National regulations must be observed.

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2.6 Lifting of loads

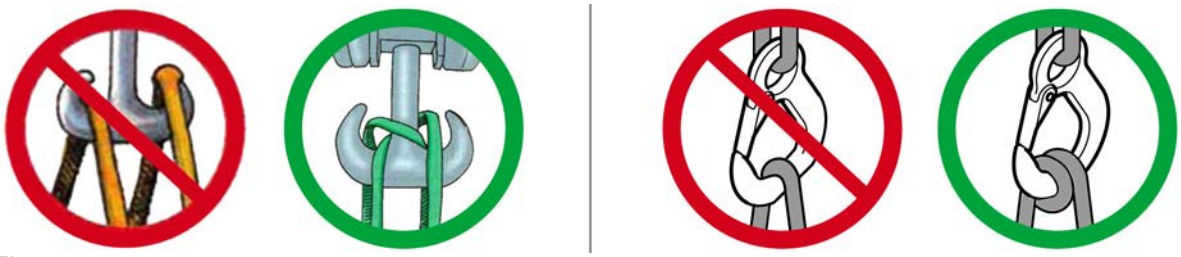

Figure 4

WARNING

Suspended loads

Loads that are not attached according to regulations can cause physical injuries with grave consequences or fatal accidents.

- ▶ Fasten assemblies or individual parts above 25 kg carefully on properly functional lifting gear with a sufficient load limit.
- ▶ Pay attention to the correct attachment of loads on the crane hook.
- ▶ No persons must remain under suspended loads.

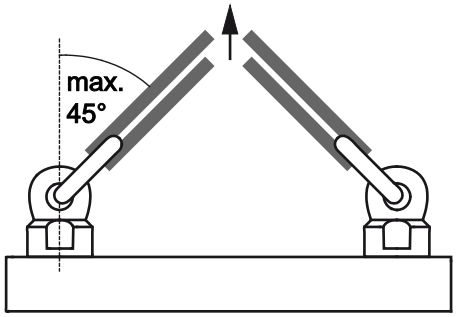

Figure 5

If there are two or more suspension points, the attachment angle of 45° must not be exceeded. This prevents excessive loading due to diagonal pull.

- ▶ Attach components of the turbocharger as described in the respective action steps.
- ▶ Before looping around the components of the turbocharger, let them cool down (maximum 80 °C).
- ▶ Use a suitable edge guard if there are sharp edges.
- ▶ The assembly devices must be completely screwed in and must not unscrew during use.
- ▶ Use assembly devices only for the described applications.
- ▶ Put down dismantled components of the turbocharger in such a way that they cannot tip over.

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2.7 Periodic check of the pressure vessels

The pressure vessels used by ABB Turbo Systems, for example, in the wet or dry cleaning process, are so-called simple pressure vessels.

- The locally applicable legal regulations regarding periodic checks of the pressure vessels must be observed.
- The operating company is responsible for the safe operation of the pressure vessel.

WARNING

Danger due to pressure vessels

The operating company must make sure the pressure vessels are in proper working condition and monitor them. Necessary repair or maintenance work must be performed promptly, and the required safety measures must be taken.

▶ Pressure equipment must not be operated if defects are present.

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3 Introduction

3.1 Essential information

Design variants

This document is valid for different design variants of turbochargers. There may be sections and descriptions of components that are not relevant for a specific turbocharger variant.

The ABB Turbocharging Service Stations will be happy to provide information on questions regarding a design variant.

Accuracy of illustrations

The graphics and photographs presented in this document are general in nature and intended for ease of understanding. Differences in detail are therefore possible.

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3.2 Layout and function of the turbocharger

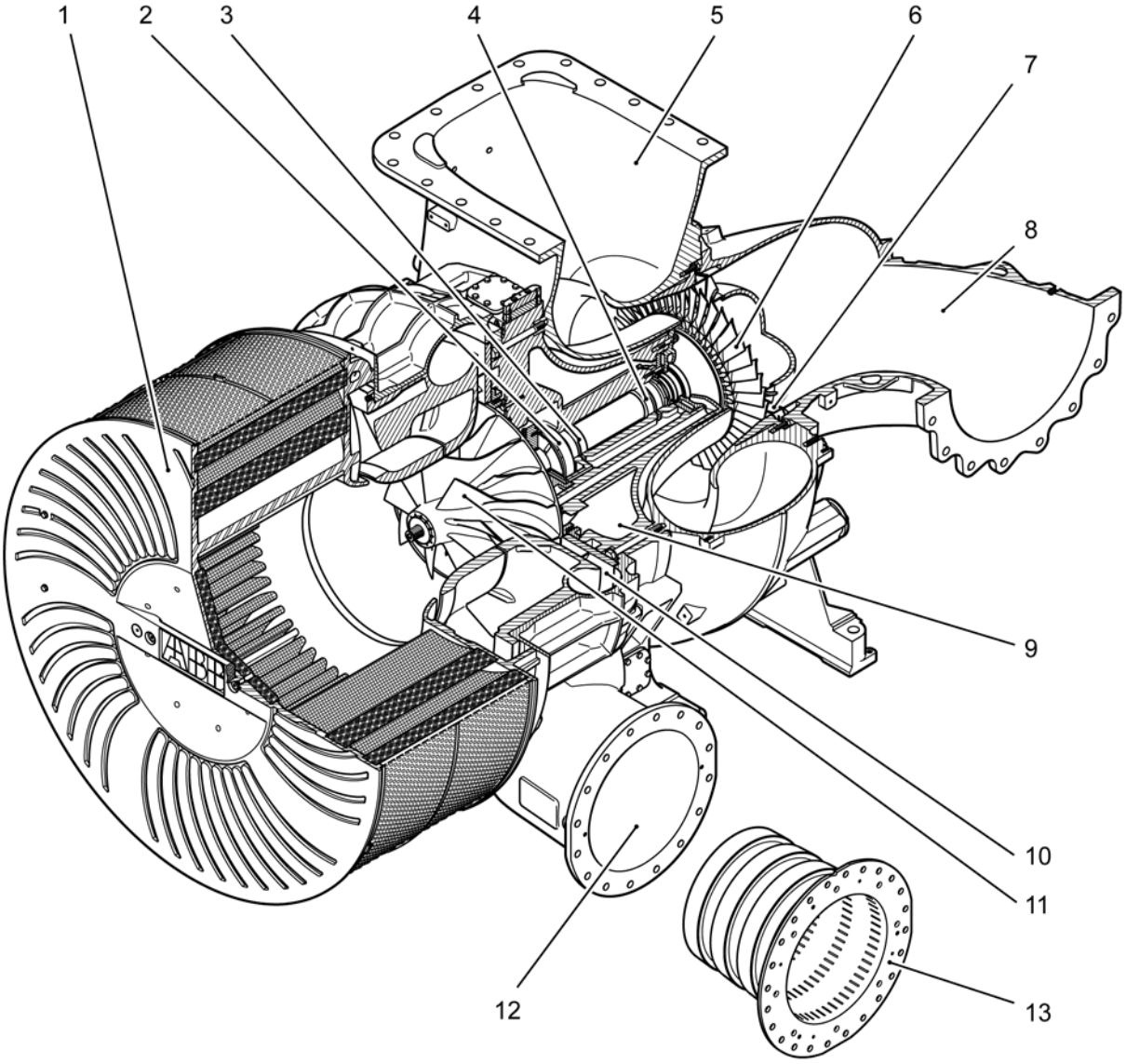

Figure 6

1 Filter silencer
2 Thrust bearing
3 Radial plain bearing
4 Radial plain bearing
5 Gas outlet casing
6 Turbine wheel
7 Nozzle ring
8 Gas inlet casing
9 Bearing casing
10 Diffuser
11 Compressor wheel
12 Compressor casing
13 Air-outlet silencer (option)

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Mode of operation

The turbocharger is a turbo machine and consists of the following main components:

- Turbine
- Compressor

These components are installed on a common shaft and form the rotor (see Figure 6).

The exhaust gases of the internal combustion engine flow through the gas-inlet casing (8) and the nozzle ring (7) onto the turbine wheel (6). The turbine wheel uses the energy contained in the exhaust gas to drive the rotor and, hence, the compressor wheel (11).

The exhaust gases then reach the atmosphere through the exhaust gas pipe connected to the gas-outlet casing (5).

The compressor wheel (11) sucks in fresh air and presses the compressed air into the cylinder.

The air passes through the filter silencer (1) to the compressor wheel (11). The air then flows through the diffuser (10) and exits the turbocharger through the compressor casing (12). An air outlet silencer (13) is available as an option. It reduces the noise emitted by the components on the outlet side downstream of the compressor casing.

The rotor runs in two radial plain bearings (3/4) which are located in the bearing casing (9) between compressor and turbine. The axial thrust bearing (2) is located on the compressor end.

The plain bearings are connected to a central lubricating oil duct which is normally supplied by the lubricating oil circuit of the engine. The oil outlet always lies at the deepest point of the bearing casing (9).

The turbocharger is equipped with an oil tank which is integrated in the bearing casing (9). This oil tank supplies the bearings of the rotor with oil until standstill in the event that a malfunction of the lubrication oil system causes an emergency stop of the engine.

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3.3 Storage of new turbochargers and cartridge groups

Storage of new turbochargers and cartridge groups for up to 6 months

New turbochargers and cartridge groups from ABB Turbo Systems can be stored in their closed packages for 6 months from the date of delivery without additional mothballing measures (indicated by VCI label on package).

Figure 7: **V**olatile **C**orrosion **I**nhibitor (VCI)

Only dry rooms with 40-70% atmospheric humidity, in which no water condensation can form, are suitable as storage locations.

Storage of new turbochargers and cartridge groups for more than 6 months (VCI)

WARNING

Health protection when handling VCI

VCI products are not hazardous in terms of the Ordinance on Hazardous Substances. Nevertheless, the following points must be observed when handling VCI:

- ▶ Ensure proper space ventilation.
- ▶ Do not eat, drink or store food at the workplace while working with VCI.
- ▶ Wear protective gloves.
- ▶ After working with VCI, clean your hands and face.
- ▶ For more information, see www.branopac.com.

Every 6 months, the following mothballing measures are required:

- ▶ Open package.
- ▶ Remove VCI corrosion protection emitter from package and replace with a new VCI corrosion protection emitter of the same kind. New VCI corrosion protection emitters can be obtained from www.branopac.com.
- ▶ Old VCI corrosion protection emitters must be disposed of in an environmentally compatible, professional way and in compliance with locally applicable regulations.
- ▶ Close package. The more tightly the package is sealed, the longer the protection duration.

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Long-term storage of replacement turbochargers or replacement cartridge groups

ABB Turbo Systems will prepare turbochargers or cartridge groups for long-term storage if requested in the purchase order. The package is equipped with a hydrometer (see illustration).

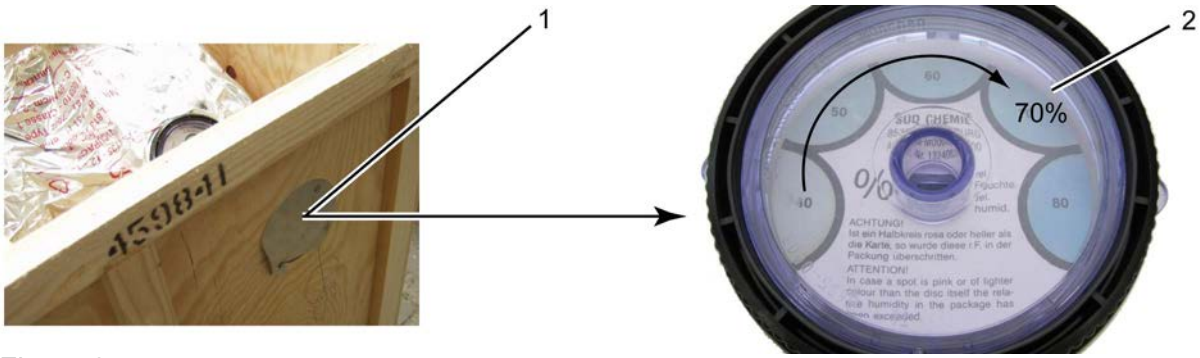

Figure 8

Every 6 months, the following measures are required:

- ▶ Check the hydrometer display (2) in the sight-glass. There is an opening (1) in the wooden crate to enable you to perform this check. If the 70% indicator field has changed colour, the maximum admissible atmospheric humidity has been exceeded. In this case, the turbocharger or cartridge group must be checked and repackaged by an ABB Turbocharging Service Station.
- ▶ Check the package for damage. If the package is damaged, the turbocharger or cartridge group must be checked and repackaged by an ABB Turbocharging Service Station.

After every 3 years, the following steps must be carried out by an ABB Turbocharging Service Station:

- Checking the component
- Replacing the desiccant
- Repackaging the component

NOTICE

Replacement components which are ready for operation

If the 70% field of the hydrometer (2) has not changed colour and the package is not damaged, the replacement turbocharger or replacement cartridge group can be put into operation without previously having been checked by an ABB Turbocharging Service Station.

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3.4 Intended use

Use on internal combustion engines

ABB turbochargers are intended for turbocharging internal combustion engines.

The A...-L turbochargers are designed for use on 2-stroke diesel engines.

The turbocharger supplies the engine with the air volume or air/gas mixture and the associated charging pressure required for operation.

The specific operating limits of the turbocharger were determined on the basis of information from the enginebuilder about the intended use. These data are given on the rating plate.

ABB Turbo Systems accepts no liability and rejects all warranty claims for any non-intended uses.

WARNING

Approved operation

Any operation of the turbocharger outside of its operating limits can be hazardous to personnel.

▶ Only trained personnel must operate the turbocharger.

The intended use of the turbocharger includes compliance with all regulations and conditions. The following points must be specifically observed:

- The operation manual
- The instructions of the enginebuilder

State of the art

The turbocharger is designed and built according to the state of the art and is safe to operate.

Flawless condition

The turbocharger must only be used when it is in a technically flawless condition and operated in compliance with its intended use.

ABB Turbo Systems excludes any liability for damage resulting from unauthorized modifications to the turbocharger.

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3.5 Prerequisites for operation

Responsibility of the operating company

In awareness of its responsibility, the operating company must ensure that only authorised personnel work on the turbocharger, who:

- Are versed in the general and locally applicable regulations for occupational safety and accident prevention
- Have read and understood the operation manual
- Have been instructed in the use of the turbocharger

The safety-conscious work of the personnel and adherence to the operation manual must be checked periodically.

Suitable working materials and personal protective equipment must be kept in a perfect condition.

Only authorised personnel may remain in the vicinity of the turbocharger when the engine is running.

Competence of personnel

The turbocharger must only be operated and serviced by trained and authorised personnel.

Modifications to the turbocharger

Modifications to the turbocharger must be approved by ABB Turbo Systems.

▶ The turbocharger must be taken out of operation immediately by stopping the engine if there is a malfunction or any abnormal operating behaviour.

▶ The responsible body must be notified of the malfunction.

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Original parts and safety

Original parts and accessories are specially designed by ABB Turbo Systems for the ABB turbochargers.

WARNING

Use original parts

Operation of the turbocharger with non-original parts can impair the safety of the turbocharger and can cause serious damage to property and injury to personnel.

▶ Only use original parts from ABB Turbo Systems.

ABB Turbo Systems accepts no liability for any damage resulting from the use of non-original parts and associated accessories.

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3.6 Turbocharger rating plate

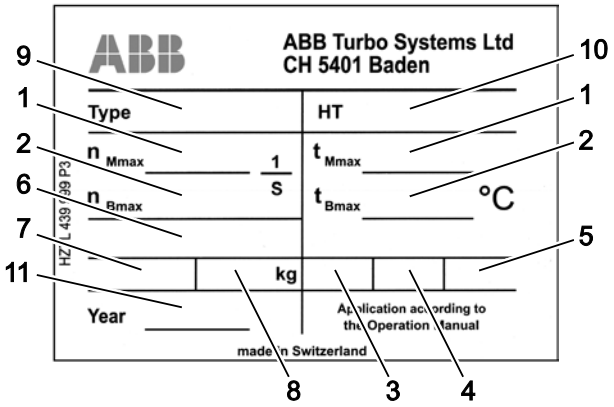

Figure 9

Operating limits

1 Turbocharger operating limits at engine overload (110 %).
In test rig operation only, unless otherwise agreed with the enginebuilder.
2 Turbocharger operating limits during operation

Recommended replacement intervals of turbocharger components

3 Replacement interval of plain bearings in 1000 h
4 Replacement interval of compressor in 1000 h
5 Replacement interval of turbine in 1000 h

Further data

6 Customer part number
7 Designation for special design
8 Weight of turbocharger in kg
9 Turbocharger type
10 Serial number
11 Year of construction of turbocharger

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Explanations of the rating plate

The recommended replacement intervals and the corresponding operating limits are jointly defined with the enginebuilder. This information is specific to the system.

Operation above the indicated values n_{Bmax}, t_{Bmax} can considerably shorten the recommended replacement intervals. In such a case, we recommend that you contact the nearest official service station of ABB Turbo Systems.

n_{Mmax}, t_{Mmax} normally apply only when running at overload (110 %) during trials on the engine test bed. These limit values can also be permitted during operation for special applications. Operation above n_{Mmax} and t_{Mmax} is not permitted.

Non-observance of the recommended replacement intervals increases the risk of unpredictable component failures.

Locations of the rating plates

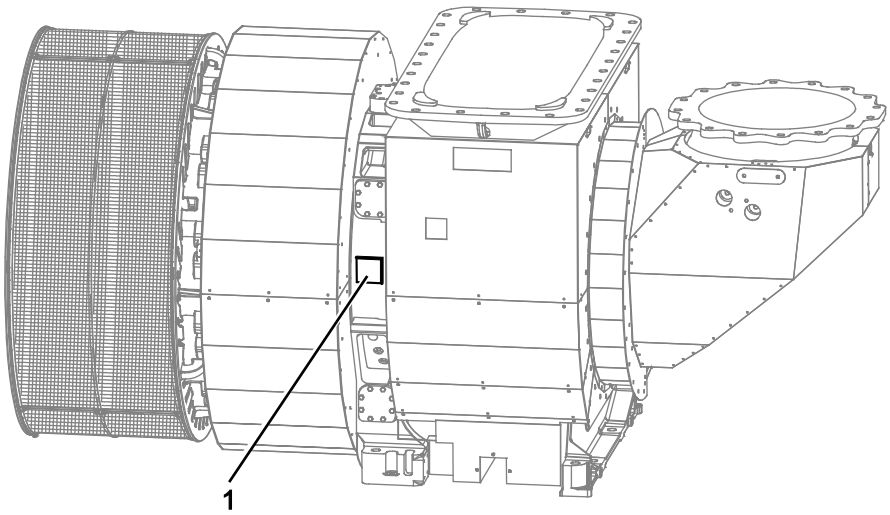

Figure 10

One rating plate (1) each is attached on the left and the right side of the turbocharger bearing casing.

3.7 CE conformity

Information

ABB turbochargers comply with the Machinery Directive 2006/42/EC and are incomplete machines as defined by Article 2 g.

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4 Removal and installation

4.1 Turbocharger weight

Lifting gear with a sufficient load limit must be used for removing and installing the turbocharger. The following weight specification applies to the heaviest variant possible. Depending on the specification, the weight specified on the rating plate may be lower than the standard value specified here.

Weight [kg]

A165-L	A170-L	A175-L	A180-L	A185-L	A190-L
2300	3300	5600	7500	10500	13500

Table 1

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4.2 Removing the turbocharger

▶ Remove cable to speed sensor

▶ Disconnect all gas, air and lubricating oil pipes.

▶ Check lifting gear.

▶ Fasten lifting gear on suspension eyes of the bearing casing and tauten.

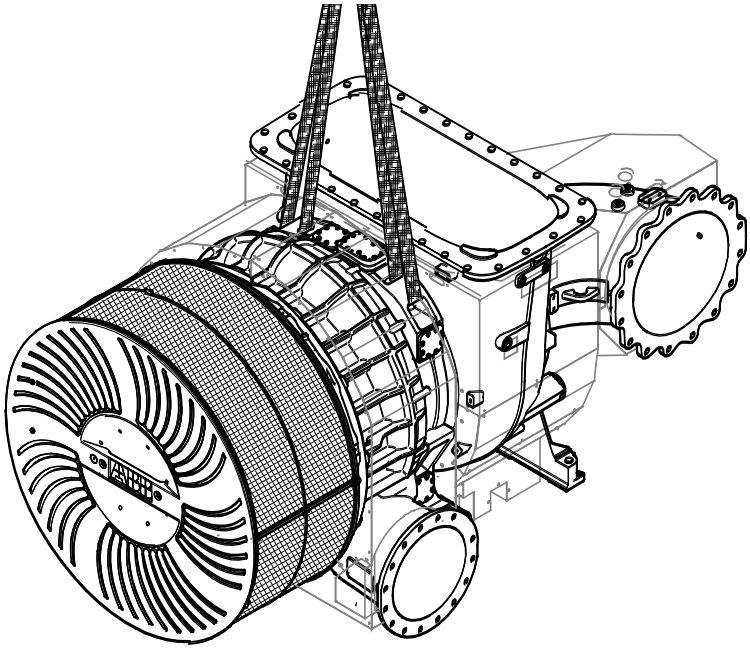

Figure 11

▶ Loosen fixing screws on compressor-end and turbine-end foot.

▶ Lift turbocharger from the engine and place the turbocharger at a suitable location.

WARNING

Risk of tipping over

If the turbocharger is not sufficiently supported or not supported at all during removal and installation, it can tip over and cause severe injury to personnel or accidents resulting in fatalities.

▶ Support the turbocharger at a suitable location.

▶ Cover oil connections.

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4.3 Installing the turbocharger

4.3.1 Placing the turbocharger on the bracket

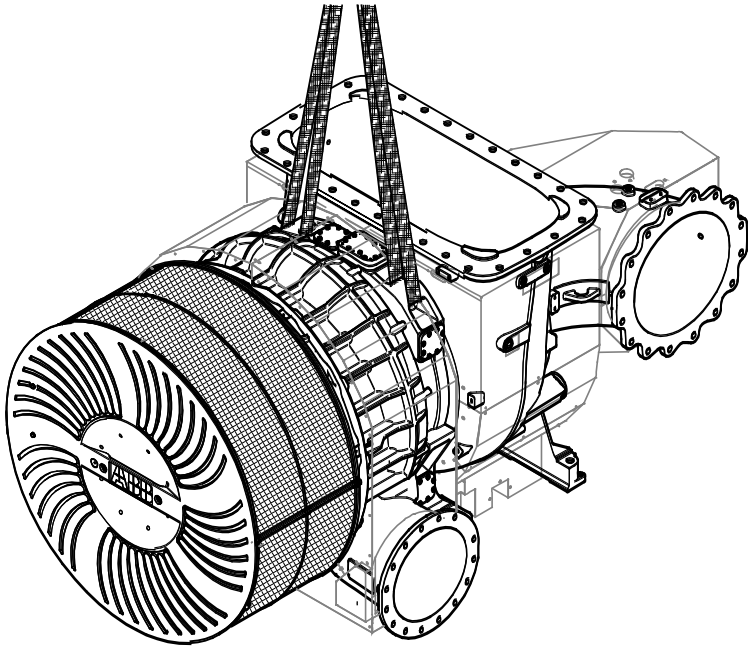

Figure 12

- ▶ Remove the covers on the oil connections.
- ▶ Align turbocharger and place on engine bracket.
- ▶ Tighten fixing screws (Steps for fastening the turbocharger [→ 34]) while only slightly loosening the lifting gear.
- ▶ Remove lifting gear from suspension eyes of the bearing casing.

- ▶ Connect cable to speed sensor.
- ▶ Connect all gas, air and lubricating oil pipes.

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4.3.2 Steps for fastening the turbocharger

General information

Subject	Related requirements
Material of fixing elements (for securing turbocharger on bracket)	ISO property class ≥ 8.8
Washers under the screw head or nut	Use hardened washers, thickness ≥ 15 % of the nominal thread diameter
Dimension a	Height of the turbocharger foot
Dimension b	Thread set deeper in bracket
Depth of thread c	≥ 1.5 x nominal thread diameter
With the 2 screws, in the centre of the turbine-end foot	Dimension a, including spacer sleeve D and foot F
Coefficient of friction	0.12 (lightly oiled)

Table 2

Compressor-end foot

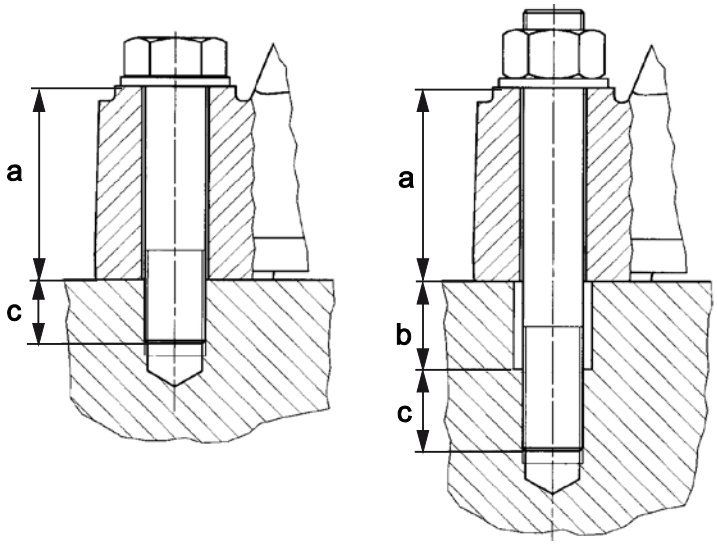

Figure 13

▶ Tighten the foot fixing screws or nuts diagonally according to the selected tightening method.

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Turbine-end foot

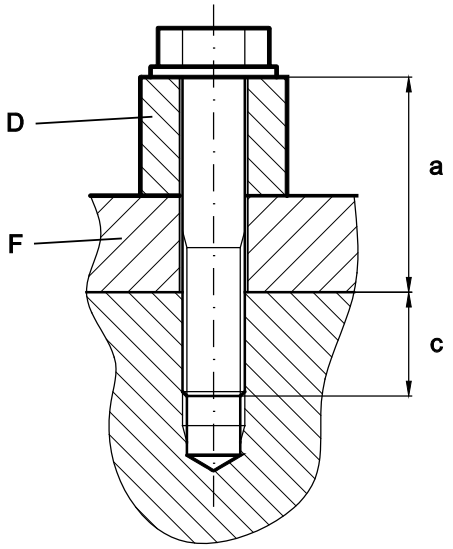

Figure 14

▶ Tighten the foot fixing screws or nuts according to the selected tightening method.

Torque-controlled tightening

Product	Thread size	Height a of foot [mm]	Tightening torque [Nm]
A165-L	M22	86	560
A170-L	M27	100	1000
A175-L	M30	120	1400
A180-L	M33	136	1900
A185-L	M39	151	3200
A190-L	M42	167	3900

Table 3

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Angle-controlled tightening

Product	Thread size	Height a of foot [mm]	Pre-tightening torque [Nm]	Tightening angle for height a [DEG]	Additional tightening angle for every 10 mm of additional screw length b [DEG]
A165-L	M22	86	120	30	3.7
A170-L	M27	100	220	30	3.1
A175-L	M30	120	300	30	2.6
A180-L	M33	136	400	35	2.6
A185-L	M39	151	600	35	2.4
A190-L	M42	167	700	35	2.2

Table 4

NOTICE

Property classes of screws

Screws with a property class higher than 8.8 can also be used to install the turbocharger.
Tightening torque and tightening angle remain identical to property class 8.8.

Pinning of turbocharger feet with positioning pins

If the turbocharger is pinned at its feet, one pin hole per foot must be used.

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5 Commissioning

5.1 Oil supply

5.1.1 Introduction

In all operating states, a functioning and carefully executed oil supply is an important prerequisite for trouble-free operation of the turbocharger.

The lubrication of the turbocharger is usually carried out with oil from the engine oil circulation.

▶ The directives of the enginebuilder on the selection of the lubricating oil and the oil change intervals must be followed.

5.1.2 Pre-lubrication and post-lubrication

CAUTION

Pre-lubrication

Serious damage to engine or property can result if the turbocharger is not supplied with oil from the first moment after starting the engine.

▶ Activate the pre-lubrication device each time before starting the engine.

The pre-lubrication time is at least 5 minutes.

The post-lubrication time is at least 10 minutes.

If the engine is operated for 5 to 10 minutes in idle mode before stopping, no additional post-lubrication is required.

5.1.3 Oil filtering

Filtering of the lubricating oil with a filter mesh width of ≤ 0.050 mm is sufficient for the turbocharger.

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5.1.4 Oil pressure

Comply precisely with the oil pressure before the turbocharger for trouble-free operation.

Status for operation	Oil pressure before turbo-charger [bar]
Admissible, for normal operation, with an oil temperature range at the inlet of 30 ... 70 °C	**0.8 … 2.5**
Admissible, for normal operation, with an oil temperature range at the inlet of 70 ... 85 °C	**0.8 … 2.0**
Admissible, during engine warm-up	0.8 … 4.0
Temporarily admissible (< 1 h) → **alarm**	0.6 … 0.8
Not admissible → **emergency stop**	0.0 … 0.6
Admissible, during pre-lubrication and post-lubrication (engine stopped)	≥ 0.2

Table 5

If the oil pressure at the inlet of the turbocharger is too high, it can be reduced with a throttle valve. The throttle valve is normally already fitted on the turbocharger and has been correctly set by the enginebuilder. This takes place either during the trial run on the engine test bed or during the trial phase of the system.

If the oil pressure values are outside the admissible range during normal operation, then:

▶ Contact the enginebuilder.

5.1.5 Oil temperature

Status for operation	Oil temperature at the inlet $T_{oil,inlet}$ [°C]
Admissible	30 … 85
Temporarily admissible (< 1 h) → alarm	> 85
Not admissible → stop engine	> 90
Not admissible → do not start engine (before start: preheat oil)	< 30

Table 6

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5.2 Inspection procedures

5.2.1 Introduction

The inspection procedures include preventative visual controls, monitoring and measuring work which assure the operability of the turbocharger. They help in detecting deviations before and during commissioning and as a result to avoid machine damage.

5.2.2 Checks before commissioning

Air filter mat (if present)

▶ Check for damage and contamination.

Lubricating system

▶ Check that the oil filter is clean before commissioning.

CAUTION

Contaminated oil

Serious damage to engine or property can be caused by dirt and solid material particles in the oil.

▶ For the initial commissioning and after all service work, the complete lubricating system must be flushed thoroughly with warm oil.
▶ Use special running-in filters when running in the engine and after all service work on the lubricating system.

▶ Check the oil pressure in the oil supply pipes.

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5.2.3 Checks after commissioning (engine in idle mode)

Lubricating system

- ▶ Check the oil pressure in the oil supply pipes
- ▶ Check oil inlet temperature.

The admissible values are specified in section Oil supply.

Gas, air and oil pipes

- ▶ After starting the engine, check all gas, air and oil pipes for leaks.

5.2.4 Checks when starting up the engine

- ▶ Measure speed, oil pressure and charging pressure at various engine performances.
- ▶ Measure the exhaust gas temperature before and after the turbine.
- ▶ Measure the air temperature before and after the compressor.

The measured values must be compared with the values of the acceptance protocol; different operating conditions must be taken into account here.

NOTICE

Escape of oily fluids

Lubricants and pastes used during assembly can liquefy or vaporise and escape as oily fluids during the initial hours of operation. Continual escape of an oily fluid indicates a possible oil leak.
If there is a leak, contact an ABB Turbocharging Service Station.

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5.3 Commissioning after taking out of operation

If present

- ▶ Remove cover plates (blind flanges) on the compressor casing, on the gas-inlet as well as on the gas-outlet.

General

- ▶ Check the exhaust gas pipe before and after the turbine for combustion residues or water residues and clean it. Remove any foreign objects that may be present.
- ▶ Check and clean filter silencer or air supply line, and remove any foreign objects that may be present.
- ▶ Put engine-side oil circulation to the turbocharger into operation.
- ▶ Prepare the turbocharger for operation according to section "Checks before commissioning".
- ▶ Start the engine and put the turbocharger into operation.

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6 Monitoring during operation

6.1 Oil pressure, oil temperature

Lubricating oil pressure before turbocharger

CAUTION

Assuring lubricating oil pressure

Serious damage to engine or property can result from missing or insufficient lubricating oil supply.

▶ The lubricating oil pressure must be monitored during operation and the necessary pressure assured at the oil inlet.

Status for operation	Oil pressure before turbo-charger [bar]
Admissible, for normal operation, with an oil temperature range at the inlet of 30 ... 70 °C	**0.8 … 2.5**
Admissible, for normal operation, with an oil temperature range at the inlet of 70 ... 85 °C	**0.8 … 2.0**
Admissible, during engine warm-up	0.8 … 4.0
Temporarily admissible (< 1 h) → **alarm**	0.6 … 0.8
Not admissible → **emergency stop**	0.0 … 0.6
Admissible, during pre-lubrication and post-lubrication (engine stopped)	≥ 0.2

Table 7

Lubricating oil temperature at the inlet

WARNING

Engine damage and injury to personnel

If the oil temperature at the oil inlet exceeds the admissible range, this may lead to engine damage and injury to personnel.

▶ Observe oil temperature at the oil inlet according to the following table.

Status for operation	Oil temperature at the inlet $T_{oil,inlet}$ [°C]
Admissible	30 … 85
Temporarily admissible (< 1 h) → alarm	> 85
Not admissible → stop engine	> 90
Not admissible → do not start engine (before start: preheat oil)	< 30

Table 8

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Lubricating oil temperature at the outlet

The oil temperature at the outlet is mainly dependant on:

- Lubricating oil temperature and pressure at the oil inlet
- Engine load and turbocharger speed
- Exhaust gas temperature

The maximum admissible oil temperature at the outlet is listed in the following table. The specified oil outlet temperature is to be considered as alarm value for the turbocharger operation and must be monitored according to the current regulations.

Status for operation	Oil temperature at the inlet $T_{oil,inlet}$ [°C]	Oil temperature at the outlet $T_{oil,outlet}$ [°C]
Admissible	45	≤ 110
Admissible	85	≤ 130
Temporarily admissible → alarm	45	> 110
Temporarily admissible → alarm	85	> 130
Not admissible → stop engine	45	> 120
Not admissible → stop engine	85	> 140

Table 9

If the turbocharger was operated for a longer period of time outside of the admissible range, ABB Turbo Systems recommends to have the turbocharger inspected by an ABB Turbocharging Service Station.

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6.2 Turbocharger speed

6.2.1 Introduction

The speed of the turbocharger must be permanently monitored.

6.2.2 Layout and overview

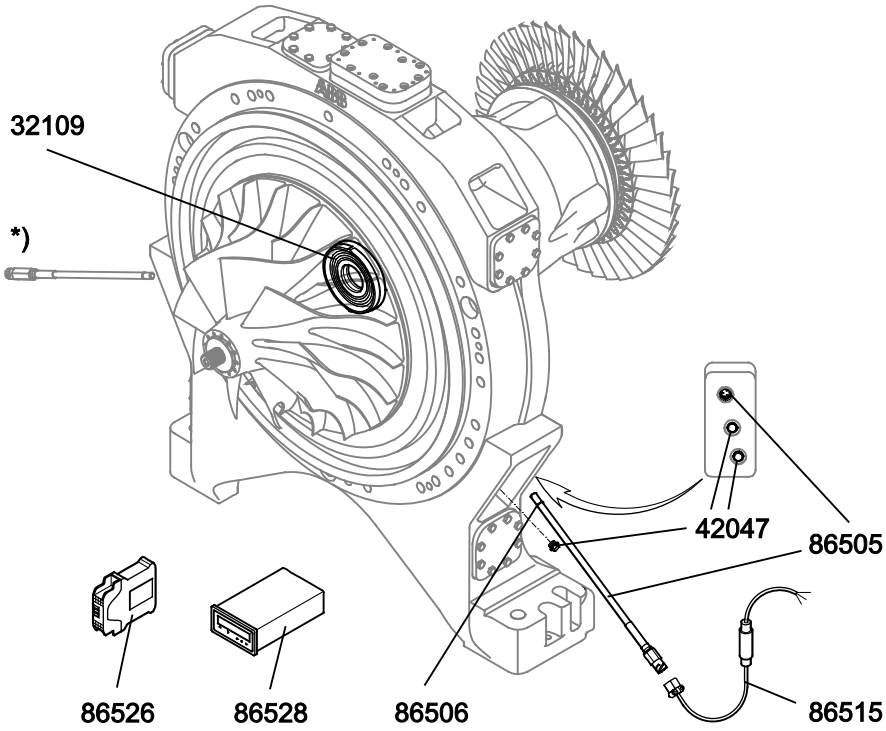

Figure 15

86505	Speed sensor	86528	Tachometer
86506	O-ring	42047	Screw plug
86515	Cable connector	32109	Sealing disc with cam
86526	F/I converter	*)	Installation variant for speed sensor or for second speed sensor

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6.2.3 Speed differences with several turbochargers per engine

The speeds of all turbochargers on an engine vary only slightly from each other in standard operation.

The difference between the highest and the lowest turbocharger speed must not be more than 3 %, relative to the speed limit n_{Bmax}.

If this admissible difference range is exceeded, the following steps must be performed:

- ▶ Reduce the engine performance immediately to the point at which the maximum turbocharger speed does not exceed 70 % of n_{Bmax}.
- ▶ If the engine cannot be stopped, it can continue to be driven with this reduced engine performance or turbocharger speed.
- ▶ If a turbocharger surges continuously, the engine performance must be reduced further.
- ▶ Measure the temperatures in the air lines and exhaust gas pipes from and to the turbochargers and compare with normal values.

If the engine can be stopped temporarily:

- ▶ Inspect air lines, exhaust gas pipes and the turbochargers and remedy any malfunctions.
- ▶ In any case, contacting the nearest ABB Turbocharging Service Station is recommended.

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6.2.4 Replacing the speed sensor

WARNING

Hot cable connector and hot speed sensor

Danger of burns. The cable connector and the speed sensor can reach temperatures of more than 100 °C during operation.

▶ When disassembling the cable connector and speed sensor, wear leather gloves.

▶ Reduce the engine performance to idling and then stop the engine. Observe post-lubrication (Stopping the engine [→ 57]).

▶ Switch off the lubricating oil supply to the turbocharger.

▶ Disconnect the cable connector from the speed sensor.

▶ Screw out defective speed sensor.

▶ Screw in new speed sensor to the stop.

▶ Observe tightening torque (Table of tightening torques [→ 110]).

NOTICE

Sealing of the speed sensor

The speed sensor is designed with a sealing lip and does not require a sealing disc for assembly.

▶ Connect cable connector (86515) with the speed sensor (86505)

▶ Switch on lubricating oil supply to the turbocharger.

6.2.5 Malfunction of the speed measurement system

The possible reasons for malfunction of the speed measuring system are described in chapter Troubleshooting.

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6.3 Low pressure measurement at the filter silencer

6.3.1 Introduction

The low pressure measurement with a U-tube manometer is used for the following purposes:

- During acceptance test of the engine: Measurement of the correction factor for the calculation of the turbocharger efficiency
- When using a filter mat: An increased pressure loss indicates an increase in the fouling of the filter material.

6.3.2 U-tube manometer at the filter silencer

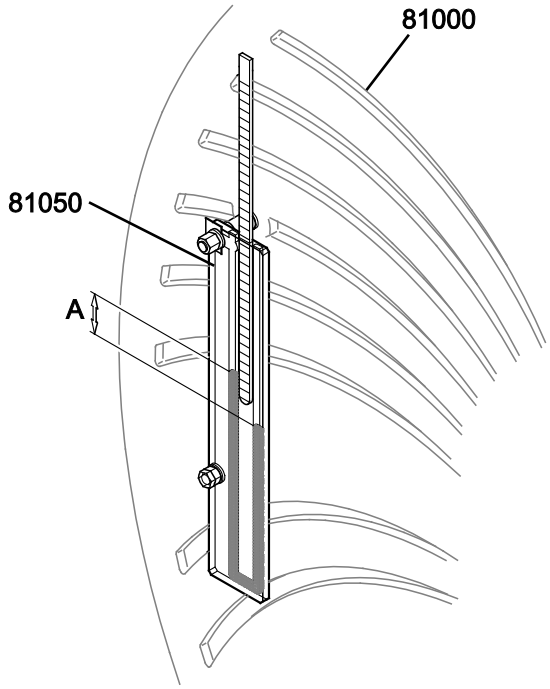

Figure 16

81000	Filter silencer
81050	U-tube manometer
A [mm H_2O]	Pressure loss / pressure difference

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With a clean filter silencer (and optional clean filter mat), the pressure loss (A) is 120 mm H_2O maximum at full load.

If the pressure loss (A) has reached the value of 200 mm H_2O:

▶ Clean filter mat.

NOTICE

Reading of pressure loss

For simple reading of the pressure loss (A), the dipstick at the U-tube manometer can be pulled out to the level of the lower water level.

Better readability of the U-tube manometer can be achieved by filling with slightly coloured water.

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7 Operation and service

7.1 Noise emission

WARNING

Danger due to noise

Exposure to noise can harm the hearing system. It can impair health and the psychological state and may lead to irritation and lack of attention.

- ▶ When the engine is running, always wear hearing protection.
- ▶ Always wear hearing protection if the noise level exceeds 85 dB(A).

The emission sound pressure level (A-weighted) is measured at a distance of 1 meter from the turbocharger.

The highest value of the emission sound pressure level[1)] is reached in the area of the filter silencer and is 105 dB(A) maximum over the entire speed range.

The following prerequisites must be fulfilled with regard to the turbocharger to observe this limit value:

- Air-inlet system has been fitted
- All standard, noise-reducing measures[2)] have been fitted
- Bellows at the air-outlet has been properly acoustically insulated by the enginebuilder (see Figure 17).

The enginebuilder is also responsible for insulating the charge air/scavenging air ducts and the charge air cooler.

1) Directive 2006/42/EC, 1.7.4.2 / u / Paragraphs 5 + 7:
A-weighted emission sound pressure level

2) The enginebuilder must provide acoustically equivalent measures in case of deviating insulation versions

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Suggestion for noise insulation, bellows

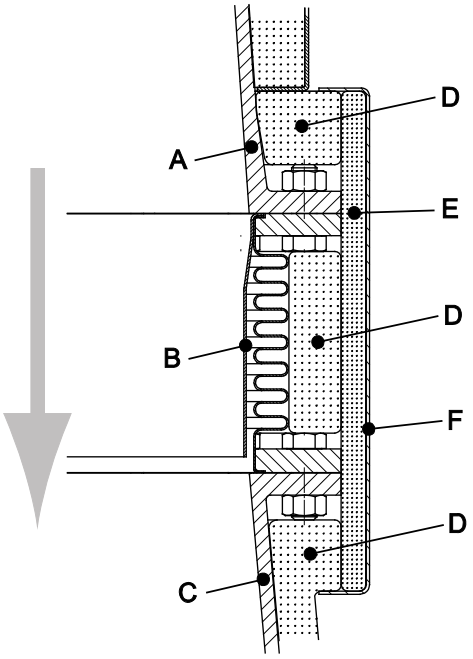

Figure 17

A	Compressor casing	D	Insulating cushion
B	Bellows	E	Insulation mat (at least 15 mm)
C	Charge air duct / scavenging air duct	F	Sheet metal cover

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7.2 Service work

Service work includes visual controls, monitoring, measuring and inspection as well as function checks. Service work enables to detect and rectify changes to the turbocharger and ensures full operability of the turbocharger.

CAUTION

Service intervals

Service work on the turbocharger that is omitted or performed too late can cause excessive contamination and wear as well as operating failures.

▶ Carry out the service work at the specified time intervals.

7.2.1 Service procedures every 25 … 50 hours

▶ Visual control for air, exhaust gas, water, and oil leaks

▶ Recording of operating data as well as entries in the engine logbook

▶ In case of deviations, determine the cause.

CAUTION

Unknown operational changes

Impairment to the degree of a possible operating failure can be the consequence.

▶ Unknown causes must be clarified by an ABB Turbocharging Service Station.

7.2.2 Service work at 100 hours after commissioning

▶ Clean or replace the oil filter located in the supply pipe to the turbocharger while the engine is stopped.

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7.2.3 Service work on turbocharger every 18000 hours

It is recommended to have service work and checks carried out by an ABB Turbocharging Service Station.

- ▶ Remove filter silencer.
- ▶ Clean filter silencer and check for damage.
- ▶ Dismantle wall insert.
- ▶ Check axial clearance A.
- ▶ Clean compressor wheel, diffuser, wall insert and compressor casing and check for damage.
- ▶ Using a borescope, visually inspect nozzle ring, cover ring and turbine blades) for possible contamination, damage and wear.
  As an option, this check can also be carried out after disassembling the gas inlet casing.
- ▶ Replace any damaged or worn parts with original parts from ABB Turbo Systems.
- ▶ Fit the wall insert.
- ▶ Install the filter silencer.

7.2.4 Service work on turbocharger every 36000 hours

The following work must be carried out by an ABB Turbocharging Service Station:

- Replacement of the bearing parts
- Checking and assessment of the rotor

- ▶ Remove filter silencer
- ▶ Clean filter silencer and check for damage
- ▶ Dismantle wall insert
- ▶ Check axial clearance A
- ▶ Clean wall insert, diffuser and compressor casing and check for damage
- ▶ Dismantle the gas inlet casing as well as the nozzle ring and cover ring
- ▶ Clean the nozzle ring and cover ring and check for damage
- ▶ Disassemble, check and assess the rotor
- ▶ Replace the plain bearings with original parts from ABB Turbo Systems

Fit the turbocharger.

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CAUTION

Service work after 5 years the latest

After 5 years, engine damage can occur even though the specified operating hours may not have been reached yet.

▶ Carry out service work after 5 years the latest.

CAUTION

Shortened service intervals

Exceptional stresses (such as several starts/stops per day), harsh environmental conditions or high system vibrations can lead to untimely engine damage even if the prescribed service intervals were observed.

▶ Agree on a shortened service interval with ABB Turbo Systems.

7.2.5 Service work according to instructions of enginebuilder

▶ Clean or replace the oil filter located in the supply pipe to the turbocharger while the engine is stopped.

7.2.6 Entries in the engine logbook

The monitoring of the engine system enables conclusions to be drawn on the behaviour of the turbocharger.

The following operating data and measured values must be entered regularly into the engine logbook of the enginebuilder:

- Performance and speed of the engine
- Speed of the turbocharger
- Air intake temperature
- Exhaust gas temperature before and after the turbine
- Pressure of the charge air
- Pressure loss in the charge air cooler
- Lubricating oil pressure and lubricating oil temperature
- Pressure loss in the filter silencer
- Air temperature after the charge air cooler

If present:

- Air temperature after the compressor

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7.3 Expected replacement intervals

Rotating components

The recommended replacement intervals for compressor and turbine wheels are specified based on the safety concept for rotating parts (SIKO) and dependant on the operating conditions. These intervals are shown on the rating plate of the turbocharger.

Non-rotating components

Depending on the system-specific operating conditions, a differentiation must be made between the intervals to be expected for:

- replacing the bearing parts and
- replacing the non-rotating components exposed to hot gas.

A decisive role is played by various influencing parameters which, in extreme cases, can drastically shorten the replacement interval of these parts.

During the prescribed periodic service work, the individual parts are examined for wear and replaced if necessary.

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Expected replacement intervals [h]

Turbocharger part	Operation with HFO *)
Gas inlet casing	50000 … 100000
Gas outlet casing	50000 … 100000
Nozzle ring	35000 … 50000
Cover ring	25000 … 50000
Other casings	100000

Table 10

*) HFO = Heavy Fuel Oil

Recommended replacement intervals [h]

Rotor components	See rating plate data
Bearings	See rating plate data

Table 11

Information about replacement intervals

The specified values are guideline values and are not guaranteed.

Considerable deviations are possible, for instance, through inadequate service, frequent emergency shutdowns, as well as the use of low-quality fuel or lubricating oil.

7.4 Stopping the engine

▶ Observe the instructions regarding post-lubrication (Pre-lubrication and post-lubrication [→ 37])

▶ Stop the engine.

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7.5 Flexible cut-out

If the load is low, an engine which is charged by multiple turbochargers can be operated with one turbocharger switched off. The flexible switch-on or switch-off of a turbocharger is referred to as "flexible cut-out". In flexible systems, slide valves or flaps are installed before the gas inlet and after the air-outlet of the turbocharger.

The lubricating oil supply of the switched-off turbocharger must not be switched off due to the engine vibrations. To ensure that there are no oil or gas leaks on this turbocharger, it must be supplied with sealing air.

The turbocharger may only be switched on or off while the engine is stopped or in "dead slow" mode (auxiliary blowers are operating). If the switching results in surging of a turbocharger, further switching may only be performed with the engine stopped until the cause has been remedied.

CAUTION

Cut-out operation

If the gas inlet flap is opened during cut-out operation or the air-outlet flap is closed during normal operation, this causes very high turbocharger speeds. These can result in damage with serious consequences or even a total loss of the turbocharger.

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8 Periodic maintenance

8.1 Foreword to maintenance

Maintenance work includes regular visual controls and cleaning operations which are intended to ensure the trouble-free functioning of the turbocharger.
In this process, the exterior condition and the degree of contamination of the components on which maintenance work is to be performed are determined.

The maintenance points described include:

- Filter silencer
- Compressor
- Turbine and nozzle ring.

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8.2 Cleaning the filter silencer

Filter silencer with tension band

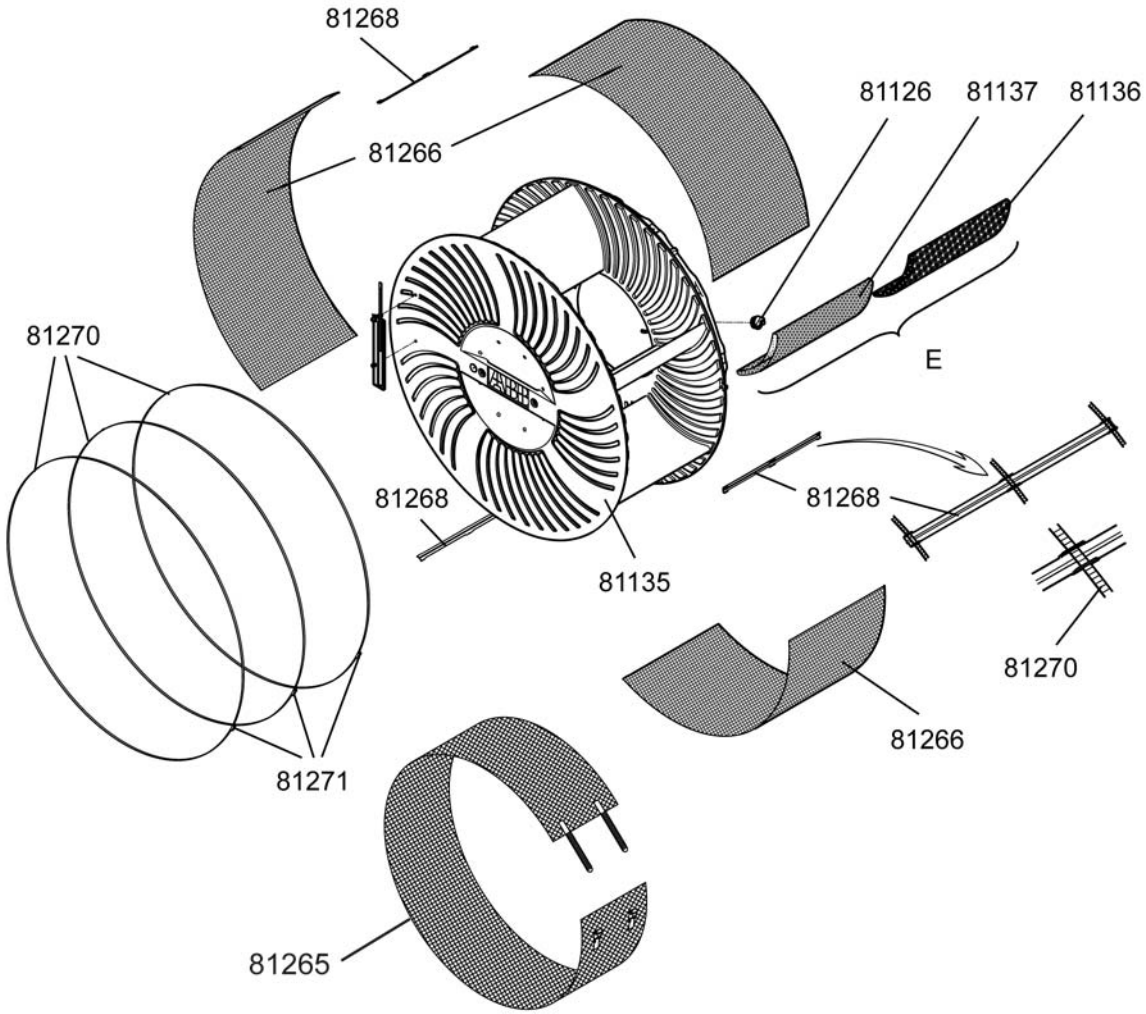

Figure 18

81126	Lock	81266	Cover grid
81135	Body of filter silencer	81268	Connecting strip
81136	Absorption segment	81270	Tension band
81137	Sheet-metal covering	81271	Lock
81265	Filter ring (if present)		
E	Insert unit (absorption segment / sheet-metal covering fitted)		

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NOTICE

Disassembly and assembly

The disassembly and assembly of the filter silencer is described in chapter "Disassembly and assembly".

Cleaning the filter ring (if present)

- ▶ Remove filter ring (81265).
- ▶ Clean filter ring (81265) as required or every 500 hours of operation and replace after the fifth cleaning process at the latest.
  Contamination of the filter ring depends on the degree of purity of the sucked-in air.
- ▶ Rinse the filter ring (81265) with water and mild detergent or, in the case of heavy contamination, soak and carefully push through. Rinse in cold water. Avoid high mechanical loads (water jet).
- ▶ Let the filter ring dry completely before assembling.

Cleaning the absorption segments

- ▶ Loosen the tension bands (81270) at the locks (81271) and remove them along with the cover grid (81266) and connecting strips (81268) (see Figure 18).
- ▶ Pull out insert units (E).
- ▶ Bend up the sheet-metal coverings (81137) and remove the absorption segments (81136).
- ▶ Clean the absorption segments (81136).
  When cleaning, note that the absorption segments may only be cleaned lightly with pressurized air, with a soft brush or a moist cleaning cloth. Otherwise there is a danger of damage or changing of the shape.
- ▶ Replace heavily contaminated absorption segments (81136) and any damaged connecting strips (81268) with original parts from ABB Turbo Systems.

Fitting the filter silencer

- ▶ Insert the absorption segments (81136) into the sheet-metal coverings (81137).
- ▶ Bend the sheet-metal coverings (81137) back into the original shape.
- ▶ Insert the insert units (E) into the slotted guides in the filter silencer body (81135).
- ▶ Fit the cover grid (81266) and connecting strips (81268) on the filter silencer body (81135).
- ▶ Guide the tension bands (81270) through the eyelets of the connecting strips (81268).
- ▶ Tighten the tension bands (81270) at the locks (81271).
- ▶ Any damaged tension bands must be replaced.
- ▶ Fit filter ring (81265), if present.

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8.3 Changing the filter strip on the filter silencer casing

This chapter applies only to turbochargers with filter silencer casing. The filter ring (81265) is replaced with the filter silencer installed.

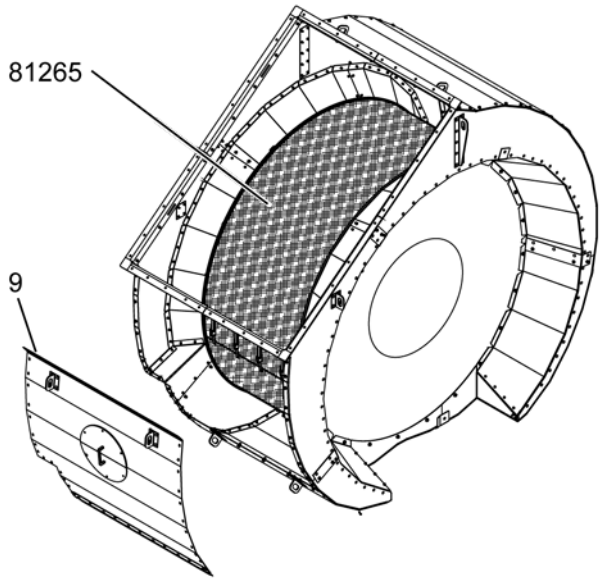

Figure 19

▶ Dismantle the circumferential part (9).

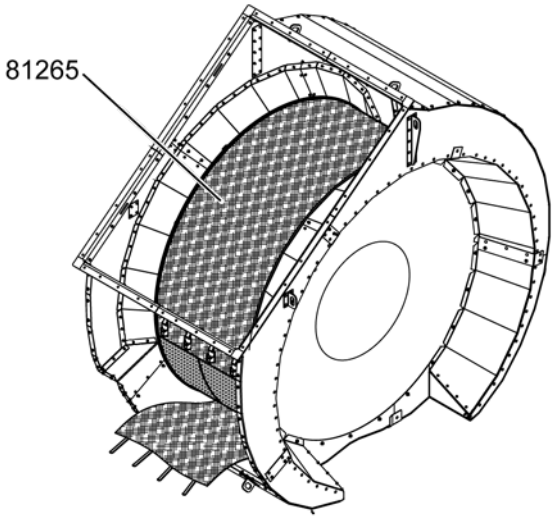

Figure 20

▶ Open the lock of the filter ring (81265).

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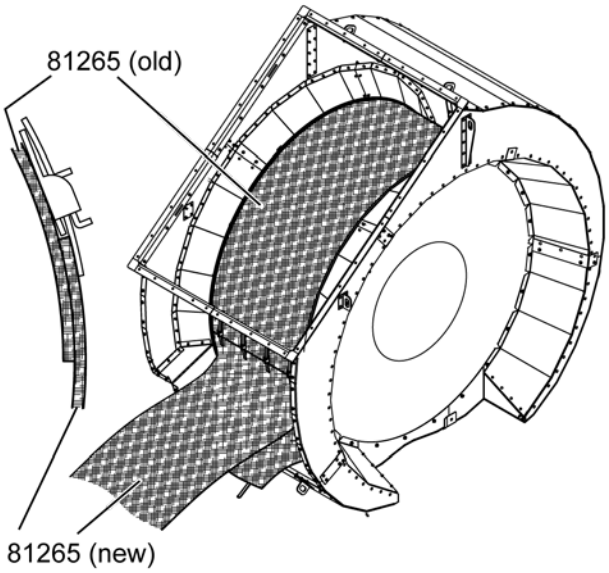

Figure 21

▶ Attach the new filter ring (81265) on the filter ring to be replaced so they overlap.

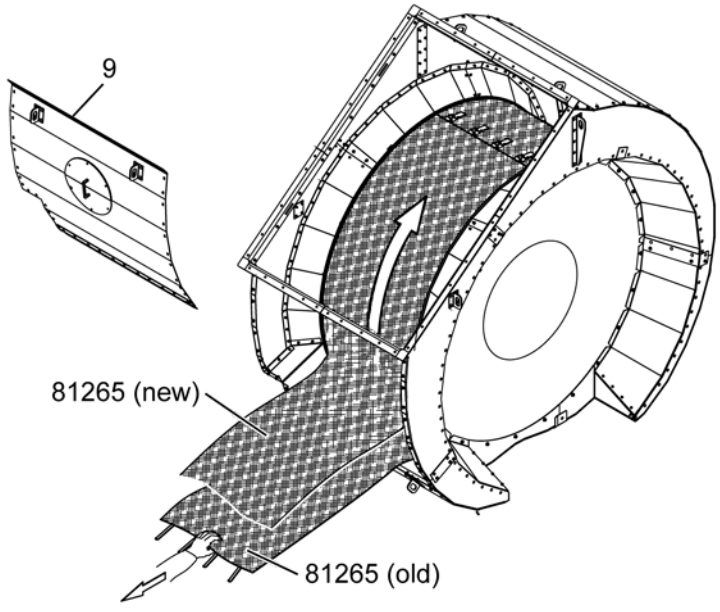

Figure 22

▶ Pull on the old filter ring until the new filter ring is completely wrapped around the filter silencer.

▶ Undo the connection between the new and the old filter ring.

▶ Fasten the newly installed filter ring (81265), then fit circumferential part (9).

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8.4 Cleaning the compressor during operation

8.4.1 Introduction

Approval by enginebuilder

These instructions for wet cleaning only apply to cleaning with pure water and under the precondition that the enginebuilder approves the process.

The contamination of the compressor stage (compressor wheel, wall insert and diffuser) depends on the degree of purity of the taken-in air.

Deposits can form in the flow channels if salt, oil mist or dust are sucked in with the air.

Consequences of contamination:

- Impaired compressor efficiency
- Higher exhaust gas temperatures
- Increased fuel consumption
- Increased rotor unbalance

Periodic cleaning of the compressor during operation prevents or delays any great increase in the contamination, but never replaces the regular service procedures where the turbocharger is completely dismantled and the compressor is mechanically cleaned.

Cleaning interval

The interval between the cleaning cycles depends greatly on the operating conditions. Cleaning should normally take place about every 50 hours of operation.
If the specified cleaning intervals are incompatible with operation of the engine, contact ABB Turbo Systems.

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Cleaning method and operating state

The compressor is cleaned during operation using the wet cleaning method. It is carried out at an engine load of 25 ... 85 %.
This cleaning method has been tested and approved by ABB Turbo Systems.

Principle of wet cleaning

To clean the compressor stage during operation, water is injected before the compressor wheel.

The water does not act as a solvent. The coating is removed by the mechanical action of the impacting droplets. The process is particularly suitable as long as the fouling is not too advanced.

CAUTION

Corrosion and deposits when cleaning

Salt water and cooling water treatment substances damage and adversely affect turbocharger parts.

▶ Never use salt water, but only pure water for cleaning.

Cleaning several turbochargers

If several turbochargers are installed on an engine, it is recommended to clean one compressor after the other.

CAUTION

Volume of water for cleaning the compressor

Uncontrolled volumes of water can cause great damage in the turbocharger and especially in the engine.

▶ Do not guide water pipes to the filler openings.

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8.4.2 Wet cleaning of compressor

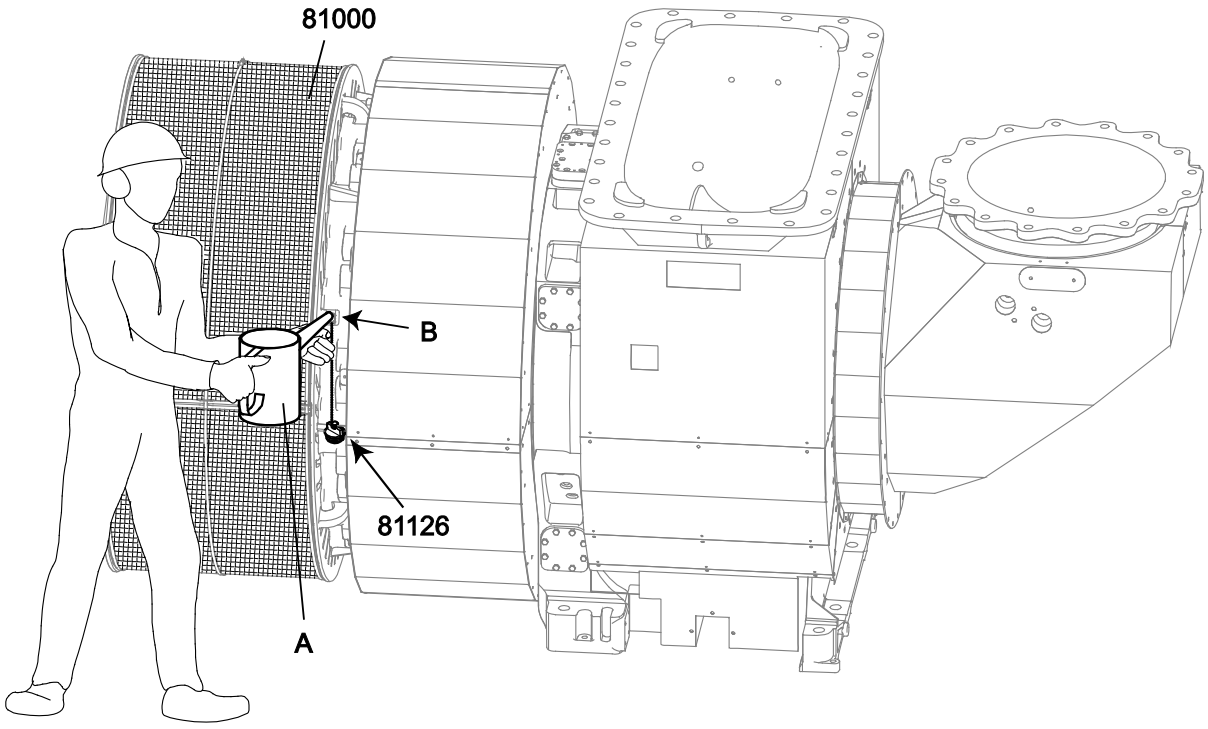

Figure 23

81000	Filter silencer
81126	Lock
A	Can
B	Filler opening

Wet cleaning of compressor

- ▶ Remove insulation at the flange of the filter silencer (81000) (if present)
- ▶ Unscrew lock (81126)
- ▶ Measure volume of water according to the following table
- ▶ Fill this water into a clean can (A)
- ▶ Carefully pour this water into the filling orifice (B) with the can
- ▶ Screw in lock and hand-tighten
- ▶ Fit insulation on the flange of the filter silencer (if present)
- ▶ After cleaning, allow the engine to continue to run for at least 5 minutes under normal load.

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Repeating the cleaning

If the cleaning is still unsuccessful after three processes, it is recommended to have the turbocharger checked and cleaned by an ABB Turbocharging Service Station if the engine values are unsatisfactory.

Volume of water per cleaning process

Product	A165-L	A170-L	A175-L	A180-L	A185-L	A190-L
Quantity [dm^3]	2.0	2.0	3.0	3.0	3.0	3.0

Table 12

The filling time is 4 ... 15 seconds.

Checking the filter plug

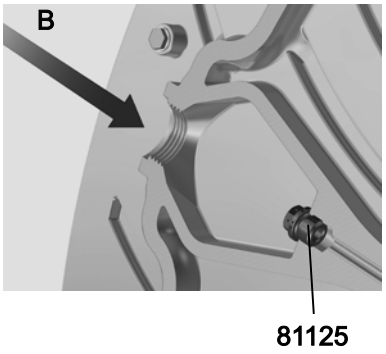

Figure 24

Disassembly and checking of the filter plug (81125) is required if 20 seconds after the cleaning process water is still visible in filler opening B.

- ▶ Loosen and remove the filter plug (81125) with box spanner
- ▶ Clean the drill holes of the plug
- ▶ Fit filter plug (81125) (Table of tightening torques [→ 110]).

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8.5 Cleaning the turbine during operation

8.5.1 Introduction

Combustion of heavy fuel oil in diesel engines causes contamination of the turbine blades and nozzle rings of the turbochargers.
Contamination increases with time, which is why regular and properly carried out cleaning operations are important to remove any deposits.

Contaminated turbine components lead to a decrease in turbocharger efficiency. Furthermore, the exhaust gas temperature after the cylinders can rise and the charging pressure in the air receiver can drop.
Moreover, contamination of the turbine leads to rotor unbalance. A very high level of contamination can lead to intolerably high rotor unbalance.

Despite periodic cleaning during operation, experience shows that overhauls where the turbine and nozzle ring (or VTG) are mechanically cleaned cannot be omitted.

Interval for dry cleaning

The interval between the cleaning cycles depends greatly on the operating conditions. Cleaning should normally take place about every 50 hours of operation.

Cleaning method

The turbine and the nozzle ring (or VTG) are cleaned during operation using the dry cleaning method.
This cleaning method has been tested and approved by ABB Turbo Systems.

Principle of dry cleaning

During dry cleaning, the dirt coating is removed by the mechanical action of the impacting solids (granulate).

Operating state

The dry cleaning of the turbine-end components is carried out at an engine load of 25 ... 85 %.

Cleaning several turbochargers

If several turbochargers are installed on an engine, it is recommended to clean one turbine after the other.

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8.5.2 Procedure for dry cleaning the turbine

Dry cleaning device

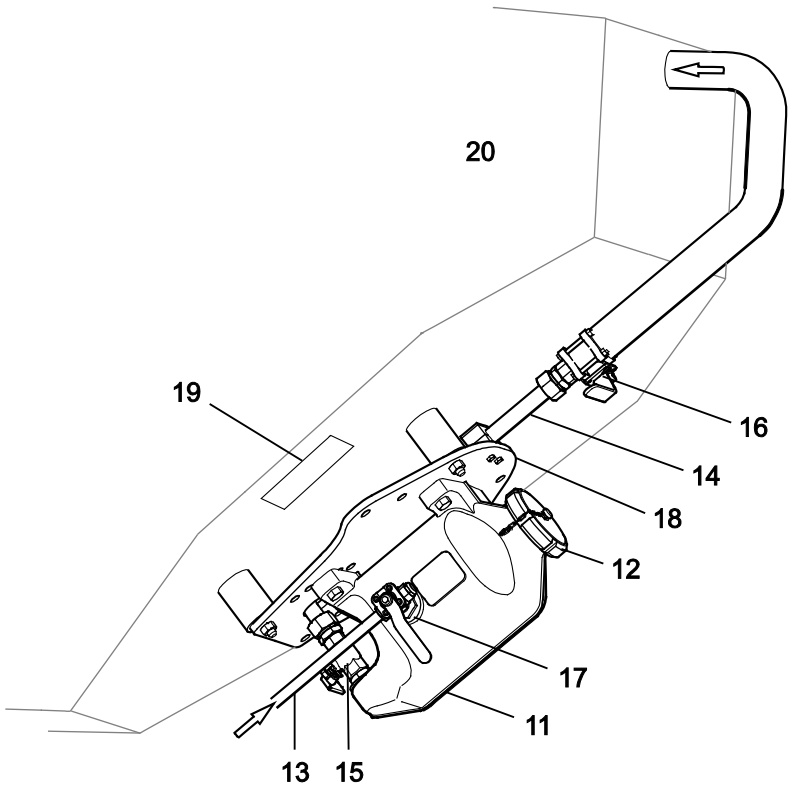

Figure 25

11	Container for granulate material (51702)	16	Protection valve [closed] (51713)
12	Cover cap (51703)	17	Pressurised air valve [venting] (51704)
13	Pressurised air supply [4 ... 10 bar]	18	Plate
14	Piping	19	Cleaning instruction (51717)
15	On-Off valve [closed] (51705)	20	Gas inlet casing, insulated

CAUTION

Protecting the pressurised air system

▶ Protect the pressurised air system against overpressure (> 10 bar).

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Operating the dry cleaning device

CAUTION

Escape of burnt granulate particles

Incompletely burnt granulate and soot particles can escape as a result of careless handling.

▶ Close the discharge openings in the gas inlet and gas outlet casings.

- ▶ Make sure that the conditions with regard to the operating state and the maximum exhaust gas temperature before the turbine are observed.
- ▶ Check that the protection valve (16) is closed (see Figure 25).
- ▶ Check that the On-Off valve (15) is closed.
- ▶ Check that the combined pressurised air valve/pressure release valve (17) is in the venting position.
- ▶ Loosen and carefully remove the cover cap (12).
- ▶ Fill the specified amount of granulate into the container (11).
- ▶ Screw on and tighten the cover cap (12).
- ▶ Open the pressurised air valve (17).
- ▶ Open the protection valve (16).
- ▶ Open the On-Off valve (15) for cleaning the turbine for 3 ... 4 minutes.
- ▶ Close the On-Off valve (15).
- ▶ Close the protection valve (16).
- ▶ Set the combined pressurised air valve/pressure release valve (17) to venting.
- ▶ Check that the exhaust gas temperature after the turbine is less than before the cleaning.

Repeating the cleaning

If the cleaning is still unsuccessful after three processes, it is recommended to have the turbocharger checked and cleaned by an ABB Turbocharging Service Station if the engine values are unsatisfactory.

Optimum cleaning effect

It is important that the specified amount of granulate is blown in for each cleaning process in order to achieve an optimum cleaning effect.

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8.5.3 Cleaning parameters for dry cleaning

Material selection

The following materials are suitable for dry cleaning:

- Hard, granulated materials (such as natural core granulates)
- Softblast media
- Activated carbon particles

The average grain size of the cleaning granulate must be between 1.2 and 2.0 mm.

The specific weight of the cleaning granulate must not exceed 1.2 kg/dm³.

Amount of granulate per turbocharger

Product	A165-L	A170-L	A175-L	A180-L	A185-L	A190-L
Quantity [dm³]	1.0	1.5	2.0	2.5	3.0	3.5

Table 13

NOTICE

Storage of dry cleaning materials

The cleaning material must be stored in a dry and clean location to prevent blockage of the pipes when cleaning.

Possible suppliers are listed in section Suppliers of dry cleaning materials.

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8.6 Suppliers of dry cleaning materials

Manufacturer	Country	Address	Contact numbers
ABB Australia Pty. Limited	Australia	Dock 7W Bapaume Road 2170 Moorebank- N.S.W.	Tel.: +61 2 9821 0940 Fax: +61 2 9821 0941 Email: turbo@au.abb.com
Paul AUER GmbH	Germany	Bad Kreuznacherstr. 18 D-68309 Mannheim-Kaefertal	Tel.: +49 621 72 769 - 0 Fax: +49 621 72 769 - 88 Email: vertrieb@auer-strahltechnik.de
BRIGANTINE Service Ltd.	Hong Kong	48 Wang Lok Street Yuen Long Industrial Estate N.T. Hong Kong	Tel.: +852 2473 7933 Fax: +852 2237 4731 Email: gcabrgpropur@brigantinegroup.com
LEERING HEN-GELO B.V.	Nether-lands	Barnsteenstraat 1 NL-7554 TC Hengelo The Netherlands	Tel.: +31 74 255 82 82 Fax: +31 74 242 23 73 Email: info@leering.nl
GUYSON International Ltd	United Kingdom	Snaygill Industrial Estate Keighley Road, Skipton, North Yorkshire BD23 2QR United Kingdom	Tel.: +44 1756 799911 Fax: +44 1756 790213 Email: info@guyson.co.uk
DASIC International Ltd.	United Kingdom	Winchester Hill, Romsey, Hampshire SO51 7YD United Kingdom	Tel.: +44 1794 512 419 Fax: +44 1794 522 346 Email: info@dasicinter.com
PAN Abrasives (Pte) Ltd.	Singapore	24 Pioneer Sector 2 Jurong 628381 Singapore	Tel.: +65 6861 6988 Fax: +65 6861 0919 Email: pagroup@pan-abrasives.com
CARLANDER & Co.	Sweden	Valtersang 9 S-442 49 Kungalv Sweden	Tel.: +46 303 630 75 Fax: +46 303 630 77 Email: lars@carlander.com
BOSUNG Engine-ering Co., Ltd.	Korea	1189-1, Choryang-3 Dong, Dong-Ku, Busan, 601-013	Tel.: +82 51 466 0881-5 Fax: +82 51 466 0886-9 Email: master@bosung.com
POLITEK Ltd.	Turkey	Barajyolu Cad. No: 22/6 Y. Camlica Mahallesi Yukari Dudullu 34779 Umraniye Istanbul / Turkey	Tel.: +90 216 455 77 66 Fax: +90 216 455 77 25 Email: politekltd@politekltd.com
UNISERVICE S.A.	Italy	Via Al Santuario di N.S. della Guardia 58 / A 16162 Genova	Tel.: +39 010 711 395 Fax: +39 010 713 120 Email: info@uniservicemarine.com

Table 14

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8.7 Draining the gas outlet casing

If there is a boiler leak into the exhaust gas pipe or an ingress of water due to other causes, the gas outlet casing can be drained.

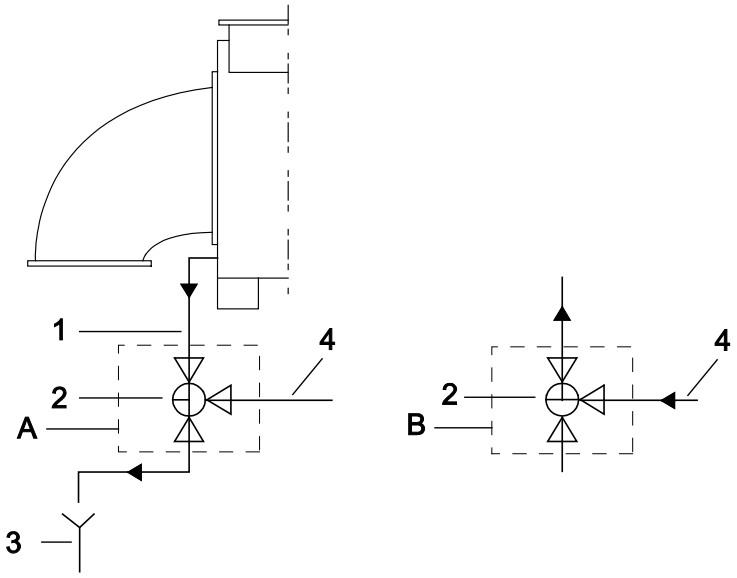

Figure 26

1 Drain pipe
2 Drain cock
A Position 1
3 Drain
4 Air line from compressor casing
B Position 2

▶ On the drain pipe (1), set the drain cock (2) to position 1 (A).

If the drain pipe (1) is blocked:

▶ Set the drain cock (2) to position 2 (B) and clean the drain pipe (1) with air from the compressor casing (4).

If cleaning with air is not sufficient, the drain pipe (1) must be cleaned mechanically.

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9 Troubleshooting

9.1 Malfunctions when starting

Delayed start-up

Possible causes		Remedy
Turbocharger	Turbocharger contaminated	Clean (Periodic maintenance [→ 59])
	Bearing damaged	Contact ABB Turbocharging Service Station
	Rotor rubbing	
	Foreign object in the turbocharger	

Table 15

Vibrations

Possible causes		Remedy
Engine	Vibrations from engine	Contact enginebuilder
Turbocharger	Rotor unbalance	Contact ABB Turbocharging Service Station
	Turbine or compressor damaged	
	Bearing damaged	

Table 16

Rubbing of rotating parts

Normal behaviour, not a malfunction	
Turbocharger	A minimal and uniform wear at the circumference of the rotor components caused by slight local rubbing against adjacent components is permitted. This causes the compressor or turbine blades to be somewhat shortened. To prevent significant loss of efficiency, specific tolerances must be fulfilled. ■ If there is any doubt about the extent of the rubbing, contact an ABB Turbocharging Service Station. ■ Have a dimension check carried out by an ABB Turbocharging Service Station.

Table 17

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9.2 Malfunctions during operation

Lubricating oil pressure too low

Possible causes		Remedy
Engine	Oil filter heavily contaminated	Clean
	Oil pump in lubricating system defective	Check/replace
	Manometer displays incorrectly	Replace manometer
Turbocharger	Axial clearance of the rotor excessive	Contact ABB Turbocharging Service Station

Table 18

Drop in speed

Possible causes		Remedy
Turbocharger	Heavy contamination of the turbine	Clean
	Damaged rotor components or bearing	Contact ABB Turbocharging Service Station
Pipes	Defects, such as leaks, in the exhaust gas pipes or charge air ducts	Repair

Table 19

Exhaust gas temperature too high

Engine performance and engine speed unchanged

Possible causes		Remedy
Engine	Malfunction in the injection system	Repair or contact manufacturer
Turbocharger	Insufficient air, for example, when filter silencer is blocked by dirt	Clean (Periodic maintenance [→ 59])
	Compressor/turbine contaminated	
	Exhaust gas back pressure too high	Clean or repair boiler or exhaust gas silencer
	Turbine damaged or eroded	Contact ABB Turbocharging Service Station
Charge air cooler	Cooler contaminated	Clean
	Cooling water volume too low	Fill
	Inlet temperature of cooling water too high	Check/clean cooling system
	Insufficient ventilation	Improve ventilation

Table 20

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Charge air pressure too low

Engine performance and engine speed unchanged, suction condition normal

Possible causes		Remedy
Engine	Air receiver not sealed	Repair
	Gas pipe between engine and turbine not sealed	
	Injection mistimed	Set correctly
	Valve controller misadjusted	
Turbocharger	Manometer display not correct	Replace manometer
	Supply pipe to manometer not sealed	Repair leak
	Filter silencer contaminated, therefore pressure drop too high	Clean (Periodic maintenance [→ 59])
	Compressor end and/or turbine end contaminated	
	Compressor/turbine damaged	Contact ABB Turbocharging Service Station
	Exhaust gas back pressure too high	Clean or repair boiler or exhaust gas silencer

Table 21

Charge air pressure too high

Engine performance and engine speed unchanged, suction condition normal

Possible causes		Remedy
Engine	Malfunction in the injection system	Repair or contact manufacturer
	Injection mistimed	Set correctly
	Engine performance higher than indicated	Check engine performance
Turbocharger	Manometer display not correct	Replace manometer

Table 22

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9.3 Surging of the turbocharger

Surging of the turbocharger

Possible causes		Remedy
Engine	Protective grating in front of the turbocharger contaminated or damaged	Clean/replace
Turbocharger	Filter silencer or diffuser contaminated	Clean (Periodic maintenance [→ 59])
	Heavy dirt deposits in the turbine or in the nozzle ring	
Charge air cooler	Cooler contaminated	Clean
	Charge air duct blocked	

Table 23

CAUTION

Continuous or periodic surging

Possible damage to components such as compressor wheel, turbine blades, bearing and filter silencer.

- ▶ Have the cause clarified and remedied immediately by an ABB Turbocharging Service Station.
- ▶ Have parts assessed for damage and, if necessary, replaced by an ABB Turbocharging Service Station.

Sporadic surge blows

Surging of the turbocharger can occur during certain operating states, such as when reducing the engine load quickly when manoeuvring. When this happens, the flow direction in the compressor is momentarily reversed. Such sporadic surge blows do not impair the safe operation of the turbocharger.

- A surge blow is accompanied by a loud bang and escape of hot air from the filter silencer.

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9.4 Malfunctions when stopping

Runout noises

Possible causes		Remedy
Turbocharger	Turbocharger contaminated	Clean
	Bearing damaged	Contact ABB Turbocharging Service Station
	Rotor rubbing	
	Foreign object in the turbocharger	

Table 24

Runout time too short

Possible causes		Remedy
Turbocharger	Turbocharger contaminated	Clean
	Bearing damaged	Contact ABB Turbocharging Service Station
	Rotor rubbing	
	Foreign object in the turbocharger	

Table 25

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9.5 Speed measurement system

Possible causes		Remedy
No signal or poor signal amplitude present	Assembly fault	The locking screw for the sensor is fitted with a gasket. This gasket must be removed when the speed sensor is assembled. If the gasket has been inadvertently fitted, the distance of the sensor tip to the sealing disc giving the signal is increased. This reduces the voltage amplitude of the speed signal which can lead to problems with the evaluation electronics. This problem will be remedied by removing the gasket.
	Sensor defective	Contact ABB Turbocharging Service Station
Measured speed too high	Contamination of the sensor tip	As the sensor tip is magnetic, it can attract material particles. This reduces the distance to the auxiliary bearing which can lead to amplification of the noise component and, hence, to false triggering. Disassemble the sensor, clean the sensor tip, and fit the sensor back on with the specified tightening torque.
Measured speed too low	- -	Contact ABB Turbocharging Service Station
Other causes of malfunction	- -	If none of the measures described above remedy the malfunction, it is recommended to have the speed measurement system checked by an ABB Turbocharging Service Station.

Table 26

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10 Disassembly and assembly

10.1 Introduction

CAUTION

Further operations

This Operation Manual may be used to carry out only those operations that are described in it. If the cartridge group is disassembled or assembled incorrectly, this can lead to serious engine damage.

▶ ABB Turbo Systems recommends having further operations carried out only by trained staff or an ABB Turbocharging Service Station.

NOTICE

Marking casing position for assembly

ABB Turbo Systems recommends marking the casing positions prior to disassembly.

Identification of the assembly devices

Not all assembly devices are marked with a part number. Identification is guaranteed by the tool list. This list is enclosed in the toolbox.

WARNING

Servicing the assembly devices

Assembly devices must be checked for damage before and after use.

▶ Visually inspect for corrosion, cracks, deformation and wear.
▶ Damaged assembly devices must no longer be used and must be replaced.

Customer spare part set

Before starting operations, make sure the required customer spare part sets are available.

▶ See chapter Spare parts [→ 123].

Tightening torques for components of the turbocharger

The specified tightening torques of the screw fittings must be observed (Table of tightening torques [→ 110]).

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Tightening torques for assembly devices from ABB Turbo Systems

Unless described otherwise, the screws and nuts of the assembly devices must be tightened so they rest firmly against the surface.

Definition of terms

- **Suspension point**
  Defined loading point on a component or an assembly (blind hole thread, eyelet, lug).

- **Assembly device**
  Devices that are fitted on the turbocharger in order to obtain a suspension point. Assembly devices are specially constructed and designed for the defined use; they are not trading goods. Use assembly devices only for the described applications.

- **Lifting gear**
  Equipment for the lifting and transporting of loads (ropes, chain block, crane). Lifting gear is not supplied by ABB Turbo Systems.

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10.2 Weights of assemblies

The specified weights of the individual parts or assemblies are rounded-up standard values.

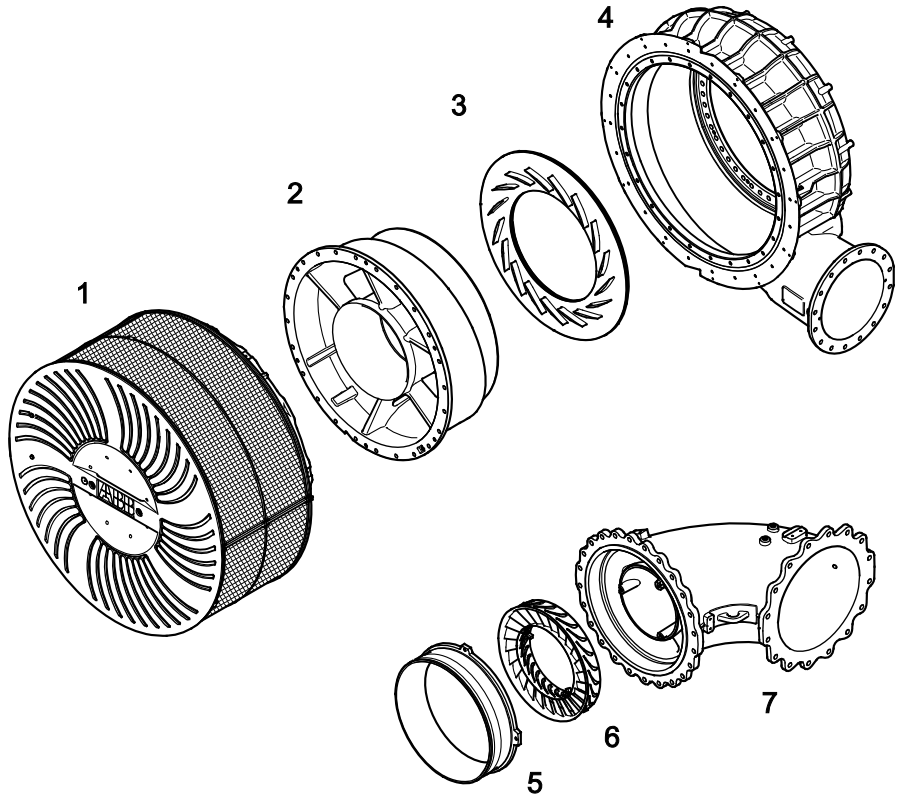

Figure 27

Weights of assemblies [kg]

Item	Assembly	A165-L	A170-L	A175-L	A180-L	A185-L	A190-L
1	Filter silencer	220	280	480	620	850	1050
2	Wall insert	240	340	560	820	1090	1500
3	Diffuser	40	60	100	140	200	270
4	Compressor casing	320	450	740	960	1360	1800
5	Cover ring	30	50	75	90	110	150
6	Nozzle ring	10	20	25	50	65	85
7	Gas inlet casing	180	240	380	520	700	810

Table 27

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Weight of complete wall insert [kg]

The total weight of the complete wall insert is made up of the wall insert and diffuser assemblies.

A165-L	A170-L	A175-L	A180-L	A185-L	A190-L
280	400	660	960	1290	1770

Table 28

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10.3 Disassembly and assembly of the filter silencer casing

NOTICE

Disassembly / Assembly of the filter silencer casing

This chapter applies only to turbochargers with filter silencer casing.
Only the assembly of the filter silencer casing is described in detail.
The disassembly must be carried out in **reverse order** of the assembly.

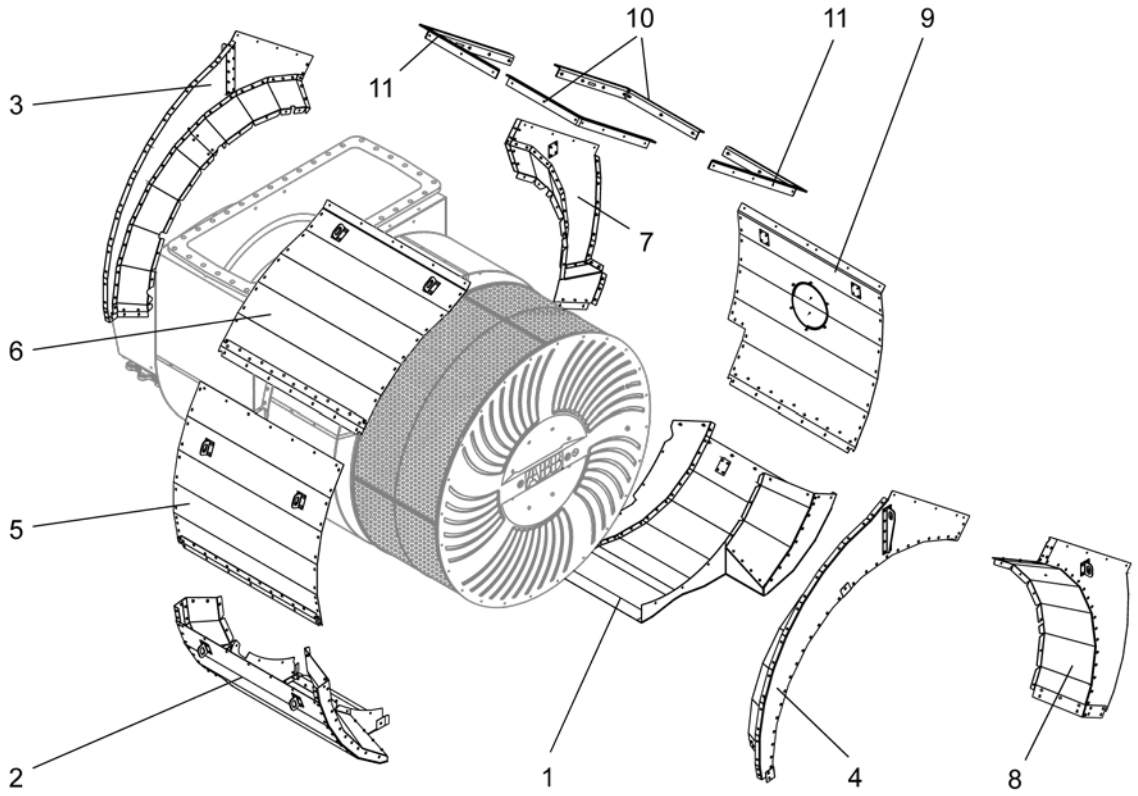

Figure 28

1, 2	Bottom part
3, 4, 7, 8	Side part
5, 6, 9	Circumferential part
10, 11	Flange

The complete filter silencer casing has the part number 81500.

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Assembly

NOTICE

Screws on the filter silencer casing

All screws are not tightened until **at the end of the assembly** of the filter silencer casing. Only this way is it possible to fit all the parts.

▶ Do not tighten the screws during assembly.

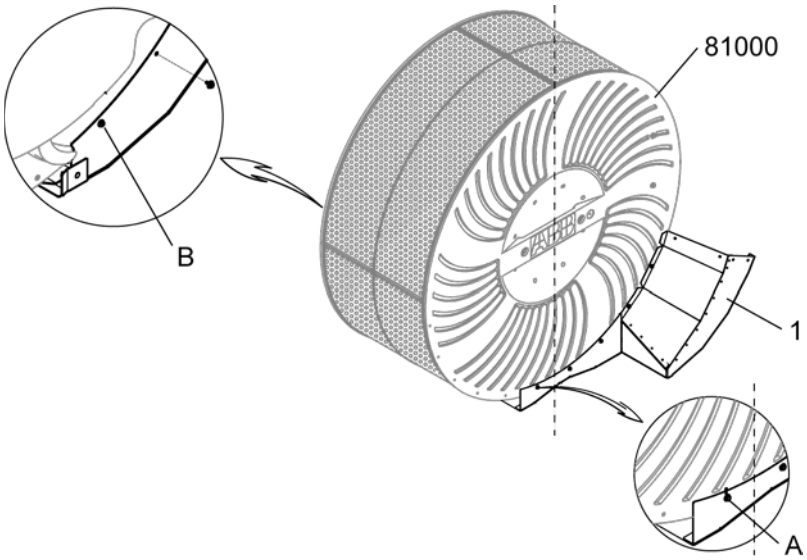

Figure 29

▶ Fit the bottom part (1) with the screws (A) and (B) on the filter silencer (81000).

NOTICE

Screw (A)

The location of screw (A) serves as a reference for the correct assembly of the filter silencer casing.

▶ Before disassembling the bottom part (1), mark the location of screw (A).

▶ Fit all remaining screws on the bottom part (1).

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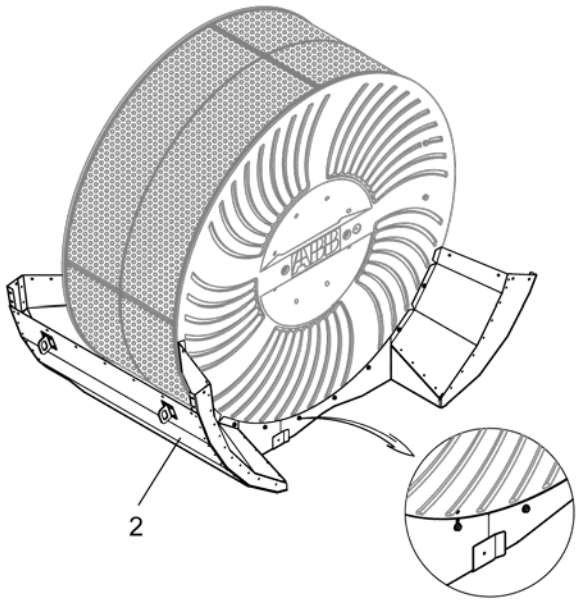

Figure 30

▶ Fit the bottom part (2) with the screws on the filter silencer.

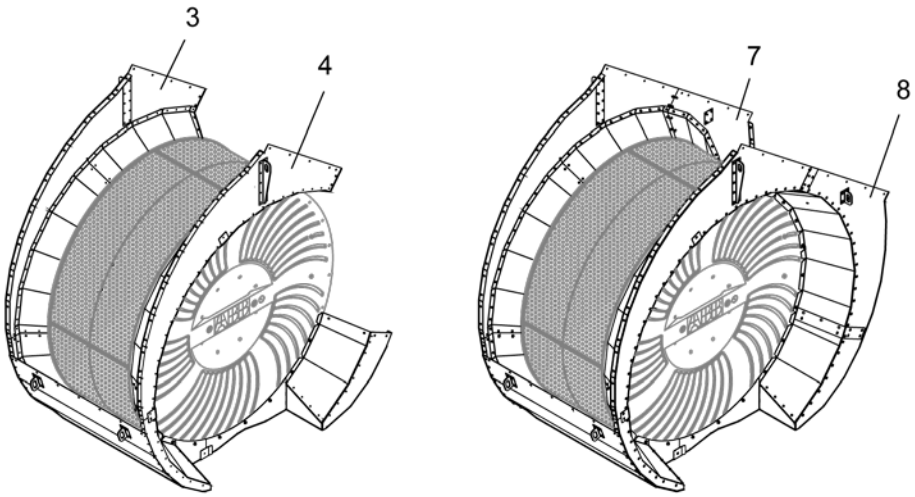

Figure 31

▶ Fit the side parts (3) and (4) with the screws on the filter silencer and on the bottom part.

▶ Fit the side parts (7) and (8) with the screws on the filter silencer, on the bottom part, and on the side parts (3, 4).

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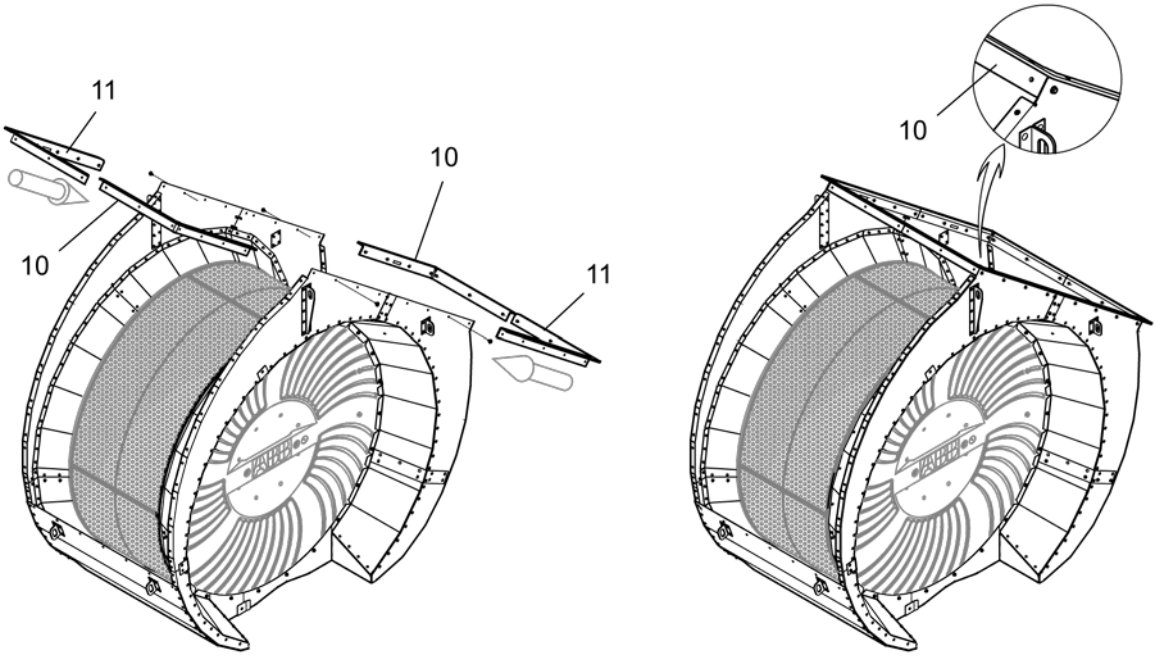

Figure 32

▶ Insert the flanges (10) and (11) laterally **between** the side parts and fit the screws.

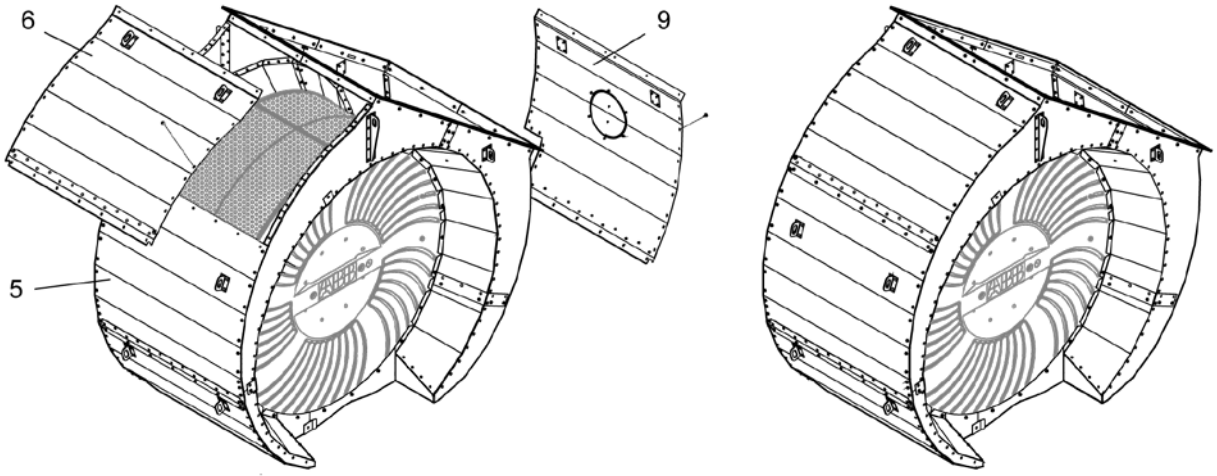

Figure 33

▶ Fit the circumferential part (5) with the screws.
▶ Fit the circumferential part (6) with the screws.
▶ Fit the circumferential part (9) with the screws.

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Tightening torques [Nm]

Screws for fastening the individual parts on the filter silencer	Screws for fastening the individual parts
M10 30	M8 25

Table 29

▶ Tighten all screws of the bottom parts (1) and (2).
▶ Tighten all screws of the side parts (3, 4, 7, 8) and the flanges (10, 11).
▶ Tighten all screws of the circumferential parts (5, 6, 9).

Bellows

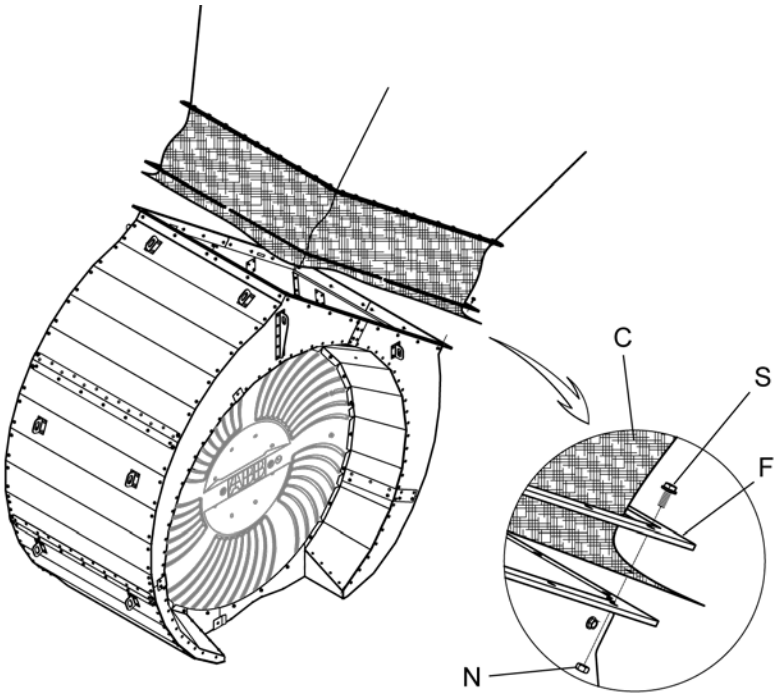

Figure 34

▶ Fit bellows (C) with frame (F), screws (S) and nuts (N) on the filter silencer casing.

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10.4 Dismantling and fitting the filter silencer

▶ Dismantle the insulation if necessary.

Dismantling the filter silencer

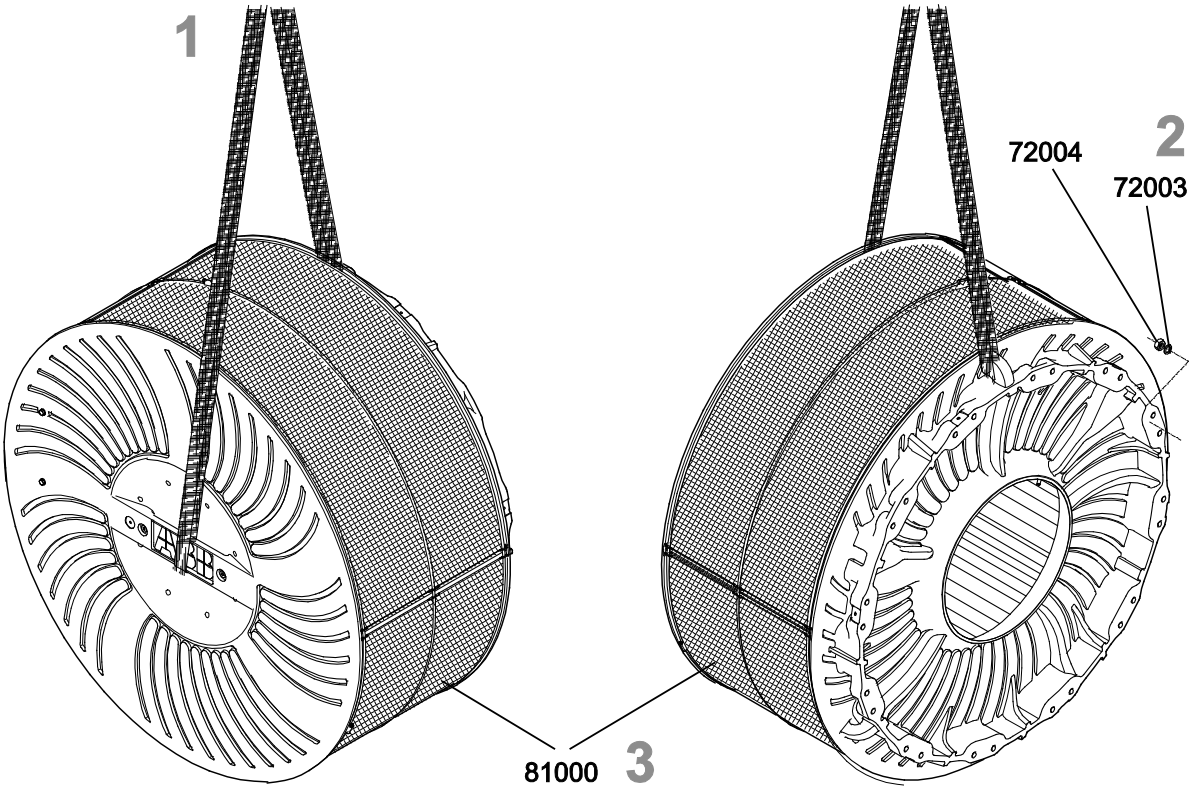

Figure 35

1. Attach the lifting gear to the front lug and rear eyelet of the filter silencer (81000).
2. Loosen nuts (72004) and remove with washers (72003).
3. Remove and put down filter silencer (81000).

Fitting the filter silencer

The fitting of the filter silencer (81000) is carried out in reverse order.

▶ Fit the nuts (72004) with the corresponding tightening torque (Table of tightening torques [→ 110]).

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10.5 Dismantling wall insert and diffuser

Dismantling the wall insert

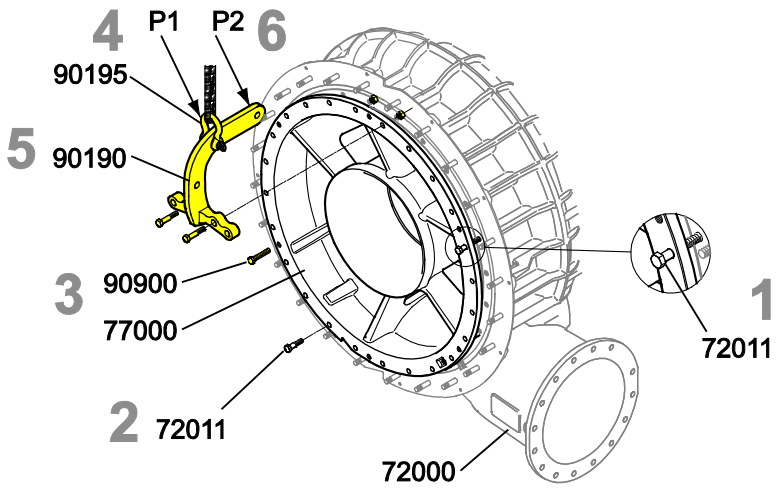

Figure 36

1. Loosen one screw (72011) and leave 2/3 of the thread length screwed into the compressor casing (72000).
2. Loosen and remove the remaining screws (72011).
3. Use the press-off screws (90900) to press off the wall insert (77000) from the compressor casing (72000) until the lifting device (90190) can be fitted.
4. Fit shackle (90195) with lifting gear on P1 of lifting device (90190).
5. Fit lifting device (90190) with crane on upper area of wall insert (77000).
6. Change the position of the shackle (90195) with the lifting gear to P2 of the lifting device (90190).

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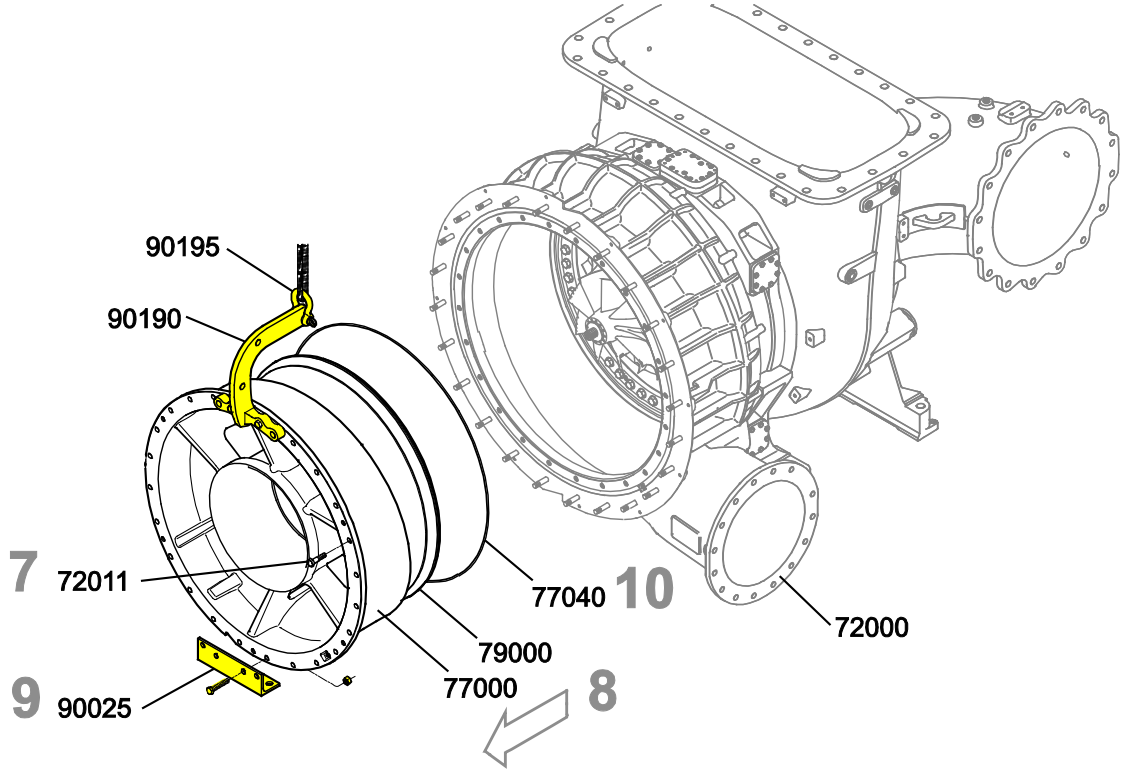

Figure 37

7. Remove screw (72011).
8. Carefully move out the wall insert (77000) with diffuser (79000).
9. Fit support angle (90025).
10. Remove O-ring (77040).

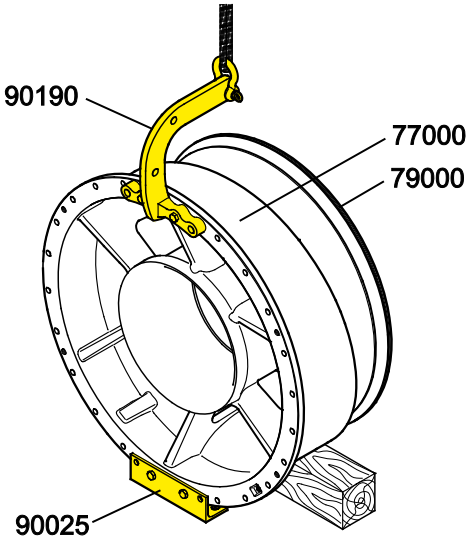

Figure 38

▶ Put the wall insert (77000) with diffuser (79000) down in a horizontal position and support it with the underlay.

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Dismantling the diffuser

WARNING

Support for the wall insert

The support can slip away when the wall insert is placed on flange F.
Incorrect or improperly used supports can lead to serious injury to personnel or fatal accidents.

▶ Check the position of the support and correct if necessary.

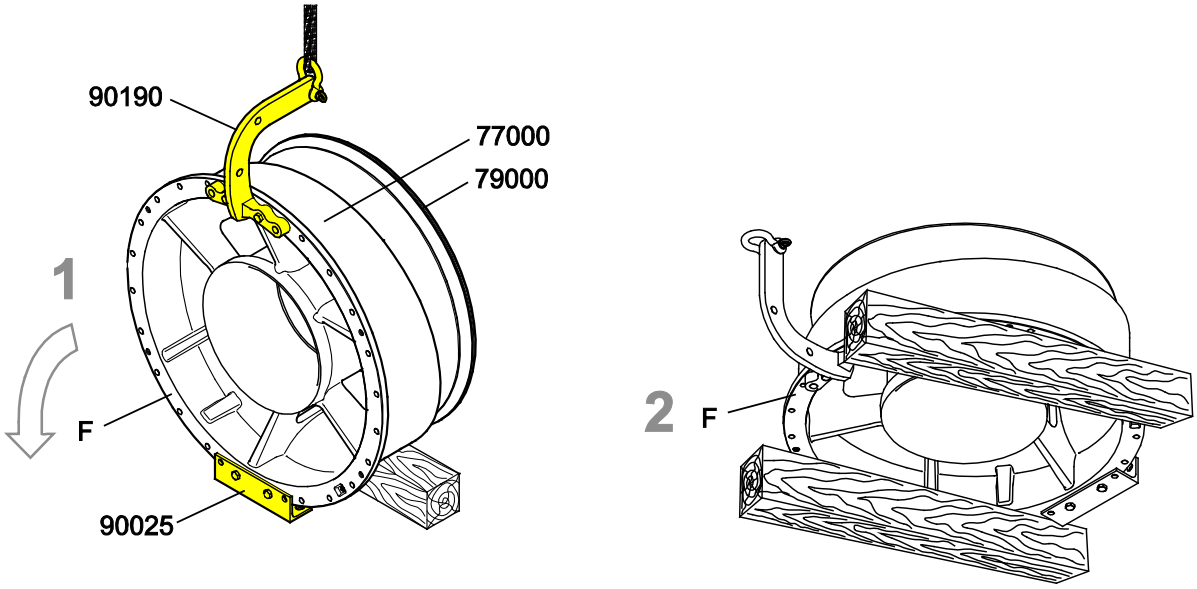

Figure 39

1. Tilt the wall insert (77000) with diffuser (79000) on the lifting device (90190) over the support angle (90025) and bring to a vertical position.
2. Place wall insert with the flange (F) on the underlay.

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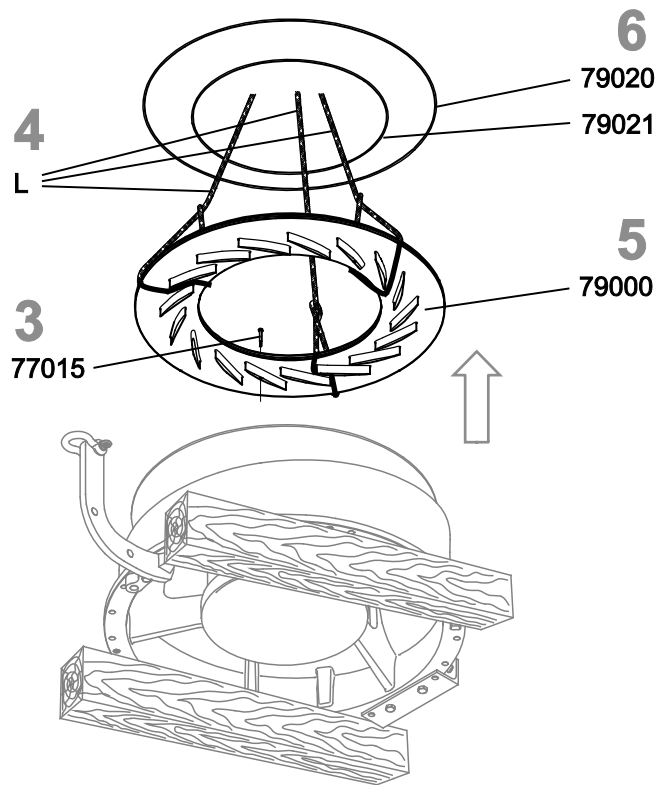

Figure 40

3. Loosen and remove screws (77015).
4. Attach lifting gear (L) to the diffuser (79000).
5. Remove and put down diffuser.
6. Remove O-rings (79020, 79021).

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10.6 Axial clearance A prior to disassembly

WARNING

Physical hazards due to sharp edges on compressor wheel

The compressor wheel has sharp edges which can result in injury.

▶ Wear gloves.

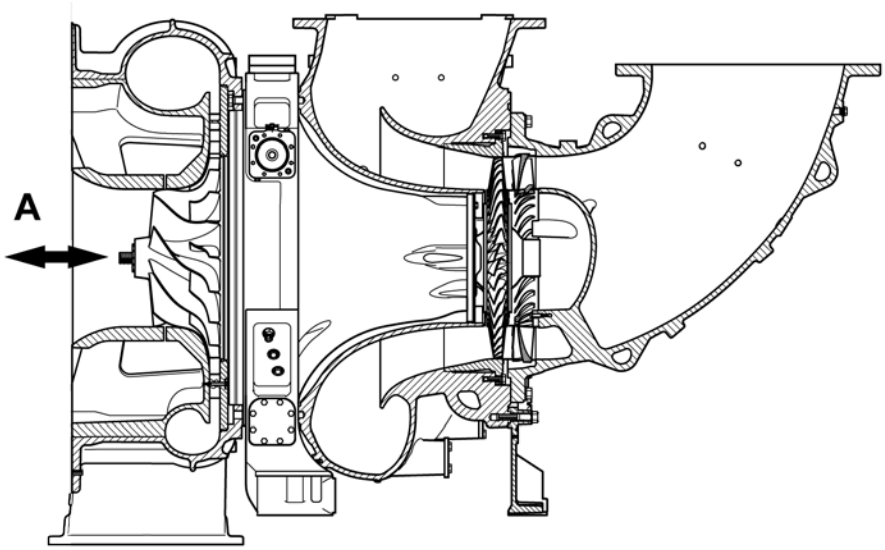

Figure 41

The axial clearance (A) of the rotor must be measured at the beginning and at the end of any service work on the turbocharger.

▶ Measure and note axial clearance (A).

Product	Axial clearance A [mm]
A165-L	0.32 ... 0.62
A170-L	0.33 ... 0.63
A175-L	0.38 ... 0.68
A180-L	0.41 ... 0.73
A185-L	0.44 ... 0.76
A190-L	0.44 ... 0.80

Table 30

CAUTION

Clearances outside the tolerance

Serious damage to engines or property can be caused by clearances outside the tolerance and excessively worn parts.

▶ Have the components assessed and, if necessary, replaced by an ABB Turbocharging Service Station.

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10.7 Dismantling the gas inlet casing, cover ring, nozzle ring

Dismantling the gas inlet casing

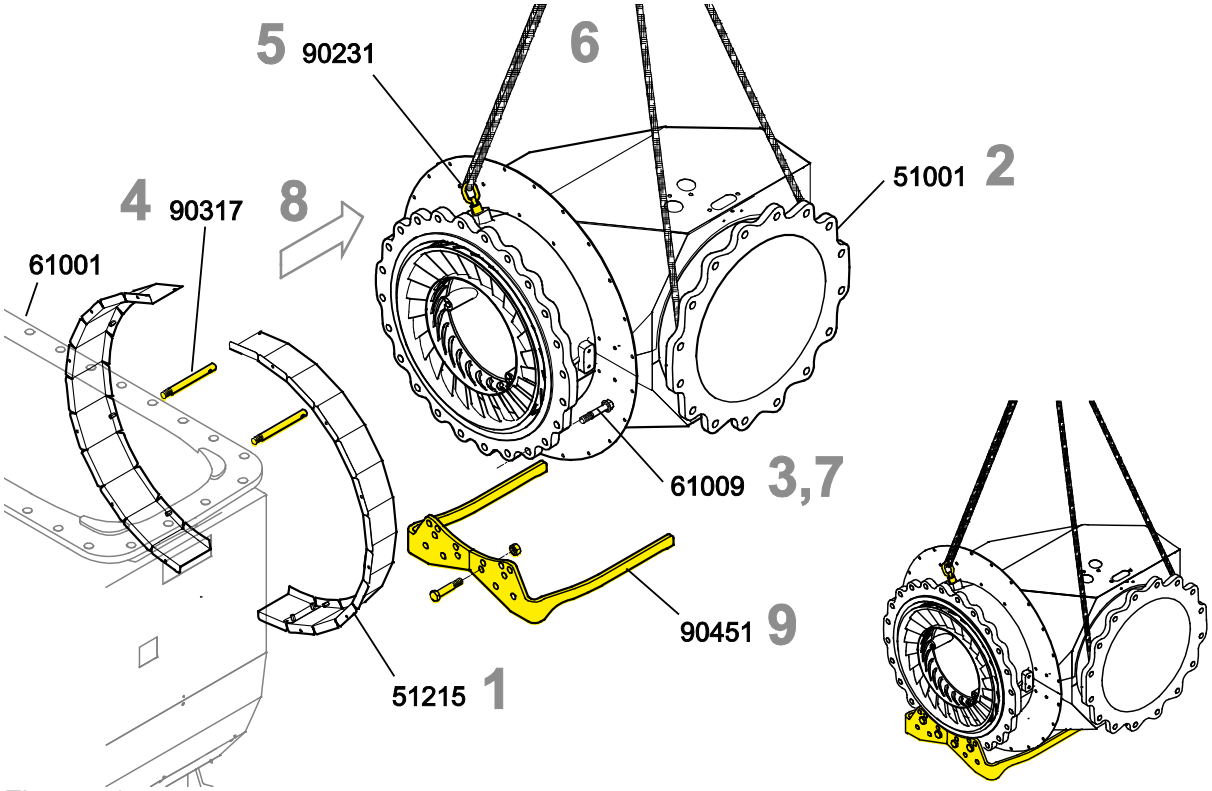

Figure 42

1. Dismantle both halves of the insulation segment (51215) and remove with all fixing elements.
2. Detach the flange connection between gas inlet casing (51001) and bellows.
3. Loosen and remove all but two (opposite) screws (61009).
4. Fit two guide studs (90317) in the upper area on the gas outlet casing (61001).
5. Fit the swivel lifting eye (90231) on the gas inlet casing (51001).
6. Attach the lifting gear to the swivel lifting eye and to the gas inlet casing.
7. Loosen and remove remaining two screws (61009).
8. Carefully move out gas inlet casing and remove with guide studs.
9. Fit support (90451) on the gas inlet casing (51001), then put down the casing.

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Dismantling the cover ring

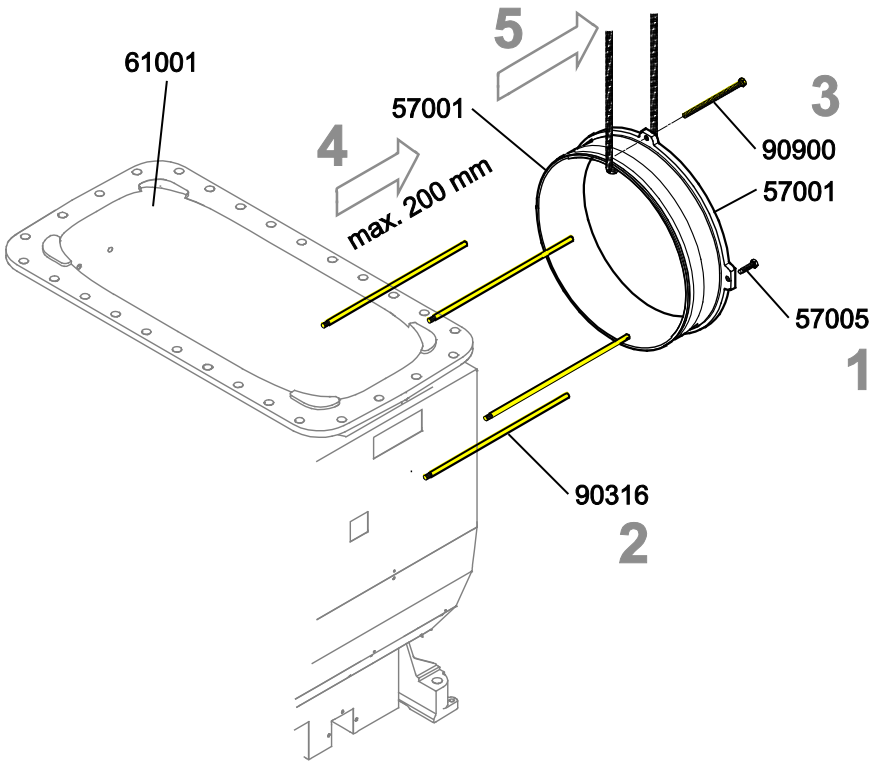

Figure 43

1. Loosen and remove screws (57005).
2. Fit four guide studs (90316) in the gas outlet casing (61001).
3. Using press-off screws (90900), press off the cover ring (57001).
4. Pull the cover ring (57001) out of the gas outlet casing (61001) no more than 200 mm maximum until the lifting gear can be fitted.
5. Remove the cover ring (57001) via the guide studs (90316) and put it down.

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Dismantling the nozzle ring (A175-L and smaller)

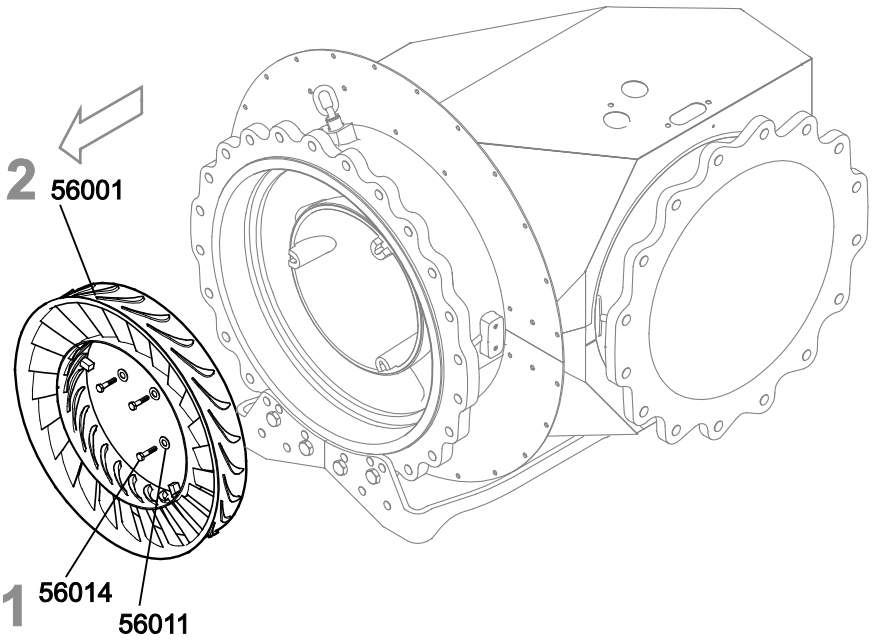

Figure 44

1. Loosen screws (56014) and remove with washers (56011).
2. Remove and put down nozzle ring (56001).

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Dismantling the nozzle ring (A180-L and larger)

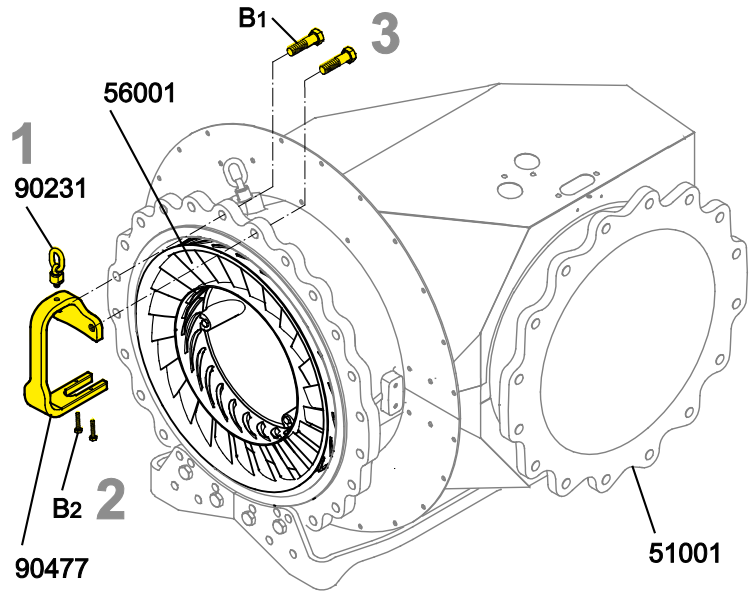

Figure 45

1. Fit the swivel lifting eye (90231) on the nozzle ring holder (90477).
2. Remove screws (B_2).
3. Fit the nozzle ring holder (90477) with screws (B_1) at the top of the flange of the gas inlet casing (51001).

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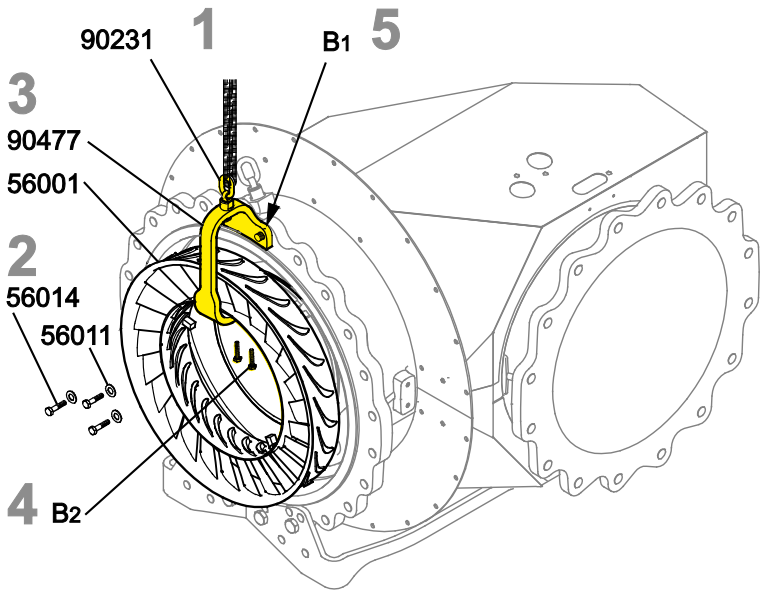

Figure 46

1. Fit lifting gear on swivel lifting eye (90231) and secure on crane.
2. Loosen screws (56014) and remove with washers (56011).
3. Pull the nozzle ring (56001) towards the front onto the nozzle ring holder (90477).
4. Screw the screws (B_2) into the nozzle ring holder.
5. Remove screws (B_1).

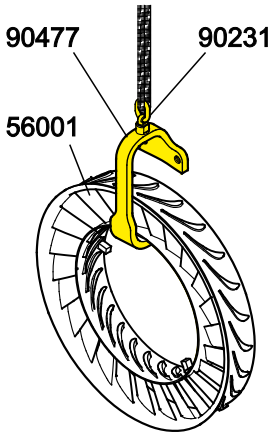

Figure 47

▶ Use the crane to remove and put down the nozzle ring (56001).

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10.8 Fitting the nozzle ring, cover ring, gas inlet casing

Pretreatment of heat-resistant screws

▶ Coat the screw threads with high-temperature grease.

Fitting the nozzle ring (A175-L and smaller)

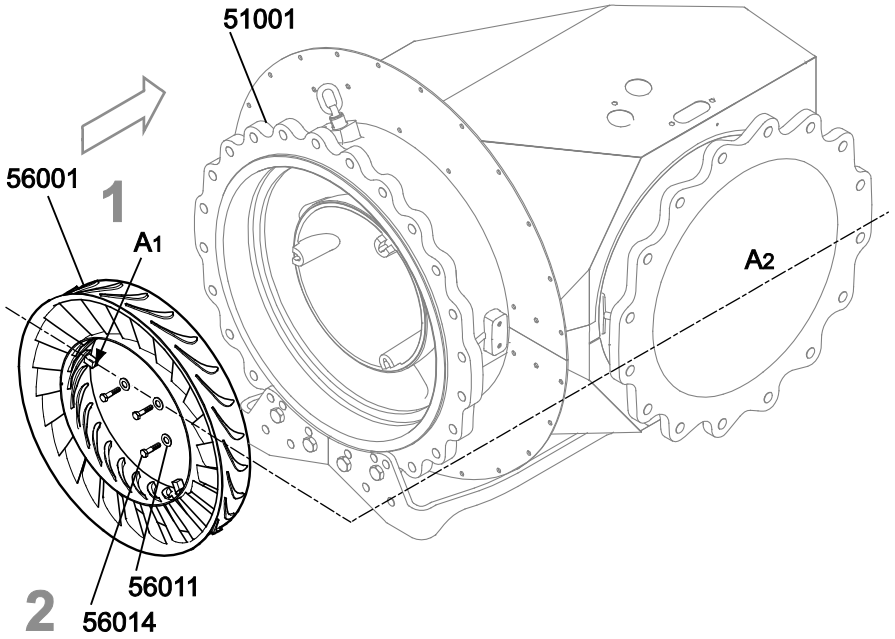

Figure 48

1. Align the notch (A_1) with the flange connection (A_2) and slide the nozzle ring (56001) into the gas inlet casing (51001).
2. Fit screws (56014) with washers (56011) (Table of tightening torques [→ 110]).

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Fitting the nozzle ring (A180-L and larger)

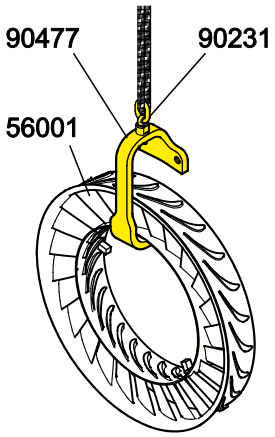

Figure 49

▶ Use lifting gear to secure the nozzle ring (56001) on the nozzle ring holder (90477) and transport it.

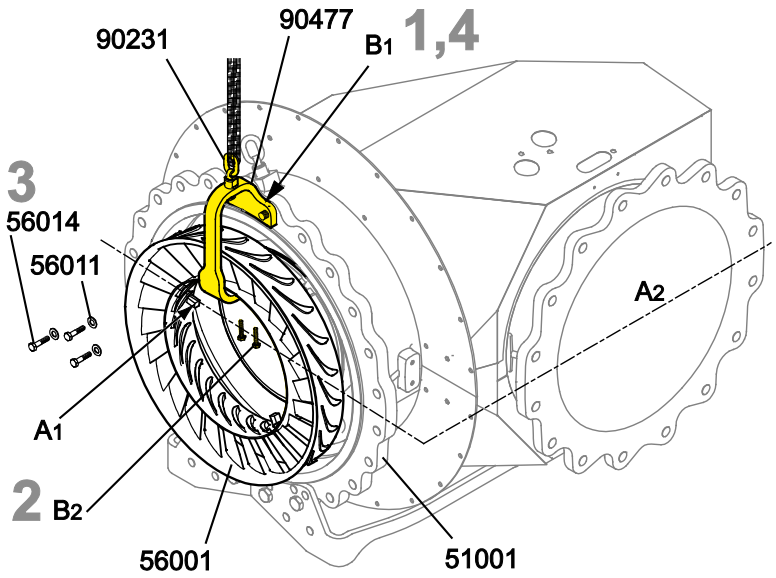

Figure 50

1. Fit the nozzle ring holder (90477) on the flange of the gas inlet casing (51001) with screws (B_1).
2. Remove screws (B_2), align the notch (A_1) on the cam of the nozzle ring (56001) with the flange connection (A_2) and slide the nozzle ring into the gas inlet casing (51001).
3. Fit screws (56014) with washers (56011)
   (Table of tightening torques [→ 110]).
4. Remove screws (B_1) along with the nozzle ring holder (90477).

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Fitting the cover ring

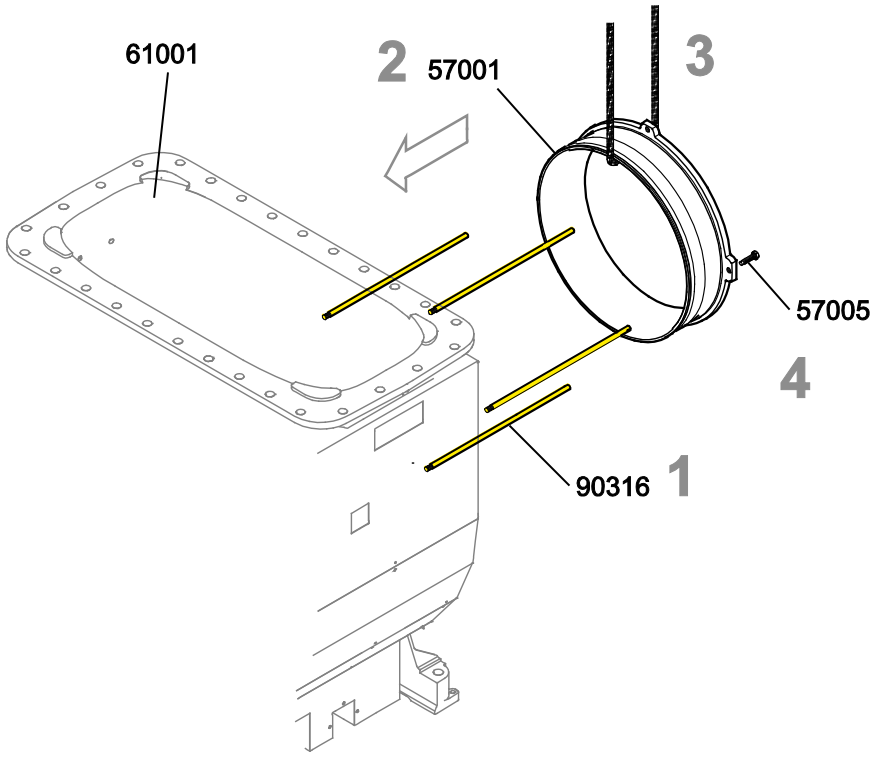

Figure 51

1. Fit four guide studs (90316) in the gas outlet casing (61001).
2. Slide the cover ring (57001) over the guide studs towards the gas outlet casing and stop 200 mm away from it.
3. Remove the lifting gear and slide the cover ring into the gas outlet casing.
4. Remove the guide studs (90316) and fit the screws (57005) (Table of tightening torques [→ 110]).

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Fitting the gas inlet casing

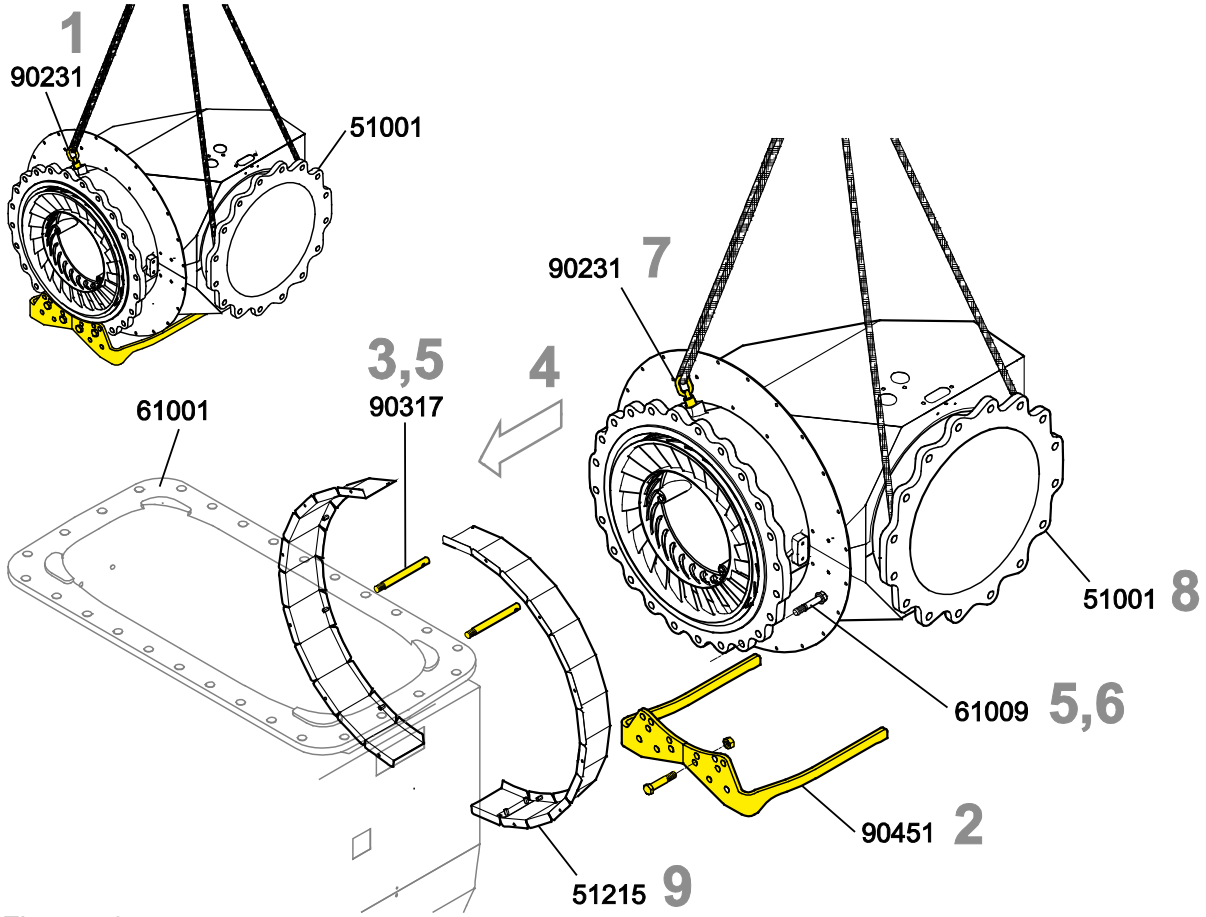

Figure 52

1. Attach lifting gear to swivel lifting eye (90231) and gas inlet casing (51001) and secure to the crane.
2. Dismantle and remove support (90451) from the gas inlet casing (51001).
3. Fit two guide studs (90317) in the upper area on the gas outlet casing (61001).
4. Push gas inlet casing (51001) via the guide studs up to the gas outlet casing (61001).
5. Screw in two (opposite) screws (61009), then remove both guide studs (90317) and fit the remaining screws (61009).
6. Fit the screws (61009) by tightening alternately crosswise, first to the pre-tightening torque, then to the tightening torque (Table of tightening torques [→ 110])
7. Remove swivel lifting eye (90231) and lifting gear.
8. Connect the flanges of the gas inlet casing and the bellows.
9. Fit both halves of the insulation segment (51215) (Table of tightening torques [→ 110]).

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10.9 Axial clearance A after assembly

WARNING

Physical hazards due to sharp edges on compressor wheel

The compressor wheel has sharp edges which can result in injury.

▶ Wear gloves.

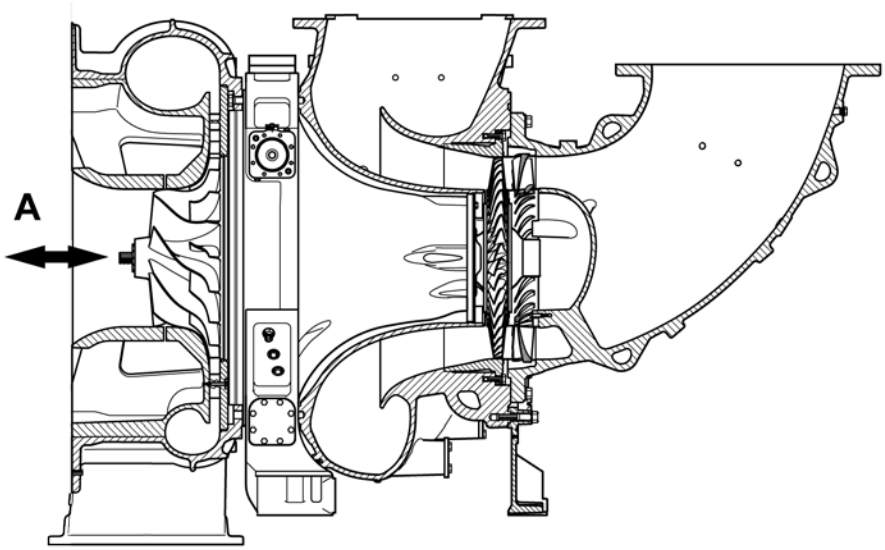

Figure 53

The axial clearance (A) of the rotor must be measured at the beginning and at the end of any service work on the turbocharger.

▶ Measure and note axial clearance (A).

Product	Axial clearance A [mm]
A165-L	0.32 ... 0.62
A170-L	0.33 ... 0.63
A175-L	0.38 ... 0.68
A180-L	0.41 ... 0.73
A185-L	0.44 ... 0.76
A190-L	0.44 ... 0.80

Table 31

CAUTION

Clearances outside the tolerance

Serious damage to engines or property can be caused by clearances outside the tolerance and excessively worn parts.

▶ Have the components assessed and, if necessary, replaced by an ABB Turbocharging Service Station.

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10.10 Fitting diffuser, wall insert

Fitting the diffuser

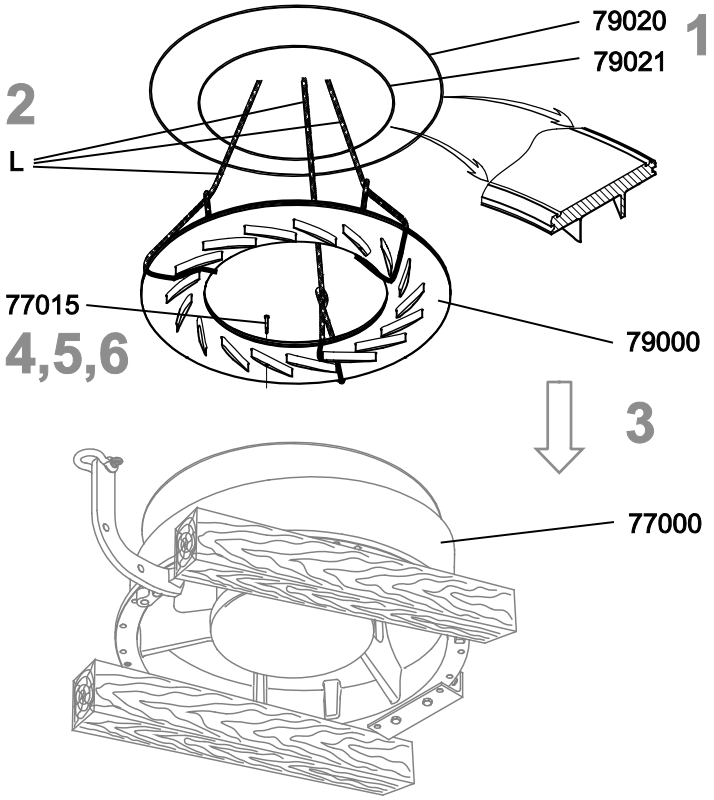

Figure 54

1. Fit the O-rings (79020, 79021) on the diffuser (79000).
2. Attach lifting gear (L) to the diffuser (79000).
3. Carefully place the diffuser (79000) on the wall insert (77000), then remove lifting gear.
4. Degrease screws (77015) and threaded holes in wall insert (77000).
5. Coat threads of the screws (77015) with Loctite 542.
6. Fit screws (77015) (Table of tightening torques [→ 110]).

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Fitting the wall insert

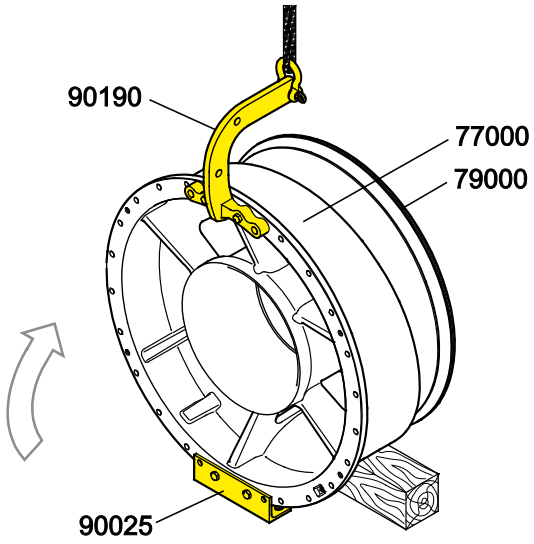

Figure 55

▶ Use the lifting device (90190) to carefully raise the wall insert (77000) over the support angle (90025) and bring to a horizontal position.

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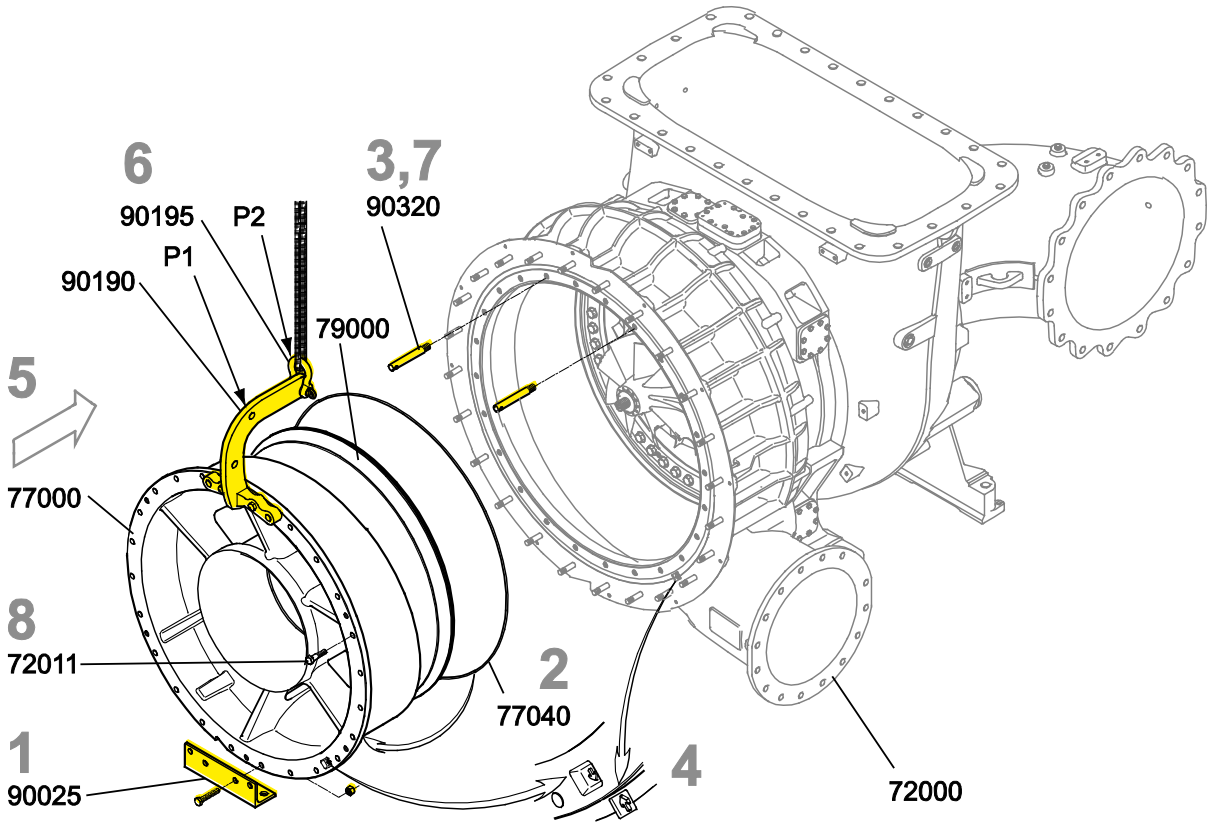

Figure 56

1. Remove the support angle (90025).
2. Attach the O-ring (77040) to the wall insert (77000).
3. Fit two guide studs (90320) in the upper area of the compressor casing (72000).
4. Align arrow markings of wall insert (77000) and compressor casing (72000) to one another.
5. Carefully move the wall insert (77000) with diffuser (79000) over the guide studs into the compressor casing.
6. Change the position of the shackle (90195) with the lifting gear to P1 of the lifting device (90190) and remove with the crane.
7. Move the wall insert fully in, then remove guide studs (90320).
   Check the correct position of both casings (arrow markings are aligned to one another).
8. Fit screws (72011) (Table of tightening torques [→ 110]).

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10.11 Table of tightening torques

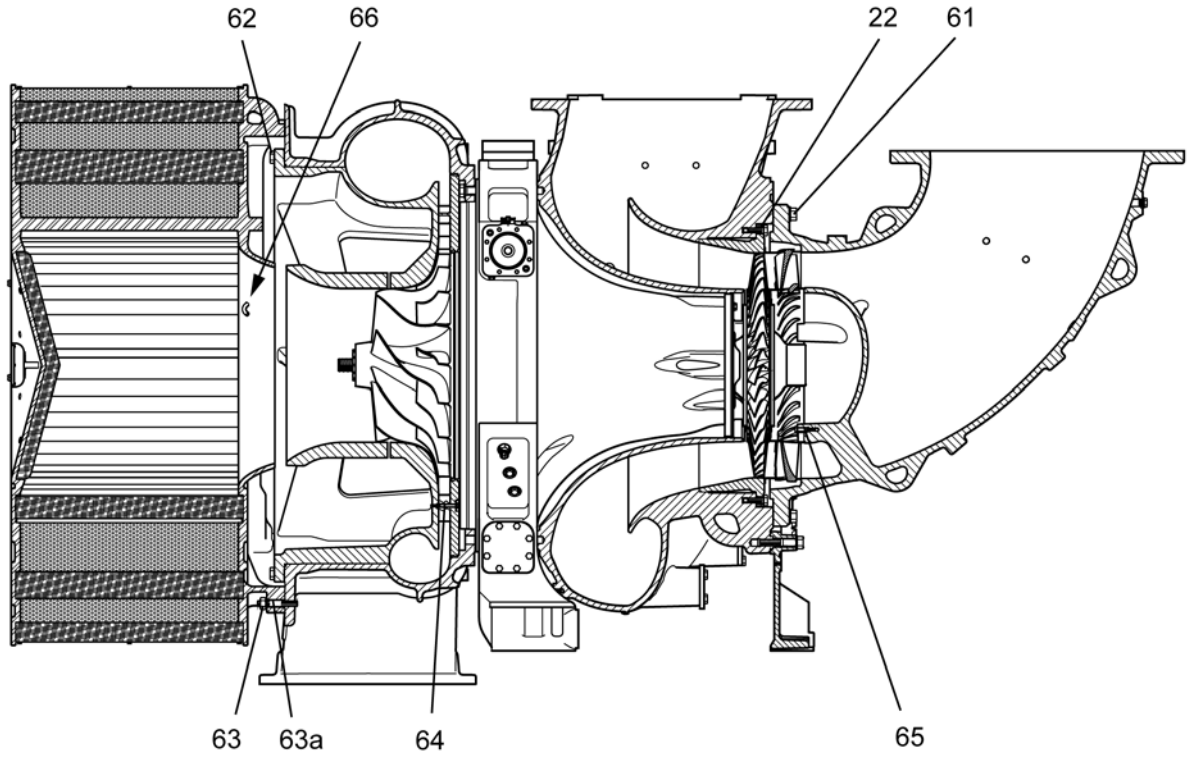

Figure 57

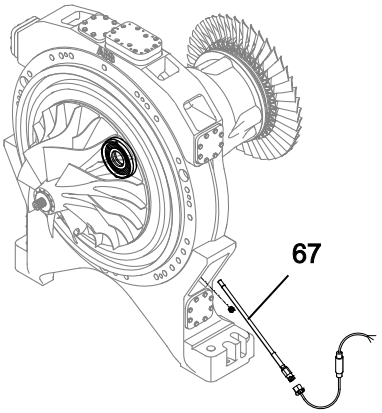

Figure 58

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Tightening torques [Nm]

Item	Part number	A165-L	A170-L	A175-L	A180-L	A185-L	A190-L
22	57005	M12 50	M12 50	M16 80	M20 160	M20 160	M24 280
61 1)	61009	M16 30 2) 180	M18 40 2) 260	M22 50 2) 500	M24 80 2) 630	M27 100 2) 920	M30 100 2) 1260
62 1)	72011	M18 400	M20 500	M24 950	M27 1400	M30 1900	M33 2570
63 1)	72004	M14 130	M16 200	M18 300	M20 420	M22 570	M24 710
63a	72002	M14 40	M16 60	M18 80	M20 100	M22 120	M24 140
64	77015	M5 5	M6 10	M8 25	M8 25	M10 45	M10 45
65	56014	M10 35	M10 35	M10 35	M12 65	M12 65	M16 170
66	81125	G1/2" 45	G1/2" 45	G1/2" 45	G1/2" 45	G1/2" 45	G1/2" 45
67	86505	M18x1.5 150	M18x1.5 150	M18x1.5 150	M27x2 320	M27x2 320	M27x2 320

Table 32

1) Tighten crosswise

2) Pre-tightening torque of the screws

▶ Use hydraulic tool for tightening torques exceeding 500 Nm.

Assembly of insulation [Nm]	M8 25	M10 45	M12 85

Table 33

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11 Taking out of operation at short notice

11.1 Possible emergency repairs

WARNING

Danger of fire and explosion due to lubricating oil leaks

Leaking hot oil can ignite. This can cause severe injuries to personnel or accidents resulting in fatalities.

▶ Seal any oil leaks immediately.

CAUTION

Directives for taking out of operation

Serious damage to engine or property can be caused by non-compliance with the directives for locking/blanking off the turbocharger on the engine.

▶ Follow the directives of the enginebuilder.

If the engine has to be brought back into operation again as quickly as possible in the case of turbocharger damage, the following possible emergency repairs are available:

- Locking the rotor
- Blanking off the inlet and outlet flange of casings
- Bypassing the turbocharger

NOTICE

Carrying out emergency repairs

The emergency repairs that can be carried out the most quickly are listed first.

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11.2 Locking the rotor

11.2.1 Introduction

A locked rotor must be removed after emergency operation and checked for unbalance.

The removal, the unbalance check and the installation of the rotor must be carried out by an ABB Turbocharging Service Station.

Exception

The exception concerns customer requirements for test bed runs of new engines at a maximum engine load of up to 25 %.

In these cases, subsequent removal of the rotor is not required as the engine is only operated briefly with a locked rotor.

In these test bed runs, it is not allowed to remove any set screws from the compressor wheel when fitting the locking device (94003) (Fitting the locking device [→ 115]).

CAUTION

Cooling of a locked rotor

Serious damage to engine or property can be caused by the overheating of intact turbocharger components.

If the gas inlet is not blanked off, the lubricating oil supply remains switched on (Further information for operation of 2-stroke engines, with blocked rotor [→ 117]).

▶ If there is a lubricating oil leak on the turbocharger, stop the oil supply.

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11.2.2 Fitting the locking device

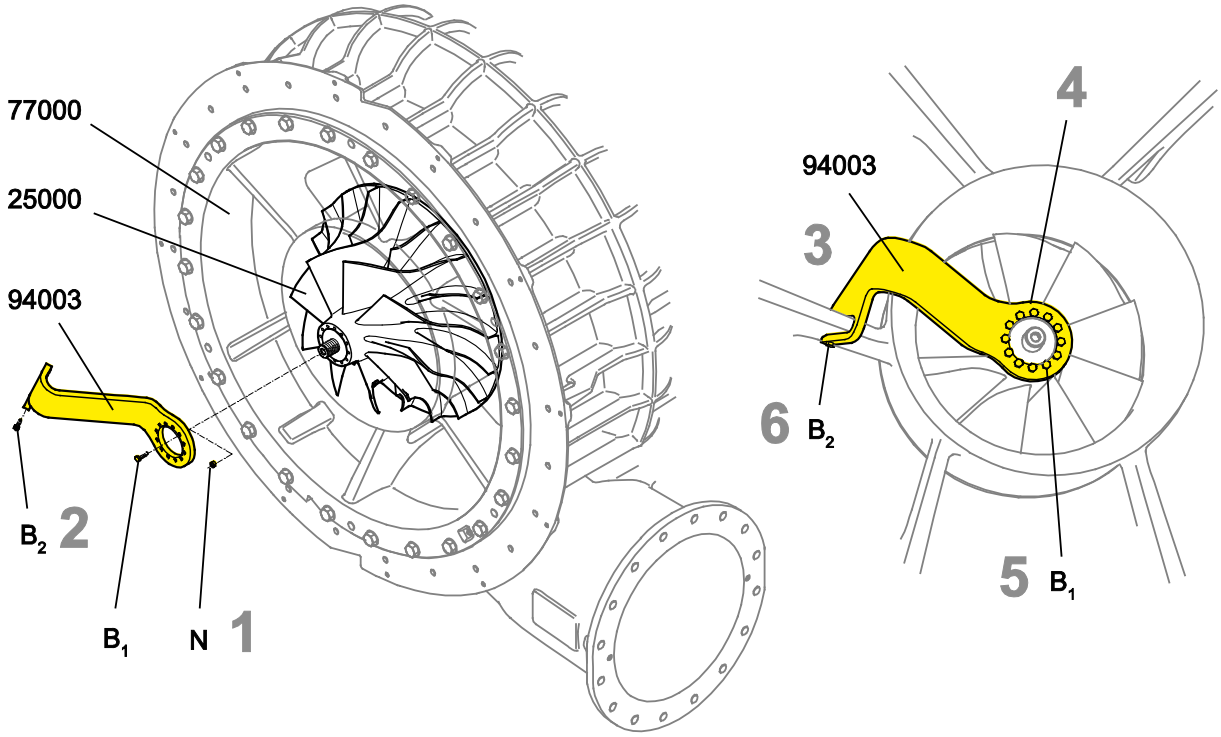

Figure 59

▶ Dismantle the filter silencer
(Dismantling and fitting the filter silencer [➞ 90]).

1. Loosen retaining nuts (N) and remove with screws (B_1).
2. Turn back the screw (B_2) until the slot of the locking device (94003) is fully open.
3. Position the slot of the locking device on a rib of the wall insert (77000).
4. Align the hole circle of the locking device with the drill holes in the compressor wheel (25000).
5. Fit at least 9 screws (B_1) (for tightening torque, see following table) without the retaining nuts (N).
   If more than 3 drill holes in the hub of the compressor wheel are occupied by set screws, the corresponding number must be unscrewed.
6. Fit screw (B_2) (for tightening torque, see following table).

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Product	Tightening torques of screws B_1 , B_2 [Nm]
A165-L	M8 25
A170-L	M8 25
A175-L	M10 45
A180-L	M10 45
A185-L	M12 75
A190-L	M12 75

Table 34

CAUTION

Locking of the rotor on the compressor wheel

Serious damage to engine or property can be caused by excessive vibrations and unbalance values if set screws (balancing screws) are loosened or unscrewed on the compressor wheel.

Before recommissioning of the turbocharger, the compressor wheel must be balanced at an ABB Turbocharging Service Station.

- ▶ Do not screw any set screws that have become unscrewed into the compressor wheel again.
- ▶ Balance the compressor wheel.

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11.2.3 Further information for operation of 2-stroke engines, with blocked rotor

Engine with one turbocharger

No further measures are necessary. The engine can be operated with an auxiliary blower according to the instructions of the enginebuilder.

- The lubricating oil supply remains connected and switched on.

Engine with several turbochargers

CAUTION

Speed limit of the turbocharger

The speed limit n_{Bmax} specified on the rating plate of the turbocharger must not be exceeded. Serious damage to engine or property can be caused by excessive speeds.

▶ Observe the speeds of the undamaged turbochargers.
▶ Reduce the engine load if necessary.

- The bellows on the compressor casing outlet must be removed and the air line blanked off on the engine side because the undamaged turbochargers build up a charging pressure. The lubricating oil supply remains switched on.
- The operating limit of the engine can be raised by additional blanking off of the gas inlet because the exhaust gas is then used to drive the undamaged turbochargers. Moreover, the load and temperature of the locked rotor are lowered.
  The lubricating oil supply is switched off.

Gas inlet on the turbocharger not blanked off

The following operating limits must be maintained in this case:

- The charging pressure in the charge air duct must not exceed 1 bar.
- Maximum admissible engine load: 50 %.

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11.3 Blanking off the inlets and outlets

The chapter is only applicable for engines with several turbochargers and joint air and exhaust gas receivers.

- ▶ Close the lubricating oil supply to the turbocharger
- ▶ Blank off flanges of compressor casing outlet, gas inlet and gas outlet by installing cover plates
- ▶ Observe specifications from enginebuilder.

11.4 Bypassing the turbocharger

The chapter only applies for engines with one turbocharger and for systems on which the connections for a bypass have been prepared and the necessary pipe connections have been provided.

- ▶ Close the lubricating oil supply to the turbocharger.
- ▶ Fit the bypass around the turbocharger.
- ▶ Observe specifications from enginebuilder.

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12 Mothballing the turbocharger

12.1 Taking the engine out of operation for up to 12 months

State of the engine lubricating oil

The turbocharger normally remains attached to the engine. The measures to be taken for mothballing of the turbocharger depend on the state of the lubricating oil:

- If the acid number (TAN) is less than 2 mg KOH/g, no measures need to be taken.
- If the engine lubricating oil is replaced with a preservative oil and circulated with the pre-lubrication pump before the engine is taken out of operation, no measures need to be taken either. Residues of old engine oil are flushed away in this way and the bearing parts are largely protected against corrosion.

Preparations for mothballing

If the acid number (TAN) is greater than 2 mg KOH/g, the following mothballing measures are necessary after taking the engine out of operation:

▶ Dismantle the turbocharger.
▶ The rotor and bearing parts must be dismantled and subsequently refitted by an ABB Turbocharging Service Station.
▶ Clean all parts.
▶ Coat plain surfaces of steel and cast parts with anticorrosive oil.
▶ Fit turbocharger completely.

Rotation of the rotor in the stack draught

If the rotor turns as a result of the stack draught:

▶ Install a blind flange between the outlet flange of the compressor casing and the charge air duct.

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12.2 Taking the engine out of operation for more than 12 months

If the engine is taken out of operation, the following variants are possible with regard to the turbocharger:

- Turbocharger remains attached to the engine.
- The casings of the turbocharger remain attached to the engine, the rotor and bearing parts are dismantled by an ABB Turbocharging Service Station and stored separately.
- The turbocharger is completely removed, either as a whole unit or in individual parts.

For the measures always necessary for preparing the turbocharger parts for mothballing, see section Taking the engine out of operation for up to 12 months, subsection Preparations for mothballing.

If the turbocharger remains attached to the engine, see section Taking the engine out of operation for up to 12 months, subsection Rotation of the rotor in the stack draught.

If the complete turbocharger is removed or the turbocharger is assembled again from the individual parts:

▶ Seal all openings of the turbocharger with paraffin paper and wooden lids.

Only dry rooms with 40 ... 70 % atmospheric humidity, in which no water condensation can form, are suitable as storage locations.

State of the mothballed turbocharger

▶ Check the turbocharger parts annually for corrosion.

▶ If there are signs of rust: Thoroughly clean parts and renew corrosion protection.

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13 Disposing of turbocharger components

Disposal must be environmentally compatible, professional, and in compliance with locally applicable regulations.

The turbocharger consists largely of metal (cast iron materials, steel, nickel-steel alloys, aluminium and bearing brass).

Further components are: Non-metallic materials (filter components of felt and polyethylene), lubricants (engine oil), electronic parts (speed sensor and associated components), and thermal insulation.

- ▶ Dispose of metals as scrap metal for recycling.
- ▶ Dispose of non-metallic materials as waste.
- ▶ Dispose of residues of lubricants as waste oil.
- ▶ Dispose of electronic components as electronic waste.

WARNING

Handling of damaged thermal insulation

Damaged thermal insulation can lead to dust exposure. The glass fibres can cause mechanical irritation of the eyes, skin and respiratory tracts.

- ▶ Avoid the formation of dust
- ▶ Vacuum up dust with a suitable vacuum cleaner
- ▶ Wear respirator mask for particles (P1 or P2 mask)
- ▶ Wear work gloves made of leather
- ▶ Wear tightly fitting protective goggles.

- ▶ Dispose of thermal insulation as hazardous waste.

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14 Spare parts

14.1 Ordering spare parts

Please quote the following data when making queries and ordering spare parts:

- Turbocharger type
- Serial number (HT……)
- Designation and part number

Spare parts can be ordered from any ABB Turbocharging Service Station.

▶ If different model variants are not taken into account in this document, contact an ABB Turbocharging Service Station.

Required customer spare part set (97070)

For the operations described in the operation manual, the customer spare part set (97070) is required. These parts are only available in the complete set.

Quantity	Designation	Part number
3	Washer	56011
3	Hexagon-head screw	56014
3	Washer	72003
3	Hexagon nut	72004
2	Hexagon-head screw	77015
1	O-ring	77040
1	O-ring	79020
1	O-ring	79021
1	O-ring	86506

Table 35

CAUTION

Spare part storage

All spare parts that were ordered together with the turbocharger must be kept intact and ready for use.

▶ Carefully clean any rusted parts and grease them.

▶ Dispose of replaced parts and parts that are not reusable in a professional and environmentally compatible manner.

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14.2 View of turbocharger with part numbers

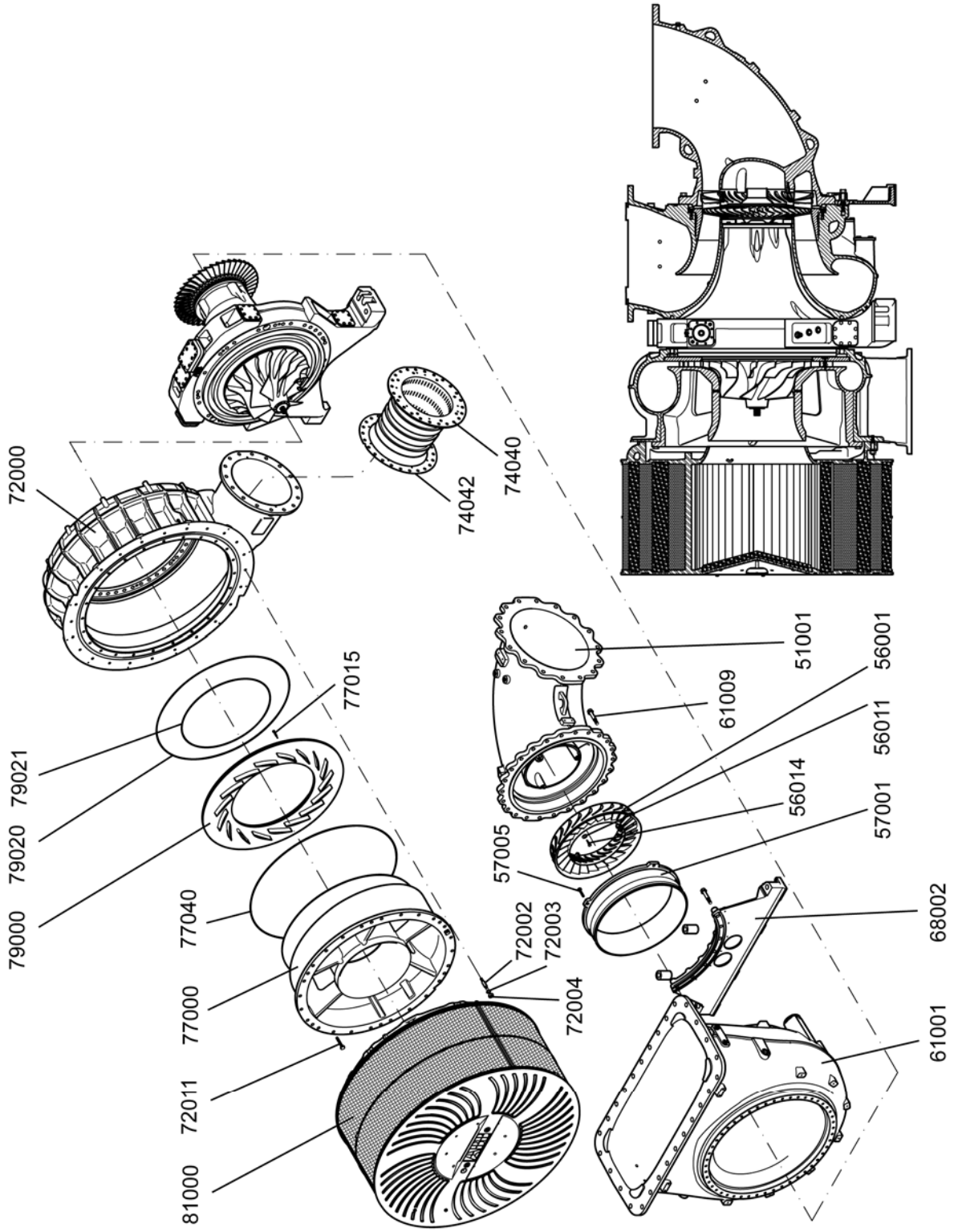

Figure 60

Turbocharger

Part number	Designation
- -	Cartridge group
51001	Gas inlet casing
56001	Nozzle ring
56011 (in the customer spare part set)	Washer
56014 (in the customer spare part set)	Hexagon-head screw
57001	Cover ring
57005	Hexagon-head screw
61001	Gas outlet casing
61009	Hexagon-head screw
68002	Foot, turbine end
72000	Compressor casing
72002	Threaded stud
72003 (in the customer spare part set)	Washer
72004 (in the customer spare part set)	Hexagon nut
72011	Hexagon-head screw
74040	Air-outlet silencer (option)
74042	Gasket (option)
77000	Wall insert
77015 (in the customer spare part set)	Hexagon-head screw
77040 (in the customer spare part set)	O-ring
79000	Diffuser
79020 (in the customer spare part set)	O-ring
79021 (in the customer spare part set)	O-ring
81000	Filter silencer

Table 36

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14.3 View of cartridge group with part numbers

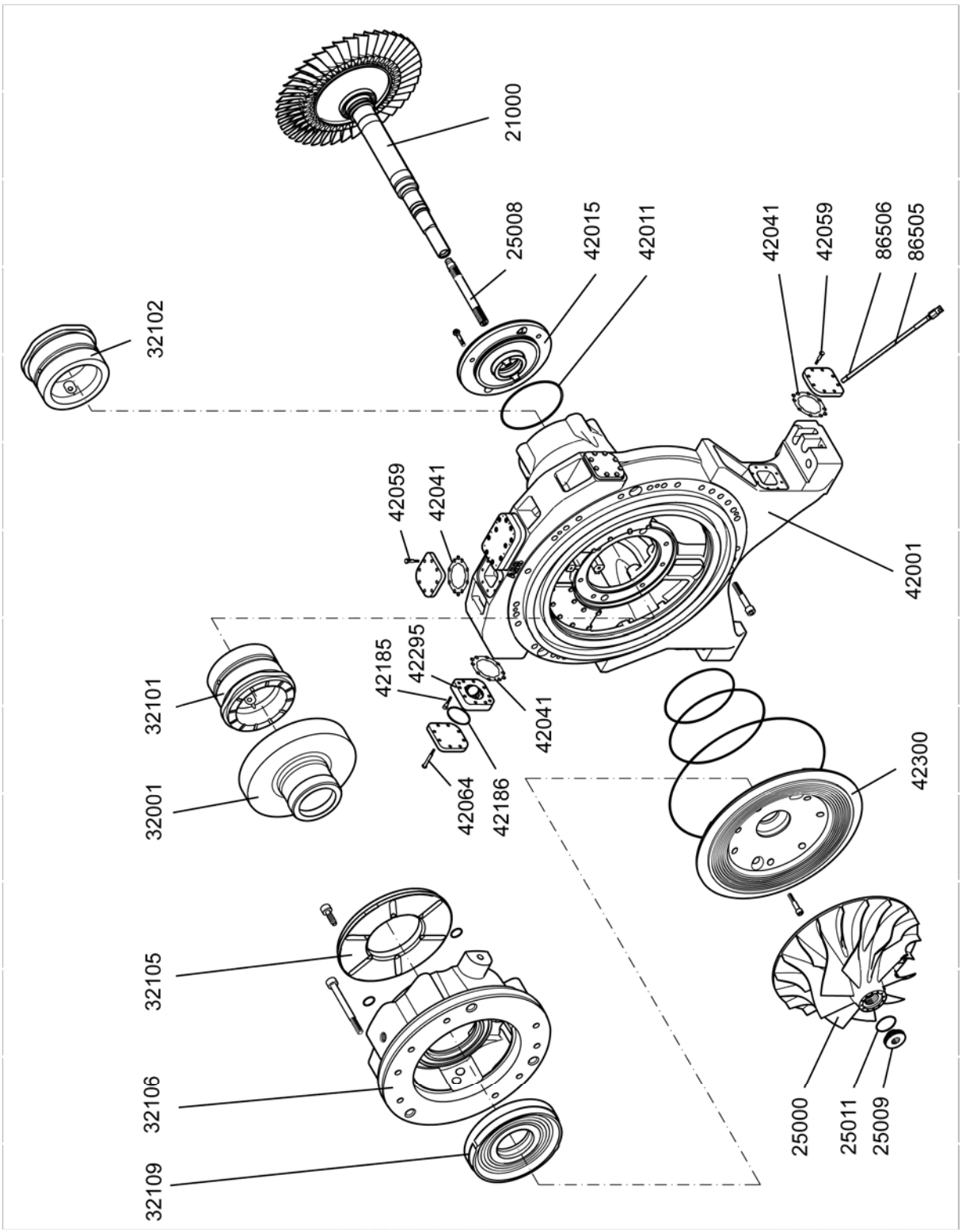

Figure 61

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Cartridge group

Part number	Designation
21000	Turbine
25000	Compressor wheel
25008	Threaded stud
25009	Ring nut
25011	O-ring
32001	Thrust bearing
32101	Radial bearing, compressor end
32102	Radial bearing, turbine end
32105	Floating disc
32106	Axial bearing
32109	Sealing disc
42001	Bearing casing
42011	O-ring
42015	Sealing cover
42041	Gasket
42059	Hexagon-head screw
42064	Hexagon-head screw
42185	Socket screw
42186	O-ring
42295	Pressure adjusting unit
42300	Partition wall
86505	Speed sensor
86506 (in the customer spare part set)	O-ring

Table 37

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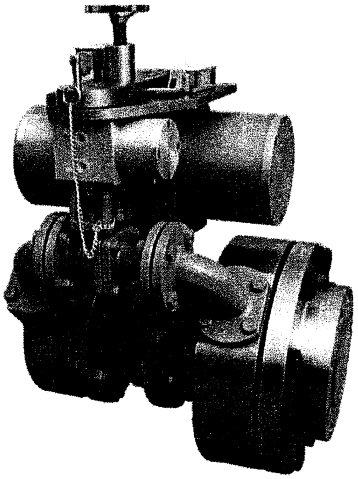
ZQ系列主起动阀使用说明书

Handling Manual of the ZQ Series Main Starting Valves



上海维川船用设备有限公司

SHANGHAI WELL-TRUE MARINE EQUIPMENT CO., LTD.

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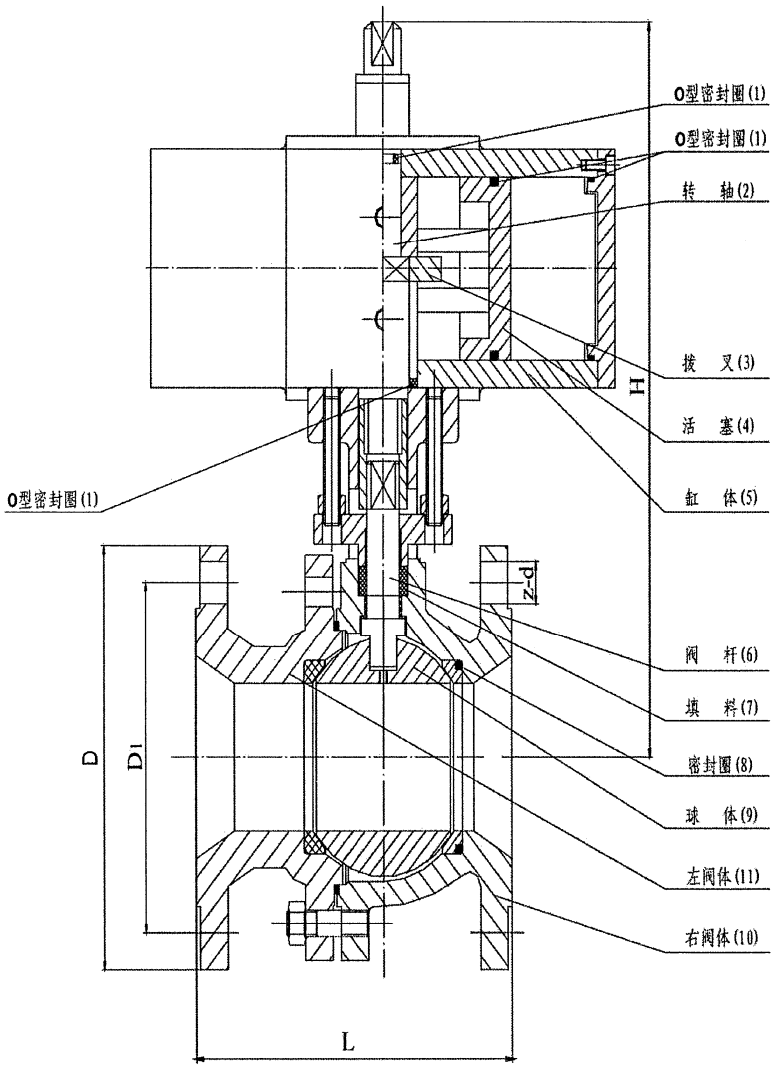

O型密封圈(1)
O型密封圈(1)
转　轴(2)
拔　叉(3)
活　塞(4)
缸　体(5)
O型密封圈(1)
阀　杆(6)
填　料(7)
密封圈(8)
球　体(9)
左阀体(11)
右阀体(10)
H
Z-d
D
D1
L

ZQ系列主起动阀使用说明书

一、前言

ZQ系列主起动阀的特点是启闭迅速、结构紧凑，能用于遥控操作，维修方便。

主起动阀传动执行机构是双作用活塞，以压缩空气为动力源，实现遥控启闭。活塞动作可靠灵活，输出扭矩大，足以保证球阀启闭所需要的力矩。

二、尺寸系列

公称通径 DN	L	D	D1	z-d	H
Φ25	165	Φ115	Φ85	4-Φ14	225
Φ40	200	Φ145	Φ110	4-Φ18	270
Φ65	190	Φ185	Φ145	8-Φ18	385
Φ100	229	Φ230	Φ190	8-Φ23	445
Φ150	267	Φ300	Φ250	8-Φ27	530

三、主要性能参数

(1) 工作压力： 3Mpa

(2) 工作介质： 空气

(3) 球阀开启速度：2 Sec/Per

(4) 球阀控制压力：0.7Mpa

四、作用原理与结构

(1) 球阀的开、关由双活塞气缸带动，气缸顶部的扁榫指示开或关，当扁榫与通径孔平行时为开启，垂直时为关闭。

(2) 球阀为浮动型结构，对球体与密封圈加预紧力而实现密封。即使阀门经长期使用而失去预紧力后也能靠介质在阀门通径两端的压差达到密封。

(3) 气缸结构是双活塞拨叉式，由活塞带动拨叉使转轴作回转运动，转动角度为90°，通过转轴和阀杆带动球体，作同步转动实现启闭动作。

五、保管、安装和使用

(1) 球阀二端口需用盲法兰封死，以防杂物入内。球阀处于开启状态存放在干燥室内。

(2) 安装前应将主起动阀清洗干净，才能转动气动球阀阀体，以防损坏球面和密封面。

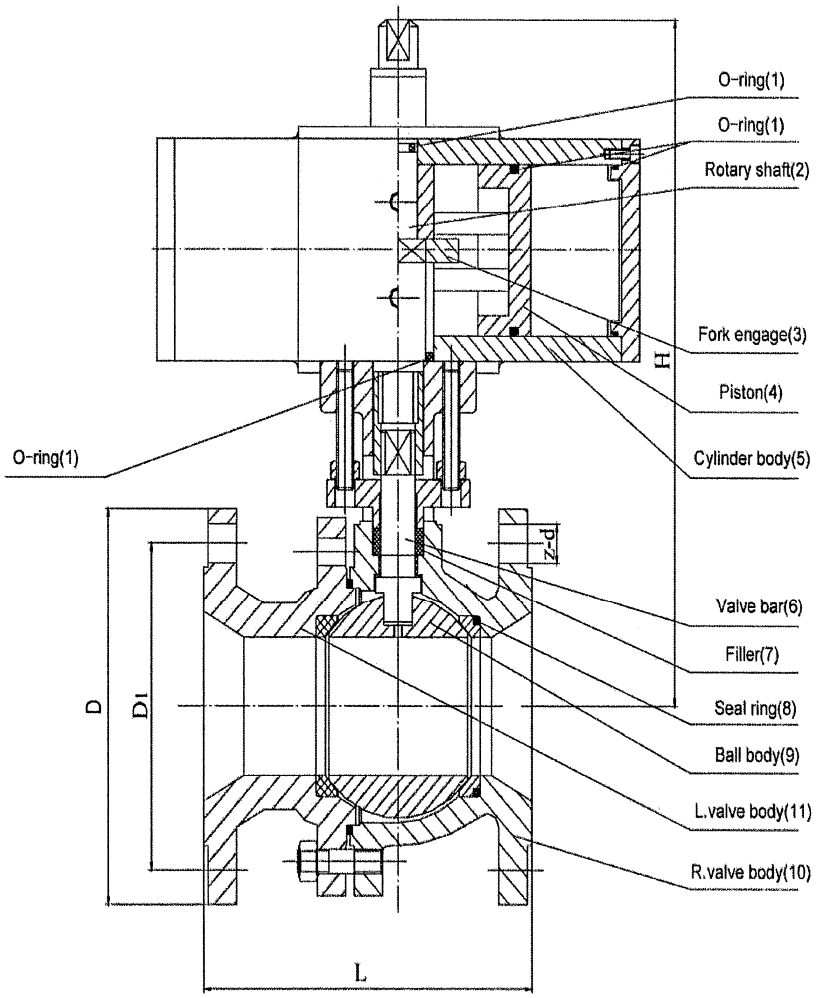
(3) 球阀在使用时必须全开或全闭，严禁作节流使用。

六、球阀可能发生故障的原因及消除方法见下表。

故障现象	原　　因	消除方法
气动球阀的阀杆转动不灵活或不能转动	(1)压缩空气气源的压力达不到要求 (2)气缸密封部分漏气或O型密封圈损坏 (3)阀杆与转轴不同轴度过大	(1)调整球阀控制压力到0.7Mpa以上 (2)检查气缸密封部位，更换O型密封圈 (3)旋松联接右阀体与气缸支架的螺母、重新调整阀体与气缸支架的联接部分
气动球阀填料渗漏	(1)填料未压紧 (2)填料使用过久失效	(1)均匀地拧紧填料压盖上的螺钉 (2)更换填料
气动球阀左右体连接处泄漏	(1)联接螺柱、螺母拧得不紧或松紧不匀 (2)联接法兰密封面上有损伤或污物 (3)密封垫片损坏	(1)均匀地拧紧螺母 (2)修整密封面或清除污物 (3)更换密封垫片
气动球阀通道密封处泄漏	(1)球面和密封圈上有损伤或积有污物 (2)密封圈底面与阀座之间夹有污物 (3)密封圈变形或磨损严重而失效	(1)研磨球面或更换密封圈或清除污物 (2)清除污物 (3)更换密封圈
气动球阀通道密封处大量泄漏	球体未转到完全关闭的位置	调整气缸背后的螺母与螺钉到需要的位置

七、起动装置如需配备慢转功能，则可由大小两个球阀组成，通称双球阀。
具体配置见下表：

球阀 / 图号	主阀通径 DN	副阀通径 DN	适用机型
ZQ065	Φ65		S26、S/L35
ZQ065/25	Φ65	Φ25	S26、S/L35
ZQ100	Φ100	/	S/L42、S/L46、S/L50
ZQ100/25	Φ100	Φ25	S/L42、S/L46、S/L50
ZQ150	Φ150	/	S/L60、S/L70、S/L/K80、S/L/K90
ZQ150/40	Φ150	Φ40	S/L60、S/L70、S/L/K80、S/L/K90


O-ring(1)
O-ring(1)
Rotary shaft(2)
Fork engage(3)
Piston(4)
Cylinder body(5)
O-ring(1)
H
n-d
Valve bar(6)
Filler(7)
Seal ring(8)
Ball body(9)
L.valve body(11)
R.valve body(10)
D
D1
L

Handling Manual of the ZQ Series Main Starting Valves

1. Introduction

The quick open-close functions and the well-knit structure are the features of the ZQ series Main Starting valves. That series product can be used in remote handling and they are easy to maintain.

A drive mechanism of the main starting valve, the double acting piston adopts compress air as its motive source and brings the open-close function to success. The piston's actions are quick and reliable. In order to secure big enough torsion required in the open-close actions, it has a big output torque.

2.Dimension series

Metric diameter DN	L	D	D1	z-d	H
Φ25	165	Φ115	Φ85	4-Φ14	225
Φ40	200	Φ145	Φ110	4-Φ18	270
Φ65	190	Φ185	Φ145	8-Φ18	385
Φ100	229	Φ230	Φ190	8-Φ23	445
Φ150	267	Φ300	Φ250	8-Φ27	530

3.Main characteristic parameters

(1) operation pressure: 3Mpa

(2) operation media: air

(3) ball valve opening speed: 2sec./per

(4) ball valve control pressure: 0.7Mpa

4.Functional principles and structure

(1) The double acting piston completes the open-close actions of the ball valve. The flat rabbet at the top of the cylinder indicates "open" or "close". When the rabbet and the passageway hole are on an equal line, it indicates "open". And when the two meet at right angles, it indicates "close".

(2) The ball valve's structure if of floating type. In order to secure thoroughly sealing, pre-tighten forces are rendered to the ball-body and the sealed ring. Depending upon the media pressure difference at both ends of the valve's passageway, tight-sealing can be assured, even operation.

(3) The cylinder's structure is of double acting piston for type. Drive by the piston, the fork engages a simple turn-round movement with a rotary angle efficiency of 90°. And through the rotary shaft and the valve bar, it drives the ball to rotate synchronously and thus completes the open-close functions.

5.Maintenance, installation and handling

(1) In order to prevent impure substances, both ends of the ball valve should be tightly sealed with the blind flange. The ball valve should be in "open" condition and lay in dry places.

(2) Before installation, the main starting valve should be cleaned thoroughly so as to rotate the pneumatic ball valve's ball-body,and thus keep the ball surface and the sealed surface from damage.

(3) In operation, the ball valve should be set in thorough opening position or in thorough closing position. The usage of reducing airflow is strictly forbidden.

6.Possible troubles of the ball valve, causes and their solving methods.(page 9)

7.If the starting device need to have a slow rotary function, two ball valves, which consist of a main valve and an auxiliary valve, may be adopted.

Ball valve / DRG.No.	Main valve DN	Auxiliary valve DN	Eng type
ZQ065	Φ65		S26、S/L35
ZQ065/25	Φ65	Φ25	S26、S/L35
ZQ100	Φ100	/	S/L42、S/L46、S/L50
ZQ100/25	Φ100	Φ25	S/L42、S/L46、S/L50
ZQ150	Φ150	/	S/L60、S/L70、S/L/K80、S/L/K90
ZQ150/40	Φ150	Φ40	S/L60、S/L70、S/L/K80、S/L/K90

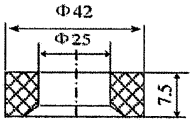
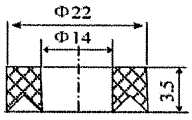
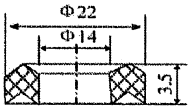
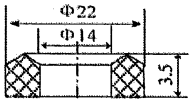
The explanation of additional figure

(1) O型密封圈 The O sealed ring
(2) 转 轴 The rotary shaft
(3) 拨 叉 The fork engage
(4) 活 塞 The piston
(5) 缸 体 The cylinder body
(6) 阀 杆 The valve bar
(7) 填 料 The fillers
(8) 密封圈 The sealed ring
(9) 球 体 The ball body
(10) 右阀体 The right valve body
(11) 左阀体 The left valve body

Trouble's phenomena	Causes	Trouble shoot
Thevalve bar of the pneumatic ball valve cannot rotate smoothly or loses its rotary function completely.	(1) The pressure of the compress air source is not up to the standard. (2) Leakage of the sealed portion of the cylinder or damage of the O sealed ring. (3) Alignment of the valve bar and the rotary shaft is not up to the standard.	(1) Adjust the pressure source till it exceeds 0.7Mpa. (2) Check the sealed portion of the cylinder or replace the O sealed ring. (3) Release the joint nut between the right valve body and the cylinder stand. And then readjust the joint portion.
Leakage of the fillers of the pneumatic ball valve.	(1) The fillers are not pressed tightly. (2) The fillers lose effectiveness for the cause of excessively use.	(1) Properly tighten the screws on the press-cap of the filler. (2) Replace the fillers.
Leakage at the joint part of the left and right bodies of the pneumatic ball valve.	(1) The joint screws are relaxed or the corresponding screws are not property tightened. (2) Damage or stain of the flange sealed surface. (3) Damage of the sealed washers.	(1) Properly tighten the screws and nuts. (2) Repair the sealed surface or clear off the impure substances. (3) Replace the sealed washers.
Leakage at the sealed part of the passageway of the pneumatic ball valve.	(1) Damage or stain on the ball surface and the sealed surface. (2) Stain at the portion between the bottom of the sealed ring and the valve stand. (3) Loss efficacy of the sealed ring.	(1) Grind the ball surface or replace the sealed ring or clear off the stained impurity. (2) Replace the sealed ring. (3) Replace the sealed ring.
A large quantity leakage at the sealed part of the pass away of the pneumatic ball valve.	The ball body cannot completely turn to the "close" position.	Adjust the screws and nuts behind the cylinder until they are up to the standard.

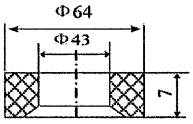
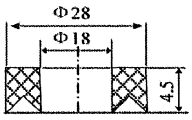
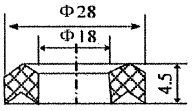
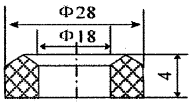
ZQ系列主起动阀DN25球阀备件清单

Spare Parts List of DN25 of the ZQ Series Main Starting Valves

订货号 Order No.	名　称 Name	主要尺寸 Main dimension	材　料 Material	数　量 Quantity
WZ25-1	Sealing ring 04(FQCB-006-89) 密封圈		Polyper Fluorethylene 聚四氟乙烯	2
WZ25-2	Upper filler DN14(FQCB-005-83) 上填料		Polyper Fluorethylene 聚四氟乙烯	1
WZ25-3	Middle filler DN14(FQCB-005-83) 中填料		Polyper Fluorethylene 聚四氟乙烯	2
WZ25-4	Lower filler DN14(FQCB-005-83) 下填料		Polyper Fluorethylene 聚四氟乙烯	1
WZ25-5	O - ring O形密封圈	Φ16×2.4	FPM 氟橡胶	1
WZ25-6	O - ring O形密封圈	Φ22×2.4	FPM 氟橡胶	1
WZ25-7	O - ring O形密封圈	Φ55×3.5	FPM 氟橡胶	2
WZ25-8	O - ring O形密封圈	Φ55×3.1	FPM 氟橡胶	2
WZ25-9	Elastic ring 挡圈GB894.2-86	Φ16	65Mn	1

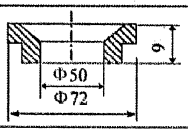
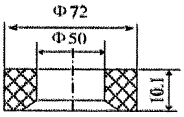
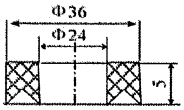
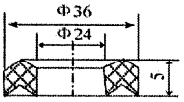
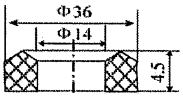
ZQ系列主起动阀DN40球阀备件清单

Spare Parts List of DN40 of the ZQ Series Main Starting Valves

订货号 Order No.	名　称 Name	主要尺寸 Main dimension	材　料 Material	数　量 Quantity
WZ40-1	Sealing ring 02(FQCB-019-89) 密封圈		Polyper Fluorethylene 聚四氟乙烯	2
WZ40-2	Upper filler DN18(FQCB-005-83) 上填料		Polyper Fluorethylene 聚四氟乙烯	1
WZ40-3	Middle filler DN18(FQCB-005-83) 中填料		Polyper Fluorethylene 聚四氟乙烯	2
WZ40-4	Lower filler DN18(FQCB-005-83) 下填料		Polyper Fluorethylene 聚四氟乙烯	1
WZ40-5	O - ring O形密封圈	Φ16×2.4	FPM 氟橡胶	1
WZ40-6	O - ring O形密封圈	Φ24×2.5	FPM 氟橡胶	1
WZ40-7	O - ring O形密封圈	Φ65×5.7	FPM 氟橡胶	2
WZ40-8	O - ring O形密封圈	Φ65×3.1	FPM 氟橡胶	2
WZ40-9	Elastic ring 挡圈GB894.2-86	Φ16	65Mn	1

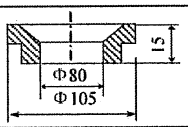
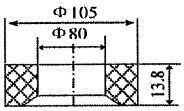
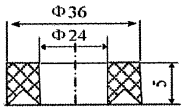
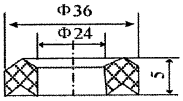
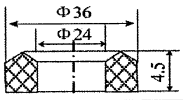
ZQ系列主起动阀DN65球阀备件清单

Spare Parts List of DN65 of the ZQ Series Main Starting Valves

订货号 Order No.	名　称 Name	主要尺寸 Main dimension	材　料 Material	数　量 Quantity
WZ65-1	Sealing ring 密封圈		ZQAL9-4 铝青铜	1
WZ65-2	Sealing ring 密封圈		Polyper Fluorethylene 聚四氟乙烯	1
WZ65-3	Upper filler DN24(FQCB-005-83) 上填料		Polyper Fluorethylene 聚四氟乙烯	1
WZ65-4	Middle filler DN24(FQCB-005-83) 中填料		Polyper Fluorethylene 聚四氟乙烯	2
WZ65-5	Lower filler DN24(FQCB-005-83) 下填料		Polyper Fluorethylene 聚四氟乙烯	1
WZ65-6	O - ring O形密封圈	Φ28×3.1	FPM 氟橡胶	1
WZ65-7	O - ring O形密封圈	Φ32×3.1	FPM 氟橡胶	1
WZ65-8	O - ring O形密封圈	Φ100×5.7	FPM 氟橡胶	2
WZ65-9	O - ring O形密封圈	Φ100×3.1	FPM 氟橡胶	2
WZ65-10	Elastic ring 挡圈GB894.2-86	Φ28	65Mn	1

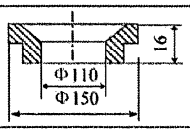
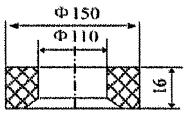
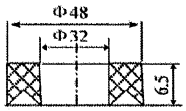
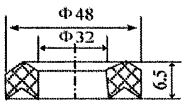
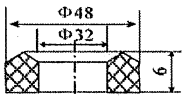
ZQ系列主起动阀DN100球阀备件清单

Spare Parts List of DN100 of the ZQ Series Main Starting Valves

订货号 Order No.	名　称 Name	主要尺寸 Main dimension	材　料 Material	数　量 Quantity
WZ100-1	Sealing ring 密封圈		ZQAL9-4 铝青铜	1
WZ100-2	Sealing ring 密封圈		Polyper Fluorethylene 聚四氟乙烯	1
WZ100-3	Upper filler DN24(FQCB-005-83) 上填料		Polyper Fluorethylene 聚四氟乙烯	1
WZ100-4	Middle filler DN24(FQCB-005-83) 中填料		Polyper Fluorethylene 聚四氟乙烯	2
WZ100-5	Lower filler DN24(FQCB-005-83) 下填料		Polyper Fluorethylene 聚四氟乙烯	1
WZ100-6	O - ring O形密封圈	Φ28×3.1	FPM 氟橡胶	1
WZ100-7	O - ring O形密封圈	Φ32×3.1	FPM 氟橡胶	1
WZ100-8	O - ring O形密封圈	Φ100×5.7	FPM 氟橡胶	2
WZ100-9	O - ring O形密封圈	Φ100×3.1	FPM 氟橡胶	2
WZ100-10	Elastic ring 挡圈GB894.2-86	Φ28	65Mn	1

ZQ系列主起动阀DN150球阀备件清单

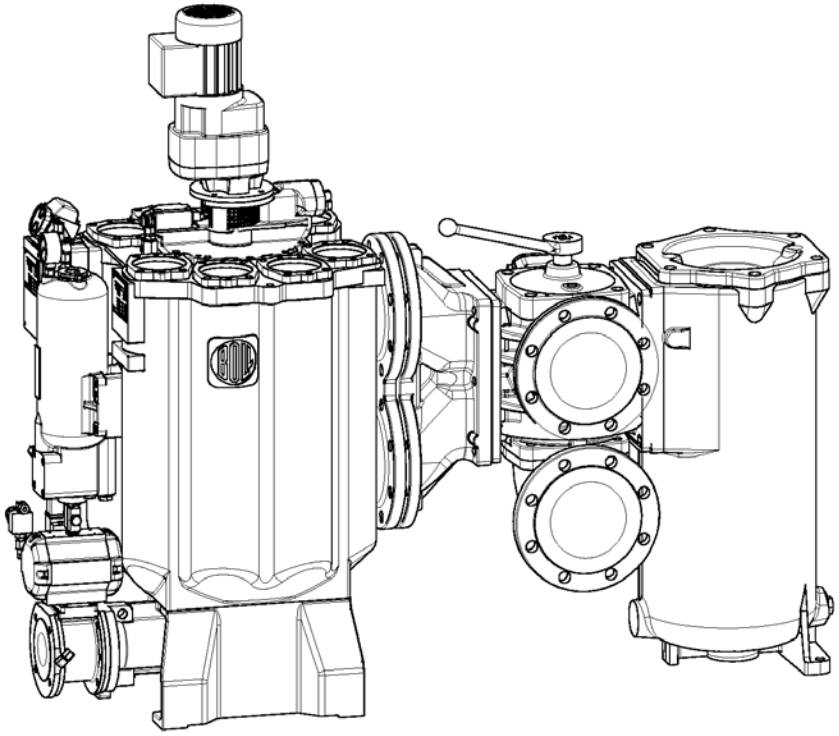
Spare Parts List of DN150 of the ZQ Series Main Starting Valves

订货号 Order No.	名　称 Name	主要尺寸 Main dimension	材　料 Material	数　量 Quantity
WZ150-1	Sealing ring 密封圈		ZQAL9-4 铝青铜	1
WZ150-2	Sealing ring 密封圈		Polyper Fluorethylene 聚四氟乙烯	1
WZ150-3	Upper filler DN24(FQCB-005-83) 上填料		Polyper Fluorethylene 聚四氟乙烯	1
WZ150-4	Middle filler DN24(FQCB-005-83) 中填料		Polyper Fluorethylene 聚四氟乙烯	2
WZ150-5	Lower filler DN24(FQCB-005-83) 下填料		Polyper Fluorethylene 聚四氟乙烯	1
WZ150-6	O - ring O形密封圈	Φ35×3.1	FPM 氟橡胶	1
WZ150-7	O - ring O形密封圈	Φ40×3.1	FPM 氟橡胶	1
WZ150-8	O - ring O形密封圈	Φ160×5.7	FPM 氟橡胶	2
WZ150-9	O - ring O形密封圈	Φ160×3.1	FPM 氟橡胶	2
WZ150-10	Elastic ring 挡圈GB894.2-86	Φ35	65Mn	1

BOLLFILTER
Protection Systems

Operating instructions for automatic filter

Type	**6.64.1**
Nominal diameter	**DN 100 - DN 150**
Filter element	**Filter candle**



NOTE:
Print document on both sides

Translation of the original operating instructions

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Date	Version	Language	Order No.	Item No.
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1 Preamble

1.1 General

These operating instructions are designed to make it easier to get to know the BOLL & KIRCH filter and make use of its proper intended uses.

The operating instructions contain all important instructions on how to operate the filter safely, properly and economically. Adherence to the operating instructions helps to prevent hazards, repair costs and reduce down times and increase the reliability and even the serviceable life of the filter. Read the operating instructions carefully and attentively.

Supplement the operating instructions with any instructions required due to existing national and international regulations for the prevention of accidents and environmental protection. Make sure that the operating instructions are always available in the place of use for the filter. The operating instructions must be read and applied by every person given the task of performing the following work:

- transportation,
- installation,
- operation,
- maintenance and servicing,
- Disposal.

1.2 Warranty and liability

The "General Terms and Conditions" of BOLL & KIRCH Filterbau GmbH apply.

BOLL & KIRCH Filterbau GmbH shall not recognise any warranty or liability claims for personal and material damages if they can be attributed to one or more of the following causes:

- improper use of the filter,
- failure to comply with the information and instructions in the operating instructions,
- arbitrary constructional modifications to the filter,
- insufficient monitoring of parts which are subject to wear and tear,
- maintenance/repair work performed improperly or too late,
- disasters caused by external influences or an act of God.

All the information in these operating instructions is provided to the best of our knowledge based on our prior experience. We reserve the right to make technical changes as part of further technical development.

The text and graphic illustrations do not necessarily correspond exactly to the actual delivery. Reference to any deviations is made in the respective place if required for comprehension. The graphic illustrations are not true to scale.

A list of spare parts is enclosed with the operating instructions for spare parts orders.

1.3 Copyright

These operating instructions are a certified document as per the terms of the law against unfair competition.

The copyright of the document is held by

BOLL & KIRCH Filterbau GmbH

Siemensstraße 10 - 14

50170 Kerpen

Germany

These operating instructions are for the user of the filter and the user's staff. They contain text and drawings which, without the express permission of the manufacturer must not be

- reproduced,
- distributed or
- otherwise made available to others, either in full or in part.

Failure to comply will require compensation.

2 Basic safety instructions

2.1 Proper use

The filter is constructed with state-of-the-art technology and according to the recognised rules of safety. However, use of the filter may result in risks to the life and limb of the user or third parties and/or damage to the filter or other objects of material value.

Only use the filter if it is in a technically perfect condition and only use it properly; paying due attention to safety and hazards, and in adherence to the operating instructions. It is particularly important to remedy any faults (or have them remedied), which may compromise safety.

The filter is designed only for liquid media filtration. The filter is designed for installation in pipes. The type of medium agreed in the order, and the limit values for operating pressure and temperature as set out in the technical data sheet, must be adhered to. Any other type of use or use going beyond this use, is regarded as improper use. The manufacturer/supplier shall not be liable for any damage caused as a result of improper use. The user bears the sole risk.

Proper use includes observance of the operating instructions and adherence to the inspection and maintenance conditions.

Operationally safe function is only ensured if all the instructions, settings and performance limits for the filter, are adhered to.

2.2 Warning signs and symbols

The following designations and symbols are used in the operating instructions to denote particularly important information:

DANGER!

Denotes immediate hazard with high risk which will cause death or serious physical injury if not avoided.

WARNING!

Denotes possible hazard with medium risk which may cause death or serious physical injury if not avoided.

CAUTION!

Denotes a hazard with low risk which could cause light or medium physical injury or material damages if not avoided.

NOTE

Denotes special user tips and other particularly useful or important information.

DISPOSAL

Denotes special measures for environmental protection.

2.3 Target group

The operating instructions apply for use by qualified specialist staff only.

2.4 Obligations of the user/operator

- Always keep the operating instructions at hand at the place of use of the filter.
- Adhere to general legal and other binding accident prevention regulations and environmental protection, and provide supplementary instructions in the operating instructions accordingly. This type of obligation can apply to the handling of hazardous substances or the provision / wearing of personal safety clothing and equipment, for instance.
- Supplement the operating instructions with your own instructions, including supervision and reporting obligations for specific operational matters, e.g. with regard to organisation of work, working sequences and the appointed staff.
- Observe all existing safety instructions and hazard warnings on the filter.
- Keep all existing safety instructions and danger signs on the filter complete (in number) and in a legible condition.
- Do not make modifications of any kind to the filter which may compromise safety, without the permission of the manufacturer.
- The spare parts which are used must comply with the technical requirements set out by the manufacturer. This is always guaranteed by the use of original spare parts.
- The user is responsible for the selection of materials and the chemical resistance of the installed components, internal linings and coatings. The user must specify the technical details when ordering the filter.

2.5 Selection and qualifications of staff

- All work on the filter must be performed exclusively by reliable staff. Staff must not be under the influence of drugs or medication. Adhere to the legal minimum age requirement.
- Only appoint trained staff or staff who have received appropriate instruction. Clearly delegate the areas of responsibility of staff for installation, operation and maintenance and servicing.

2.6 Organisational measures

2.6.1 General

- Follow the respective valid national and international accident prevention regulations.
- Avoid direct contact with the surfaces. Depending on the operating temperature, there may be a risk of burns.

2.6.2 Maintenance and servicing

- Adhere to the maintenance tasks and intervals set out in the operating instructions, including instructions on the replacement of parts/equipment.
- Only use original spare parts.
- If the filter is subject to a regular inspection by an inspection and testing organisation, with regard to temperature, steam pressure and the dangerousness of the medium, the inspection periods must be adhered to by the user.

2.7 Consumables

- Observe the regulations for environmental protection. Make sure that consumables are disposed of properly and in an environmentally friendly manner.

2.7.1 Filtered media

- When handling media which are to be filtered, make sure you follow the respective safety regulations for the media.

2.7.2 Cleaning agent

- When handling the cleaning agents, make sure you follow the respective safety regulations for the cleaning agents.

3 Transportation and storage

3.1 Transportation

DANGER!

Risk of accidents from falling loads

During transportation of the filter, accidents may occur due to sizes and weights.

- Exercise extreme caution when transporting the filter in order to prevent damage to or deformation of the filter.
- Only use suitable means of transport and lifting gear with sufficient load-bearing capacity.
- Do not stand underneath suspended loads. Do not work underneath suspended loads.
- Wear the appropriate protective clothing.

3.2 Storage

CAUTION!

Improper storage will cause damage to the filter and filter elements

If stored incorrectly and improperly, moisture and soiling, for example, may cause damage to the filter and the filter elements.

- Protect the filter and filter elements from moisture and soiling during storage.
- Do not store the filter and filter elements below the frost line.
- If the filter and the filter elements have been stored for more than one year, check that all seals are fully functional before installation.

3.3 Packaging material

CAUTION!

Risk of explosion from electrostatic charge

Packaging material, such as paper or plastic, can become statically charged and generate sparks when discharged.

- Remove the packaging material before transportation into an explosive atmosphere.

DISPOSAL

Observe the regulations for environmental protection. Make sure that the packaging material is disposed of properly and in an environmentally friendly manner.

4 Scope of delivery

Immediately after receiving the delivery, check that the content is not damaged and that it corresponds to the scope of the order. In case of discrepancies, contact the manufacturer.

5 Technical data

NOTE

The filter described in these operating instructions is a combination of an automatic filter and a bypass filter. The switchover between the two filters is performed using a segmented plug valve.

NOTE

You will find the technical data in the appendix of these operating instructions.

5.1 Type plate

The type plate is on the filter. You can read the maximum permitted operating pressure and the maximum / minimum operating temperature from the type plate.

NOTE

When making enquiries or ordering spare parts, always provide the information on the type plate.

5.2 Overview of automatic filter assembly group

NOTE

The description of assembly groups can be found in the "Operation" chapter of these operating instructions.

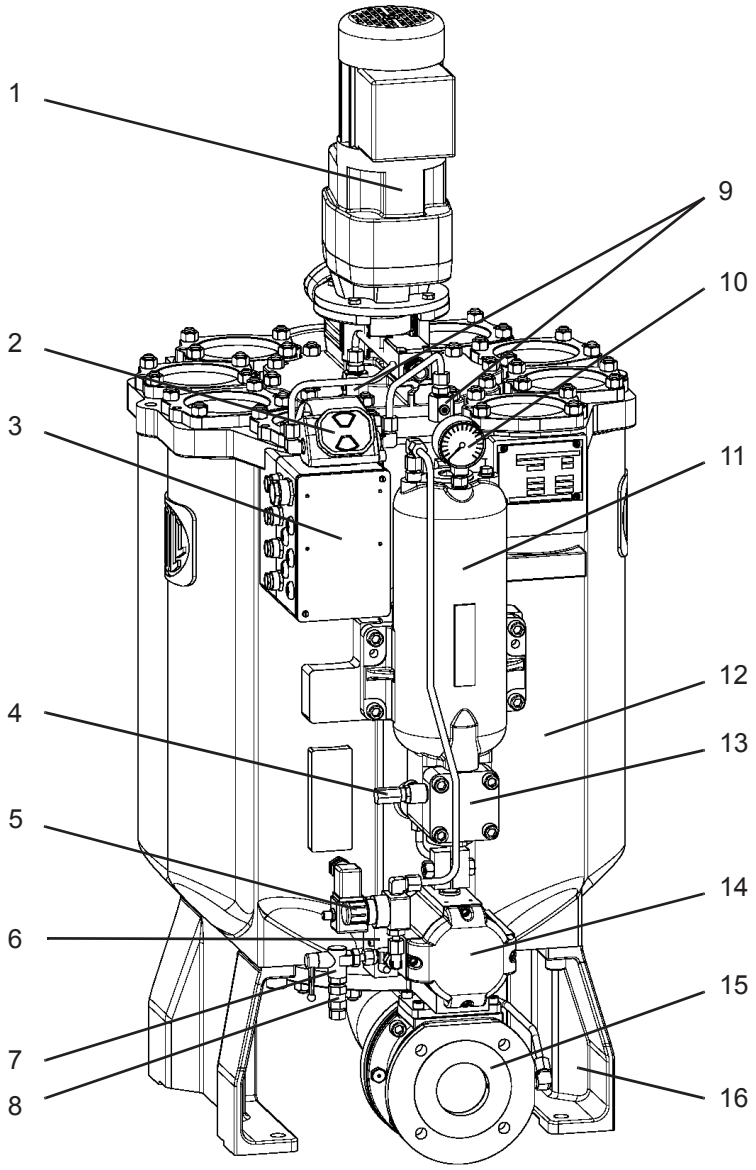


Fig. 5-1 Overview of assembly groups (view I)

1	Gear motor	9	Shut-off valve
2	Differential pressure monitoring system	10	Pressure gauge
3	Junction box	11	Air tank
4	Safety valve	12	Housing
5	Pressure control valve	13	Air valve
6	Solenoid valve	14	Pivoting actuator
7	Ball valve	15	Flushing valve
8	One-way restrictor valve	16	Floor fastening

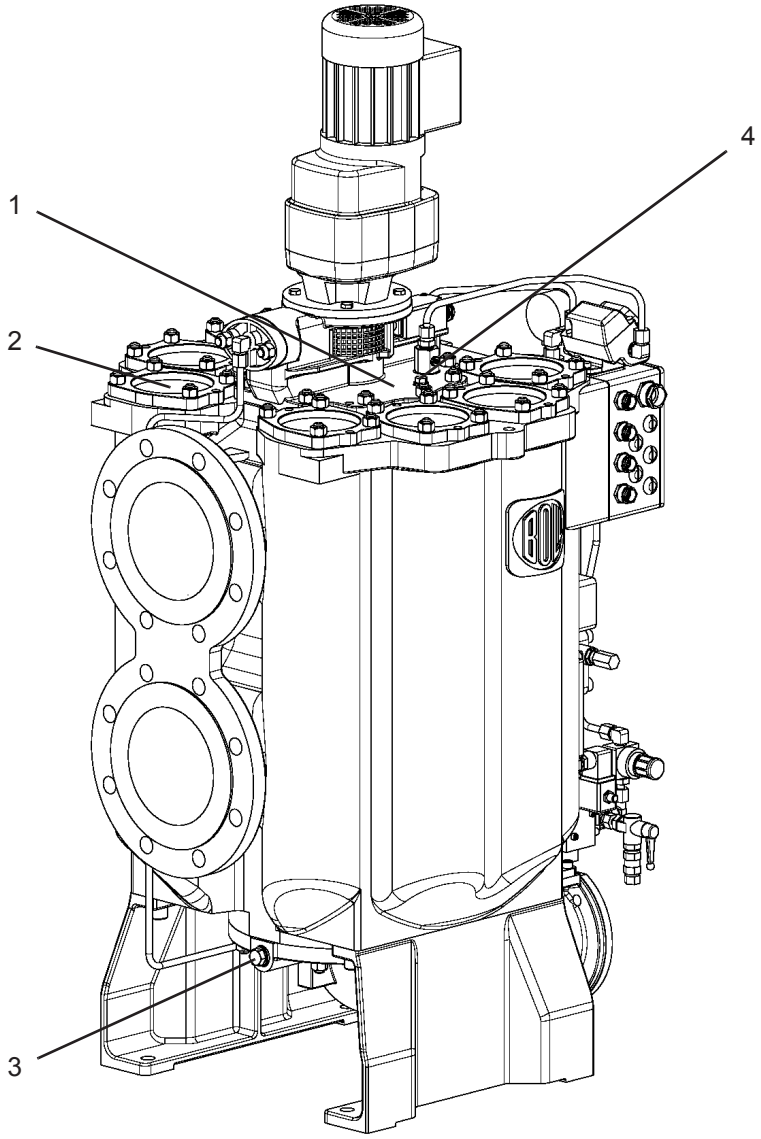


Fig. 5-2 Overview of assembly groups (view II)

1	Change-over housing cover	3	Draining
2	Cover	4	Vent

NOTE

On filters 6.64 DN 100 and DN 125, the vent is located on the housing above the air tank.

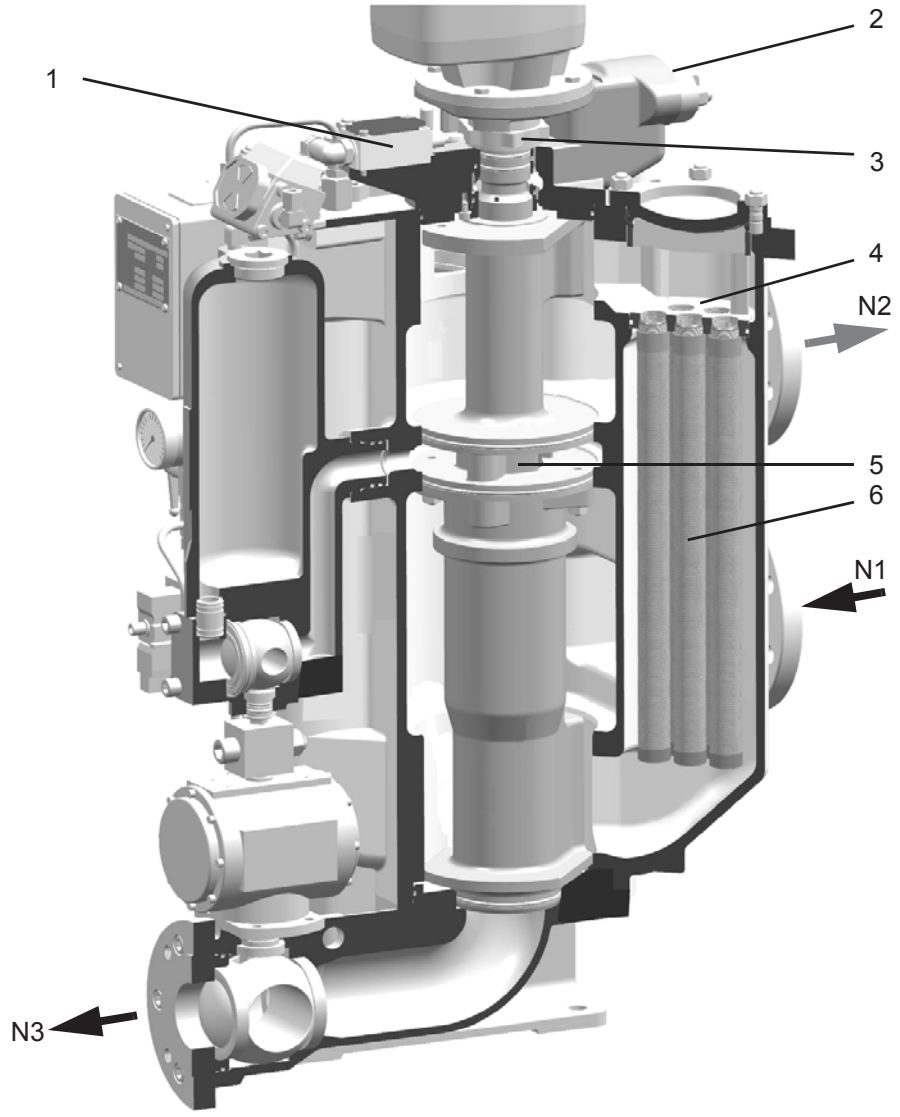


Fig. 5-3 Overview of assembly groups (cross sectional view)

1	Limit switch	6	Filter candle
2	Vent (automatic)	N1	Filter inlet
3	Cam disc	N2	Filter outlet
4	Sieve plate	N3	Flushing oil outlet
5	Plug valve		

5.3 Overview of assembly groups, segmented plug valve

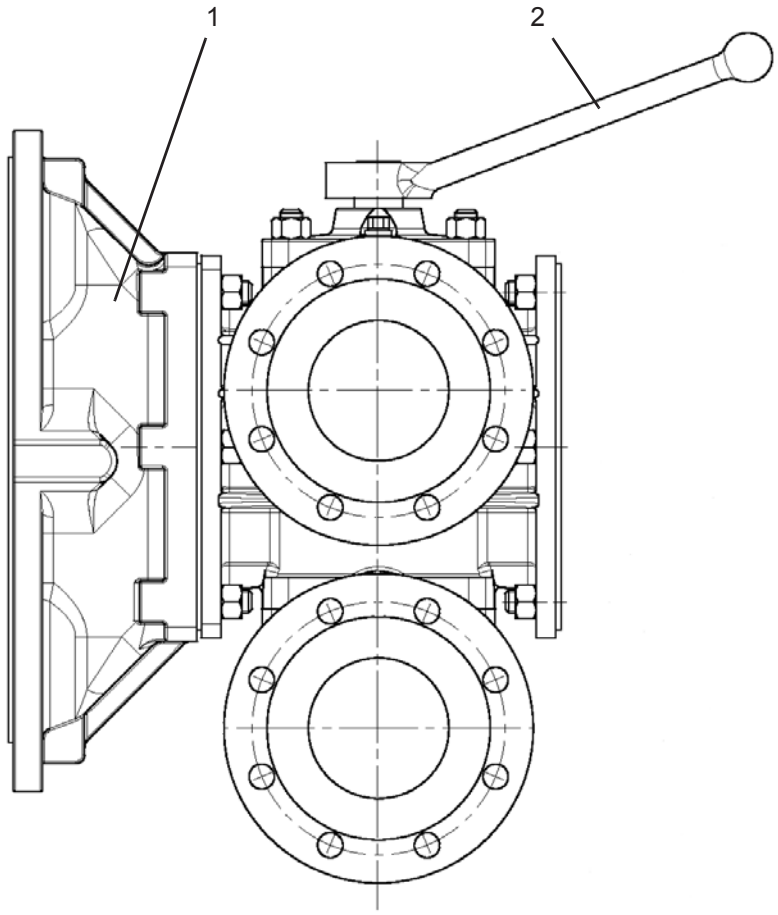


Fig. 5-4 Overview of assembly groups (view)

1 Intermediate piece

2 Key

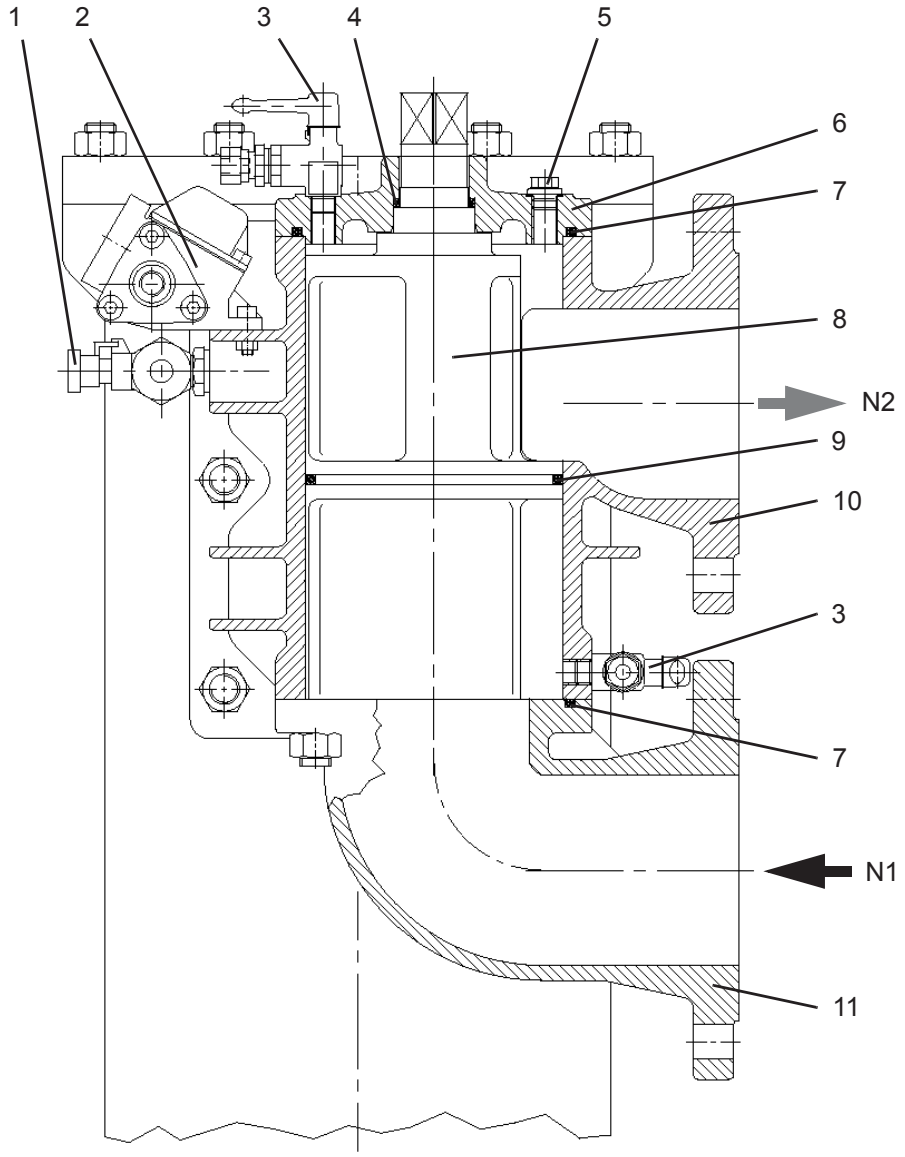


Fig. 5-5 Overview of assembly groups (cross sectional view)

1	Pressure compensation	8	Plug valve
2	Differential pressure monitoring system	9	Seal
3	Ball valve	10	Valve housing
4	Seal	11	Angled inlet
5	Vent	N1	Filter inlet
6	Valve housing cover	N2	Filter outlet
7	Seal		

5.4 Overview of bypass filter assembly group

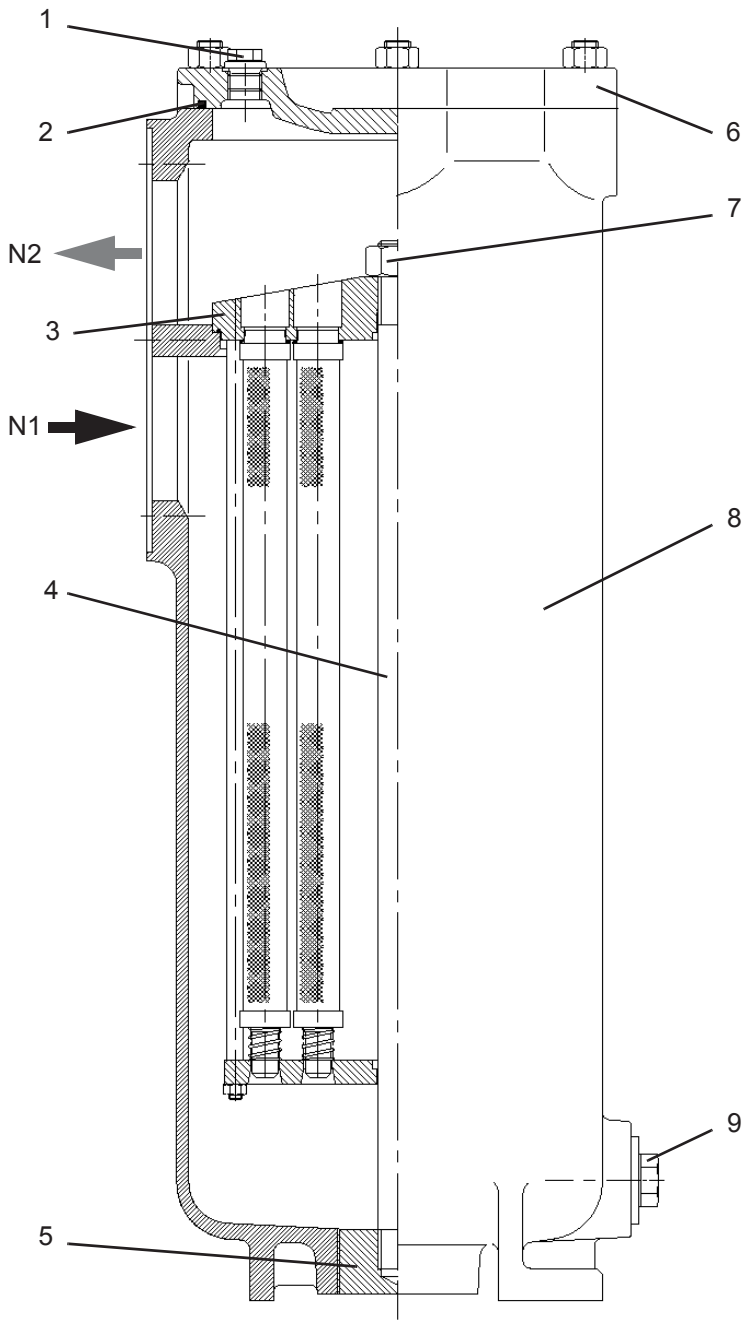


Fig. 5-6 Overview of assembly groups

1	Vent	7	Nut
2	Seal	8	Housing
3	Filter insert	9	Draining
4	Filter element anchor	N1	Filter inlet
5	Threaded plug	N2	Filter outlet
6	Cover		

6 Installation

6.1 Special safety instructions

DANGER!

Risk of accidents from improper installation

Incorrect installation and failure to observe the listed safety instructions can lead to accidents or damage to property.

Make sure of the following:

- The filter must be installed by qualified specialist staff or persons who have received appropriate instruction.
- Wear the appropriate protective clothing.
- Use of the lifting gear is only permitted for authorised persons who have received appropriate instruction.
- Cordon off the working and suspending area against access before lifting the load.
- Only use suitable lifting gear with sufficient load-bearing capacity.
- Only use lifting gear on the provided suspension points (if available).
- Proceed with extreme caution when handling the loads.
- Use lifting gear in such a way that the filter does not become damaged.
- Raise the filter evenly. Avoid tilting.
- Do not stand underneath suspended loads. Do not work underneath suspended loads.
- As there is a risk of crushing, all limbs must be kept away from separating joints.
- Additional devices to prevent maximum temperatures being exceeded and temperatures dropping below the minimum and for compensation and relief of overpressure, must be provided by the user throughout the entire system of the plant. Observe the minimum and maximum permitted operating temperatures and pressure values for the filter.
- Additional devices for monitoring the ambient temperature of the filter must be provided by the user throughout the entire system of the plant.
- Install a ground cable with a cross section of at least 10 mm² as a potential equalisation for the filter.

NOTE

Contact the manufacturer with any special questions you may have regarding installation. The contact data for the respective national subsidiaries can be found in the appendix of the operating instructions.

6.2 Preparation for transportation

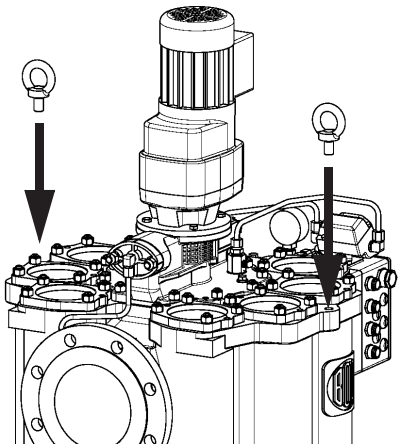


Fig. 6-1 Preparation for transportation

▶ Screw the two eye bolts (DIN 580) into the respective drilled holes in the housing.

6.3 Filter installation

CAUTION!

Risk of damage to the filter housing

The filter housings are only designed for internal overpressure.

- The housing and connection flanges of the filter must not be exposed to any external force or moment.

6.3.1 Floor fastening

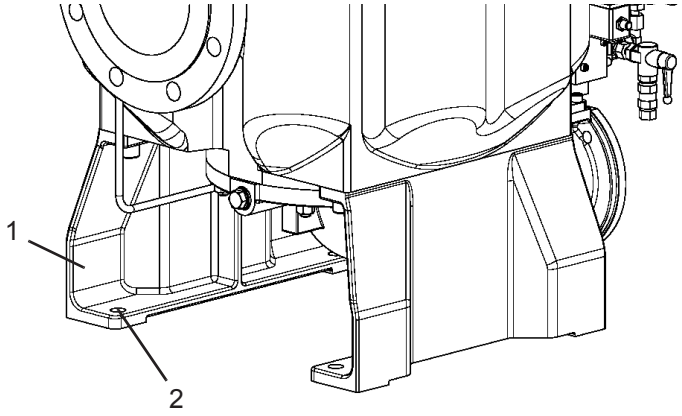


Fig. 6-2 Automatic filter with support leg for floor fastening

1 Floor fastening
2 Fastening point

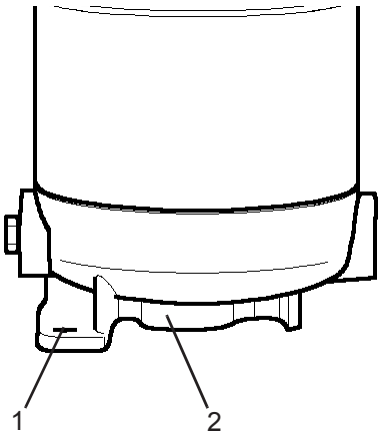


Fig. 6-3 Bypass filter with support leg for floor fastening

1 Fastening point
2 Support leg

- ▶ Make sure the foundation has sufficient load bearing capacity.
- ▶ Make sure that there is sufficient space in the vicinity of the filter for maintenance and servicing work.
- ▶ Align the filter.
- ▶ Screw the filter housing to the fastening points. When fastening the filter in place, the filter housing must not be twisted.

6.3.2 Installation diagram

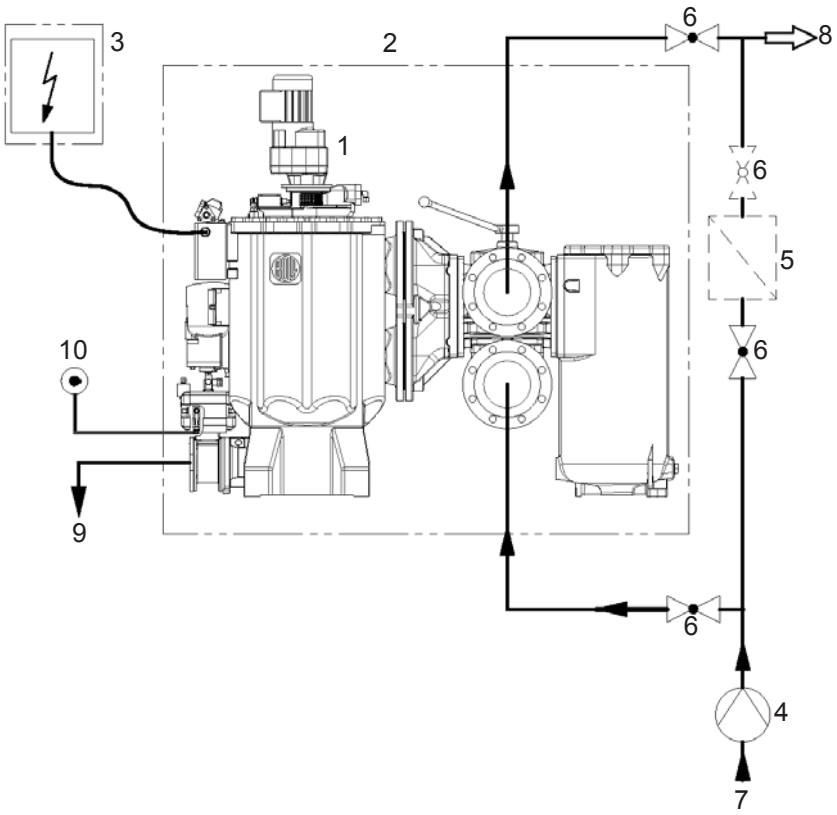


Fig. 6-4 Installation diagram

1	Filter	6	Shut-off valve
2	Scope of delivery (standard)	7	from consumer
3	Controller	8	to the consumer
4	Pump	9	Flushing oil outlet
5	Bypass filter	10	Compressed air supply

6.3.3 Identifying the flow direction

NOTE

- The filter inlet/outlet and flushing oil outlet are indicated by the inscriptions (Ein/In), (Aus/Out) and (Spülölaustritt/Flushing oil).
- The direction of flow is also shown in the technical data sheet which is included in the appendix of these operating instructions.

6.3.4 Filter inlet/outlet pipe connections

▶ Establish the connections between the filter and piping.

▶ Use the appropriate seals.

- The pipes for the filter inlet and outlet may need to be provided with additional supports, depending on the installation conditions. When installing the piping, the filter housing must not be twisted.

6.3.5 Flushing oil outlet pipe connection

- Establish the connection between the flushing oil outlet and piping.
- Use the appropriate seal.
- The pipe may need to be provided with additional supports, depending on the installation conditions. When installing the piping, the filter housing must not be twisted.
- Select a pipe cross section which is at least equal in size to the pipe cross section shown in the technical data sheet. A cross section which is too small may cause backpressure. The pipe must also be laid with an inclination and without any counterpressure.

6.3.6 Filter heater (optional)

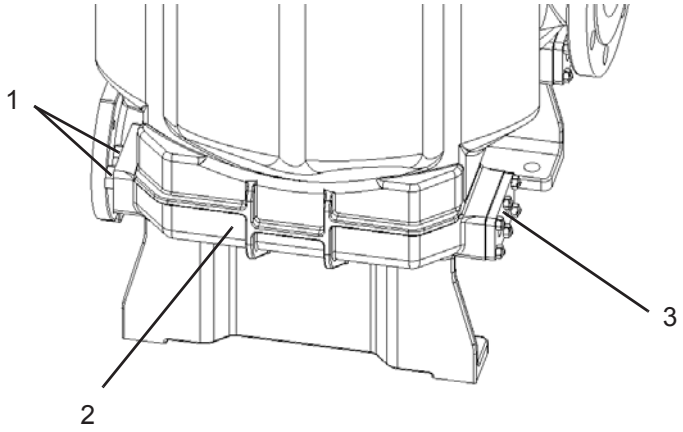


Fig. 6-5 Automatic filter heating (optional)

1 Piping connection
2 Filter heating (optional)
3 Drain plug

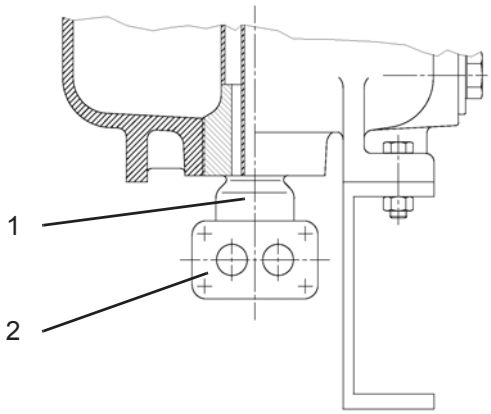


Fig. 6-6 Bypass filter heating (optional)

1 Threaded plugs with filter heating (optional)
2 Piping connection

The filter heating is used during the filtering process to cover heat loss in the filter and before starting up the plant in order to heat up the medium in the filter. The filter can be heated with water vapour, hot water or thermal oil.

DANGER!

Risk of accidents from expelled hot medium

Too much pressure in the heating system can cause hot medium to be expelled and lead to damage to the filter and accidents.

- Adhere to the maximum permitted operating temperature and operating pressure for the filter heater.

▶ Connect the medium-carrying pipes to the filter heating on the plant side. Welded joints must be made in line with the valid regulations.

6.3.7 Connection of compressed air supply

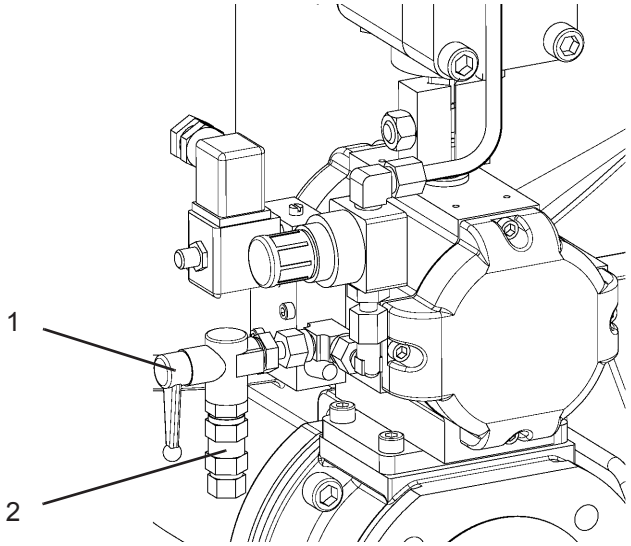


Fig. 6-7 Connection of compressed air supply

1 Ball valve

2 One-way restrictor valve

▶ Connect the plant's compressed air supply line to the one-way restrictor valve on the ball valve.

6.3.7.1 Pneumatic diagram

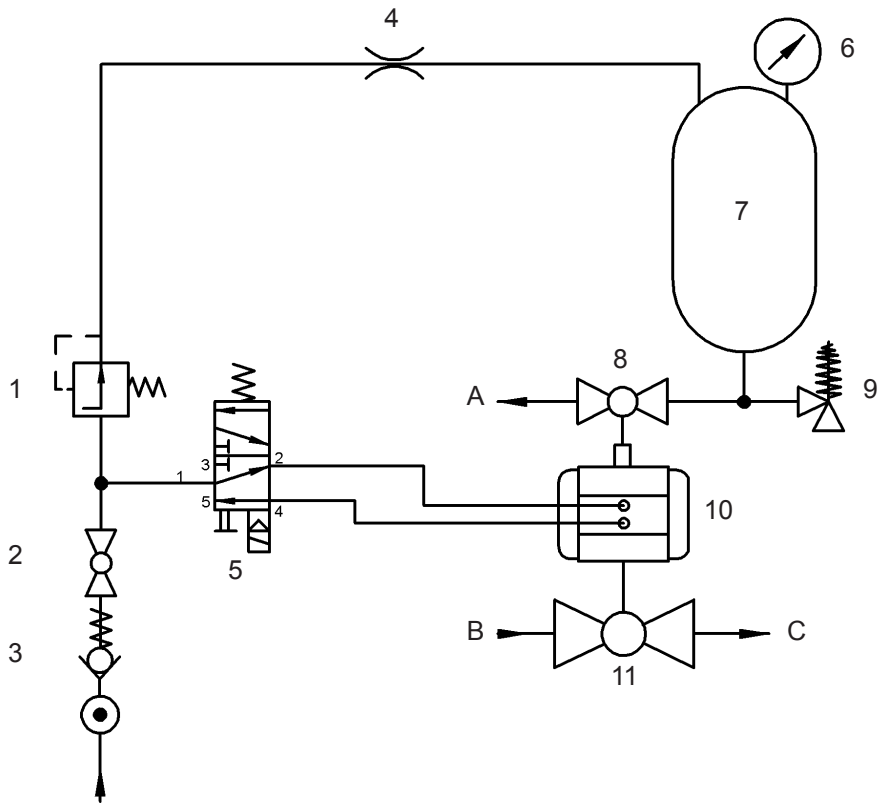


Fig. 6-8 Pneumatic diagram

1	Pressure control valve	8	Air valve
2	Ball valve	9	Safety valve
3	One-way restrictor valve	10	Pivoting actuator
4	Nozzle	11	Flushing valve
5	Solenoid valve	A	to the filter
6	Pressure gauge	B	from the filter
7	Air tank	C	Flushing oil outlet

6.3.8 Electrical connections

DANGER!

Risk of accidents from electric shock

When connecting to the power supply, the supply voltage can cause accidents from electric shock.

- All the electrical connections on the filter must be made by a qualified electrician and in line with the rules of electrical engineering.

Controller

NOTE

If you are using a BOLL & KIRCH Filterbau GmbH controller, you will find more detailed information in the documentation for the controller.

If you are using your own controller or another manufacturer's controller, the respective documentation must be followed.

Differential pressure monitoring system, electrical

NOTE

You will find more detailed information on the differential pressure monitoring system in the appendix of these operating instructions or in the manufacturer's documentation.

NOTE

BOLL & KIRCH Filterbau GmbH differential pressure indicators have potential-free contacts.

CAUTION!

Risk of malfunction or damage to the filter or plant

Failure to react to the alarms can lead to malfunctions or damage to the filter or the plant.

- Connect the differential pressure monitoring system so that the alarms are issued.
- It is imperative to react to any active alarms and remedy the cause immediately.

6.3.9 Potential equalisation

▶ For potential equalisation, install a ground cable with a cross section of at least 10 mm² on the filter.

▶ Connect the ground cable to the fastening screw on the filter. If necessary, prior to the installation of the ground cable, remove the paint from the fastening point to ensure sufficient electrical contact.

7 Operation

7.1 Functional description of the automatic filter

The automatic filter is used to filter particles from media in order to protect the downstream parts of the plant.

The filter candles are cleaned automatically so that the plant does not have to be switched off for cleaning.

7.1.1 Filter housing

The filter housing contains all the pipe connections and assembly groups of the backflushing device, the vent, drain hole and the connection points for the pressure monitoring system.

The filter chambers are arranged in a circle around the central drilled hole for fitting the plug valve. The filter chambers are sealed by a single cover.

7.1.2 Controller

The controller regulates and monitors all automatic filter functions.

NOTE

If you are using a BOLL & KIRCH Filterbau GmbH controller, you will find more detailed information in the documentation for the controller.

If you are using your own controller or another manufacturer's controller, the respective documentation must be followed.

7.1.3 Differential pressure monitoring system

The differential pressure monitoring system measures the differential pressure between the filter inlet and filter outlet. As the soiling increases, the differential pressure in the filter also increases.

The controller processes the electrical signals from the differential pressure monitoring system and triggers backflushing when the set maximum value is reached.

NOTE

- You will find more detailed information on the differential pressure monitoring system in the appendix of these operating instructions or in the manufacturer's documentation.
- The differential pressure can also be displayed optically on the differential pressure monitoring system.
- The control line for the differential pressure monitoring system is fitted with shut-off valves (e.g. shut-off valves).

7.1.4 Air tank

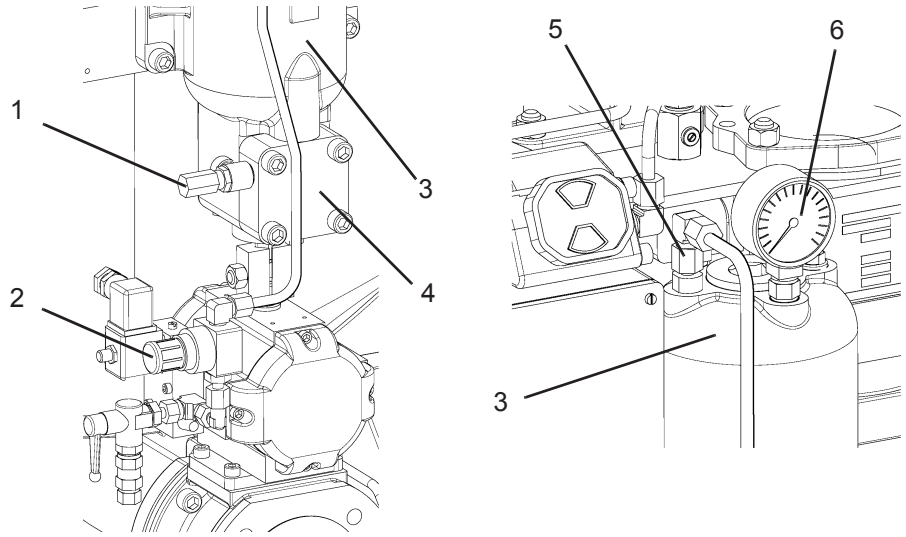


Fig. 7-1 Overview of the air tank

1	Safety valve	4	Air valve
2	Pressure control valve	5	Nozzle
3	Air tank	6	Pressure gauge

The compressed air in the air tank expands explosively when the air valve is opened. The flow which this causes, pushes the medium on the clean side of the filter candles through the filter material of the filter candles in the counterflow direction at high speed. The pressure level in the air tank can be read from the pressure gauge and set using a pressure control valve. The air tank is equipped with a safety valve to prevent the air tank from being damaged by overpressure.

7.1.5 Gear motor with limit switch

If the pressure gradient between the dirty side and the clean side reaches a set value due to the growing layer of dirt on the filter material, the automatic filter chamber regeneration is triggered. The gear motor turns the plug valve so that the flow to one of the soiled filter chambers is shut off and, at the same time, the stand-by filter chamber is activated. Once the plug valve reaches the filter chamber which is to be cleaned, a cam and limit switch stop the turning movement.

7.1.6 Flushing oil line

The particles flushed out of the filter candles are discharged via the flushing oil line. The flushing valve opens or seals off the flushing oil line.

7.1.7 Filtration stage

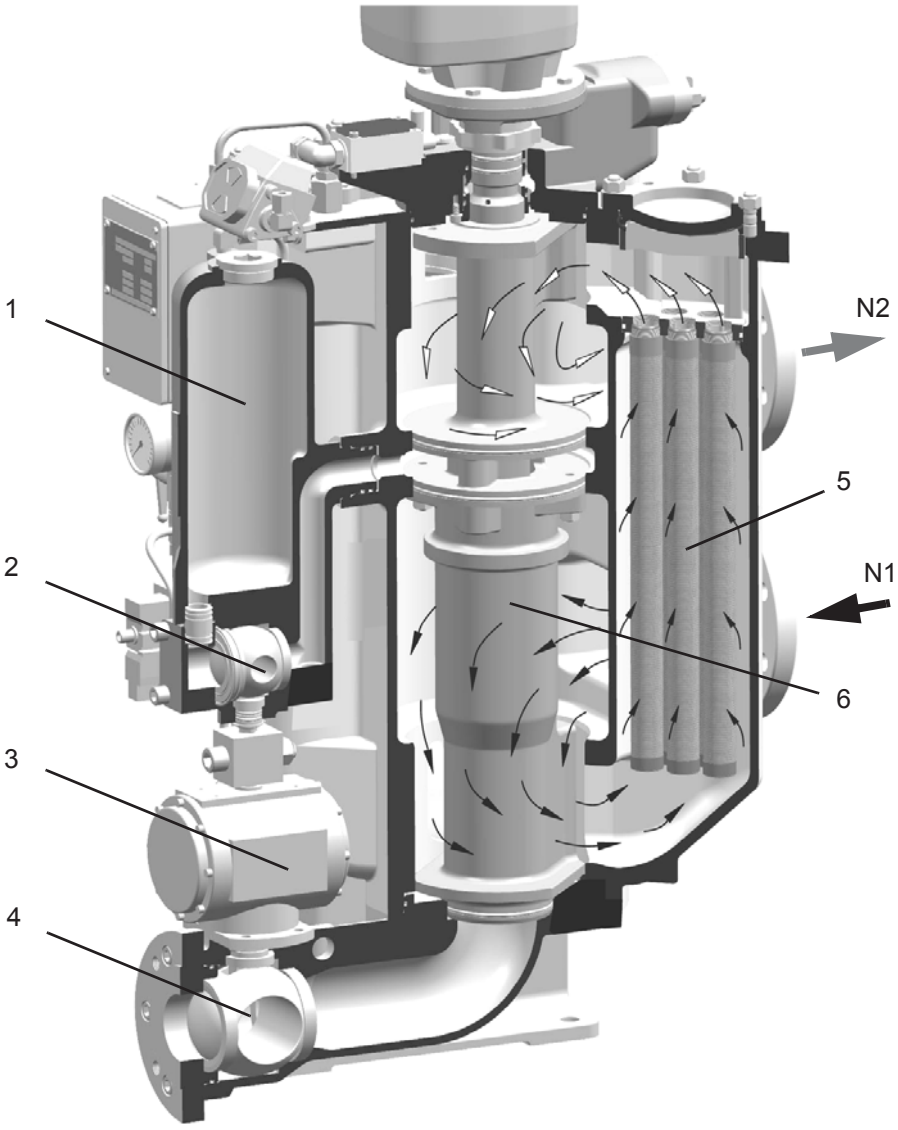


Fig. 7-2 Filtration stage

1	Air tank	5	Filter candle
2	Air valve	6	Plug valve
3	Pivoting actuator	N1	Filter inlet
4	Flushing valve	N2	Filter outlet

The medium being filtered flows through the lower inlet flange into the housing, from where it flows into the individual filter chambers and to the filter candles. The medium flows through the filter candles from the outside to the inside and the particles in the medium are held back on the filter medium of the filter candles.

The cleaned medium proceeds to the filter outlet above.

The solenoid valve is switched so that the pivoting actuator keeps the air valve and the flushing valve closed.

The plug valve isolates one of the cleaned filter chambers.

In the air tank, compressed air is available for the next backflushing.

7.1.8 Backflushing stage

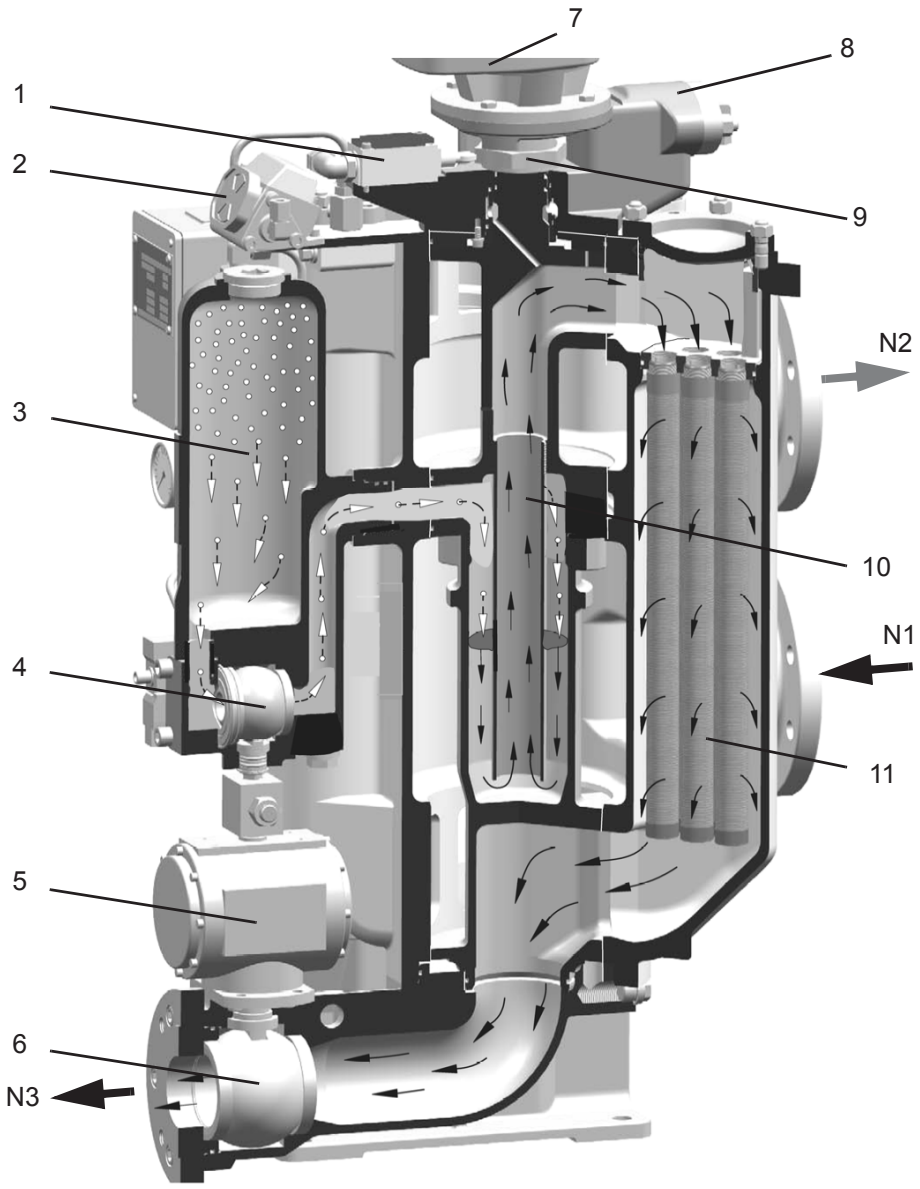


Fig. 7-3 Backflushing stage

1	Limit switch	8	Vent (automatic)
2	Differential pressure monitoring system	9	Cam disc
3	Air tank	10	Plug valve
4	Air valve	11	Filter candle
5	Pivoting actuator	N1	Filter inlet
6	Flushing valve	N2	Filter outlet
7	Gear motor	N3	Flushing oil outlet

The foreign substances held back on the filter candles generate a growing differential pressure between filter inlet and outlet.

Backflushing is triggered by the controller when the differential pressure reaches a certain value.

When backflushing is triggered the gear motor is switched on and the plug valve is turned from the filter chamber on stand-by to the nearest soiled filter chamber.

The activation of the stand-by filter chamber with the clean filter candles causes an immediate differential pressure relief. Once the plug valve reaches the filter chamber which is to be cleaned, a cam disc and limit switch stop the turning movement.

The solenoid valve is then switched over electrically and the air valve and the flushing valve are opened simultaneously by the pivoting actuator. The compressed air in the air tank is expelled abruptly into the internal cavity in the plug valve and pushes the medium through the filter candles at high speed, in the opposite direction to the direction of filtration. This dislodges deposited particles of dirt from the filter material and discharges them through the flushing valve with the liquid in the filter chamber.

The flushing valve and the air valve are then closed by the pivoting actuator. The air tank is re-filled with compressed air.

The filter chamber is filled with cleaned medium through a drilled hole on the clean side of the plug valve. In the process, the air in the filter chamber is discharged by an automatic vent.

During this flushing time, a further backflushing process cannot be started because the controller disables this action.

The backflushing process is completed; the cleaned filter chamber remains shut off from the filtration process until the next backflushing process.

CAUTION!

Risk of damage to the filter from improper flushing

Flushing an only partially filled filter causes increased strain on the filter candles.

- Never perform backflushing due to installation or control circumstances in an only partially filled filter. A completely drained filter can be flushed for test purposes without any restrictions.

7.2 Functional description of the segmented plug valve

The segmented plug valve is used to switch between the connected automatic and bypass filter.

The special shape of the plug valve prevents breaks in the flow of medium and pressure surges when switching over and, at the same time, guarantees ease of movement due to lower levels of frictional force.

The plug valve only requires seals in two positions; on the large washer and on the plug valve neck.

The switch-over is performed manually using the attachable lever. The mark sawn into the neck of the plug valve shows the direction of flow and indicates which filter is in operation. The construction of the circuit prevents both filter from being shut down at the same time.A pressure compensation valve is fitted to the segmented plug valve to compensate pressure between the two connected filters. It is opened and closed manually. The valve housing can be bled through the vent. The attached differential pressure monitoring system is the filter's contamination indicator.

7.2.1 Plug valve circuit

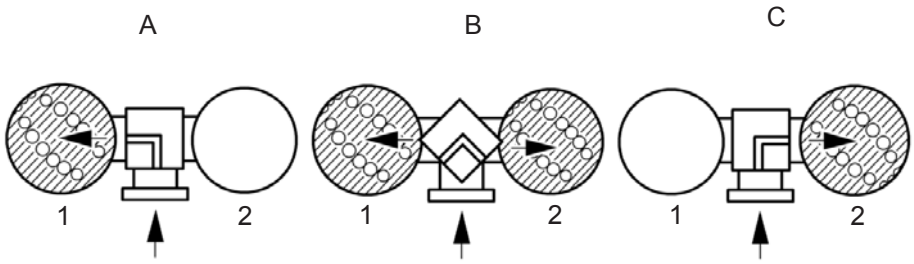


Fig. 7-4 Position of the segmented plug valve

1	Automatic filter
2	Bypass filter
A	Automatic filter in operation
B	Automatic filter and bypass filter in operation
C	Bypass filter in operation

7.2.2 Pressure compensation

CAUTION!

Risk of damage or expelled medium if the pressure compensation is positioned incorrectly

Depending on the operating stage, if the pressure compensation valve is in the wrong position, medium may be expelled or damage may be caused.

- The pressure compensation valve must always remain open during operation.
- Before opening a filter the pressure compensation valve must be closed so that no medium flows when the filter is open.

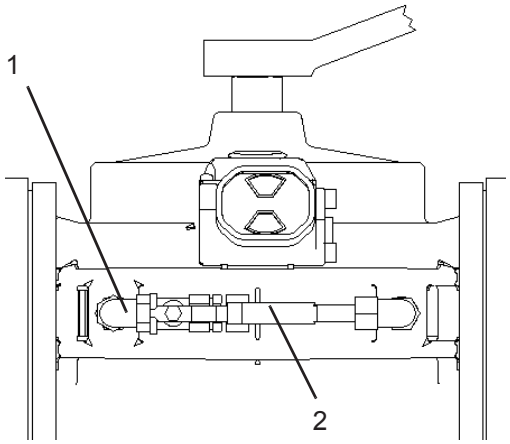


Fig. 7-5 Pressure compensation

1	Pressure compensation
2	Pressure compensation valve

Lever pointing lengthways along the line	Pressure compensation valve open
Lever pointing across the line	Pressure compensation valve closed

7.3 Functional description of the bypass filter

The bypass filter is used to filter particles from media in order to protect the downstream parts of the plant. The bypass filter is used in situations in which the filtering process must not be stopped even whilst maintenance or repairs are being performed on the automatic filter.

The medium being filtered flows through the lower inlet flange into the housing, from where it flows into the filter chambers. The medium flows through the filter element from the outside to the inside and the particles in the medium are held back on the filter material of the filter element.

The cleaned medium proceeds to the filter outlet above.

The bypass filter is monitored by the differential pressure monitoring system on the segmented plug valve.

7.3.1 Differential pressure monitoring system

The differential pressure monitoring system measures the differential pressure between the filter inlet and filter outlet. As the soiling in the filter element increases, the differential pressure in the filter also increases.

The differential pressure monitoring system indicates the differential pressure optically and/or provides electrical signals for further processing.

NOTE

- You will find more detailed information on the differential pressure monitoring system in the appendix of these operating instructions or in the manufacturer's documentation.
- The control line for the differential pressure monitoring system is fitted with shut-off valves (e.g. ball valves).

7.3.2 Housing cover safety device (optional)

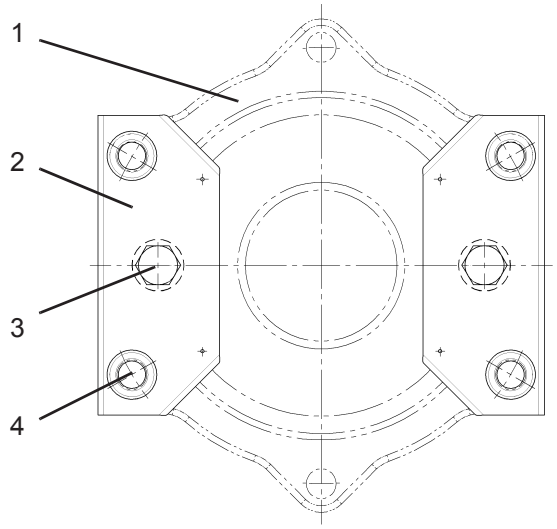


Fig. 7-6 Housing cover safety device (optional)

1	Cover
2	Housing cover safety device (optional)
3	Vent
4	Cover screw

The housing cover safety device has the task of preventing pressurised medium from being expelled uncontrolledly in case of incorrect operation. The cover sheet covers a minimum number of cover screws so that the cover cannot be removed without opening the vent to bleed the system.

The filter chamber is relieved via the vent. When the filter is shut off, the operating pressure is immediately relieved and hardly any medium is expelled. Otherwise, close the vent immediately and the expulsion of medium is limited.

DANGER!

Risk of accidents from expelled medium

Hot medium may be expelled when opening the vent.

- Proceed with extreme caution.
- Wear the appropriate safety equipment and clothing.

DISPOSAL

Leaks must be caught immediately. Make sure that expelled medium is disposed of properly and in an environmentally friendly manner.

7.4 Automatic filter filter insert

7.4.1 Filter insert with filter candles

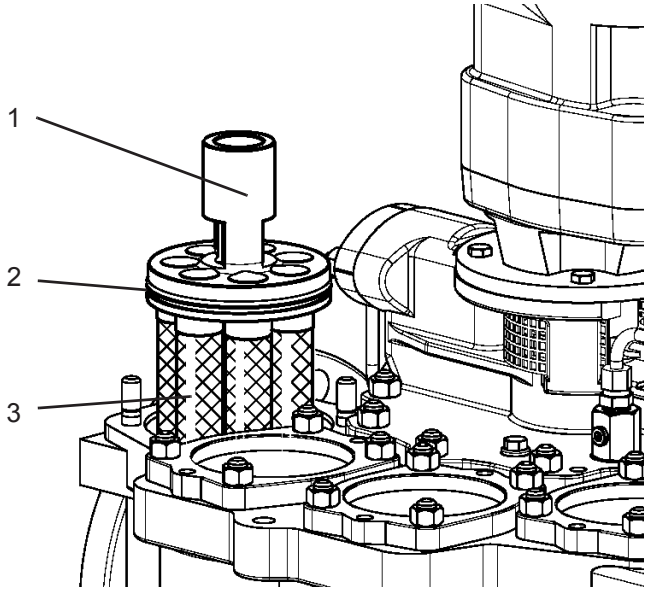


Fig. 7-7 Construction of the filter insert with filter candles

1 Sieve plate

2 Seal

3 Filter candle

7.4.2 Functional description of the filter insert with filter candles

Filter inserts with filter candles are used for filtration. The flow runs from the outside to the inside into the individual filter candles.

Particles of dirt in the flow are thus filtered off by the filter candles. The cleaned medium exits from the top of the filter candles and is fed back into the plant.

The filter insert comprises several filter candles arranged in parallel. The filter candles all have the same dimensions; they are interchangeable and can also be removed separately. They are screwed into the sieve plate.

The type, design and number of filter candles used depends on the medium being filtered.

For media with a high ferrite content, a filter candle in the middle of the filter insert can be replaced with an optional magnetic primary filter.

The sieve plate secures the filter candles and thus protects the filter material of the filter candles from damage during removal and installation.

The dirty side is sealed off from the clean side by seal on the sieve plate.

7.5 Bypass filter filter insert

7.5.1 Star-pleated filter element

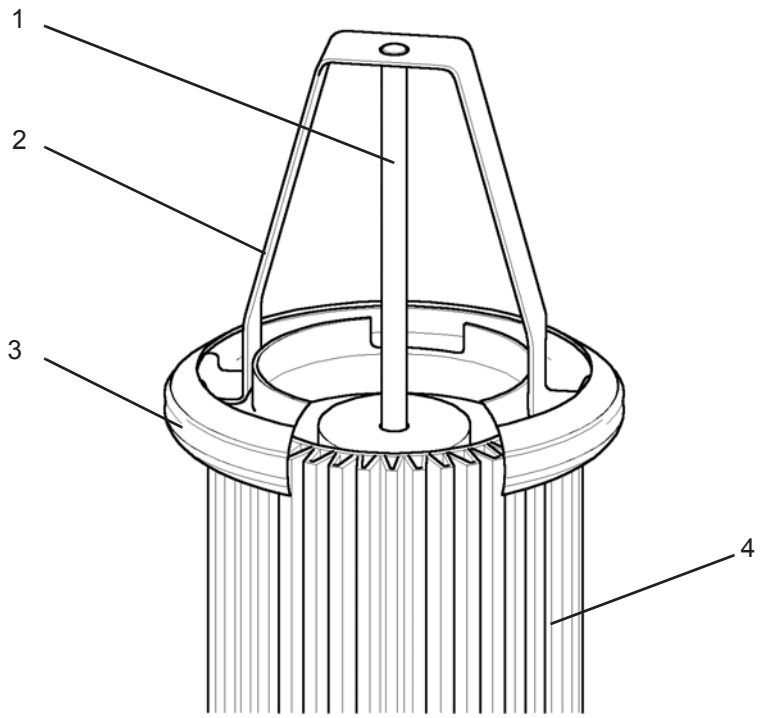


Fig. 7-8 Construction of star-pleated filter element

1 Magnetic insert (optional)
2 Filter element clamp
3 Seal
4 Filter material

7.5.2 Functional description of the star-pleated filter element

Star-pleated filter elements are used for filtration. The flow runs from the outside to the inside.

Particles of dirt in the flow are thus filtered off by the star-pleated filter element and held back in the filter material outside. The cleaned medium then exits from the star-pleated filter element and is fed back into the plant.

The filter element clamp fastens the star-pleated filter element in the filter chamber.

The dirty side is sealed off from the clean side by a seal.

Construction and function of the magnetic insert (optional)

For media with a high ferrite content, it is recommendable to equip the star-pleated filter element with a magnetic insert.

The magnetic insert comprises a cylinder-shaped magnet which is mounted on a metal bar. The top end of the magnetic insert has a thread for connecting it to the filter element clamp.

The magnetic insert is removed for cleaning and the collected dirt particles can be easily removed.

7.6 Commissioning

CAUTION!

Risk of damage to the filter from improper filling

If the filter is filled improperly, the filter elements may be damaged.

- Filling the filter against the indicated direction of flow of the filter elements is not permitted.

NOTE

If you are using a BOLL & KIRCH Filterbau GmbH controller, you will find more detailed information in the documentation for the controller.

If you are using your own controller or another manufacturer's controller, the respective documentation must be followed.

- ▶ Check whether all connections have been made properly.
- ▶ Check that the segmented plug valve circuit moves easily. Attach the lever and move it several times from one limit stop position to the other.
- ▶ Attach the lever to the segmented plug valve and set the plug valve to the "Automatic filter in operation" position.
- ▶ Open the shut-off valves in the control lines to the differential pressure monitoring systems.
- ▶ Open the pressure compensation valve (lever pointing lengthways along the line).
- ▶ Make sure that there is compressed air with sufficient operating pressure on the filter's ball valve.

CAUTION!

Risk of damage to the filter if operated without compressed air supply

If the controller is switched on and the filter is commissioned without compressed air supply, the solenoid valves may become damaged.

- Always open the filter's ball valve first when commissioning in order to ensure that compressed air is supplied.

- ▶ Open the compressed air shut-off valve on the filter.
- ▶ Check the set pressure on the air tank's pressure gauge. If necessary, adjust the pressure on the pressure control valve.
- ▶ Put the filter into operation using the controller. Backflushing is automatically performed in one of the filter chambers.
- ▶ Check that the controller is functioning by performing backflushing manually.
- ▶ Open the filter outlet shut-off valve
- ▶ Slowly open the filter inlet shut-off valve. Avoid pressure surges.

DANGER!

Risk of accidents from expelled medium

Hot medium may be expelled when opening the vent.

- Proceed with extreme caution.
- Wear the appropriate safety equipment and clothing.

DISPOSAL

Leaks must be caught immediately. Make sure that expelled medium is disposed of properly and in an environmentally friendly manner.

▶ Carefully open the vent on the bypass filter. The bypass filter is filled via the open pressure compensation valve.

▶ Close the vent as soon as medium is expelled from a vent without any bubbles.

▶ Carry out backflushing once more manually using the controller.

NOTE

After backflushing is complete, the next backflushing cycle (manual or triggered by the differential pressure monitoring system) can only be started with a time delay. This time delay is the time set on the time relay or the preset time on the controller. It is needed to ensure that the cleaned filter chamber can be filled.

▶ The filter is ready for operation.

DISPOSAL

Leaks must be caught immediately. Make sure that expelled medium is disposed of properly and in an environmentally friendly manner.

▶ After each time you commission the filter, check the filter for leaks and eliminate them as necessary.

7.6.1 Determination of time interval for time-controlled backflushing

▶ Allow the filter to operate for 24 hours with differential pressure and record the number of flushes from the flushing cycle counter or the controller. In order to allow the filter to operate for 24 hours with differential pressure, you have to deactivate the intervals for forced flushing on the controller.

▶ Calculate the average of all flushing intervals.

▶ Reset the flushing interval time (which should be 30 % shorter) on the controller.

7.7 Removal from service

7.7.1 Short-term removal from service

▶ Depressurise and drain the filter chambers, see chapter 8, section "Preparatory work".

NOTE

When using the filter in watery media, it is imperative to adhere to the following:

- Do not allow the filter to run to empty after switching off the supply pump. Dirt may otherwise be allowed to harden.
- If the above condition cannot be met, set the controller so that backflushing is triggered every 2 hours even if the supply pump is switched off.

7.7.2 Longer term removal from service / removal

▶ Depressurise and drain the filter chambers, see chapter 8, section "Preparatory work".

NOTE

When removing the filter and taking it out of service for longer periods, pay attention to the following points:

- The filter must be completely emptied.
- Disconnect all connections from the filter.
- The filter must be thoroughly cleaned.
- The filter must be sealed by applying an appropriate anticorrosive, if necessary.
- The connection flange openings must be sealed with plastic (or similar) dummy plugs.

7.7.3 Disposal

DISPOSAL

When the filter or individual components and consumables are finally disposed of, make sure that they are disposed of in an environmentally friendly manner.

8 Maintenance and servicing

8.1 Special safety instructions

DANGER!

Risk of accidents from improper maintenance and servicing

Incorrect maintenance and servicing and failure to observe the listed safety instructions can lead to accidents and damage to property. Make sure of the following:

- Maintenance and servicing work must only be carried out by qualified specialist staff or persons who have received appropriate instruction.
- When performing any work on the filter, always wear the appropriate safety clothing.
- Use of the lifting gear is only permitted for authorised persons who have received appropriate instruction.
- Cordon off the working and suspending area against access before lifting the load.
- Only use suitable lifting gear with sufficient load-bearing capacity.
- Only use lifting gear on the provided suspension points (if available).
- Proceed with extreme caution when handling the loads.
- Use lifting gear in such a way that the filter or the components do not become damaged.
- Raise the filter or the components evenly. Avoid tilting.
- Do not stand underneath suspended loads. Do not work underneath suspended loads.
- As there is a risk of crushing, all limbs must be kept away from separating joints.
- Only perform maintenance and servicing work when the filter is cooled, depressurised and drained. Depending on the operating temperature, there may be a risk of burns.
- Ensure the highest levels of cleanliness when opening the filter. No foreign substances, e.g. tools, cleaning cloths, impurities, etc., must be allowed to remain in the filter.
- Visually inspect all seals during maintenance and replace them as necessary.
- Clean all sealing surfaces thoroughly before assembly.
- On completion of the maintenance work, re-fit all available safety equipment properly.
- Filling the filter against the indicated direction of flow of the filter elements is not permitted.
- Remove the filter from service if the inspection periods (if indicated) have elapsed.
- Filter elements are sensitive to pressure and impact. Always exercise extreme caution when installing and removing the filter elements. Before installation, check all filter elements/seals and replace any damaged filter elements/seals as necessary.

8.2 Cleaning agents

CAUTION!

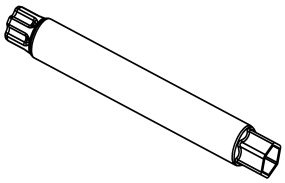
Risk of damage to the filter from incorrect use of cleaning agents

The components of the filter may become damaged if cleaning agents are used incorrectly. The correct cleaning agent is selected in accordance with the type of medium being filtered and the associated contaminations.

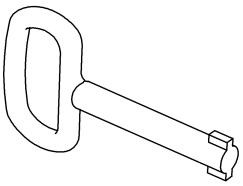
- BOLL & KIRCH Filterbau GmbH recommends BOLL CLEAN 2000 cleaning agent. For more detailed information, see the appendix of these operating instructions.

8.3 Special tool

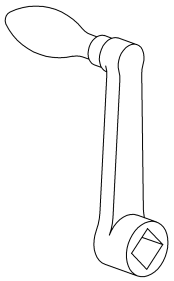
The manufacturer provides the following special tools for the filter:



Wrench for removing the filter candles



Key for opening the controller



Hand winch for actuating the filter in case of mains failure

8.4 Maintenance intervals

Even automatic filters have to undergo regular checks and maintenance.

It is particularly important to note that the filter material on the filter elements may become blocked over time despite regular backflushing. This depends largely on the quality of medium and the available partial flow cleaning function. The soiling can be removed by cleaning the filter elements by hand using a suitable cleaning agent.

NOTE

BOLL & KIRCH Filterbau GmbH recommends BOLL CLEAN 2000 cleaning agent. For more detailed information, see the appendix of these operating instructions.

You can tell that the filter elements are becoming increasingly blocked because the flushing intervals become shorter and shorter.

The number of backflushing cycles performed is recorded by the controller.

CAUTION!

Risk of damage to the filter and the plant from damaged filter elements

If the flushing intervals suddenly become longer, this may indicate that the filter elements are damaged.

- In such an event, check all filter elements for damage immediately. Replace any damaged filter elements as necessary.

In order to make sure the automatic filter continues to operate properly, observe the following points for maintenance:

- Regularly check:
  - the differential pressure,
  - the leak tightness of the automatic filter, especially all connections and seals and
  - the automatic filter for corrosion and other damage,
  - the condition of all lines,
  - the condition of the filter elements and
  - the condition of all screw connections and whether they are firmly tightened.
- Replace any damaged components.
- The automatic filter must be inspected annually for leaks.
- Check all filter elements for soiling after the first 500 flushes, then after a further 5,000 and afterwards, every 10,000 flushes. To do so, remove the filter inserts and clean the filter elements. If the backflushing intervals shorten considerably beforehand, you must carry out checks and cleaning earlier.
- Replace all seals at least every 2 years and when overhauling.

NOTE

The filter elements are subject to wear from two-way strain. It is therefore recommendable to keep a complete set of filter elements in stock.

In order to make sure the bypass filter continues to operate properly, observe the following points for maintenance:

- Regularly check:
  - the differential pressure,
  - the leak tightness of the bypass filter, especially all connections and seals and
  - the bypass filter for corrosion and other damage,
  - the condition of the filter element and
  - the condition of all screw connections and whether they are firmly tightened.
- The bypass filter must be inspected annually for leaks.
- If the differential pressure reaches the preset maximum value, the filter has to be cleaned.
- Replace all seals at least every 2 years and when overhauling.

In order to make sure the segmented plug valve continues to operate properly, observe the following points for maintenance:

- Regularly check:
  - the ease of movement of the plug valve,
  - the leak tightness of the segmented plug valve circuit, especially all connections and seals and
  - the segmented plug valve for corrosion and other damage and
  - the condition of all screw connections and whether they are firmly tightened.
- The segmented plug valve must be inspected annually for leaks.
- Replace all seals at least every 2 years and when overhauling.

NOTE

When filtering media which can leave deposits on the segmented plug valve circuit, it is recommendable to activate the segmented plug valve circuit as often as possible and at regular intervals in order to prevent it from seizing up.

8.5 Cleaning/replacing the filter element on the automatic filter

8.5.1 Preparatory work

NOTE

If you are using a BOLL & KIRCH Filterbau GmbH controller, you will find more detailed information in the documentation for the controller.

If you are using your own controller or another manufacturer's controller, the respective documentation must be followed.

DANGER!

Risk of accidents from expelled medium

Hot medium may be expelled when opening the vent.

- Proceed with extreme caution.
- Wear the appropriate safety equipment and clothing.

DISPOSAL

Leaks must be caught immediately. Make sure that expelled medium is disposed of properly and in an environmentally friendly manner.

- ▶ Carefully open the vent on the bypass filter to check whether it is full.
- ▶ Close the vent once medium starts to be expelled.
- ▶ Attach the lever to the segmented plug valve and set the plug valve to the "Bypass filter in operation" position.
- ▶ Close the pressure compensation valve (lever pointing across the line).
- ▶ Using the controller, trigger one backflushing for each filter chamber but one.
- ▶ Afterwards, close the ball valve for the filter's compressed air supply. Secure the compressed air supply to prevent it from being switched on unintentionally.
- ▶ Then, carry out manual backflushing for the filter chamber which has not yet been flushed to relieve the remaining pressure from the air tank.
- ▶ Switch off the controller.

DANGER!

Risk of accidents due to controller being switched on unintentionally

During maintenance accidents may be caused if the controller is switched on unintentionally, e.g. by starting up the drives or from expelled medium.

- Secure the controller to prevent it from being switched on unintentionally, e.g. by attaching a lock.

- ▶ Check the pressure gauge to establish whether the air tank is genuinely depressurised.
- ▶ The filter chambers are now drained and depressurised.

DANGER!

Risk of accidents from expelled medium

Hot medium may be expelled when opening the filter chamber.

- Depressurise and lower the level of medium before removing the filter insert.

NOTE

Unlike valve and ball valve circuits, the segmented plug valve circuit cannot be fully sealed off. Flowing medium can be drained during the cleaning process as necessary using the drain hole. Afterwards, close the drain hole again.

DISPOSAL

Leaks must be caught immediately. Make sure that expelled medium is disposed of properly and in an environmentally friendly manner.

▶ Remove the covers from the filter chambers. If necessary, use jacking bolts.

8.5.2 Removing the filter insert with filter candles

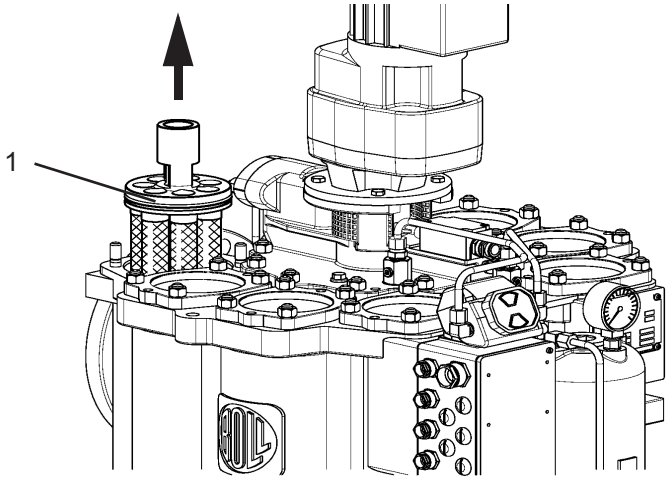


Fig. 8-1 Removing the filter insert with filter candles

1 Filter insert

- ▶ Remove the filter inserts from the filter chambers by pulling them vertically upwards.
- ▶ Allow the filter inserts to drip dry in a suitable container.

8.5.3 Cleaning the filter insert with filter candles

CAUTION!

Risk of damage to the filter insert from improper cleaning

If the filter insert is cleaned or handled improperly, the filter insert may become damaged. Observe the following safety instructions:

- Proceed with extreme caution when performing all cleaning work.
- The soaking time in the "BOLL CLEAN 2000" cleaning agent must not exceed 24 hours.
- The cleaning temperature, when using "BOLL CLEAN 2000" must not exceed 60 °C.
- When cleaning using a high-pressure cleaner, the pressure must not exceed a maximum of 60 bar. When cleaning using a high-pressure cleaner, keep a sufficient distance (at least 20 cm) from the surface of the filter material to prevent damage.
- When cleaning the filter insert using a cleaning gun and compressed air, the pressure must not exceed a maximum of 4 bar.
- Particles of dirt must not be allowed to enter the clean side of the filter element.
- Do not place the filter elements on top of each other as you may otherwise cause damage.

NOTE

BOLL & KIRCH Filterbau GmbH recommends BOLL CLEAN 2000 cleaning agent. For more detailed information, see the appendix of these operating instructions.

- ▶ Place the filter insert in a container with cleaning agent, with the opening of the filter elements facing downwards. This way, particles detaching from the filter elements can sink to the bottom.
- ▶ Remove loose particles which float on the top of the cleaning agent during the soaking stage.
- ▶ After soaking, remove the filter insert from the container and place it on a suitable surface (e.g. perforated plate) with the filter element openings facing downwards. Allow the cleaning agent to drip dry.
- ▶ Turn the filter insert around and place it down with the openings facing upwards.
- ▶ Blow out the filter elements with compressed air from the inside to the outside.
- ▶ Now dip the filter insert in the container with fresh cleaning agent again, with the openings of the filter elements facing downwards. Rinse the filter insert through again by turning it and moving it up and down in the cleaning agent.
- ▶ Allow the filter insert to drip dry again.
- ▶ Blow out the filter elements with compressed air from the inside to the outside.
- ▶ Then check all filter elements for damage. Replace any damaged filter elements/seals as necessary.

NOTE

Sufficient cleaning results (approximately 60 %) have been achieved using the described manual cleaning process for filter elements in similar applications.

In our experience, a cleaning effect of almost 100 % can only be achieved manually by using the type 5.04 filter element cleaning unit with BOLL CLEAN 2000.

- In case of heavier soiling, you can clean using the high-pressure cleaner procedure mentioned above. As liquid, use water or water with cleaning agent.

8.5.3.1 Cleaning the filter candles in case of stubborn soiling

In case the filter elements are heavily soiled (lacquer contamination, incrustation, tar residue, fibres, chippings), the individual filter elements will have to be removed and cleaned.

NOTE

BOLL & KIRCH Filterbau GmbH recommend the use of the BOLL & KIRCH cleaning unit with rotating nozzle and flat-jet nozzle for cleaning purposes.

If you do not have a filter element cleaning unit available, proceed as follows:

NOTE

BOLL & KIRCH Filterbau GmbH recommends BOLL CLEAN 2000 cleaning agent. For more detailed information, see the appendix of these operating instructions.

- Place the filter insert in a container with cleaning agent, with the opening of the filter elements facing upwards. The sieve plate must protrude from the cleaning agent. This prevents dirt from penetrating into the clean side.
- Remove loose particles which float on the top of the cleaning agent during the soaking stage.
- Remove the filter insert from the cleaning agent. Allow the filter insert to drip dry with the openings pointing downwards.

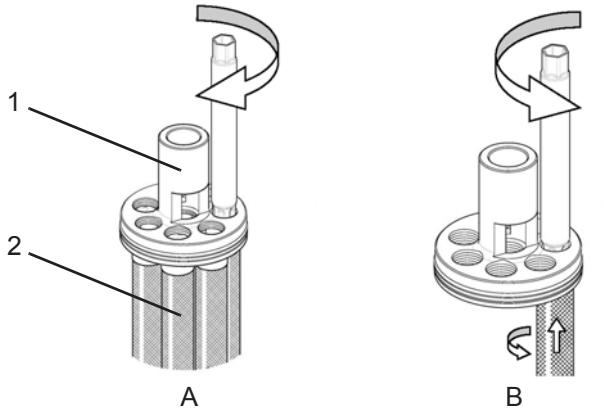


Fig. 8-2 Removing and installing the filter elements

1	Sieve plate	A	Removing the filter elements
2	Filter element	B	Installing the filter elements

- ▶ Unscrew the filter elements from the sieve plate using the key included in the scope of delivery.
- ▶ Then spray the filter elements through using the high-pressure cleaner with suitable cleaning agent. First clean from the inside to the outside, then from the outside to the inside. Repeat the process several times as necessary. Finally, spray the filter elements from the inside to the out.
- ▶ Carefully rinse out the filter elements in fresh cleaning agent and allow the filter elements to drip dry.
- ▶ Blow out the filter elements with compressed air from the inside to the outside.
- ▶ Then check all filter elements for damage. Replace any damaged filter elements/seals as necessary.
- ▶ Remove any particles collected on the magnetic primary filter (if fitted).
- ▶ Re-assembly is performed by carrying out the steps for disassembly in reverse order. Clean the sieve plate as necessary before assembly.

CAUTION!

Risk of damage to the filter elements from incorrect installation

Improper installation can cause damage to the filter elements.

- Adhere to the recommended tightening torque values for filter candles: 25 Nm for filter candles with a candle diameter of 28 mm or 50 mm.

8.5.4 Installing the filter insert with filter candles

- ▶ Clean any soiling which has collected on the inside of the filter.
- ▶ Check all the seals for damage. Replace any damaged seals as necessary.
- ▶ Insert the filter inserts vertically into the filter chambers from above.
- ▶ Make sure that the seals are properly in place.

8.5.5 Concluding work

- ▶ Check the seals for damage. Replace any damaged seals as necessary.
- ▶ Fit the covers. Make sure that the seals are properly in place. Tighten the screw connection evenly, gradually tightening opposite screws step-by-step.
- ▶ Put the filter back into operation. See the section "Commissioning".

8.6 Cleaning/replacing the filter element on the bypass filter

8.6.1 Preparatory work

- ▶ Attach the lever to the segmented plug valve and set the plug valve to the "Automatic filter in operation" position.
- ▶ Close the pressure compensation valve (lever pointing across the line).

DANGER!

Risk of accidents from expelled medium

Hot medium may be expelled when opening the vent.

- Proceed with extreme caution.
- Wear the appropriate safety equipment and clothing.

DISPOSAL

Leaks must be caught immediately. Make sure that expelled medium is disposed of properly and in an environmentally friendly manner.

- ▶ Carefully open the vent on the bypass filter. This depressurises the filter chamber and allows you to check whether the bypass filter is properly shut off by the segmented plug valve.

NOTE

Unlike valve and ball valve circuits, the segmented plug valve circuit cannot be fully sealed off. Flowing medium can be drained during the cleaning process using the drain hole.

DANGER!

Risk of accidents from expelled medium

Hot medium may be expelled when opening the drain hole.

- Proceed with extreme caution.
- Wear the appropriate safety equipment and clothing.
- Collect the expelled medium in a suitable container.

DISPOSAL

Leaks must be caught immediately. Make sure that expelled medium is disposed of properly and in an environmentally friendly manner.

- ▶ Carefully open the drain hole.
- ▶ Remove the housing cover safety device (if available).
- ▶ Unfasten the screw connection on the cover.
- ▶ Lift the cover off the housing.

8.6.2 Removing the star-pleated filter element

NOTE

One or more filter elements can be inserted into the filter chamber depending on the overall size of the bypass filter.

- ▶ Remove the filter element from the housing by pulling it vertically upwards by the filter element clamp.

8.6.2.1 Removing and attaching the filter element clamp

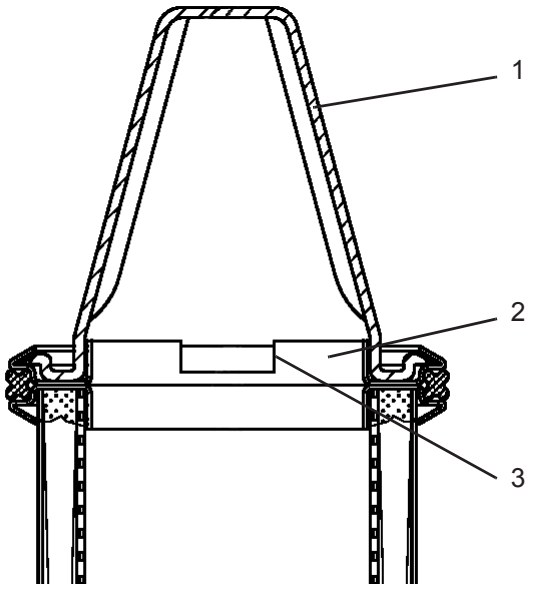


Fig. 8-3 Removing and attaching the filter element clamp

1 Filter element clamp

2 Sieve ring

3 Recess

- ▶ Turn the filter element clamp so that one end of the clamp aligns with the recess in the sieve ring.
- ▶ Press the ends of the filter element clamp together so that the end of the filter element clamp on the recess no longer reaches into the sieve ring.
- ▶ Remove the filter element clamp from the sieve ring by pulling it upwards.
- ▶ It is attached by carrying out the steps in reverse order.
- ▶ Clean the magnetic insert (if available) before installing.
- ▶ Finally, secure the filter element clamp by turning it so that none of the ends of the clamp align with the recess in the sieve ring.

8.6.3 Cleaning the star-pleated filter element

CAUTION!

Risk of damage to the filter element from improper cleaning

If the filter element is cleaned or handled improperly, the filter element wire mesh may become damaged. Observe the following safety instructions:

- Proceed with extreme caution when performing all cleaning work.
- The soaking time in the cleaning agent is 1 - 4 hours, depending on the level of soiling. Check the progress of cleaning whilst the element is soaking.
- The cleaning temperature, when using "BOLL CLEAN 2000" must not exceed 60 °C.
- When cleaning using a high-pressure cleaner and flat nozzle, the pressure must not exceed a maximum of 60 bar. When cleaning using a high-pressure cleaner, keep a sufficient distance (at least 20 cm) from the surface of the filter material to prevent damage.
- Particles of dirt must not be allowed to enter the clean side of the filter element.

▶ Shake the filter element to remove the coarsest dirt.

NOTE

BOLL & KIRCH Filterbau GmbH recommends BOLL CLEAN 2000 cleaning agent. For more detailed information, see the appendix of these operating instructions.

▶ Place the filter element in a container of suitable cleaning agent with the opening pointing upwards.

NOTE

BOLL & KIRCH Filterbau GmbH recommend the use of the BOLL & KIRCH cleaning unit with rotating nozzle and flat-jet nozzle for cleaning purposes.

▶ Then spray the filter element with a filter cleaning unit. First clean the filter element from the inside to the outside, then from the outside to the inside. Repeat the process several times as necessary. Finally, spray the filter element from the inside to the out.

▶ Rinse the filter element carefully and allow it to drip dry.

▶ Afterwards, check the filter material for damage and to establish whether it is clean. The cleaning effect can be assessed by holding the filter element up to the light. Use a torch for finer filter materials. The filter material is properly clean if the light shines through evenly.

▶ Repeat the cleaning process as necessary.

8.6.4 Installing the star-pleated filter element

CAUTION!

Insufficient filter performance may cause damage to downstream components

If the filter element is not fastened in the filter chamber, the filter performance will be reduced. Reduced filter performance over longer periods of operation can cause damage to downstream components.

- Only insert the filter elements into the housing with the filter element clamps fitted.

▶ Clean any soiling which has collected on the inside of the filter.

▶ Check that the filter element clamp is firmly in place in the sieve ring before inserting.

▶ Check all the seals for damage. Replace any damaged seals as necessary.

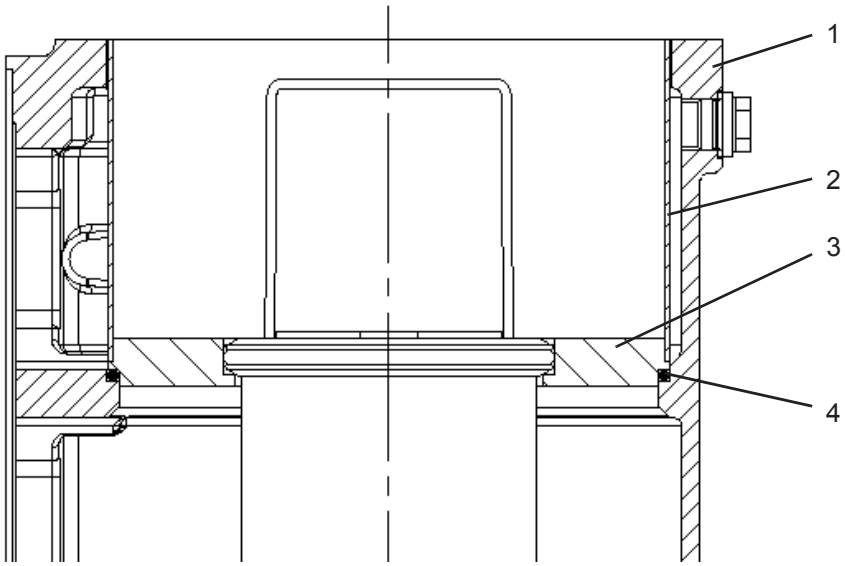


Fig. 8-4 Installing the filter element

1	Housing	3	Sieve plate
2	Perforated sheet mantle	4	Seal

▶ Check that the seal, sieve plate and the perforated sheet mantle are firmly in place in the housing. Make sure the sieve plate is installed in the correct position.

▶ Insert the filter element vertically into the sieve plate from above.

8.6.5 Concluding work

- ▶ Check the seal for damage. Replace any faulty seals as necessary.
- ▶ Fit the cover. Make sure that the seal is properly in place. Tighten the screw connection evenly, gradually tightening opposite screws step-by-step.
- ▶ Fit the housing cover safety device (if included in the scope of your delivery). Whilst you do so, the vent remains open.
- ▶ Close the drain hole.

DANGER!

Risk of accidents from expelled medium

When commissioning the filter, hot medium may be expelled from the vent.

- Proceed with extreme caution.
- Wear the appropriate protective clothing.
- Collect the expelled medium in a suitable container.

- ▶ Open the pressure compensation valve. The filter is filled via the open pressure compensation valve.

DISPOSAL

Leaks must be caught immediately. Make sure that expelled medium is disposed of properly and in an environmentally friendly manner.

- ▶ Close the vent as soon as medium is expelled from a vent without any bubbles.
- ▶ The cleaned bypass filter is on stand-by and can be put into operation as required.

8.7 Manually backflushing the filter in the event of power failure

CAUTION!

Risk of accidents caused by the filter starting back up

When the electrical power returns, the filter may start up again and the rotating movement of the hand winch attached to the gear motor may injure you.

- Before manually actuating the filter, first switch off the controller.
- Before switching on the controller, remove the hand winch from the shaft end of the gear motor.

DANGER!

Risk of accidents due to controller being switched on unintentionally

When manual backflushing is being performed accidents may be caused if the controller is switched on unintentionally, e.g. by starting up the drives.

- Secure the controller to prevent it from being switched on unintentionally, e.g. by attaching a lock.

▶ Switch off the controller.

▶ Attach the hand winch (included in the scope of delivery) to the shaft end of the electric gear motor.

▶ By turning the electric gear motor the plug valve is turned to the next switch point (to the next filter chamber).

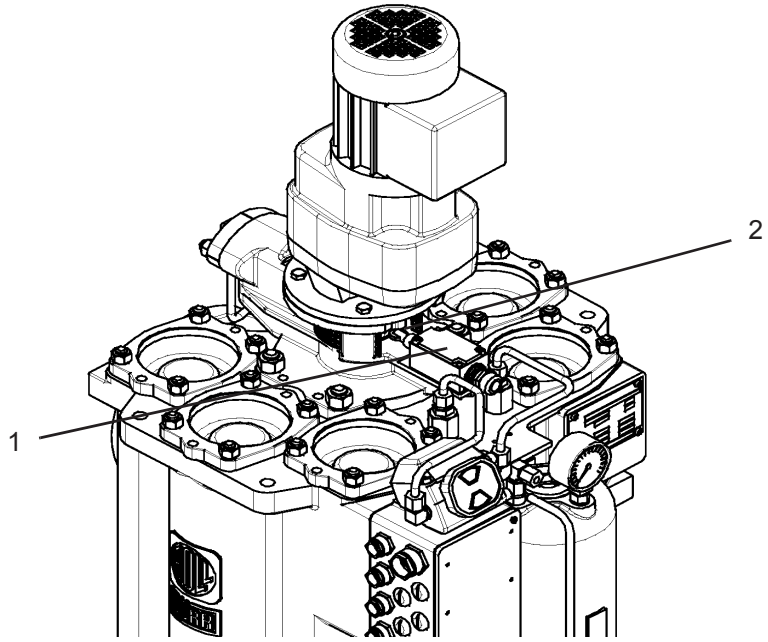


Fig. 8-5 Position of cam disc / limit switch

1 Limit switch

2 Cam disc

▶ Cams and limit switches must be aligned exactly opposite each other.

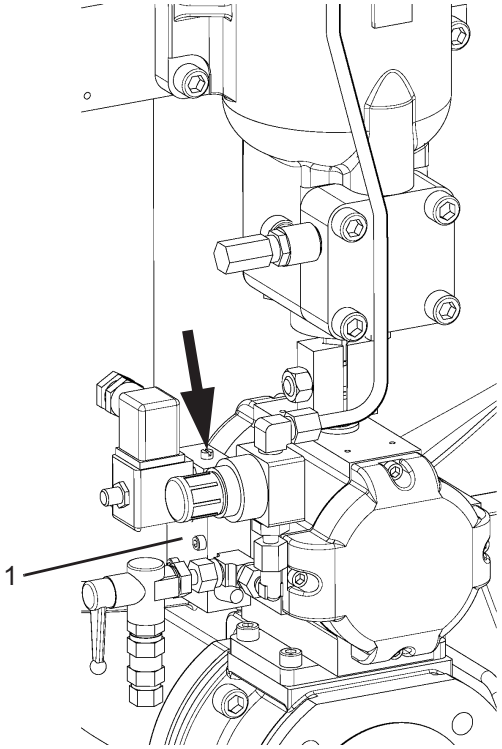


Fig. 8-6 Manual triggering of backflushing

1 Solenoid valve

- ▶ Trigger backflushing directly by manually actuating (arrow) the solenoid valve (using a screwdriver). Manual actuation must last for at least 8 s.
- ▶ Move the solenoid valve's manual actuator back into the initial position.
- ▶ The automatic venting process in the filter chamber is not completed until the filling time has elapsed. You can then turn to the next filter chamber using the hand winch.
- ▶ As soon as the differential pressure has been reduced, remove the hand winch from the gear motor.

CAUTION!

Damage to the filter

Turning the gear motor with the hand winch, for instance, to remove a blockage in the backflushing device, may damage the filter.

- A blockage in the backflushing device can only be remedied safely after removing the filter from service and opening the filter.

8.8 Remedying faults

NOTE

In case of any faults or repairs which are not listed here, contact the BOLL & KIRCH customer services department.

8.8.1 Trouble shooting

Fault	Possible cause	Remedy
Differential pressure too high, no flushing	Air pressure too low	Check the compressed air supply on the filter connection (see respective operating instructions for the entire plant)
Flushing performed often	High level of soiling in the medium	Determine the cause of soiling in the plant
	Filter elements blocked	Change / clean the filter elements
	Air pressure too low	Check the compressed air supply on the filter connection (see respective operating instructions for the entire plant)
	Piping on the flushing oil outlet blocked	Clean the piping (see respective operating instructions for the entire plant)
	Solenoid valve or pneumatic pivoting actuator is stuck	Replace the solenoid valve or the pneumatic pivoting actuator
The electric gear motor is not turning	Plug valve is stuck	Open the filter and remove the cause of the blockage
	The filling hole is blocked	Clean the filling hole in the filter housing
	No power supply	Check the power supply to the electric gear motor
Differential pressure will not reduce	Piping on the flushing oil outlet blocked	Clean the piping (see respective operating instructions for the entire plant)
	Filter elements blocked	Change / clean the filter elements
No differential pressure indicator	Shut-off valves in control line closed	Open shut-off valves
	Differential pressure monitoring system faulty	Check / replace the differential pressure monitoring system

9 Appendix

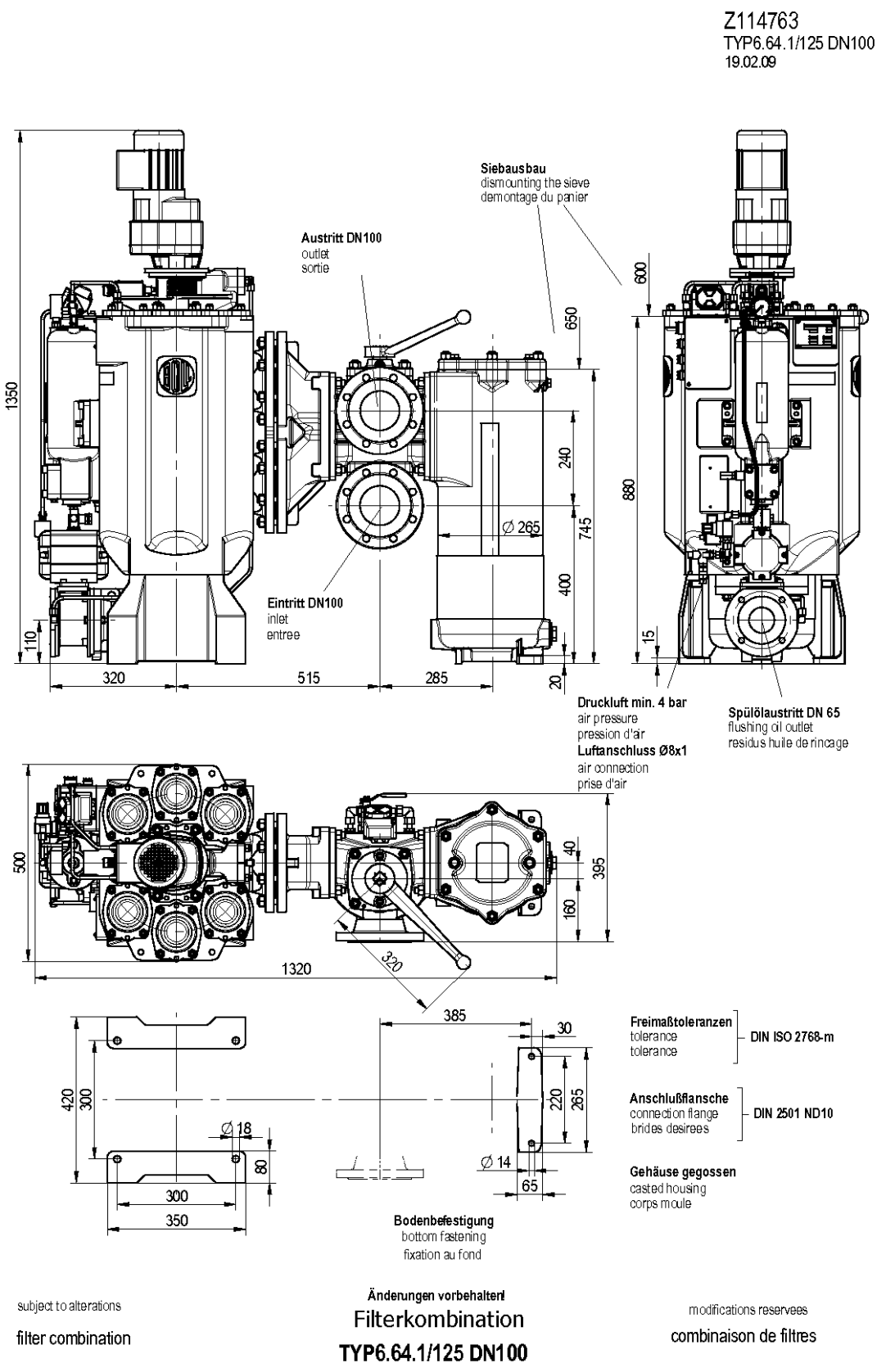
9.1 Filter

9.1.1 Technical data

Filter	
Filter type	6.64.1
Nominal connection diameter DN	100
Housing size	12
Fine filter units	6 µm
Mesh number	ST15BL3
Permitted operating pressure	10.00 bar
permitted max. operating temperature	80.00 °C
Operating voltage	3 ph 440 Volt
Frequency	60 Hz
Control voltage	24 V DC
Motor output	0.090 kW
Backflushing medium	clean/dry air max. 4 bar
Control medium	clean/dry air 4-10 bar
Flushing air requirement per flushing process	0.065 Nm³
Flushing quantity per chamber and flushing process	12.00 Liter
Flushing time	8 s
sound emission (DIN 45 635)	< 70 dB(A)

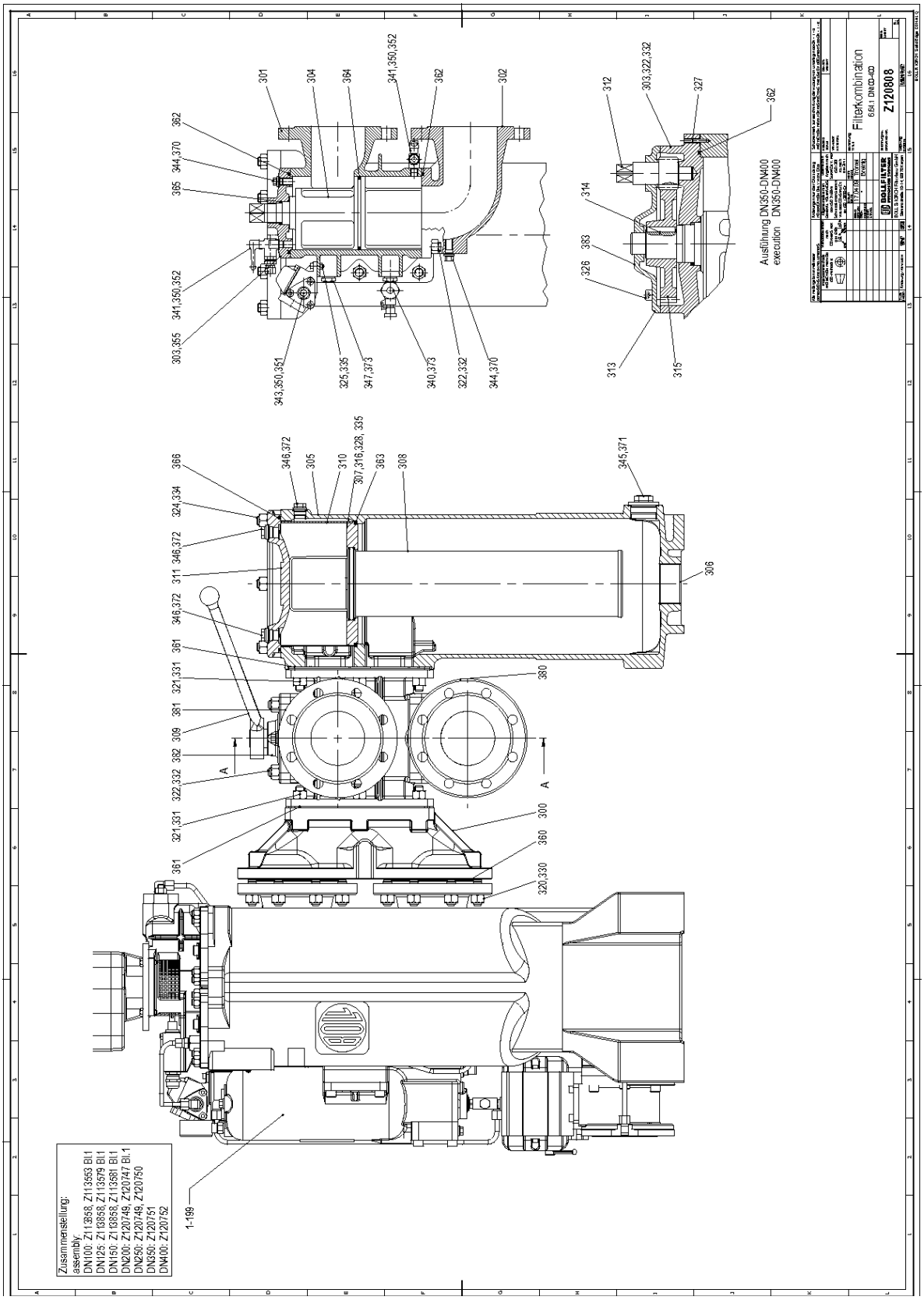
Filter element	
Element type of filter	Mesh star candle
Number of filter elements	18
Element type of bypass filter	Star pleated sieve element
Number of bypass filter elements	1

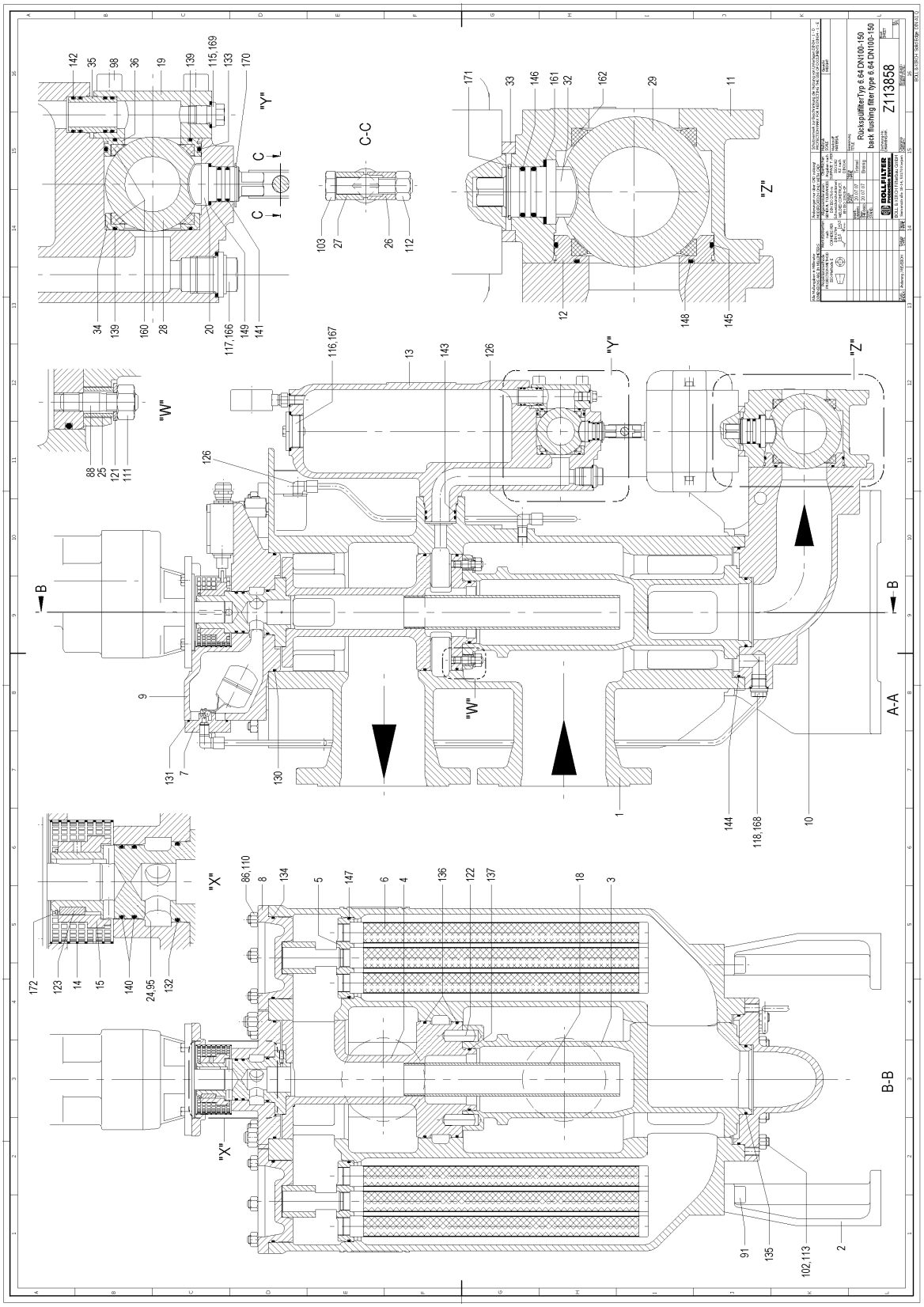
9.1.2 Technical data sheet

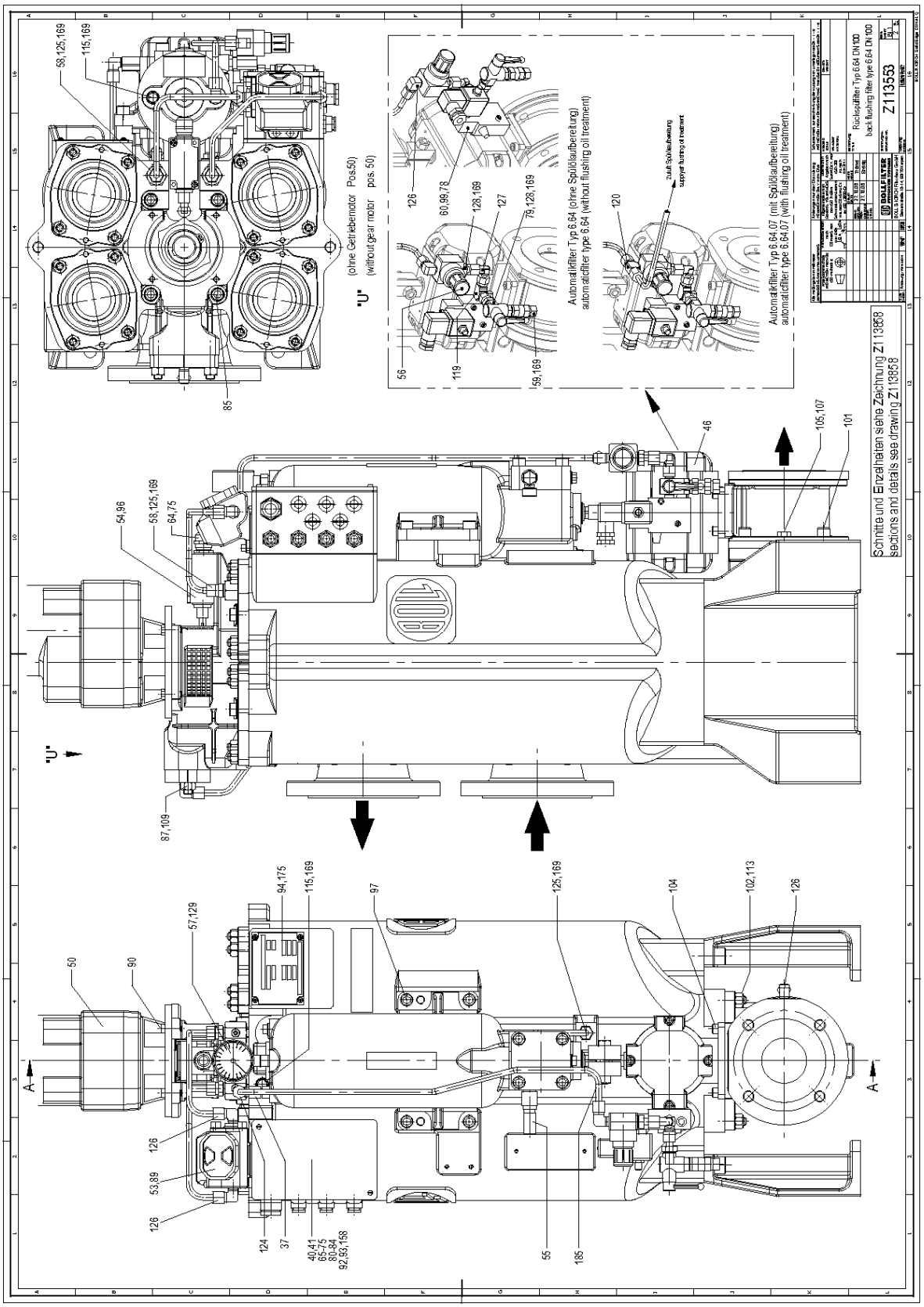


9.1.3 Spare parts

9.1.3.1 Spare parts drawing




Rücksaugfilter Typ 6.64 DN100-150
back flushing filter type 6.64 DN100-150
Z113858
"Y"
"Z"
"W"
"X"
C-C
A-A
B-B


"U"
(ohne Getriebemotor Pos.50)
(without gear motor pos. 50)
Automatikfilter Typ 6.64 (ohne Spülölaufbereitung)
automatic filter type 6.64 (without flushing oil treatment)
Automatikfilter Typ 6.64.07 (mit Spülölaufbereitung)
automatic filter type 6.64.07 (with flushing oil treatment)
Zuluft Spülölaufbereitung
supply air flushing oil treatment
Schnitte und Einzelheiten siehe Zeichnung Z113858
sections and details see drawing Z113858
Rückspülfilter Typ 6.64 DN100
back flushing filter type 6.64 DN 100
Z113553

9.1.3.2 Spare parts list

Document	Description		Date
0630292	automatic filter		05.12.11
	Dimension drawing:	Z114763	
	Assembly:	Z120808,Z113858,Z113579 BL.1	

Item	ID no.	Description	Qty	Unit
00001	6530065	housing	1	pcs.
00002	6820001	bottom fastening	2	pcs.
00003	5420002	Cock	1	pcs.
00004	5420027	Cock	1	pcs.
00005	5030028	sieve plate for 3 candles	6	pcs.
00006	9905005	star-pleated element according t	18	pcs.
00007	0600553	air escape aggregate	1	pcs.
00008	5230014	housing cover	6	pcs.
00009	5230001	cover change over housing	1	pcs.
00010	6830009	connection flush valve	1	pcs.
00011	6830011	housing flush valve	1	pcs.
00012	5100046	support ring	1	pcs.
00013	6530101	air reservoir	1	pcs.
00014	6700187	guard plate	1	pcs.
00015	5130002	Control Disc	1	pcs.
00018	5100033	riser pipe	1	pcs.
00019	5200008	air valve cover	1	pcs.
00020	5400003	selector shaft	1	pcs.
00024	5400040	coupling	1	pcs.
00025	5310041	distance bush	2	pcs.
00026	5600135	Coupling	1	pcs.
00027	5600136	Coupling	1	pcs.
00028	2300089	ball air valve	1	pcs.
00029	2300092	ball flushing valve	1	pcs.
00032	5400004	selector shaft	1	pcs.
00033	5600062	adapter plate	1	pcs.
00034	5100076	support ring	1	pcs.
00035	5100032	connector	1	pcs.
00036	5106541	support ring	1	pcs.
00037	6703846	nozzle	1	pcs.
00038	5300148	threaded bushing	1	pcs.
00040	5950197	connection box	1	pcs.
00041	8350029	cover for connection box	1	pcs.
00046	4500058	Double Piston Part Turn Actuator	1	pcs.

Item	ID no.	Description	Qty	Unit
00050	4500099	gear motor	1	pcs.
00053	9902572	DPI acc. to order	1	pcs.
00054	4200062	limit switch	1	pcs.
00055	2660037	safety valve	1	pcs.
00056	2600251	high pressure control device	1	pcs.
00057	2616316	pressure gauge	1	pcs.
00058	2600272	shock absorber for pressure gang	2	pcs.
00059	2608775	non return valve	1	pcs.
00060	4105912	connector plug	1	pcs.
00060	2656655	solenoid valve	1	pcs.
00060	4206553	coil	1	pcs.
00060	2600264	sound absorber	2	pcs.
00060	3040224	o-ring	2	pcs.
00064	4100097	cable gland	3	pcs.
00065	4105805	mounting rail	1	pcs.
00066	4100117	clamp	13	pcs.
00067	4100118	clamp	5	pcs.
00068	4100119	distance plate	3	pcs.
00068	4100121	end bracket	2	pcs.
00070	4100097	cable gland	6	pcs.
00071	4100098	cable gland	1	pcs.
00073	4870017	plug	4	pcs.
00078	2614171	sound absorber	2	pcs.
00079	2560356	angle ball valve	1	pcs.
00084	2000121	hexagon socket head cap screw	4	pcs.
00085	2000007	stud bolt	4	pcs.
00086	2000004	stud bolt	24	pcs.
00087	2009095	stud bolt	2	pcs.
00088	2009097	stud bolt	2	pcs.
00089	2000122	hexagon socket head cap screw	2	pcs.
00090	2006963	hexagon screw	4	pcs.
00091	2000167	hexagon socket head cap screw	4	pcs.
00092	2000263	slotted cheese head screw	2	pcs.
00093	2000261	slotted cheese head screw	2	pcs.
00094	2003587	threaded flange screw	4	pcs.
00095	2000131	hexagon socket head cap screw	4	pcs.
00096	2002155	hexagon socket head cap screw	2	pcs.
00097	2000155	hexagon socket head cap screw	4	pcs.
00098	2013300	hexagon socket head cap screw	4	pcs.
00099	2002155	hexagon socket head cap screw	2	pcs.
00101	2000156	hexagon socket head cap screw	4	pcs.

Item	ID no.	Description	Qty	Unit
00102	2009095	stud bolt	8	pcs.
00103	2000036	hexagon screw	1	pcs.
00104	2000132	hexagon socket head cap screw	8	pcs.
00105	2000318	hexagon fits bolt	2	pcs.
00107	2100005	hexagon nut	2	pcs.
00108	2100007	hexagon nut	4	pcs.
00109	2100006	hexagon nut	2	pcs.
00110	2100006	hexagon nut	24	pcs.
00111	2115515	lock nut	2	pcs.
00112	2100006	hexagon nut	1	pcs.
00113	2100006	hexagon nut	8	pcs.
00115	2000656	screwed sealing plug	3	pcs.
00116	2001772	screwed sealing plug	1	pcs.
00117	2000190	screwed sealing plug	1	pcs.
00118	2000910	screwed sealing plug	1	pcs.
00119	2507461	screwing	1	pcs.
00121	2200007	disc	2	pcs.
00122	2310005	grooved pin	2	pcs.
00123	2401230	feather key	1	pcs.
00124	2506980	screwing	1	pcs.
00125	2500024	screwing	2	pcs.
00126	2500025	screwing	6	pcs.
00127	2500119	angle screwing	1	pcs.
00128	2500083	screwed socket	2	pcs.
00129	2510239	screwing extension	1	pcs.
00130	3040109	o-ring	1	pcs.
00131	3142316	o-ring	1	pcs.
00132	3030164	o-ring	1	pcs.
00133	3046821	o-ring	1	pcs.
00134	3041058	o-ring	6	pcs.
00135	3042106	o-ring	1	pcs.
00136	3040109	o-ring	2	pcs.
00137	3042236	o-ring	1	pcs.
00139	3048178	o-ring	2	pcs.
00140	3031743	o-ring	2	pcs.
00141	3040157	o-ring	2	pcs.
00142	3041070	o-ring	4	pcs.
00143	3043763	o-ring	2	pcs.
00144	3040111	o-ring	1	pcs.
00145	3040105	o-ring	1	pcs.
00146	3040099	o-ring	2	pcs.

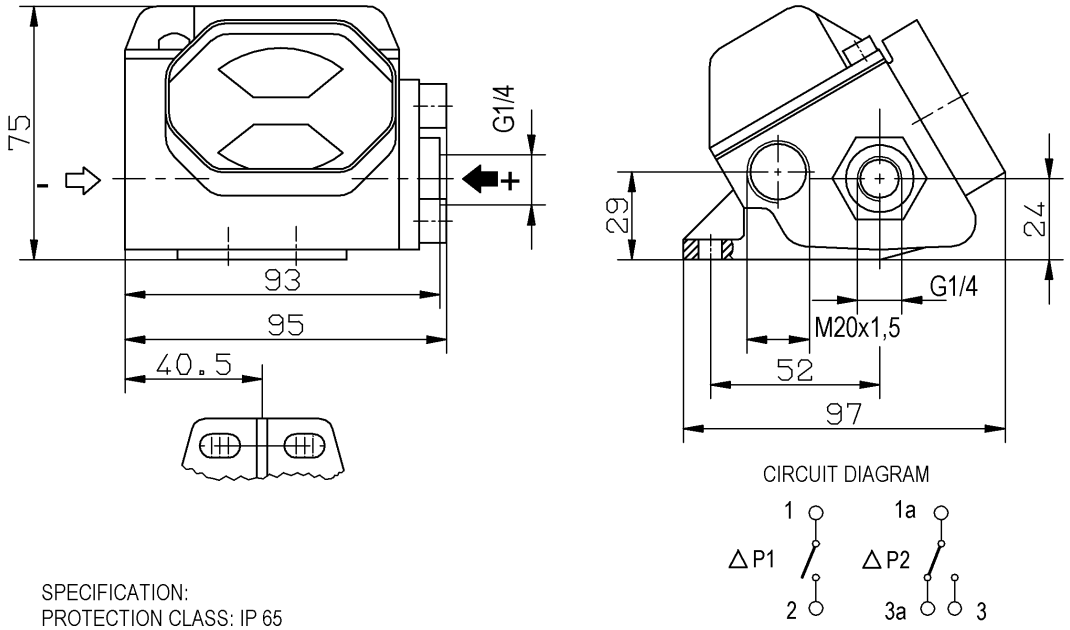
Item	ID no.	Description	Qty	Unit
00147	3040661	o-ring	6	pcs.
00148	3040103	o-ring	1	pcs.
00149	3324251	PTFE ring	1	pcs.
00158	3380199	flat gasket	1	pcs.
00160	3522906	ball gasket	2	pcs.
00161	3328072	flat gasket	1	pcs.
00162	3521600	ball gasket	2	pcs.
00166	3270005	gasket	1	pcs.
00167	3274855	gasket	1	pcs.
00168	3270010	gasket	1	pcs.
00169	3270002	gasket	7	pcs.
00170	2205949	locking ring	1	pcs.
00171	2203318	locking ring	1	pcs.
00172	2203398	locking ring	1	pcs.
00175	9401690	type plate	1	pcs.
00176	9407569	label	1	pcs.
00176	9400997	label	1	pcs.
00176	9407396	label: "mud drain"	1	pcs.
00176	9402898	label	1	pcs.
00176	9403614	label: "compressed air connectio	1	pcs.
00176	9404642	label: "Delta P differential pre	1	pcs.
00176	9808492	label	1	pcs.
00180	4300000	control box according to order	1	pcs.
00185	0600011	Pipe	1	pcs.
00197	6700379	key for unscrewing the filter el	1	pcs.
00197	2300808	crank handle	1	pcs.
00300	5130023	adapter	1	pcs.
00301	6230654	cock casing	1	pcs.
00302	5432364	angle inlet	1	pcs.
00303	6434388	cock casing cover	1	pcs.
00304	6320052	cock plug	1	pcs.
00305	6130636	housing	1	pcs.
00306	5300478	threaded plug	1	pcs.
00307	5500019	sieve plate	1	pcs.
00308	150878	star-pleated element according t	1	pcs.
00309	8650481	key	1	pcs.
00310	7110495	tube	1	pcs.
00311	6430053	cover	1	pcs.
00316	5700130	covering plate	1	pcs.
00320	2009090	stud bolt	16	pcs.
00321	2009088	stud bolt	12	pcs.

Item	ID no.	Description	Qty	Unit
00322	2009088	stud bolt	8	pcs.
00324	2009088	stud bolt	6	pcs.
00325	2000123	hexagon socket head cap screw	2	pcs.
00328	2000130	hexagon socket head cap screw	4	pcs.
00330	2100007	hexagon nut	16	pcs.
00331	2100007	hexagon nut	12	pcs.
00332	2100007	hexagon nut	8	pcs.
00334	2100007	hexagon nut	6	pcs.
00335	2100003	hexagon nut	2	pcs.
00340	0200439	pressure compensation	1	pcs.
00341	2560356	angle ball valve	2	pcs.
00343	0550001	differential pressure indicator	1	pcs.
00344	2000187	screwed sealing plug	3	pcs.
00345	2000193	screwed sealing plug	1	pcs.
00346	2000189	screwed sealing plug	3	pcs.
00347	2000188	screwed sealing plug	2	pcs.
00350	2500024	screwing	3	pcs.
00351	2500025	screwing	1	pcs.
00352	2564886	removeable double nibble	2	pcs.
00355	2300023	Spring Type Straight Pin	1	pcs.
00360	3380072	high pressure gasket	2	pcs.
00361	3540022	frame	2	pcs.
00362	3040163	o-ring	2	pcs.
00363	3041064	o-ring	1	pcs.
00364	3040653	o-ring	1	pcs.
00365	3420011	gasket	1	pcs.
00366	3040131	o-ring	1	pcs.
00370	3270002	gasket	3	pcs.
00371	3270008	gasket	1	pcs.
00372	3270004	gasket	3	pcs.
00373	3270003	gasket	4	pcs.
00380	9800300	label: "inlet"	1	pcs.
00381	9800301	label: "outlet"	1	pcs.
00382	9404402	label: "change over position"	1	pcs.

9.2 Differential pressure indicator

9.2.1 Technical data sheet

Z45550
TYP4.36.2
09.01.06



CIRCUIT DIAGRAM

SPECIFICATION:
PROTECTION CLASS: IP 65

ELECTR. DATA:	SWITCHING VOLTAGE	V≅	MAX.=	250	220
	FREQUENCY	HZ	MAX.=	0-60	0-60
	SWITCHING CURRENT	A	MAX.=	1	0.8
	MAKING AND/OR BREAKING CAPACITY				
		W/VA	MAX.=	60/60	40/60

MATERIAL : GD - ALUMINIUM
RATING : MAX. PRESSURE 100 BAR
MAX. TEMPERATURE 150°C

RANGES OF PRESSURE DIFFERENTIAL: DELTA P =
- 0 - 0.5 BAR
- 0 - 0.8 BAR
- 0 - 1.2 BAR
- 0 - 2.0 BAR
- 0 - 3.0 BAR

TO BE SPECIFIED WHEN ORDERING

DESCRIPTION:
THE PURPOSE OF THIS DEVICE IS THE MEASUREMENT, AND VISUAL INDICATION OF THE DIFFERENCE IN PRESSURE BETWEEN TWO POINTS, AND THE ESTABLISHMENT OF AN ELECTRICAL CONTACT WHEN THE PRESSURE DIFFERENTIAL ATTAINS A SPECIFIED FIGURE.

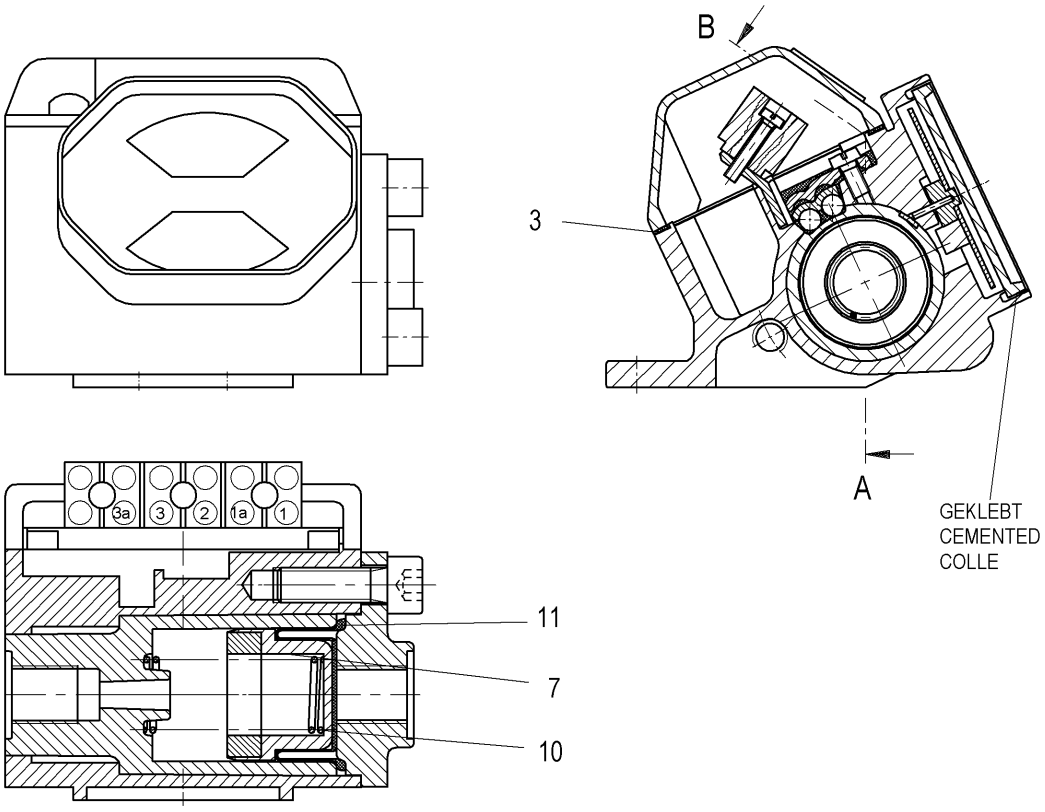
METHOD OF OPERATION:
A PLUNGER SEALED BY A DIAPHRAGM SEPARATES THE SPACE UNDER PRESSURE INTO TWO CHAMBERS. A PRE-LOADED SPRING CAUSES THE PLUNGER TO TAKE UP ITS ZERO POSITION WHEN THE PRESSURE DIFFERENCE DELTA P IS ZERO. AS THE PRESSURE DIFFERENCE INCREASES (DELTA P > 0), THE PLUNGER IS FORCED TO MOVE AGAINST THE SPRING. AT THE SAME TIME, AN INDICATOR DISC IS MOVED MAGNETICALLY, AND THEREFORE VIRTUALLY WITHOUT FRICTION, AND THE TWO REED CONTACTS ARE ACTUATED.

THE RED SEGMENT OF THE INDICATOR DISC IS VISIBLE OVER A PRESSURE RANGE EQUAL TO APROX.50-100% DELTA P . THE FIRST REED CONTACT IS ACTUATED AT 75% DELTA P1, AND THE SECOND AT 100% DELTA P2.

DIFFERENTIAL PRESSURE CONTACT INDICATOR TYPE 4.36.2

9.2.2 Spare parts list

Z21434
TYP4.36.2+4.46.2
11.02.94



A - B

BEI BESTELLUNG ANGEBEN
TO BE MENTIONED IN CASE OF ORDER
A MENTIONNER LORS DE LA COMMANDE

AUFTR.NR.:
ORDER NO.
NO DE COMMANDE

TYP 4.36.2

11	ROLLMEMBRAN	DIAPHRAGM	DIAPHRAGME	
10	FEDER	SPRING	RESSORT	
7	KOLBEN	PISTON	PISTON	
3	DICHTUNG	GASKET	JOINT	
POS.NR.	BEZEICHNUNG	DESIGNATION	DESIGNATION	

SPARE PARTS DRAWING

ERSATZTEILZEICHNUNG
ZUM TYP 4.36.2 UND 4.46.2

PLAN DES PIECES DE RECHANGE

9.3 Supplier's documentation

NOTE

Documentation for any components or assembly groups purchased externally by BOLL & KIRCH Filterbau GmbH is enclosed with these operating instructions. Adhere to the information contained, in particular information on the subject of safety.

9.4 Cleaning devices

For particularly good cleaning results, BOLL & KIRCH Filterbau GmbH recommends the filter element cleaning unit type 5.04 with rotating nozzle and flat jet nozzle or optionally, the type 5.05 ultrasonic cleaning unit.

9.5 BOLL CLEAN 2000 cleaning agent product information

Product description:

BOLL CLEAN 2000 is a liquid cleaning and degreasing agent with a broad range of applications. It can be used practically for all cleaning and degreasing needs.

BOLL CLEAN 2000 cleans quickly and thoroughly and is extremely economical.

The use of BOLL CLEAN 2000 renders all safety precautions unnecessary.

BOLL CLEAN 2000 has all these excellent characteristics without the disadvantages of solvent-based cleaners.

BOLL CLEAN 2000 is:

- not inflammable
- not subject to compulsory identification markings
- not strong smelling
- not corrosive
- physiologically harmless
- biodegradable
- Umweltbundesamt (Federal German Ministry of Environment) reg. no. 04860019

BOLL CLEAN 2000 can be overcooled or overheated during storage but is then fully useable when at normal temperature again.

Sieve mesh contaminated with heavy oil:

Sieve meshes which are contaminated with heavy oil must be soaked in normal, commercially available solvent. After soaking, the sieves are cleaned in the BOLL & KIRCH cleaning device type 5.04 with BOLL CLEAN 2000 and high-pressure pump.

Instructions for use:

BOLL CLEAN 2000 is not processed for any specific cleaning method. BOLL CLEAN 2000 can be used in a soaking bath, in a spray unit, in a steam jet cleaner or be applied by hand, using a cloth, brush or sponge, depending on the operational conditions.

It can be used cold or warm.

BOLL CLEAN 2000 can be mixed with water - even with sea water.

- Concentration for mesh cleaning: 1 : 2,5
- Maximum temperature up to 60 °C

The concentration depends on the type and extent of the collected dirt particles which have to be removed. When using a concentration of 1 : 30 and above, rinsing is usually not necessary. No visible film is left on the surface.

9.6 Worldwide sales and service network, subsidiaries and representatives

If you require service or spare parts, please contact the main site or our subsidiaries, representatives or service points.

Deutschland

1 2 3 BOLL & KIRCH Filterbau GmbH
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www.bollfilter.de

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www.ivg-neubert.de

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1	Verkaufsbüro	Agency
2	Lager	Stockist
3	Service	Service

Mai 2011

9.7 Declaration of conformity

BOLLFILTER Protection Systems	QUALITY MANAGEMENT FORM			
EC DECLARATION OF CONFORMITY	Document	Part	Issue	Page
	FB-8-89	8	06	1/1

Issued in compliance with the Machinery Directive 2006/42/EC

Manufacturer:

Boll & Kirch Filterbau GmbH
Siemensstrasse 10-14
D- 50170 Kerpen

We hereby declare that the product described in the following complies with the following standards and directives.

Designation:	*Automatic filter*
Type:	6.03, 6.04, 6.10, 6.12, 6.17, 6.18, 6.19, 6.23, 6.24, 6.41.07, 6.44, 6.46, 6.48, 6.60, 6.61, 6.62, 6.63, 6.64, 6.72

Machinery Directive 2006/42/EG

Title and/or no. and issue date of the applied standard

EN 12100 -1
EN 12100 -2
EN 14121 -1

Applied community directives of the EU

☒ **Low Voltage Directive 2006/95/EG**

☒ **Electromagnetic Compatibility 2004/108/EG**

Certification issued by:	Quality department
Date / manufacturer's signature	i.v.
Information on the undersigned:	H. Anders Head of Production

mechanical document

DC24V 不间断电源

ME UPS

（UPS 1920-3）

用户指南及说明书

4．0 版本

2013 年 10 月

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1. 系统特征

UPS1920-3 拥有如下特点:

UPS1920-3 为单相在线不间断直流系统;

UPS1920-3 可对您的载荷提供不低于额定功率的稳定电源;

UPS1920-3 采用一体化结构,性能高度稳定;

UPS1920-3 采用直流模块运行，减少线性冲突;

UPS1920-3 体积小,质量轻,单体模块重量仅为 25 公斤;

UPS1920-3 可提供绿色能源,输出近似一条直线;

UPS1920-3 电源模块部分采用铝合金外壳，六面金属屏蔽，质量高可靠性，能耐受恶劣的工作环境;

UPS1920-3 是应用户的要求制作的一种带备电输入的直流 UPS，交直流可实现零秒切换，该系统具备输出过流保护，过压及短路保护功能。充电器部分设有过放保护及电池是否在线的检测功能。此系统可在没有系统控制器或丧失测量或其他功能的情况下完美工作,UPS 运行不对系统控制器进行强制要求。UPS 模块可以进行热交换，并可进行不同系统配置。

2. 介绍

2.1 UPS1920-3 介绍

UPS1920-3 是一个直流不间断电源（UPS）组合，是一个包含相同的两个部分：UPS-A、UPS-B 的冗余系统，其电路结构图图 1-1 所示，组合后系统电路结构图如图 1-2 所示。

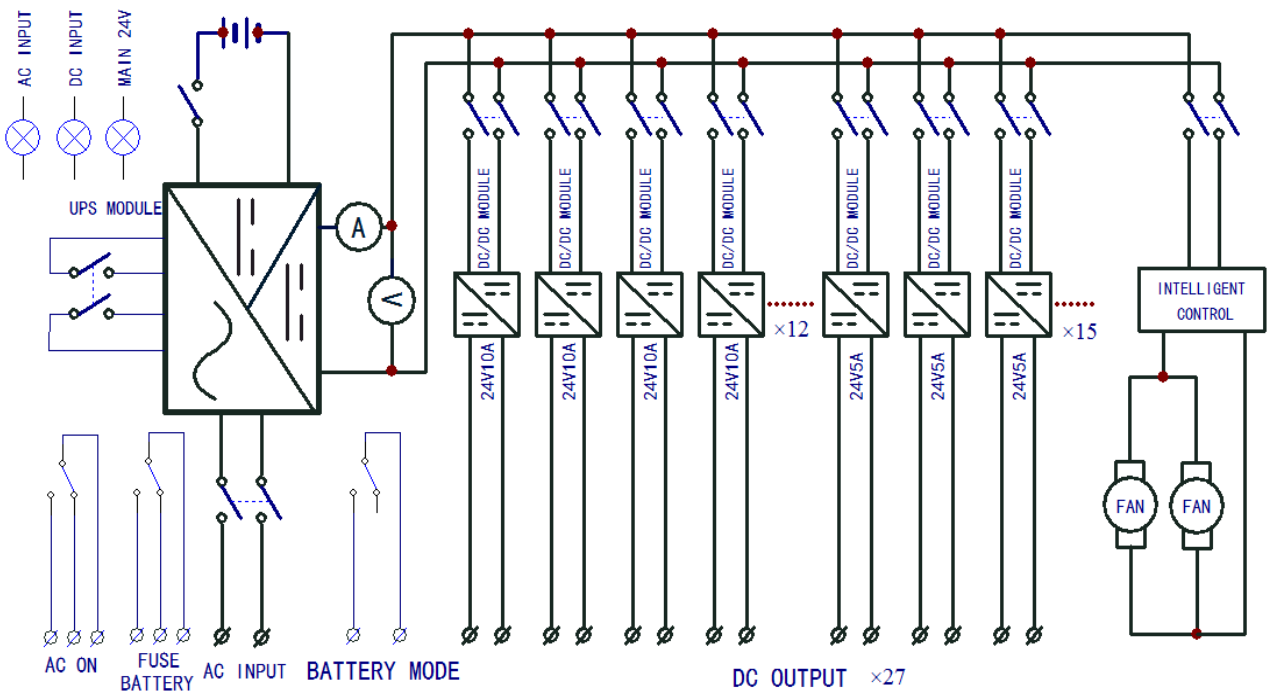


图 1：UPS-A 电路结构图

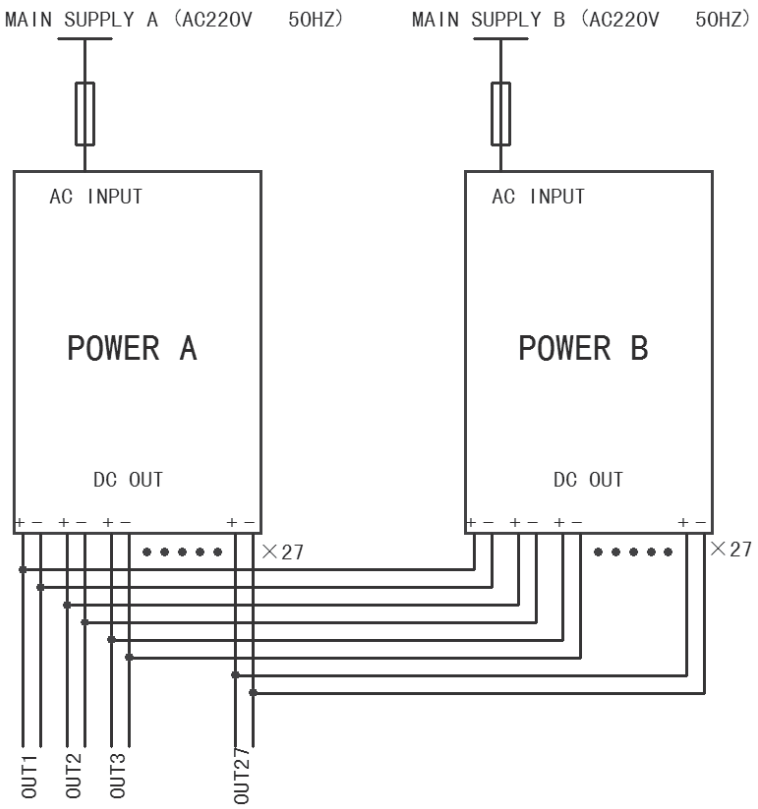


图 2:UPS1920-3 主功率部分备份式连接电路结构图

2.2 UPS1920-3 外形及结构

2.2.1 UPS1920-3 外形

UPS1920-3 电源系统包含两个部分即 UPS-A 和 UPS-B，两个部分电箱的外形尺寸相同即 600*600*2000 详见图 2。

2.2.2 UPS1920-3 内部结构及各部件其作用

此系统包含的两个部分：1.UPS-A, 2.UPS-B。其基本配置如下：

① UPS 电源模块

② 开关组合

③ 隔离模块

④ 动力输入及输出接线板

⑤后备电池

⑥ 冷却系统

电箱内部部件布置详见图 3 和图 4。

各部件功能详见表 1。

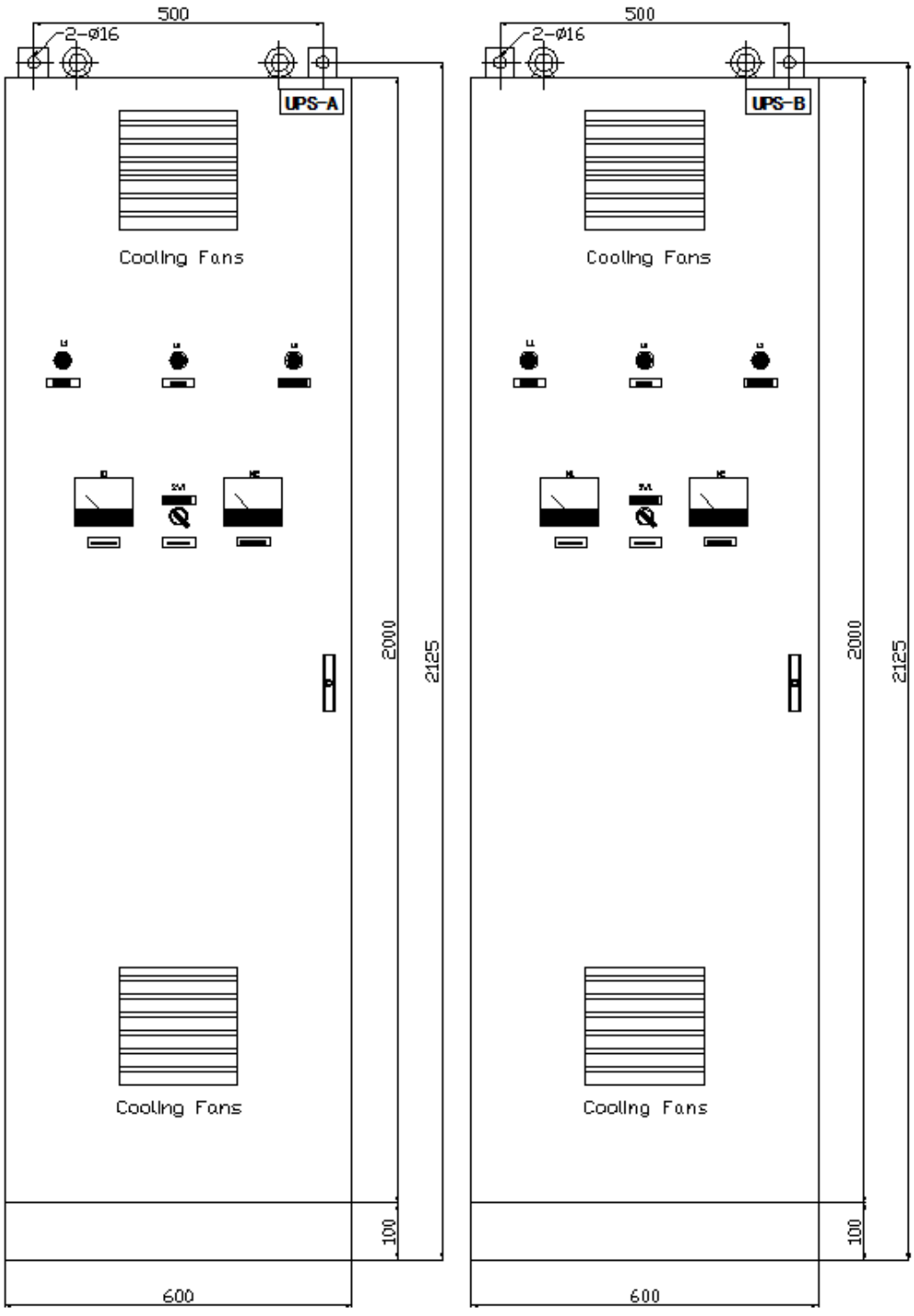


图 3：UPS1920-3 电箱外形图

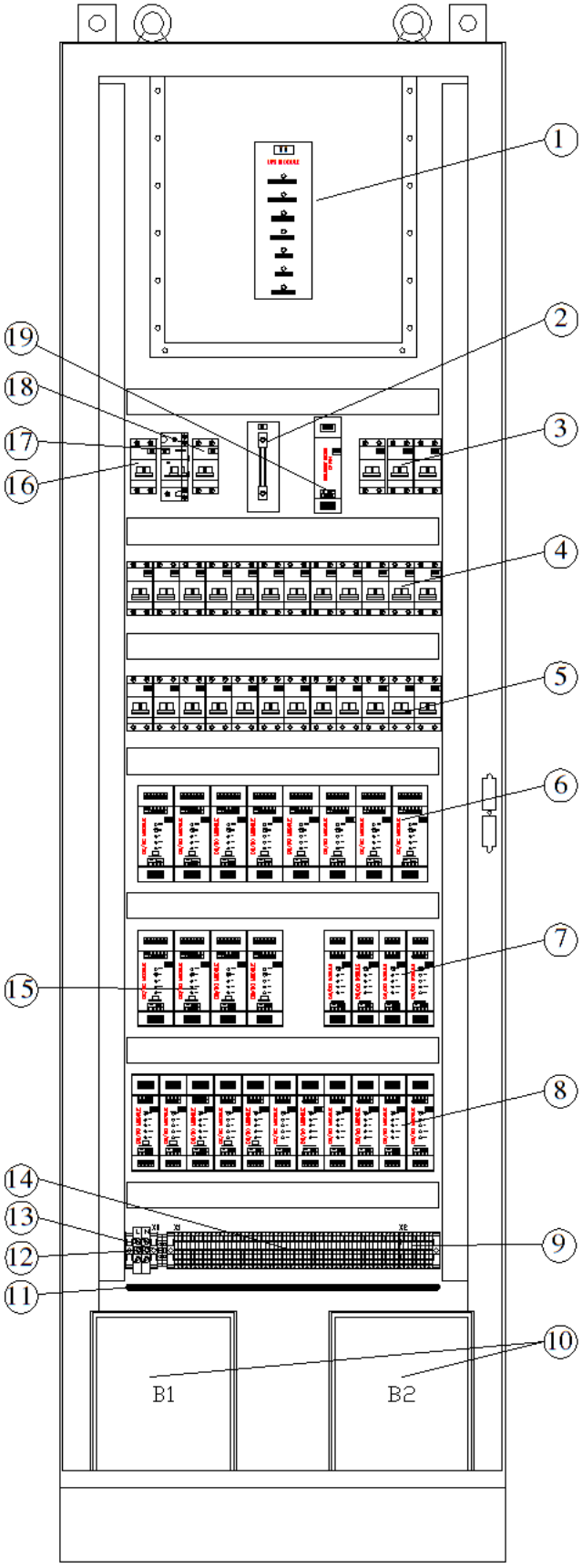


图 4：UPS1920-3 内部配置

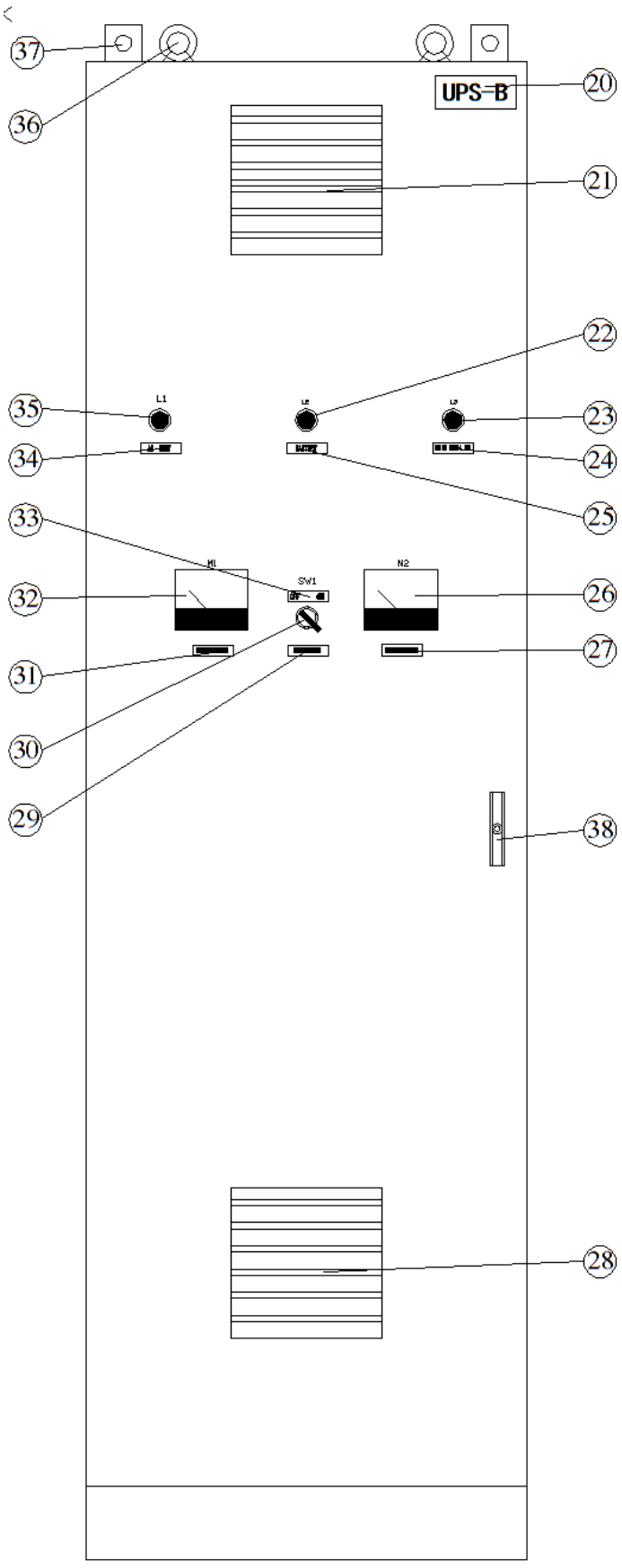


图 5：UPS1920-3 电箱前面板配置

表 1：UPS1920-3 电箱部件表

序号	部件名称	标号	说明	备注
1	UPS 模块	T1	为隔离模块提供不间断供电	
2	分流器	F3	电流采样	
3	空气开关	F101~F103	隔离模块输入开关	
4	空所开关	F104-F115	隔离模块输入开关	
5	空气开关	F116-F127	隔离模块输入开关	
6	10A 隔离模块	T101-T107	隔离直流变换	
7	5A 隔离模块	T112-T115	隔离直流变换	
8	5A 隔离模块	T116-T127	隔离直流变换	
9	结点信号端子	F4-F7	检测信号接口	
10	蓄电池组	B1 B2	为 UPS 模块提供直流输入	
11	导线固定梁		用于输出导线的固定	
12	接地端子		机壳的接线端口	
13	交流输入端子	L N	交流输入接口	
14	直流输出端子	F15-F25	直流输邮接口	
15	10A 隔离模块	T108-T111	隔离直流变换	
16	交流输入开关	F1	交流输入开关	
17	直流输入开关	F2	直流输入开关	
18	辅助开关	F3	辅助供电开关	
19	风扇智能控制模块	T201	用于风扇的智能控制	
20	主标牌			
21	上风扇窗口	M1		
22	电池指示灯	L2	电池的状态指示	
23	UPS 模块输出指示	L3	UPS 模块输出指示	

24 25	指示灯标牌	SW1/L5	用于 UPS 的输出的开启	
26	输出电流表	P2	UPS 模块输出电流指示	
27	电流表标牌			
28	下风扇窗口	M2		
29	开关标牌			
30	输入开关		交流及直流输入开关空制	
31	电压表标牌			
32	UPS 输出电压表	P1	UPS 查模块输出电压指示	
33	开关位置标牌			
34	交流输入指示灯标牌			
35	交流输入指示灯	L1	交流输入状态指示	
36	吊环		用于机柜的吊装	
37	安装耳		机柜安装固定	
38	门锁			

3.UPS1920-3 主要部件

3.1 UPS 模块组件

3.1.1UPS 组件原理框图

UPS 基本组件是此系统的核心,它可以依据容量需要设计做成大小不同的模块。并将充电器一起集成。经证实，此设计十分稳定，UPS 由正常模式切换为后备模式不需要转换时间；即交直流可以实现零秒切换，可向负载提供连续的稳定清洁的动力。其原理框图见图 6。

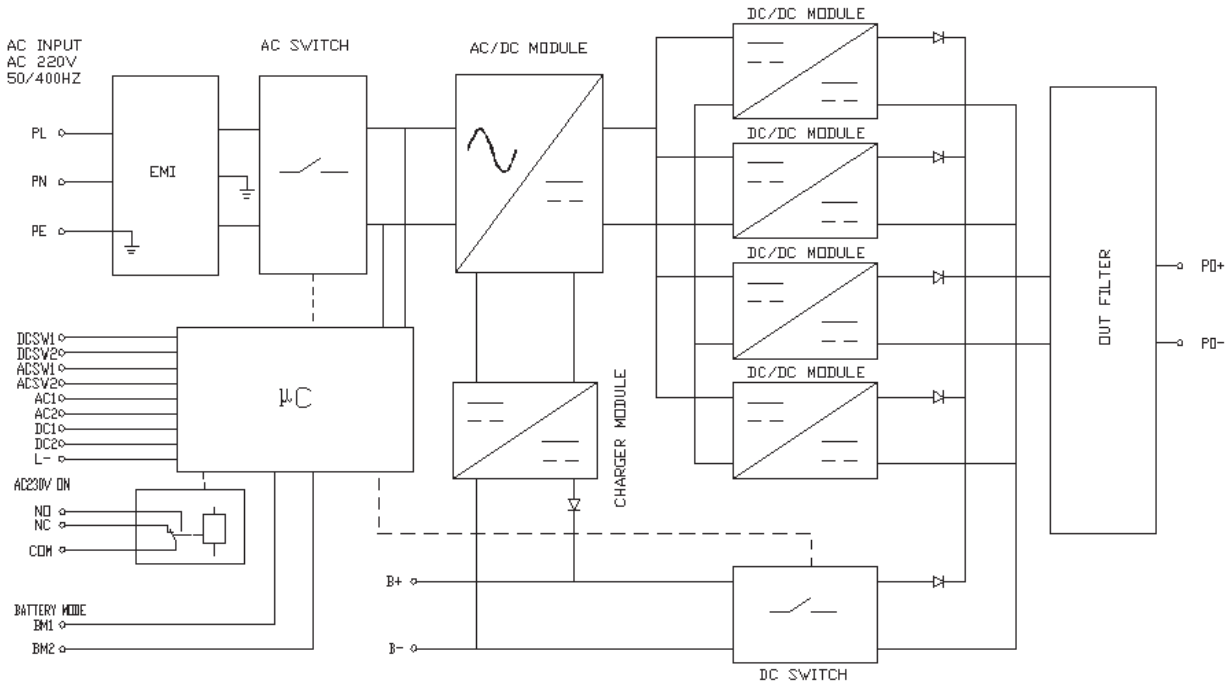


图 6：模块组件(UPS-A，UPS-B)原理图

3.1.2 UPS 模块组件外形

模块组件外壳即为散热器，具有充分的散热面积。模块组件外形见图 7。模块端子分配见表 2。

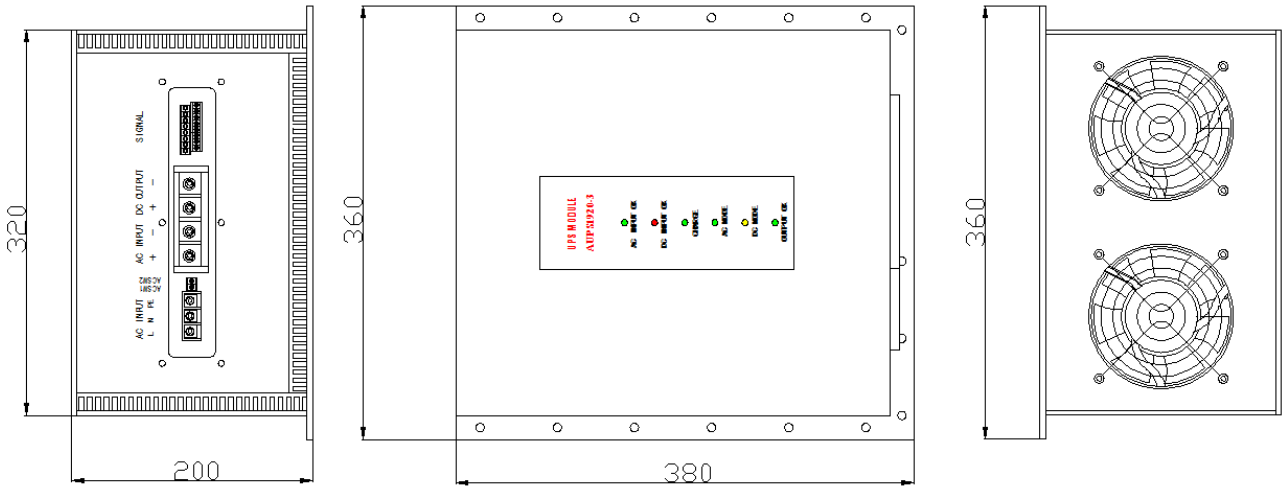


图 7：UPS 模块组件外形图

表 2：UPS 模块端子分配表

端子名称	交流输入端子			直流输入端子		
端子标识	PL	PN	PE	B+	B-	
说明	火线	零线	机壳	电池正极	电池负极	
端子名称	直汉输出		交流开关控制端		信号端	
端子标识	PO+	PO-	ACSW1	ACSW2		
说明	直流输出正极	直流输出负极	交流输出控制开关		控制信号惯用语指示信号	

3.2 隔离模块组件

隔离模块共包括两种，一种为 24V5A 输出，另外一种为 24V10A 输出。两种隔离模块均为直流 24V 输入。其原理框如图 8：

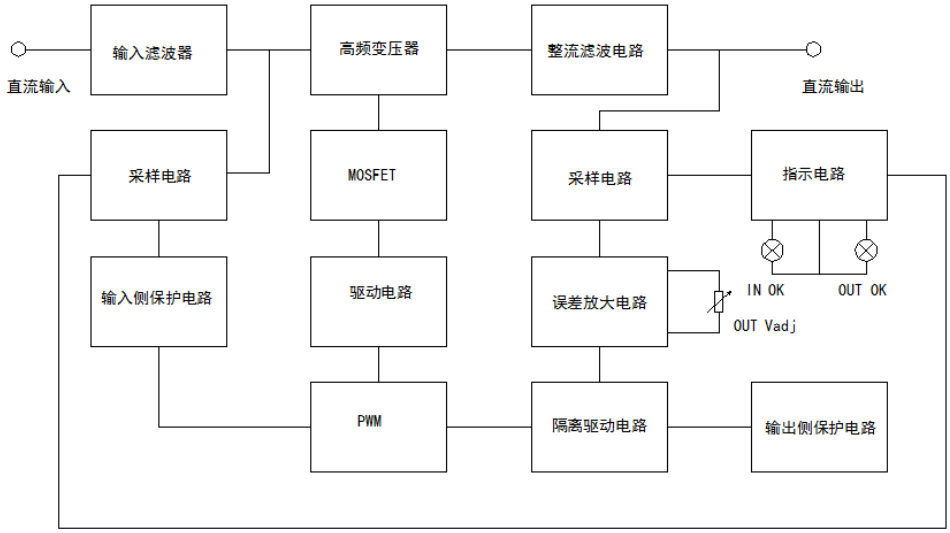


图 8 隔离模块原理框图

3.2.1 24V5A 输出隔离模块

3.2.1.1 24V5A 隔离模块外形图

24V5A 隔离模块的外形尺寸：130*120*36，详见外形图图 9

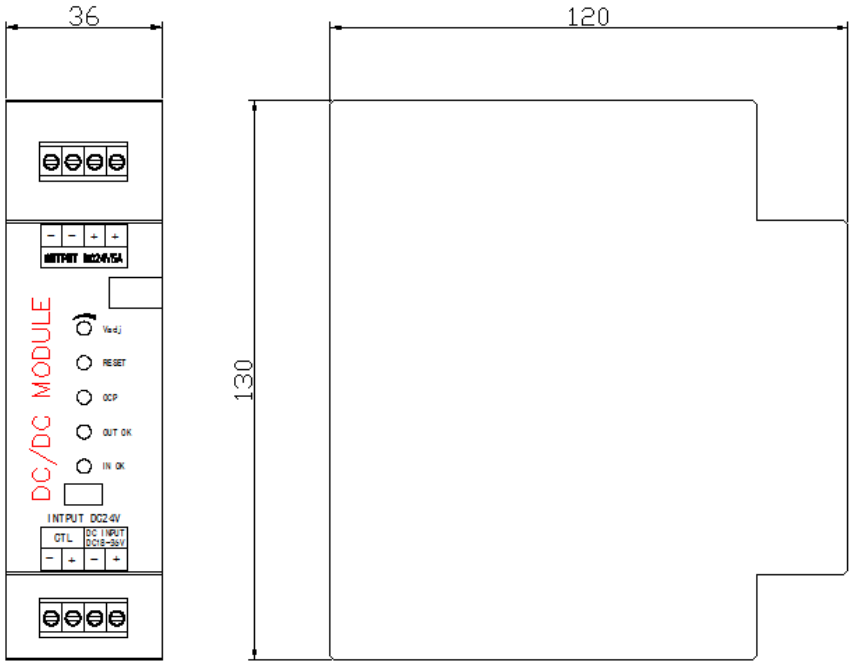


图 9　24V5A 隔离模块外形图

3.2.1.2 端子分配表

24V5A 输出 DC/DC 模块的输入输出端子定义见表 3

表 3　24V5A 模块端子分配表

端子名称	直流输入端子		遥控端		直流输出端子			
端子标识	+	−	CTL	−	+	+	−	−
说明	输入正极	输入负极	遥控正极	遥控负极	输出正极		输出负极	

注：遥控端的正极与负极短接时模块有输出，断开时无输出。正极对负极的最大拉电流不超过 2mA。

3.2.1.3 面板配置

面板配置及其功能说明见表 4

表 4　24V5A 面板配置功能说明

配置名称	输出电压调节	输出过流保护指示灯	复位键	输入正常指示灯	输出正常指示灯
配置标识	Vadj	OCP	RESET	INOK	OUT OK
说明	用于输出电压调节	输出过流时此灯亮启	过流故障的复位键	输入正常时亮	输出正常时亮

3.2.1 24V10A 隔离模块

3.2.2.1 隔离模块外形图

隔离模块外形尺寸为：130*120*48，详见外形图图 10

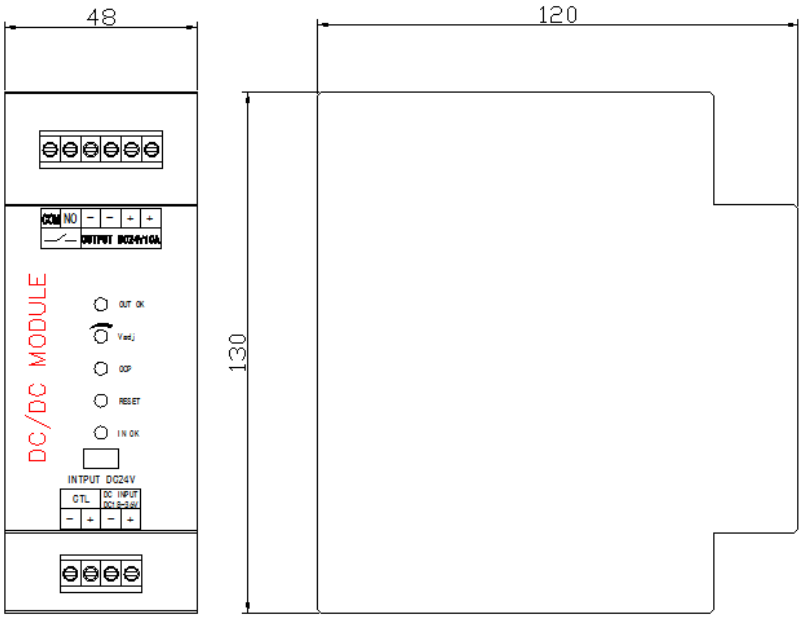


图 10　24V10A 隔离模块外形图

3.2.2.2

24V10A 输出 DC/DC 模块的输入输出端子定义见表 5

表 5　24V10A 模块端子分配表

端子名称	直流输入端子		遥控端		直流输出端子				结点输出	
端子标识	+	−	CTL	−	+	+	−	−	COM	NO−
说明	输 入正极	输入负极	遥控正极	遥控负极	输出正极		输出负极		公共点	常开点

注：1. 遥控端的正极与负极短接时模块有输出，断开时无输出。正极对负极的最大拉电流不超过 2mA。

2. 电源输出正常时结点输出状态为闭合，故障时断开。

3.2.2.3 面板配置

面板配置及其说明见表 6

表 6　24V10A 面板配置功能说明

配置名称	输出电压调节	输出过流保护指示灯	复位键	输入正常指示灯	输出正常指示灯
配置标识	Vadj	OCP	RESET	INOK	OUT OK
说明	用于输出电压调节	输出过流时此灯亮启	过流故障的复位键	输入正常时亮	输出正常时亮

3.3 电池组件

UPS1920-3 采用灵活的结构，可方便接线及更换与维修，电池抽屉包含两块 A412/65.G5 电池。电池外形如图 11：外形尺寸：353X175X190，每块重量 24.6kg，可提供 65Ah 的支持，联接时请注意电池的极性。

图 11：电池外形

4.UPS1920-3 电源使用说明

4.1 敷设电缆

4.1.1 交流输入线缆连接

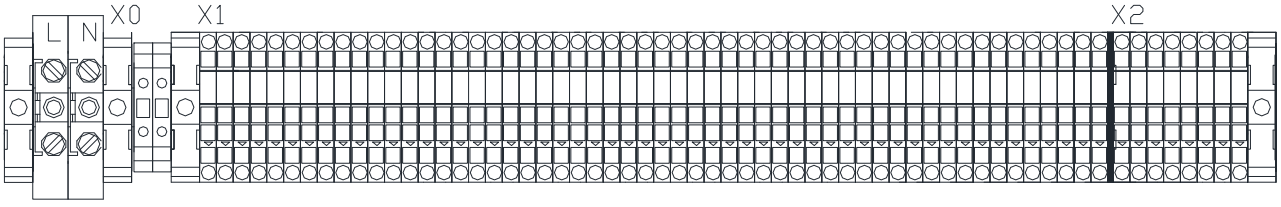


图 12：输入、输出接线排

在接入交流之前，请确认输入电压为 AC220V±20%的范围内。然后对应将交流输入线缆的 L、N、安全地线对应接入 X0 的 L、N 及 PE 端子，并确认连接牢靠。导线的截面积不小于 2.5㎜^{2}.

4.1.2 直流输出线缆连接

直流输出所关系到的接线排为 X1，X1 的端子与对应的输出分开关的对应关系见表 7

表 7： X1 端子对应表

端子标识	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
隔离模块输出	−	+	−	+	−	+	−	+	−	+	−	+	−	+	−	+	−	+
	T101		T102		T103		T104		T105		T1106		T107		T108		T109	
模块功率	24V10A																	
端子标识	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
隔离模块输出	−	+	−	+	−	+	−	+	−	+	−	+	−	+	−	+	−	+
	T110		T111		T112		T113		T114		T115		T116		T117		T118	
模块功率	24V10A						24V5A											
端子标识	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54
隔离模块输出	−	+	−	+	−	+	−	+	−	+	−	+	−	+	−	+	−	+
	T119		T120		T121		T122		T123		T124		T125		T126		T127	
模块功率	24V5A																	

直流输出的导线按最大 4A/㎜^{2}、按实际要求进行选择。在连接时一定要注意极性，即双号为正极端。同时在接线前一定要将相应的输出开关断开或确认系统未工作。

4.1.3 监测信号的引出

信号的输出端子包括两级即 X3 和 X4。X3 为无源结点信号输出。X4（只 UPS-A 配备）为绝缘监测仪的模拟量隔离电流信号输出，输出电流范围为 4-20mA.其中 1 号端子为负极，2 号端子为正极。X4 的输出结点信号如图 13 所示。

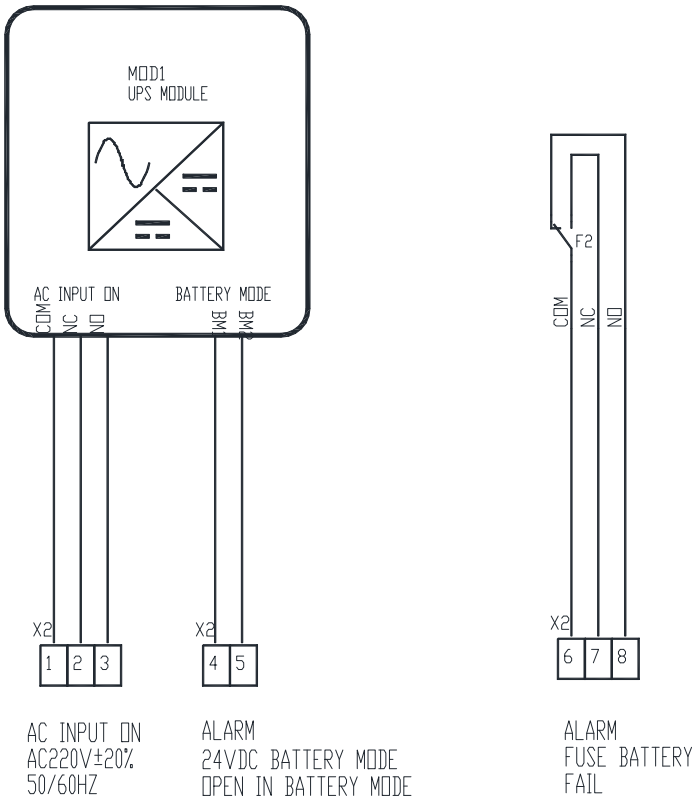


图 13：无源结点输出端子定义

表 8：结点意义及状态

结点意义	交流输入	电池模式报警	直流输入状态
端子标号	1，2，3	4，5	6，7，8
正常时状态	1， 2 闭合 1， 3 断开	电源模式闭合	6， 8 闭合 6， 7 断开
故障时状态	1， 2 断开 1， 3 闭合	交流模式时断开	6， 8 断开 6，7 闭合

4.2 接通相应的开关

将相应的电缆连接完毕，并检查接线的正确性，特别的是直流的极性。然后即可接通相应开关。
其顺序如下：

1）接通所有辅助开关直流输入开关 F2。

2）接通交流的输入开关 F1。

3）接通辅助开关 F3。

4）将面板的启动开关置于“ON”的位置。则门板上所有指示灯均为绿色。

5）接通相应隔离模块的输入。

4.3 关闭系统

关闭电源的顺序按照 4.2 的反顺序。

5. 故障现象与检修

对于 USP 电源系统，可以通过状态指示灯及状态结点对其故障类别进行判断。下面只对典型的故障现象列表进行说明，但建议不要直接对其进行内部维修，请与当地供货商进行联系确认后进行相应操作。

图14： 面板指示灯

表9：指示灯状态表

指示灯名称	AC INPUT MONITOR	DC INPUT MONITOR	MAIN 24V ON
作用	交流输入状态指示	电池输入状态指示	直流输出指示
状态	交流输入正常时为绿色，故障时为红色	正常为绿色 故障时为红色	正常为绿色 故障时为红色

表10：典型故障现象与维修方法

序号	故障现象	故障原因	排除方法
1	交流输入指示灯及主电结点告警	交流输入掉电	检查交流供电回路
2	直流输入监测指示灯告警	1.电池给供电回路断路 2.电池失效	先按一复位开关KSW2,过二分钟后，若指示重新告警。则为故障。1.检查直流输入开关组合是否全闭合。否则检查连线 2.更换同型号电池组。
3	模块失败告警	电源模块损	返厂维修
4	输出监控指示灯红色	电源模块输出过压	返厂维修

	告警	输出是否过载或短路	断开输出总开关，排除过载点

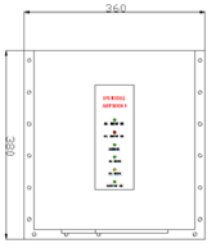
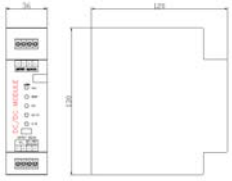
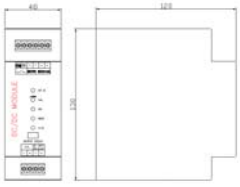
6. 系统规格

表 11: 系统规格

技术数据-系统	
	UPS1920-3
布局	在线电池, 双转换
输入	
电压(V)	AC220V
电压范围(%)	±20%
电流(A)	≤10A
频率(Hz)	45-400Hz
输入功率系数	0.80
输出	
额定输出功率	1600 W
输出电压 (V)	DC24V
输出波形	近似直线
电压调整率	≤0.5%
电流调整率	≤1%
波纹系数	≤1%
过载	1.05 I 0 ～ 1.5 I 0
过载	10 分钟达到 110%;60 秒达到 125%;一个周期到达 1000%
电池	
电池数量	2 x 12V
电容	65Ah
常态	
环境温度	-25℃ to +55℃
最大相对湿度(%)	Max : 95
外壳	IP44

7. 订购信息

表 12：订购信息

序号	名称	零件号码	图片	数量	重量
1	机箱 UPS-A	U300210		1	130 Kg
2	机箱 UPS-B	U300211		1	130 Kg
3	主电源模块 HUPS1920-3	U300220		1	25 Kg
4	电池	U100230		2	24.6 Kg
5	5A 隔离模块 HDC120S24/24	U300250		1	1.5kg
6	10A 隔离模块 HDC240S24/24	U300260		1	1.6kg

序号	名称	零件号码	图片	数量	重量
7	指示灯	U200250		1	0.1 Kg
8	旋钮开关	U300270		`1	0.1Kg
9	指针电压表	U300280		1	0.3Kg
10	指针电流表	U300290		1	0.3Kg

8.服务信息(技术支持与售后服务)

联系方式：

电话（Tel）：(8621) 50272921

传真（Fax）：(8621) 50272901

电子邮箱（E-mail）：fulinke@126.com fulinke@tom.com

Axial Vibration Monitor

Mounting and Set-up Instruction

for

LC-AVM-01

4399，No.PuSan Road.Shanghai.China

Telephone:0086 21-51961688

Fax:0086 21-51961638

SHANGHAI LECHUN
HEAVY MACHINERY & ELECTRONIC EQUIPMENT CO.,LTD.

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1、Introduction

1.1 System description

The LC-AVM-01 Axial Vibration Monitor is a control and monitoring system capable of measuring axial crankshaft vibrations on diesel engines.

The LC-AVM-01 is capable of measuring 0.00-10.00 mm (peak-to-peak) displacement of the crankshaft. The displacement is digitally read out on a display on the control unit, and send through an alarm/monitoring output terminal.

Calculations have shown that certain engine types need monitoring of the axial vibrations to ensure safe engine operation.

For easy set-up and adjustment, a label is placed on the inside of the control unit cover, showing terminal connections and set-up procedures.

1.2 Product support

If you need help installing or servicing the Axial Vibration Monitor, please contact:

SHANGHAI LECHUN HEAVY MACHINERY & ELECTRONIC EQUIPMENT CO.,LTD.

Telephone No.: 086-021-51961688

Fax No.: 086-021-51961638

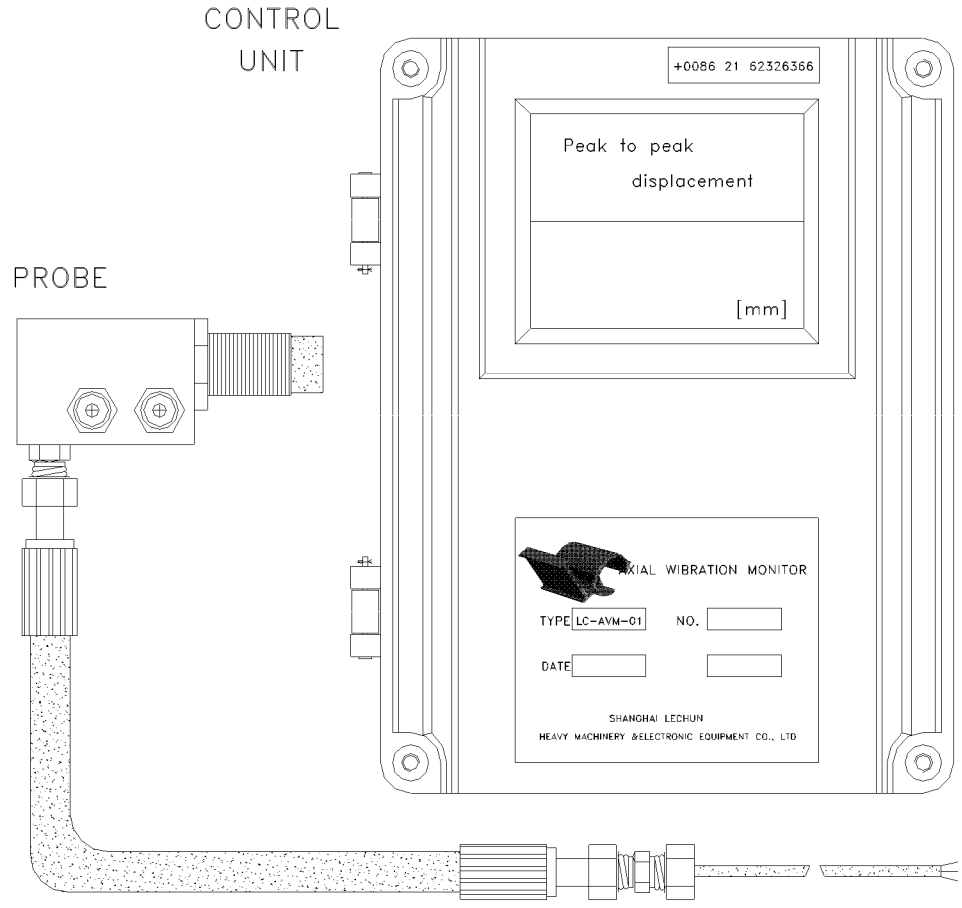
Email: LeChun@LeChun.cn

In order to assist You in the most efficient way, please prepare and include the following information:

1. Name of vessel or plant
2. Name of component suspected of malfunction
3. Identification number for the component(Serial no. ××××-×)

4. Description of problem / malfunction, characterized by troubleshooting procedures that have tested negative (e.g. “Procedure 7.1.1 tested negative, giving the result…”)

NOTE : As each Axial Vibration Monitor contains individually calibrated parts, the serial numbers are needed by us in order to deliver the correct spare parts.



2、Specifications for the LC-AVM-01

OPERATING TEMPERATURE RANGE: -10℃+70℃

PROTECTION: IP55

MEASURING RANGE: Max: 10.00 mm peak-to-peak (±5.00 mm)

Linearity:5.00 mm peak-to-peak (± 2.50 mm)

POWER SUPPLY: Supply voltage : 24 Volt ± 20 %

Max current consumption :300 mA

PROBE: Type :LC-AVM-P01 Cable length :7 m

Mounting distance : **8.5 mm**

ALARM/MONITORING CURRENT OUTPUT:

Output : 4 - 20 mA Max load :250 Ohm

0 mm peak-to-peak => 4 mA

10 mm peak-to-peak => 20 mA

Iout[mA]=1.6×(displacement in mm peak-to-peak)+4

SLOW DOWN OUTPUT: Potential free contact (No)

Max load: 50 Volt 100 mA

SET-POINT ADJUSTMENT: 0.00 to 10.00 mm

SLOW DOWN DELAY TIME: 0 - 300 sec. adjustable in steps of 20 sec.

ACCURACY: Probe input to Display, Crankshaft position output and Alarm monitoring current output : ± 5%

Slow down Delay time : ± 15%

WARNING! The negative pole of the Current output is connected to the negative pole of the power supply.

3、Functional description

The Probe delivers a current signal directly proportional to the distance between the probe and the crankshaft to the control unit. the control unit converts the current signal from the probe to a value of 1 Volt per mm displacement of the crankshaft. the converted signal is processed in a max/min detector. the peak-to-peak Value of the displacement is displayed on a four-digit display with a resolution of 0.01 mm and sent through a voltage-to-current converter, to the “Alarm/Monitoring Current Output”, as a 4 - 20 mA current signal.

When the peak-to-peak displacement signal from the probe decreases, the value of the display and the “Alarm/Monitoring Current Output” will not follow immediately ,but decrease slowly to the actual peak-to-peak displacement.

The “Slow Down Output”, an on/off signal with a potential-free contact(NO), is set if the peak-to-peak signal exceeds a set-point value for more than the “Slow Down Delay Time ”. The set-point value and the “Slow Down Delay Time ” are internally adjustable. The reset of the “Slow Down Output” and the “Slow Down Delay Time ” occurs as soon as the peak-to-peak signal has dropped below the set-point value.

The set-point value for “Slow Down Output ” is shown on the display by pressing the “Set-point” button found under the control unit cover.

External faults, such as insufficient supply voltage or short-circuiting /disruption of the probe cable, will be indicated on the

display by 18.88., and the “Alarm/Monitoring Current Output” by 0 mA. The fault condition will be maintained for 5 sec. after the disappearance of the fault. This fault condition will also occur for 4-8 sec. when the power to the system is switched on. None of these faults will cause unintended setting of the “Slow Down Output”.

4、Unpacking

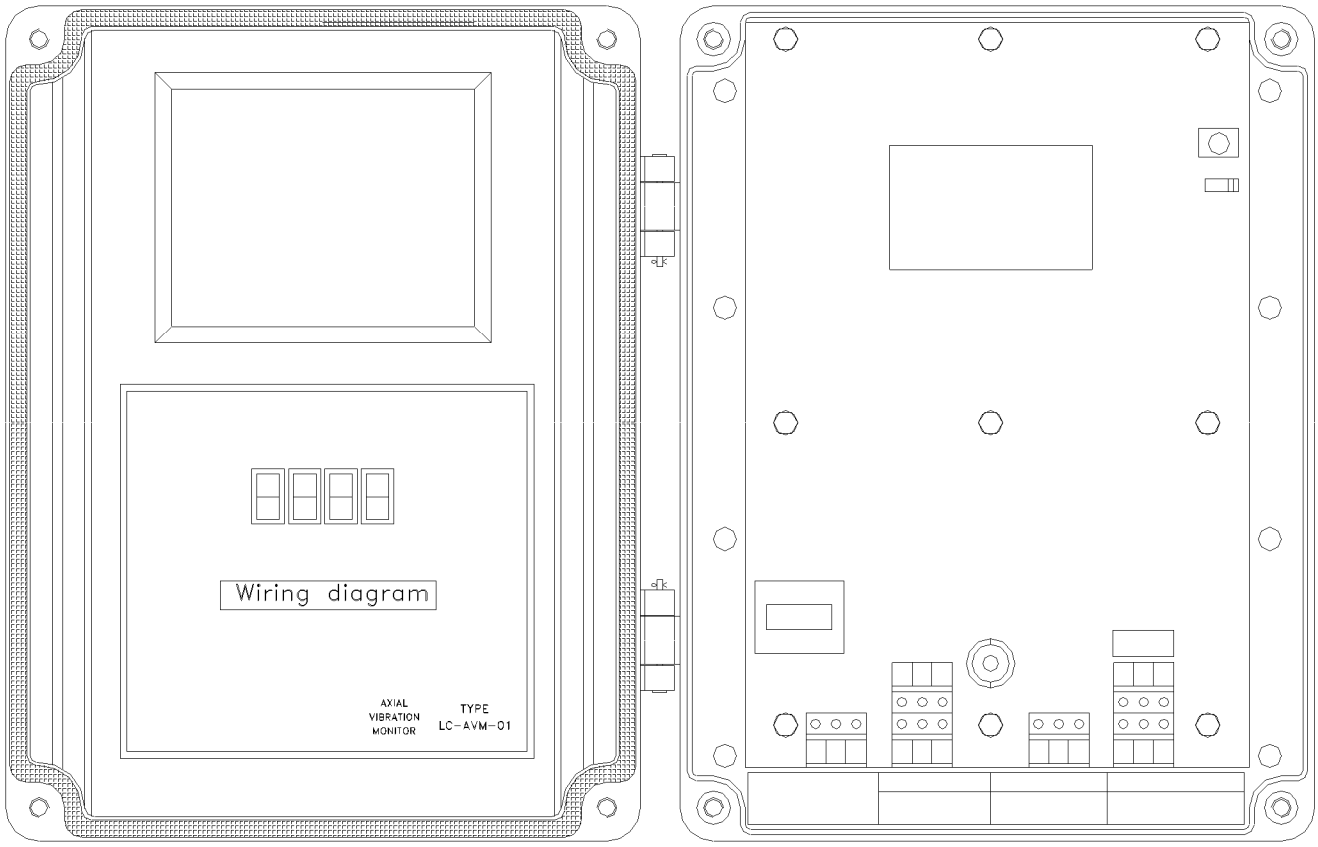
On delivery always check to ensure that the AVM system package is complete and undamaged. The contents of the package is as follows:

1、Axial Vibration Monitor Mounting and set-up instruction(This Document).

Please check this Document holds one calibration sheets, an appendix named Mechanical Mounting Instruction, and a registration form.

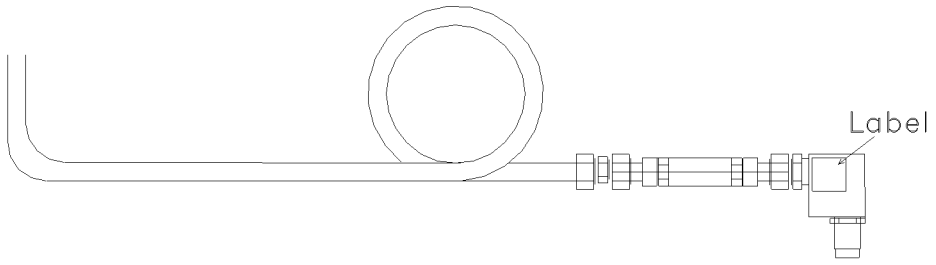
2、 Axial Vibration Monitor Control Unit

Open the box cover and check that the circuitboard identification number corresponds to the identification number on the calibration sheet for the complete AVM unit. If the identification numbers dose not correspond, please contact us.



3. Proximeter Probe and cable

Please check that the probe identification number found on probe and cable corresponds to the probe identification number found on the AVM Complete calibration sheet and the probe calibration sheet .If the identification numbers does not correspond, please contact us.



5、Mounting of the LC-AVM-01

5.1 Mechanical mounting

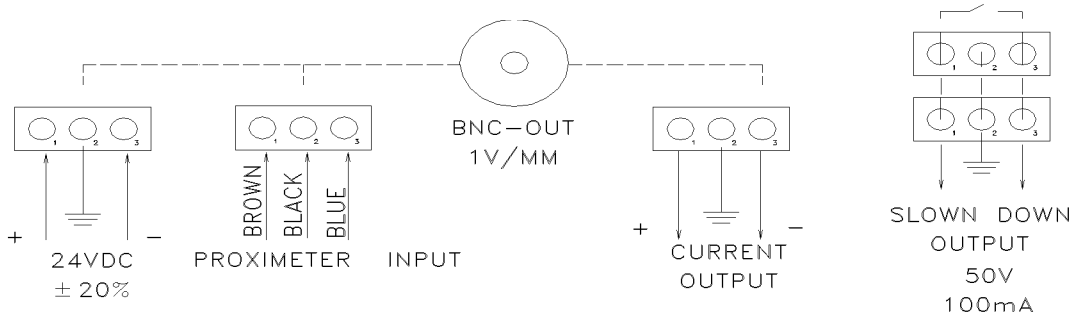
The LC-AVM-01 probe is to be mounted referring to the **Mechanical Mounting Instruction** drawing found in appendix. To ensure correct readout of peak-to -peak values it is important that the gap between the probe and the damper is correct. For the LC-AVM-01 probe, the correct mounting gap is **8.5 mm.**

Mount the steel pipe where convenient and lead the probe cable through the pipe to the outside of the engine side wall. The Axial Vibration Monitor Control Unit is to be mounted on the engine side wall within reach of the probe cable.

For further details please refer to the drawing found in appendix.

5.2 Electrical mounting

The terminals on the AVM circuitboard are designated k1 to k6, and pin numbers are indicated as indexes, i.e pin no.3 on k4 is designated k4.3. The circuitboard is to be connected as indicated below. The ground symbol indicates, that k1.2, k3.2 and k4.2 is connected to Ship Ground through the circuitboard.



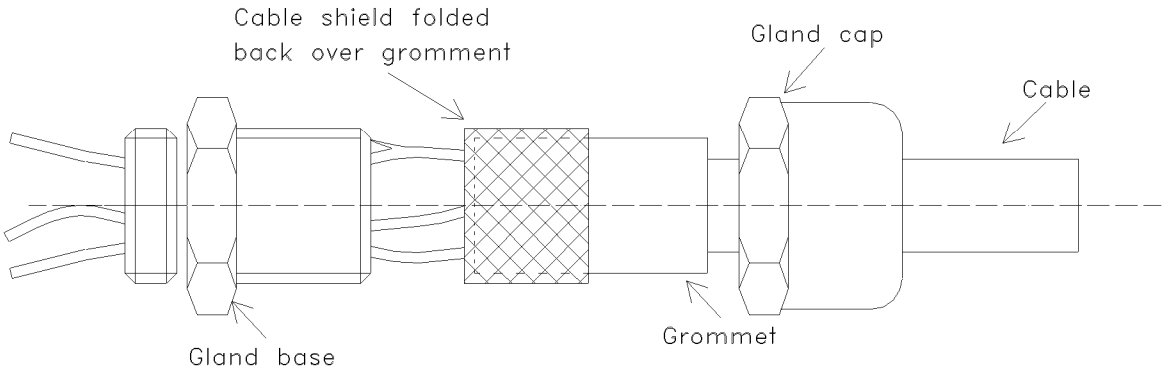
When the power is turned on, the system will indicate error by displaying 18.88., After approximately 8 seconds, the system will return to normal operating condition, and indicate 0.00-0.05 mm.

If not, refer to chapter 7 Trouble Shooting to locate the problem.

5.2.1 Cabling

The probe cable can be cut off to desired length. If needed, the cable can be extended using a junction box and a similar cable.

The Alarm/Monitoring Current Output is to be connected to the engine control system using a shielded cable. Terminate the shield in the cable gland as shown in the below figure.



The Slow Down Output is also to be connected to the engine control system using a shielded cable, and the shield is to be terminated in the cable gland.

The Slow Down and the Alarm/Monitoring Current Outputs can be connected to the Engine Control System using one shielded multi-core cable instead of two without affecting the performance of the control unit.

We recommends that cables with a cross section of 0.75 mm^2 are used. Please refer to the plant specification for information on plant specific

requirements.

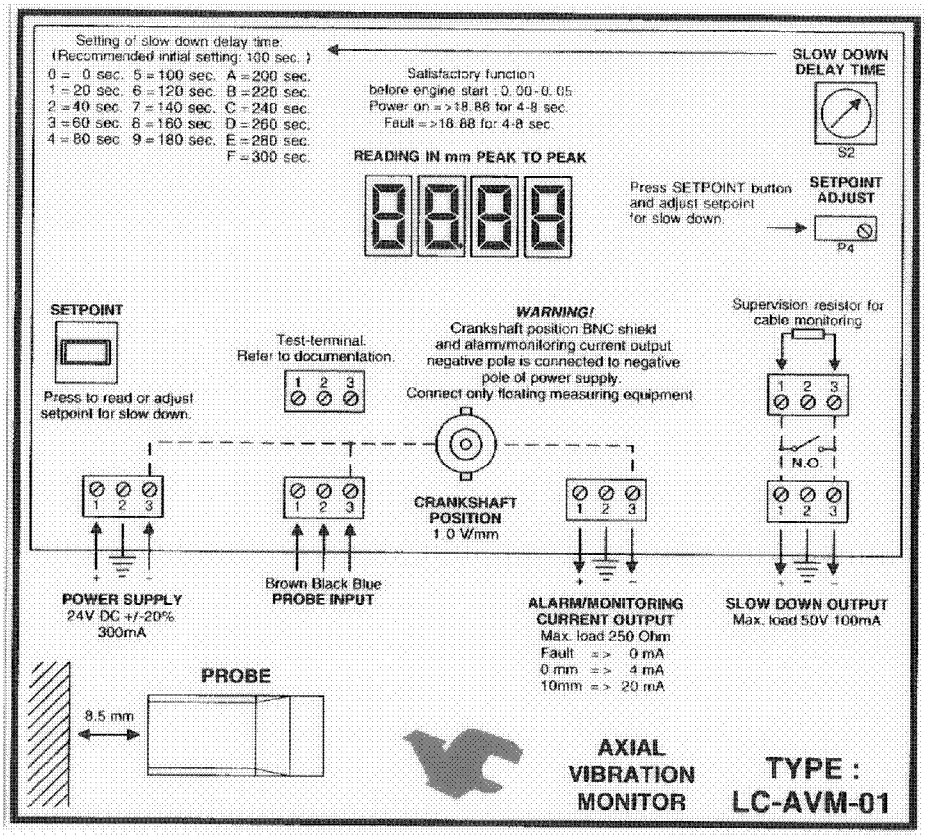
5.2.2 Registration of the installation

In order to assist in the most efficient way ,we have included a registration form. When filled out, the registration form holds system specific information needed in case of replacement of malfunctioning parts. As the circuitboard is calibrated in accordance to the probe date, we require information about type and serial numbers for fast and efficient expedition in case of future references.

Please take a minute to fill out the registration form found together with the calibration sheets, and return this to us.

6、System set-up

On the inside of the AVM control unit cover a label giving an overview over the circuitboad is fitted:



The label holed information about terminal assignments, slow down delay time settings, slow down set-point adjustment and readout. Also , the probes mounting gap is indicated for quick reference. After mounting the probe and connecting the circuitboard, the Axial Vibration Monitor is ready for set-up.

The set-up procedure has two steps:

First, the set-point for slow down has to be adjusted. Refer to the appendix **"Calibration Sheet for Axial Vibration Monitor"** for data on Your engine. Press and hold the set-point button (S1). Adjust the set-point by turning the screw on the set-point adjust potentiometer (P4), until the required set-point is shown on the display.

Second, the slow down delay time has to be adjusted. This is done by turning the arrow shaped slot in the slow down potentiometer. the recommended initial setting is 100 seconds ("5").

NOTE: The circuitboard has three additional adjustable potentiometers, marked P1, P2 and P3. Their functions are as follows:

P1: Scaling of sensor signal to meter

P2: Internal adjustment for alarm limits

P3: Internal adjustment for voltage reference.

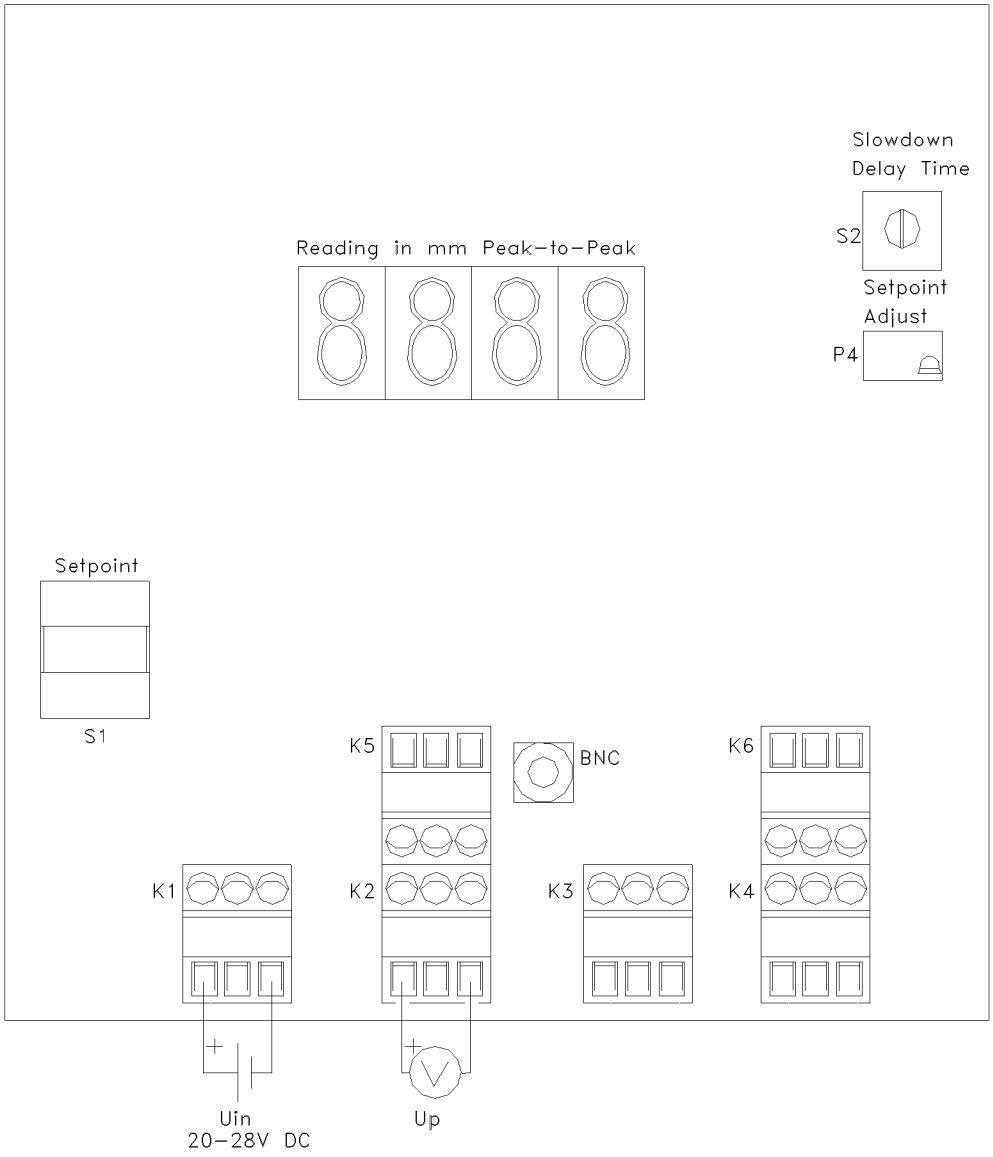
P1, P2 and P3 are not to be adjusted

7、Trouble shooting

7.1 Standard procedures

In case of suspected malfunction, a structured system test should be carried out. By following the below steps, a complete system test is carried out, and an identification of the problem should be possible.

7.1.1 Check of power supply to probe



Connect the power supply to K1

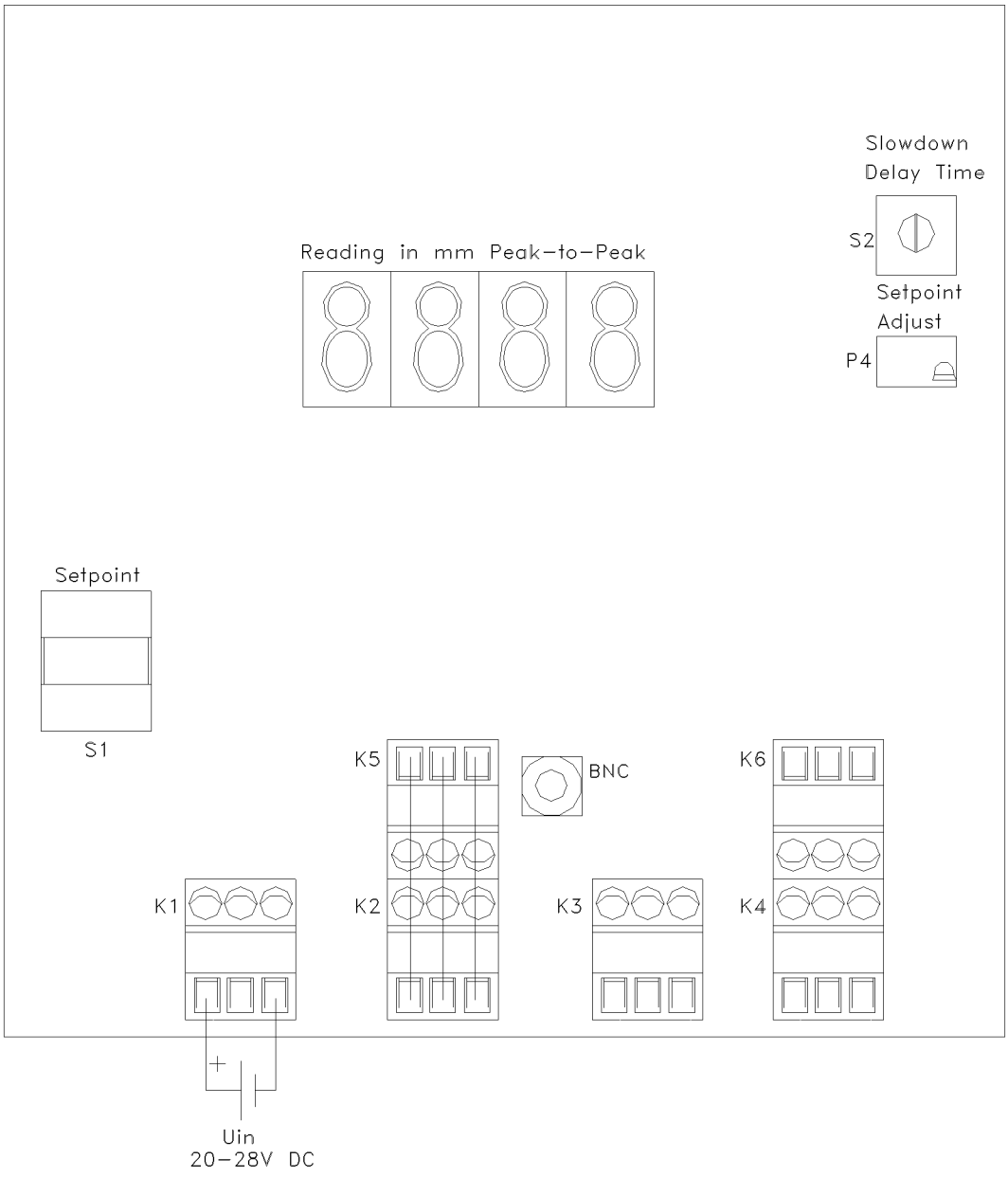
The display will indicate 18.88. (error)

Check the voltage on K2

For the LC-AVM-01 the Up readout should be 14.0-16.0 V.

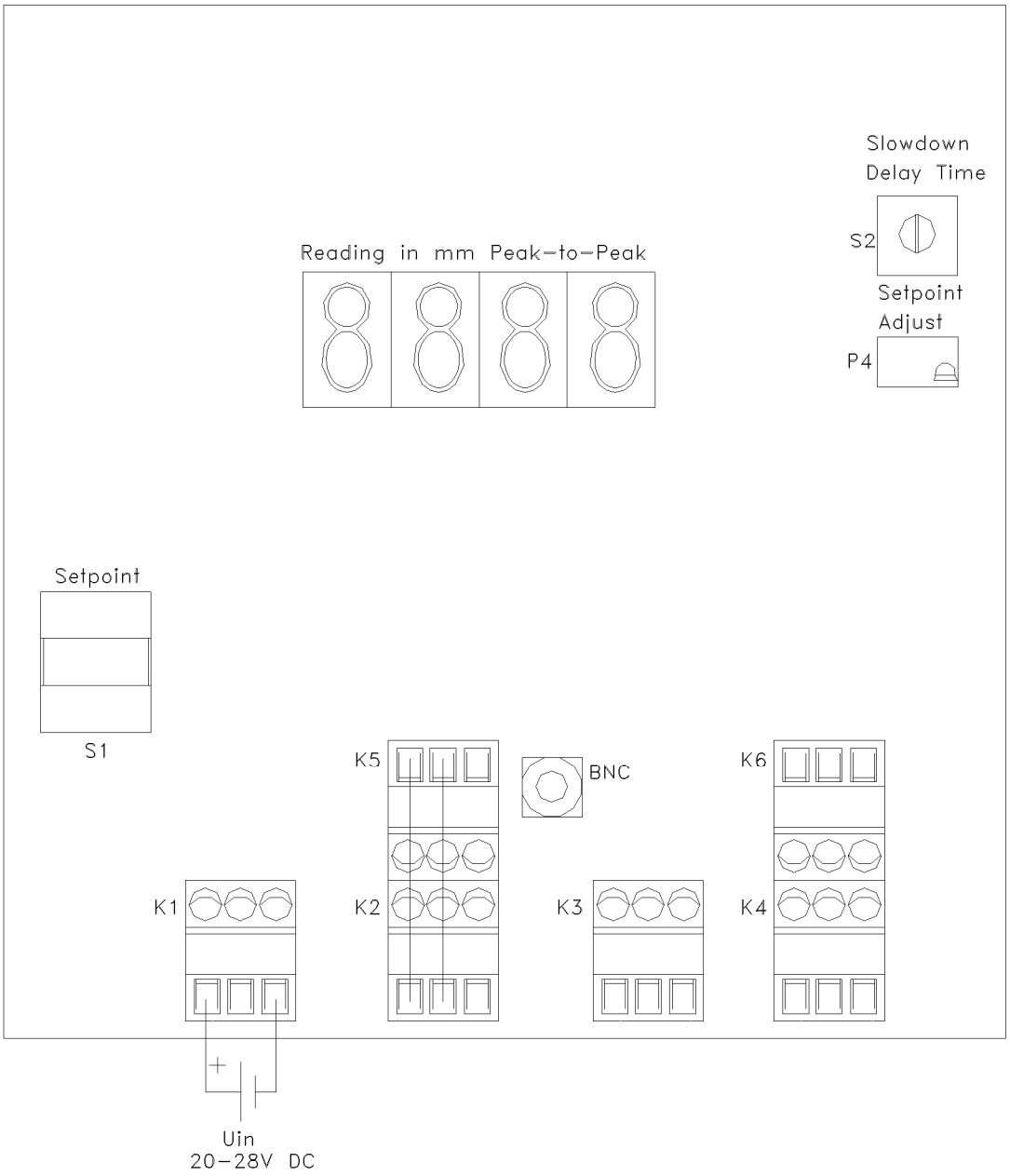
If not ,the circuitboard may be defective and should be replaced (Refer to paragraph 7.2.2 Replacing the circuitboard).

7.1.2 Check of unit behavior during power on



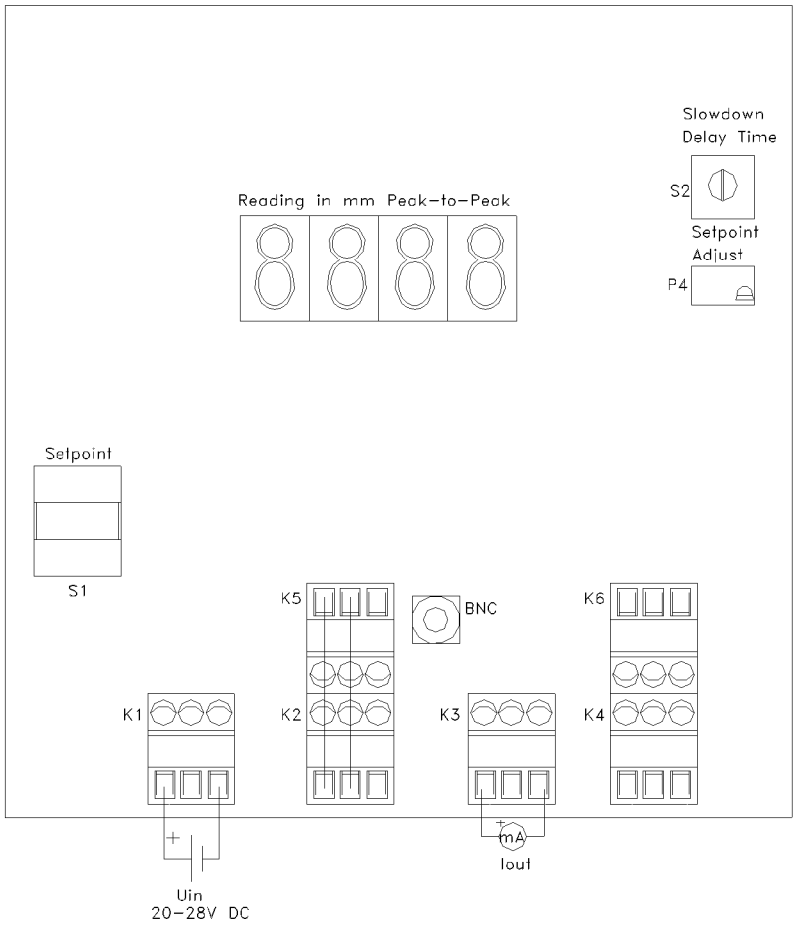
Connect K2 to the test terminal K5:K2.1-K5.1, K2.2-K5.2, K2.3-K5.3
When the power is turned on the display will indicate 18.88. (error)
After approximately 8 seconds the display will return to normal condition and indicate 0.00-0.05 mm
If not, the circuitboard may be defective and should be replaced (Refer to paragraph 7.2.2 Replacing the circuitboard).

7.1.3 Check of probe input & display



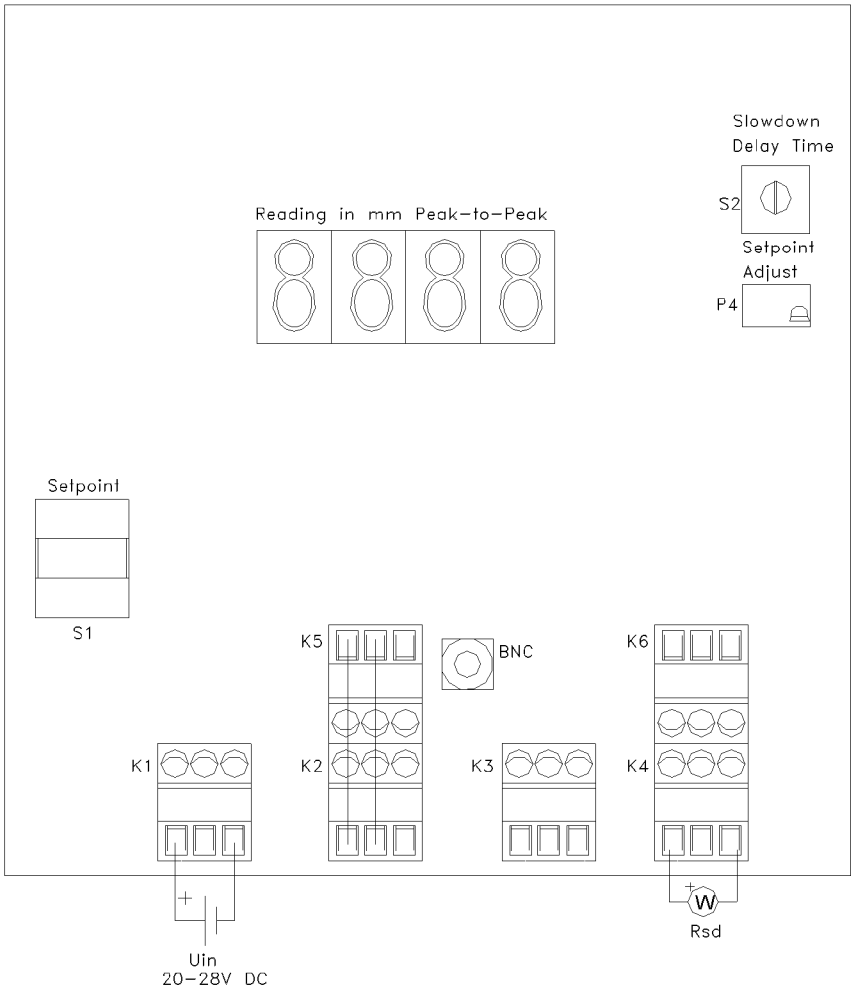
Partly connect K2 to the test terminal K5:K2.1-K5.1, K2.2-K5.2
For the LC-AVM-01 the readout will stabilize at 6.5mm±1mm. This value corresponds to the calculated slope for the probe characteristic.
If not, the circuitboard may be defective and should be replaced (Refer to paragraph 7.2.2 Replacing the circuitboard).

7.1.4 Check of current output for alarm system



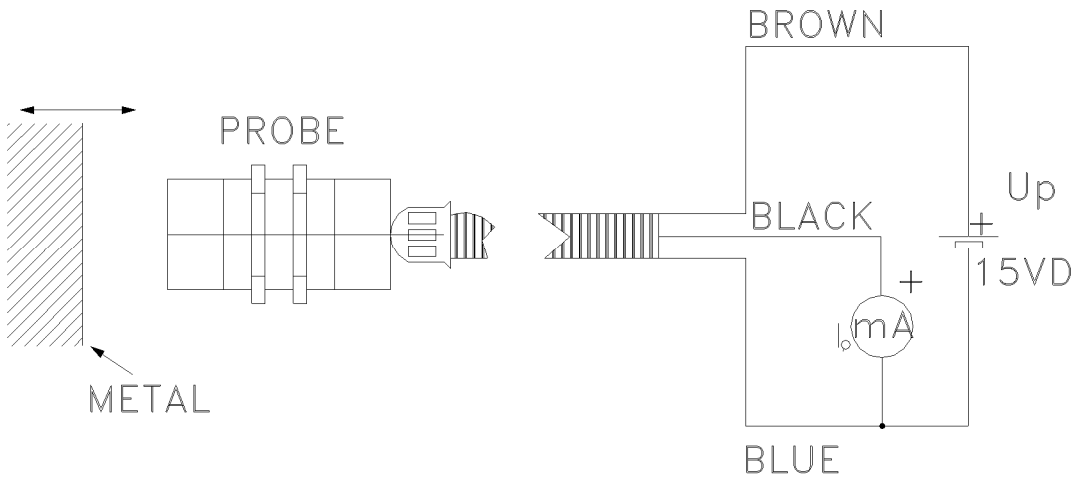
Partly connect K2 to the test terminal K5:K2.1-K5.1, K2.2-K5.2
Connect an amp-meter to K3
Connect K2.3 to K5.3 and note down corresponding values of I_{out} and the display reading, as the display reading descends to 0.00.
I_{out} will follow the value in the display according to the following formulae:
I_{out} [mA] =1.6×(display indication [mm]) +4
For the LC-AVM-01, 4 mA corresponds to 0 mm and 20 mA corresponds to 10 mm.
In case of error or during power on (display indication:18.88.) I_{out} will be 0.00-0.08 mA.
If I_{out} differs significantly from the above formulae, the circuitboard may be defective and should be replaced (Refer to paragraph 7.2.2 Replacing the circuitboard).

7.1.5 Check of Slow Down Set-point and output



Connect an ohm-meter to K4
Adjust the Slow Down Delay time to position "0"
Partly connect K2 to the test terminal K5:K2.1-K5.1, K2.2-K5.2
Check the actual Slow Down Set-point by pressing the Set-point button. If the Set-point is greater than 5 mm, reduce the Set-point accordingly to perform this test.
As the initial display indication is higher than the adjusted Set point, the Slow Down relay will be activated: R_{sd}=0Ω.
Connect K2.3 to K5.3 and watch the reading on the ohm-meter as the display reading descends. At display indications lower than the adjusted Set-point , the Slow Down relay will be deactivated: R_{sd}=∞or R_{sd}=$R_{supervision}$, if a supervision resistor is mounted between K6.1 and K6.3.
If the Slow Down relay is defective, the circuitboard should be replaced (Refer to paragraph 7.2.2 Replacing the circuitboard).
NOTE: Remember to reset the Slow Down Delay Time and Set-point to their original values.

7.1.6 Check of the probe



Connect the power supply and an amp-meter to the probe.
First, check the connection by moving a piece of metal back and forth in front of the probe. If no variation in I_p is found, the probe or the probe cable may be defective. the probe should be replaced.
In case of malfunction, refer to paragraph 7.2.1 Replacing the probe.

7.2 Replacing parts

If the trouble shooting indicates system failure, new circuitboards and probes can be delivered us. As the circuitboard has been calibrated to match the probe, the probe can not be replaced without replacing the circuitboard as well.

7.2.1 Replacing the probe

Therefore, in case of probe failure, order a new probe and a replacement circuitboard from us.

The new probe and circuitboard is to be installed according to the procedure in chapter 6 System set-up.

NOTE: Remember to replace the old calibration sheets.

7.2.2 Replacing the circuitboard

In case of circuitboard failure, order a replacement circuitboard from us. When ordering please state the identification numbers for your probe and circuitboard.

A replacement circuitboard will then be calibrated accordingly and delivered .

The old circuitboard is dismounted by taking out the six screws holding the metal plate. The new circuitboard is then mounted using the six screws, that held the old circuitboard. Do not loosen the nuts on the circuitboard!

Wiring and Set-up is carried out according to the procedures in section 5.2 Electrical mounting and in chapter 6 System set-up.

NOTE: Remember to replace the LC-AVM-01-COMOLETE calibration sheet containing the old serial number.

8、Appendix

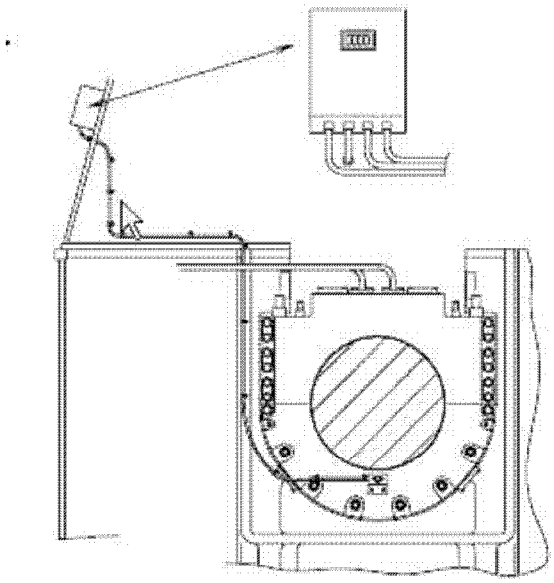
After this page, the following appendix are to be found:

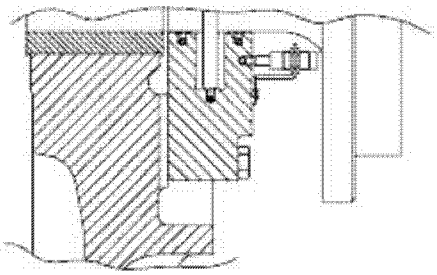
- Mechanical Mounting Instruction
- Calibration sheet for the AVM Complete unit
- Registration form (To be returned to us)

Mechanical Mounting Instruction

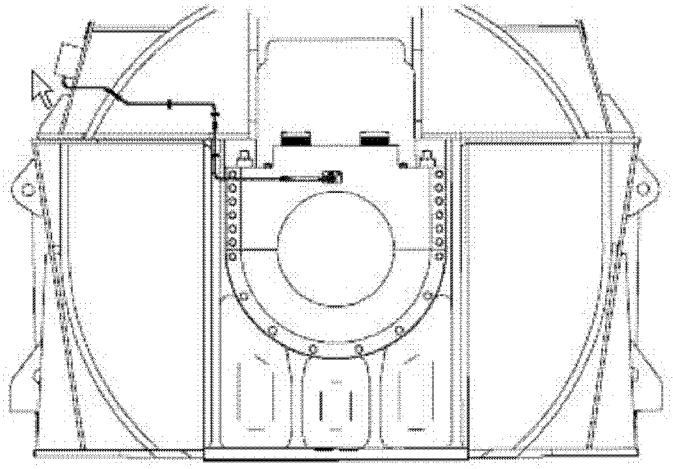
The probe is connected to a control unit which displays peak-to-peak movements and sends signals to the engine control system.

A proximeter probe is built onto the damper housing. The probe can either be fitted on the lower part of the damper housing or on the upper part of the damper housing.





2.



Registration Form

Please fill in the blanks relevant to your installation and return this form to:

SHANGHAI LECHUN HEAVY MACHINERY & ELECTRONIC EQUIPMENT CO.,LTD.

Telephone:086-021-51961688

Fax: 086-021-51961638

Axial Vibration Monitor

Product information

Type(LC-AVM-01).	
Complete Identification No.	
Circuitboard Identification No.	
Probe Identification No.	

The type and identification numbers are to be found on the circuitboard in the control unit.

Vessel/Plant information

Vessel/Plant name	
Lloyds no.	Hull no.
Yard	
Engine type	Engine no.
Engine builder	
Date of installation	Installed by: Yard/Contractor/Chief Eng (Please indicate)

Remarks:

Calibration Sheet for Axial Vibration Monitor

LC-AVM-01 Serial No.:_____

LC-AVM-01 CIRCUITBOARD Serial No.:_____

LC-AVM-01 PROBE Serial No.:_____

No other probe is to be used without re-calibration by us, as other probes may cause incorrect readouts

Axial vibration limits for safe engine Operation

Engine Type	Overhaul	Alarm	Slow-Down

Circuitboard tested and calibrated by_____

Sing._____

滑油加热柜 HTCO32

Heating Tank For Cylinder Oil

南通航海机械集团有限公司

NANTONG NAVIGATION MACHINERY GROUP CO., LTD.

电话 Tel：0513-83513339 传真 Fax：0513-83527356

地址：江苏省南通市人民西路 60 号
Email：nthj@vip.163.com Website: http://www.nnmc.com.cn
电话：0086-0513-83513339 传真：0086-0513-83527356

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3、滑油加热柜电气原理图 (HTC-DK)……6
Heating Tank For Cylinder Oil Electric Dragram (HTCO-DK)
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Spare parts for Heating Tank For Cylinder Oil

地址：江苏省南通市人民西路 60 号
Email：nthj@vip.163.com Website: http://www.nnmc.com.cn
电话：0086-0513-83513339 传真：0086-0513-83527356

滑油加热柜简介

滑油加热柜主要适用于 MAN B&W 主机的注油器系统，为注油器系统提供稳定温度的汽缸油供汽缸润滑。

一、组成

滑油加热柜主要由油箱、过滤器、温控电加热器、温度表温度开关、液位开关、球阀和电气控箱等组成。

二、电气控制箱控制开关和指示灯

1、白色指示灯——电源指示灯

2、红色指示灯——低液位报警指示灯

3、绿色指示灯——电加热运行指示灯

三、主要技术参数

1、容　　积：37L

2、工作温度：40～50℃

3、工作压力：3.0～4.0bar

4、电加热功率：750W

5、电制：440V/60Hz/3Φ

四、安装、调试（主机停车时）

1、按照外形图 HTC032-WX 连接各管路，检查各阀件的开启状态。

2、按照电气原理图接线，确保接线的正确。

2、打开加热柜电气控制箱上的电源开关。

4、加热柜进入正常状态。

五、注意事项

1、加热柜具有自动加热功能，出厂时温度已设定 45℃，不得任意调整。

2、低液位时不得启动电加热器。

Introduction for Pumping Station

Heating Tank For Cylinder Oil is mainly used for oil injection pump system for MAN B&W main engine. Cylinder Oil supplies steady temperature of system, and lubricates the cylinder.

A、consisting

Heating Tank For Cylinder Oil consists of fuel tank, filters, ELEC.heater, thermometer,temperature switch, lever switch and electric control boxes , etc.

B、Electric control box of Heating Tank indicator lamp

1、White lamp——Source lamp

2、red lamp——low level alarm lamp

3、Green lamp——heater running lamp

C、Main technical parameter

1、Vloume: 37L

2、Working temperature: 40～50℃

3、Working pressure: 3.0～4.0bar

4、Power of ELEC.heater: 750 W

5、voltage：440V/60Hz/3Φ

D、installation and commission (main engine stops)

1、According with external view HTCO32-WX,connecting each pipeline and checking the status of the valves opening.

2、Connecting by the electric principle diagram to make sure the connection.

3、Open the power on the electric control box of heating tank.

4、Heating tank is put into the normal state.

E、Note:

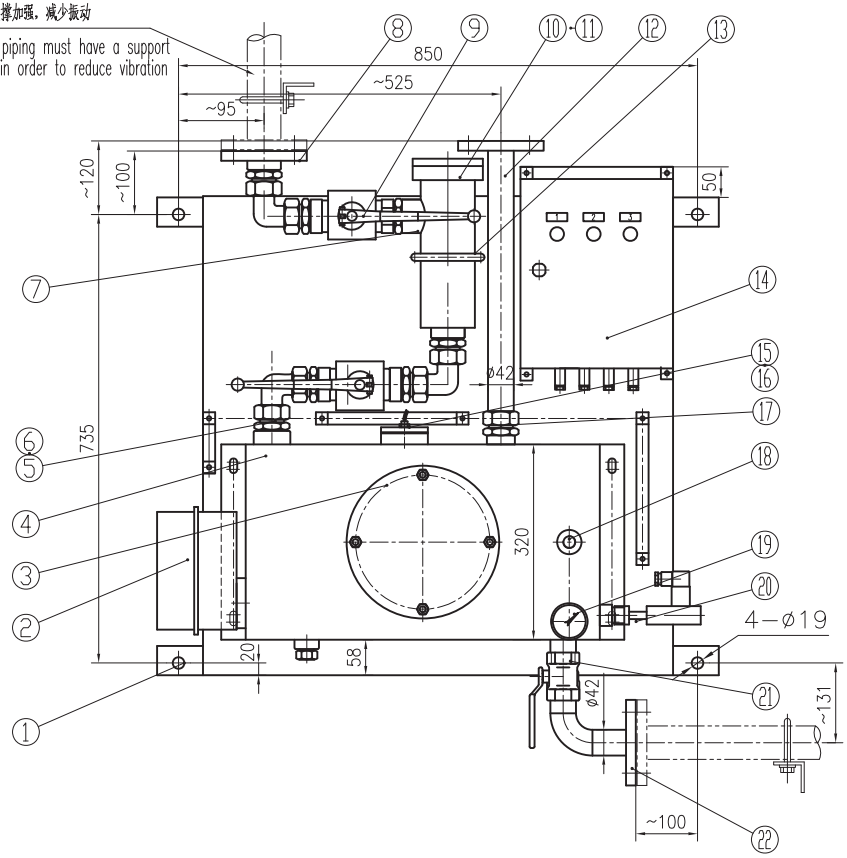
1、Heating tank can auto heating. The temperature has been set by 45℃ before delivery and can't be adjusted arbitrarily.

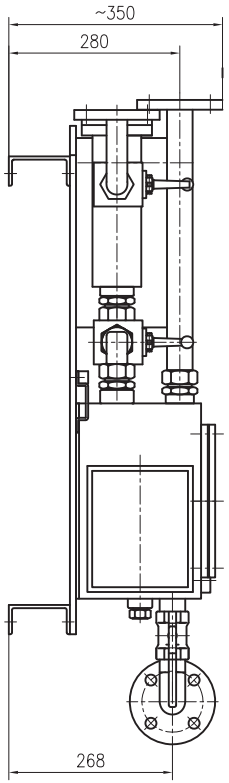
2、Do not turn on the ELEC.heater while the low liquid level.

HTCO-WX-00

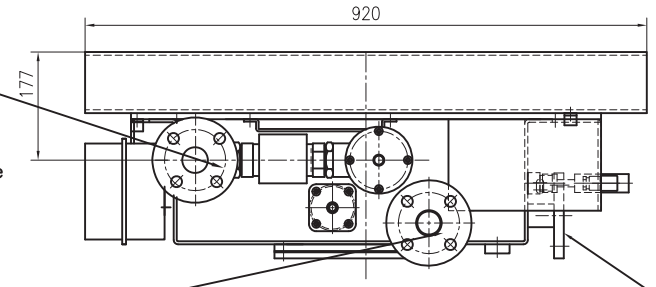
电加热器电制 voltage of ELEC.heater （订货时请选择） (please select when order)	380-420V ○ / 440-480V ● / 690V ○
油漆颜色 paint colour	Munsell 7.5 BG 7/2
油箱容积 vloume of tank	37L

外接管路必须支撑加强，减少振动
External connection piping must have a support to strengthen,which in order to reduce vibration





序号	代号	名称	数量	材料	单件重量	总计重量	备注
22	HTCO-WX-7	出口接管 tube of outlet	1	Q235A			
21	QT11F-16T	球阀 globe valve	1	组件 module			
20	IPST9565	温度开关 temperature switch	1	组件 module			G1/2"
19	WTY-301N-C	温度表 thermometer	1	组件 module			G1/2"
18	Q/NHJ122	螺塞 plug G1/2"	1	钢质 steell			
17	SANW40HL	直通接头	1	组件 module			
16	UQK-300W	液位开关 lever switch	1	组件 module			
15	HTCO-WX-6	液位开关座 lever switch seat	1	Q235A			
14		电控箱 electric cabinet	1	组件 module			
13	JB/ZQ 4321	U形螺栓 bolt M12	1	组件 module			
12	HTCO-WX-5-0	排气口接管 tube	1	Q235A			
11	Q/NHJ122	螺塞 G1/4"	1	钢质 steell			
10	XKLQ32-00	滤器 strainer	1	组件 module			80吋/吋.200μm
9	YJZQ-J32W	球阀 globe valve	2	组件 module			
8	HTCO-WX-4	进口法兰flange of inlet	1	Q235A			
7	XVM NW 32 HLED	组合管接头 oint	1	组件 module			
6	XW NW32HL	直角接头 joint	3	钢质 steell			
5	AOVM NW32 LED	组合管接头 joint	6	组件 module			
4	HTCO-WX-3-00	油箱 box	1	Q235A			
3	CLOBU0.4-10A	油箱盖 cover	1	Q235A			
2	750W	温控电加热器 ELEC.heater	1	组件 module			set:45℃
1	HTCO-WX-2	安装板 supporting plate	1	Q235A			



法兰外径ø140
4-ø18节圆100
与气缸油日用油柜连接
flange:ø140
4-ø18 PCD 100
from cylinder oil service tank/storage tank

法兰外径ø140
4-ø18节圆100
与气缸油日用油柜透气管连接
flange:ø140
4-ø18 PCD 100
to venting of cyliner iol service tank

法兰外径ø140
4-ø18节圆100
与主机连接
flange:ø140
4-ø18 PCD 100
to engine connection AC

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设计		标准化		
校对				
审核				
工艺		日期		

外形图 external view

图样标记	重量	比例
	~170Kg	1:6
共 页	第 页	

南通航海机械集团有限公司

滑油加热箱 heating tank for cylinder oil

HTCO-WX-00

借通用件登记
描 图
校 描
旧底图总号
签 字
日 期

南 通 航 海 机 械 集 团 有 限 公 司
nantong navigation machinery group Co.,Ltd.

Phone +86-513-85540960
Fax +86-513-85540085

气缸油加热器电气图纸

HEATING TANK FOR CYLINDER OIL ELECTRIC DIAGRAM

图号 DIAGRAM NUMBER:HTCO-DK

序号 NO.	代号 CODE	名称 NAME	数量 Qty	重量 单件 PC	重量 总计 AMOUNT	备注 REMARKS
1	HTCD-DK-TM	图样目录 CONTENTS	1			
2	HTCD-DK-MX	电气元件明细表 PART LIST	1			
3	HTCD-DK-YL	电气原理图 PRINCIPLE DIAGRAM	1			
4	HTCD-DK-JX	端子排接线图 CONNECTING DIAGRAM FOR ENDS	1			
5	HTCD-DK-KK	电控箱开孔图 CUT SIZE FOR ELECTRONIC CONTROL BOX	1			
6	HTCD-DK-WX	电控箱外形图 OUTLINE DRAKING FOR ELECTRONIC CONTROL BOX	1			
7	HTCD-DK-BZ	电气元器件布置图 LAY OUT DIAGRAM FOR COMPONENTS	1			

借通用件登记

描　图

校　描

旧底图总号

签　字

日　期

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设计		标准化	
校对			
审核			
工艺		日期	

气缸油加热器电控箱
HEATING TANK FOR CYLINDER OIL

图样标记	重量	比例
		1:1
共 7 页	第 1 页	

南通航海机械集团有限公司
HANG JI

图样目录
CONTENTS

HTCD-DK-TM

序号 No.	符号 Sign	名称 Name	型号(规格) Type	数量 Qua.	备注 Remarks
1	T	变压器transformer	JBK3-100 AC440V/AC24V	1	Red Flag
2	F1-F4	熔断器Fuse socket	RBT4F	4	Reliance
3	KM1	接触器 contactor	LC1-D0610 AC24V	1	Schneider
4	Q1	断路器Relay module	C65N 3P 6A	1	Schneider
5	KA1	中间继电器latch relay	DRM570524LT	1	weidmuller
6	H□	指示灯 signal lamp	AD16-22D/W23	1	A.P.T
7	H1	指示灯 signal lamp	AD16-22D/g23	1	A.P.T
8	H2	指示灯 signal lamp	AD16-22D/r23	1	A.P.T
9		填料函Cable glands	HSK-GM M20*1.5(10-14)	7	LANKELEC
10		门锁 Lock	MS721	1	
11		接线排terminal	RBT2.5+RBT2.5PE	16	Reliance
12		接地座	NHJ-1006-2009-1	1	
13		熔芯 Fuse	2A	4	
14		过热保护开关	TS-120SR(范围:0℃-120℃, 设定值:110℃)	1	RAINBOW
15		温度开关	ISPT9565(范围:5℃-95℃, 设定值:45℃, 回差4℃)	1	TRAFAG

借通用件登记

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校 描

旧底图总号

签 字

日 期

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设计		标准化	
校对			
审核			
工艺		日期	

气缸油加热器电控箱
HEATING TANK FOR CYLINDER OIL

图样标记	重量	比例
		1:1

共 页 第 页

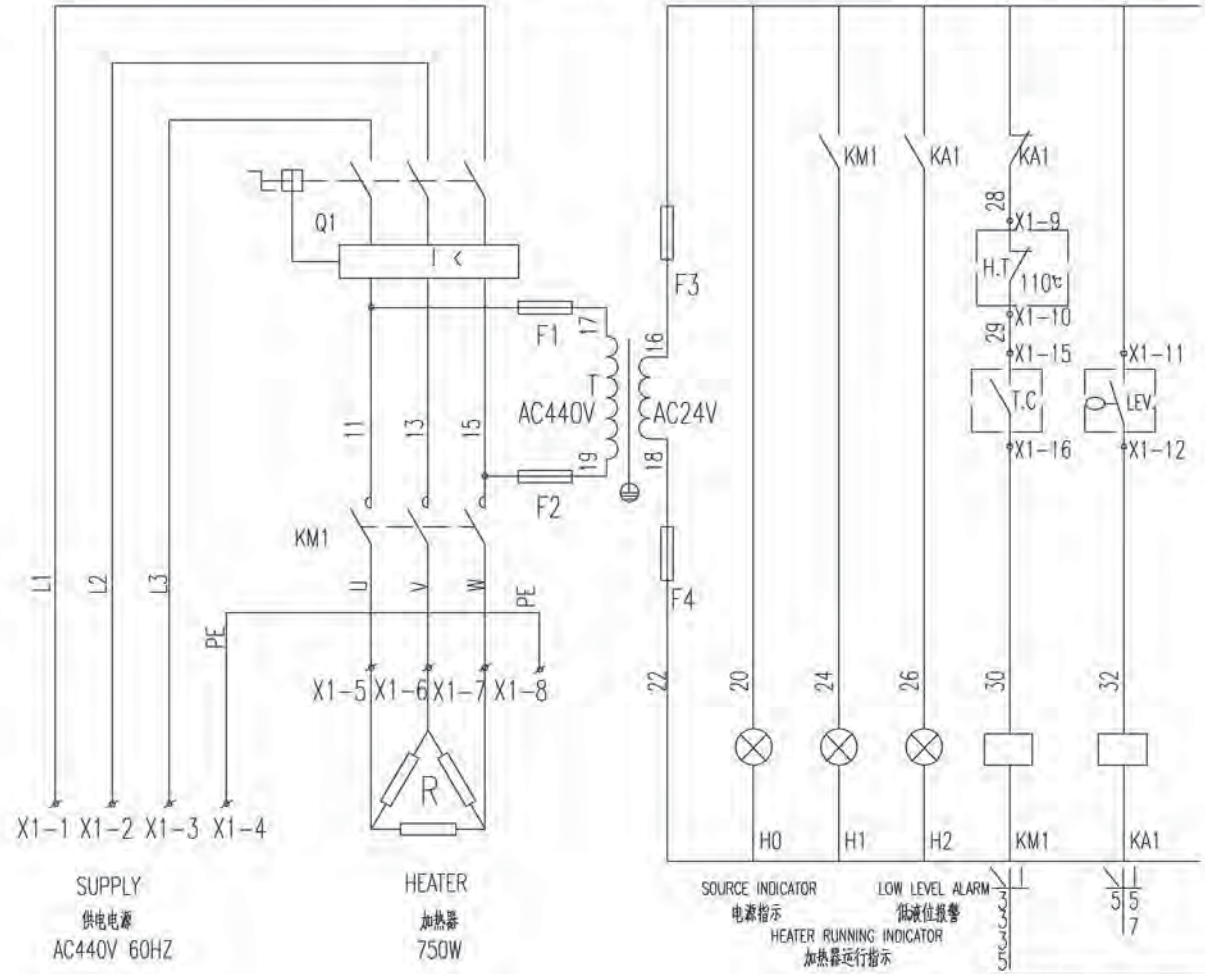
南通航海机械集团有限公司
HANG JI

电气元件明细表
PART LIST

HTC□-DK-MX

HTCO-DK-YL

主供电电源 SOURCE	加热器 HEATER	变压器 TRANSFORMER	信号指示灯 SIGNAL LAMP	温度开关 TEMP. SWITCH	浮球开关 LEVEL SWITCH	低液位报警信号 LOW LEVEL ALARM



LOW LEVEL ALARM
低液位报警

说明:
NOTE:

液位开关 Oil level switch
Low level: close; High level:open

温度开关 T.C
set point:45℃
temperature range:5℃-95℃

过热保护开关(自动复位) H.T
<110℃: close; ≥110℃:open
self-reset

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气缸油加热器电控箱
HEATING TANK FOR CYLINDER OIL

图样标记	重量	比例
		1.1:1
共 7 页	第 3 页	

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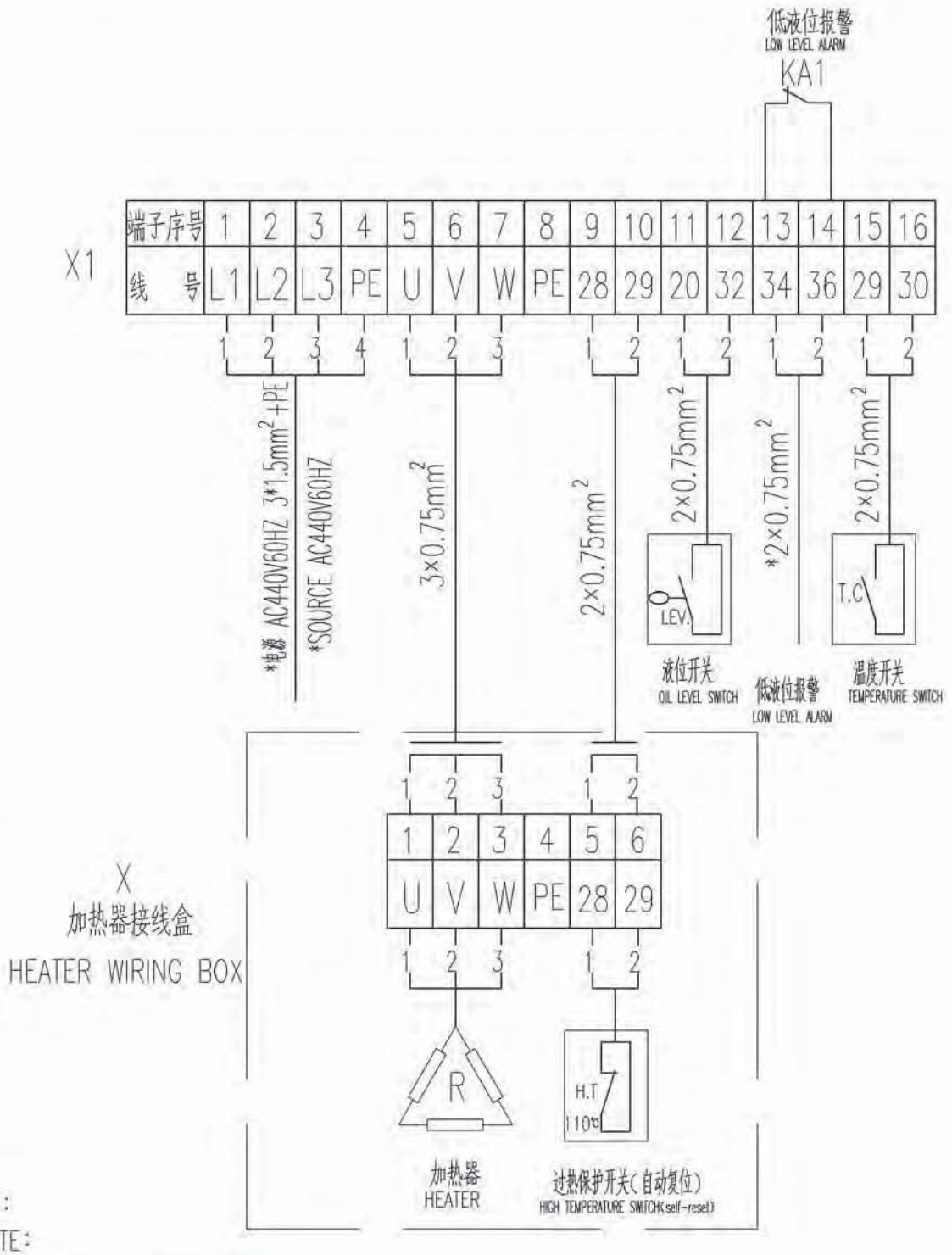
电气原理图
PRINCIPLE DIAGRAM

HTCO-DK-YL

HTCO-DK-JX



说明:

NOTE:

打"*"的电缆由船厂敷设，其余由制造厂完成。

THE CABLE WITH MARK "*" WIIL BE LAID IN SHIPYARD ,ORTHERS WILL BE LAID IN MANUFACTURE .

借通用件登记

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气缸油加热器电控箱
HEATING TANK FOR CYLINDER OIL

图样标记	重量	比例
		1.3:1
共 7 页	第 4 页	

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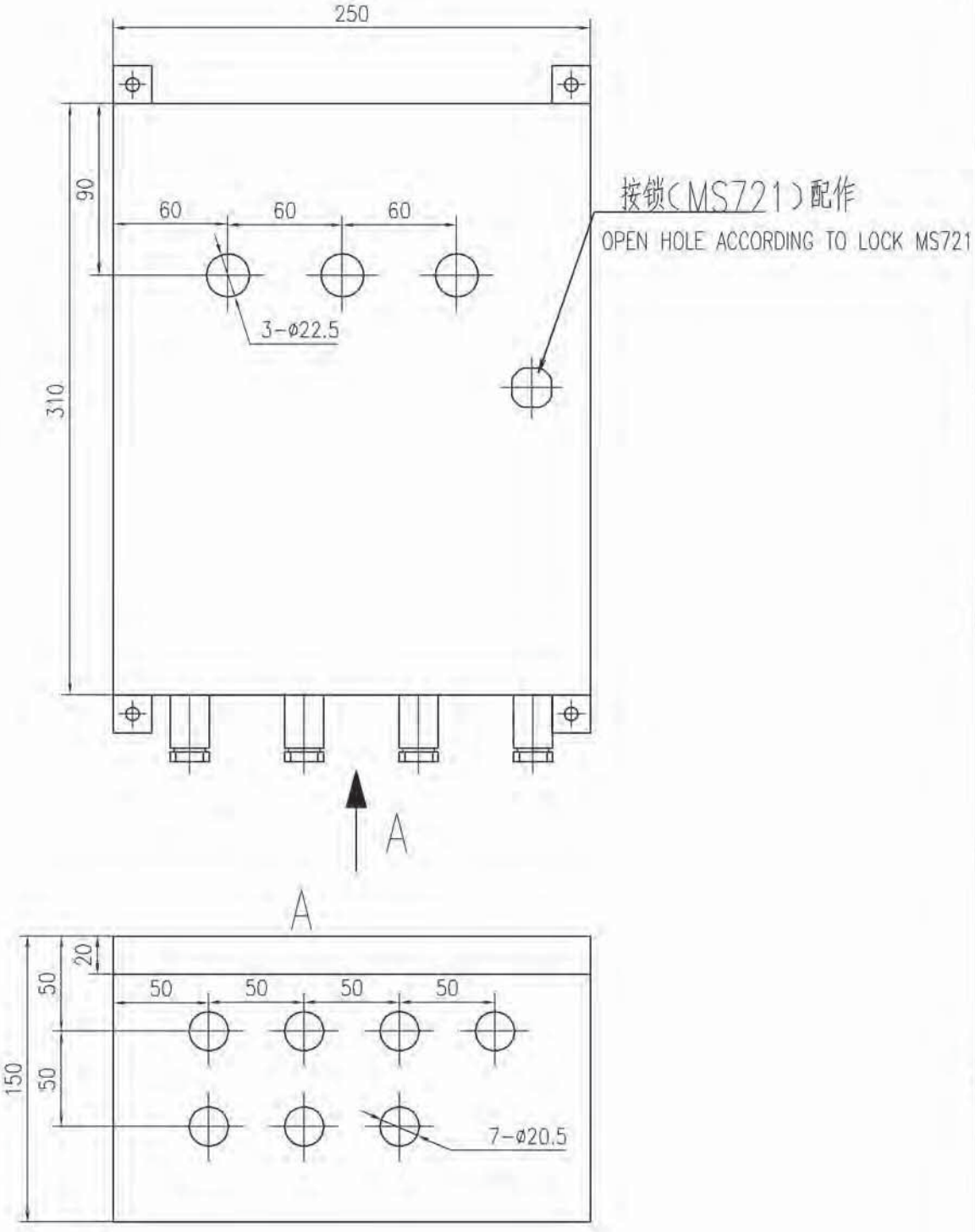
端子排接线图
CONNECTING DIAGRAM FOR ENDS

HTCO-DK-JX



说明：电控箱防护等级为IP44

Note:The protection class of the control box is IP44

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气缸油加热箱电控箱
HEATING TANK FOR CYLINDER OIL

图样标记	重量	比例
		1:2.3
共 7 页	第 5 页	

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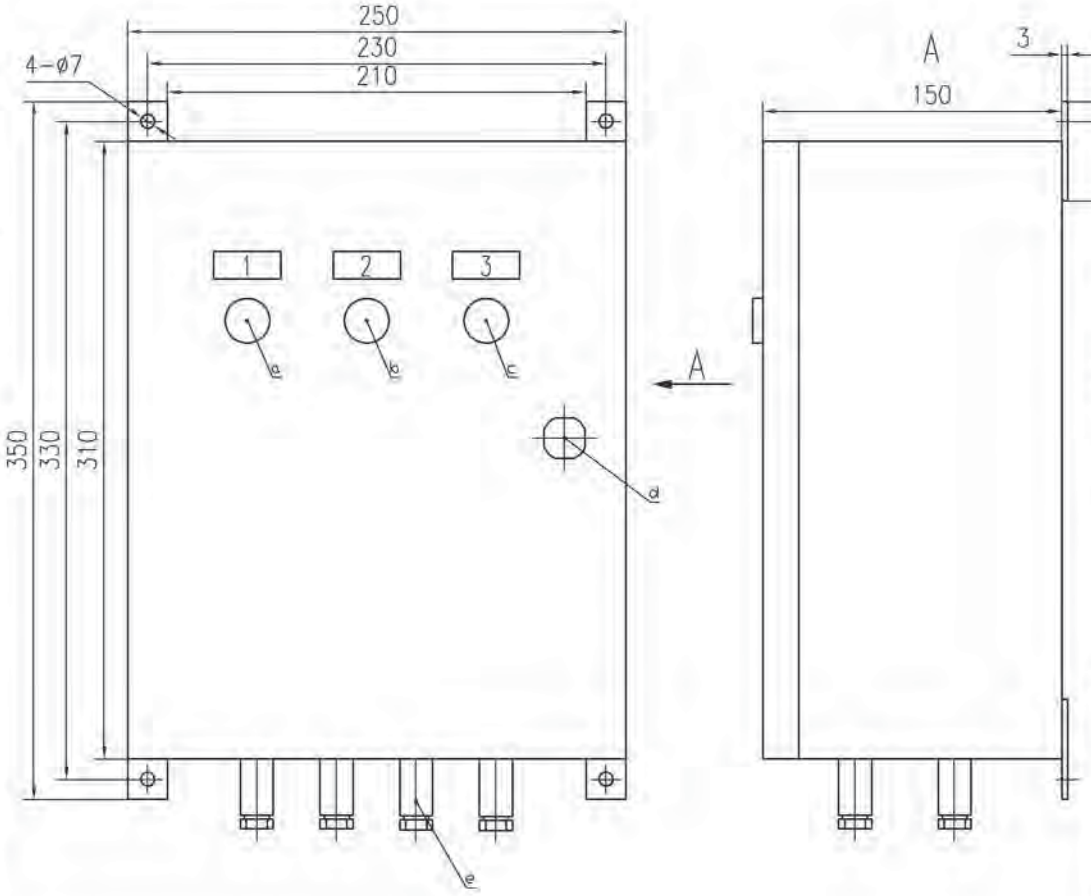
电控箱开孔图
CUT SIZE FOR ELECTRONIC CONTROL BOX

HTCO-DK-KK



铭牌对照表：

nameplate:

代号No.	字　样 printed words
1	电 源 source
2	运 行 running
3	低液位 Low level

元器件对照表 elements list:

代号No	名 称 Name	数量Quan.	备 注 Remarks
a	指示灯 signal lamp	1	AD16-22D AC24V 白 WHITE
b	指示灯 signal lamp	1	AD16-22D AC24V 绿 GREEN
c	指示灯 signal lamp	1	AD16-22D AC24V 红 RED
d	门锁 Lock	1	MS721
e	填料函 cable glands	7	HSK-GM(M20*1.5)(电缆外径10-14)

说明：电控箱防护等级为IP44

Note:The protection class of the control box is IP44

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气缸油加热箱电控箱

HEATING TANK FOR CYLINDER OIL

图样标记	重量	比例
		1:2.6
共 7 页	第 6 页	

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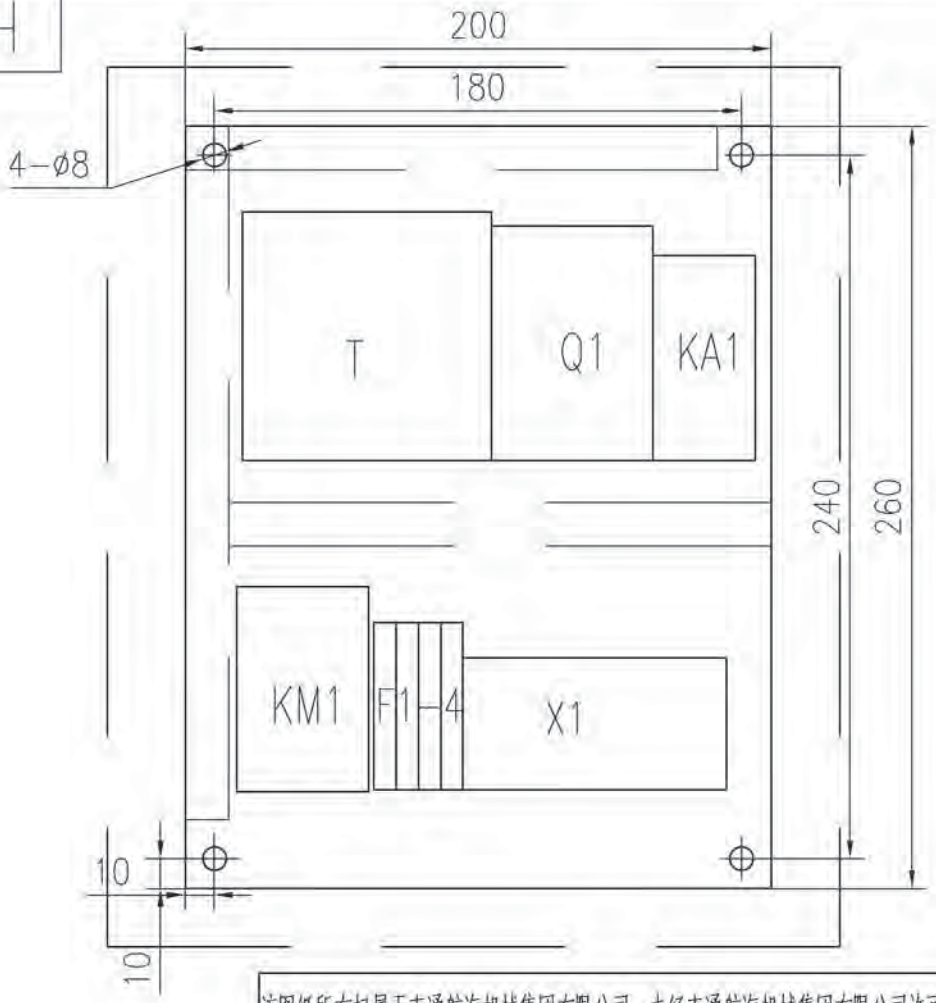
电控箱外形图

OUTLINE DRAKING FOR ELECTRONIC CONTROL BOX

HTCO-DK-WX

HTCO-DK-BZ



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气缸油加热器电控箱
HEATING TANK FOR CYLINDER OIL

图样标记	重量	比例
		1:2.5
共 7 页	第 7 页	

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HANG JI

电气元器件布置图
LAY OUT DIAGRAM FOR COMPONENTS

HTCO-DK-BZ

滑 油 加 热 柜 备 件 清 单

Spare parts of Heating Tank For Cylinder Oil

序号 No.	产品型号 Product type	备件 Spare part	规 格 Size	数量 Qty	单位 Unit	备 注 Remarks
1	HTCO32	滤芯 filter element	XKLQ25	1	Set	

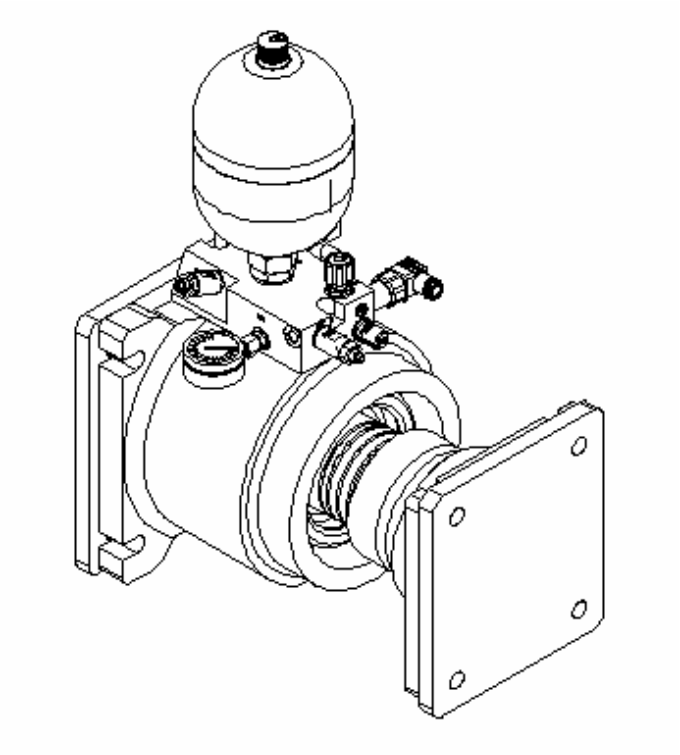
地址：江苏省南通市人民西路 60 号
Email：nthj@vip.163.com Website: http://www.nnmc.com.cn
电话：0086-0513-83513339 传真：0086-0513-83527356

独立式主机液压顶推支撑装置

HYDRAULIC TOP BRACING STAND-ALONE TYPE OF M/E

DYDZ200

认可资料
Approval Drawing



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1、简介 Introduction

独立式主机液压顶推支撑装置（以下简称液压顶推支撑）是安装在主机和船体结构强梁之间(参照液压顶推支撑布置图 DYDZ200-BZ)，用来降低主机产生的固有频率，从而降低主机振动所产生的影响，液压顶推支撑相对于主机的热膨胀以及船舶装卸所产生的变形是柔性的。

Hydraulic top bracing stand-alone type of M/E(shortened form: Hydraulic top bracing) are installed between the engine and the hull (refer to the arrangement diagram of hydraulic top bracing: DYDZ200-BZ), to detune the natural frequencies of the engine and thus lower the impact of the vibrations. The hydraulic top bracing units are flexible to thermal expansion of the engine and various loading conditions of the vessel.

其标准配置是安装在主机的右舷，如果方便的话，也可以安装在主机左舷，但只需要安装在一侧即可。

The standard installation is on the starboard side of the engine, but port side installation can alternatively be used if this is more convenient. Installation is only necessary on one side.

其标准的安装方式有 2 缸、4 缸或者 6 缸，具体数量取决于主机的缸数和缸径，液压顶推支撑的液压缸直径设计为 200mm，一般情况下，主机缸径不大于 600mm 时，液压顶推支撑利用低压类型，压力设置 26bar，主机缸径大于 600mm 时，液压顶推支撑利用高压类型，压力设置 40bar。

The standard installation features two、four or six top bracing units, depending on engine size and cylinder number. generally speaking ,the top bracing units are designed with a cylinder diameter of 200 mm and deliverer in a low-pressure version (26bar) for engines with bore ≤600mm,and a high-pressure version (40bar) for engines with bore >600mm.

液压顶推支撑的设计原理是通过液体产生压力来提供较大的机械力，操作受到高压液体和较大机械力的影响，这些外部力一旦失去控制，潜在的造成巨大的损失甚至造成主机的损坏。为了安全起见，在使用设备之前必须彻底的了解设备是如何操作和控制的。

Hydraulic equipment is designed to accomplish work using liquid pressure to produce a greater mechanical force. The operator is subject to hazards from high-pressure liquids and large mechanical forces. Either of these forces, when out of control, have the potential to cause enormous damage and great bodily injury. All safety devices should be controlled and the operator should have a thorough knowledge of how the equipment operates before the equipment is used

2、技术参数 Technical description

液压缸直径 Cylinder diameter:	200mm
安装长度 Build-in length:	475mm
重　　量 Weight:	~130kg
预紧力 Nominal force (7bar):	22kN（7bar）
最大支撑力 Max. force (26bar):	82 kN（26bar）
最大支撑力 Max. force (40bar):	127 kN（40bar）
液压油牌号 Oil type:	VG32 or VG46
润滑脂 Lubricating grease:	二硫化钼 Molykote (MoS2)
电制 Power:	24V DC

液压顶推支撑外形尺寸参照图 DYDZ200-WX
Outline dimensions please refer to diagram of hydraulic top bracing：DYDZ200-WX

3、系统组成 System parts

液压顶推支撑系统主要由以下几部分组成：

The parts of the hydraulic top bracing system, shown on the following pages, are:

3.1 根据主机型式的不同，液压顶推支撑系统主要有 1 组、2 组或 3 组顶推单元组成（参照液压顶推支撑系统原理图 DYDZ200-XT），每套单元主要由一只液压蓄能器、一套液压控制单元、一组液压缸和一套安装法兰组成。

3.1 One, two or three pairs of hydraulic top bracing units (refer to hydraulic top bracing system principle diagram：DYDZ200-XT), depending on the engine type, each consisting of: an oil accumulator、 a hydraulic control unit、a cylinder unit a set of mounting flanges.

3.2 运输用起吊工具（参照图 DYDZ200-QD）。

3.2 Lifting tools for transport (refer to the diagram：DYDZ200-QD).

3.3 正确定位安装法兰的安装工具（参照图 DYDZ200-GJ）。

3.3 Fitting tool for correct positioning of mounting flanges (refer to the diagram：DYDZ200-GJ).

3.4 电气控制箱（参照图 DYDZ200-DK-WX）。

3.4 Electric control box (refer to the diagram DYDZ200-DK-WX).

3.5 液压手摇泵（参照图 GYB6-WX）。

3.5 Hydraulic hand pump (refer to the diagram GYB6-WX)

4、工作原理 Working principle

每套液压顶推支撑系统单元主要由一套液压缸单元、液压控制单元、和直接安装在液压缸本体上的液压蓄能器组成（参照图 DYDZ200-ZC）。

Each top bracing unit consists of a single acting hydraulic cylinder and a

hydraulic control unit including an oil accumulator mounted directly on the cylinder house. (refer to the diagram DYDZ200-ZC)

当主机运行时，顶推单元建立起压力，当主机停车时，压力释放至初始压力 7bar，液压顶推支撑的工作原理图(参照图 DYDZ200-GZ).

When the engine is running, the unit builds up a pressure on the engine in proportion to the vibration lever. When the engine is at standstill, the pressure is released to the nominal pressure, 7 bar. The hydraulic top bracing’s working principle diagram (refer to the diagram DYDZ200-GZ).

当船体与主机之间距离变大时，液压缸油压下降，液压油从蓄能器流向液压缸。

When the distance between hull an engine increase, oil flows into the cylinder under pressure from the oil accumulator.

当船体与主机之间距离变小时,液压缸液压油压力上升,单向阀阻止液压油进入蓄能器，如果压力达到最大设定值，此时安全阀打开，将油引至蓄能器，将主机振动控制在允许范围内。

When the distance between hull an engine decreases, a non-return valve prevents the oil form flowing back to the accumulator and the pressure on the engine rises, of the pressure reaches the preset maximum value, the relief valve allows the oil to flow back to the accumulator, maintaining the force on the engine and hull structure below the specified level.

每套液压顶推支撑系统单元原理图参见 DYDZ200-YL。

Refer to the hydraulic top bracing system unit working principle DYDZ200-YL.

当液压活塞处于正冲程，即主机与船体之间距离变大时，液压油从蓄能器通过单向阀流向液压缸，当液压活塞处于负冲程，由于有单向阀作用，液压油缸内油压升高，阀块上的安全阀将会打开，一般情况下，当主机缸径不大于 600mm 时，安全阀在 26bar 压力时打开，当主机缸径大于 600mm 时，安全阀在 40bar 压力时打开，将油引至液压蓄能器，从而导致活塞的运动。在低压侧，阀块上有一个 25bar 打开的安全阀。

During positive stroke of the hydraulic piston-when the distance between hull side and engine side increases – oil flows from the accumulator through the non-return valve to the cylinder. On negative stroke, the piston provides a rising pressure in the cylinder due to the non-return valve. A relief valve in the valve block opens at 26 bar, for engines with bore≤600mm,or 40bar, for engines with bore >600mm，and leads the oil back to the accumulator, and thereby allows the piston to move in negative direction. On the low-pressure side, a safety relief in the valve block opens at 25 bar.

正常期间，蓄能器为液压缸提供 7bar 的液压油，这也是系统最小的工作载荷，在实际过程中，当主机开始振动时，液压油油压会迅速增加。

During normal service the accumulator supplies oil at a pressure of 7 bar to

the cylinder, and consequently this will be the minimum workload of the system. In practice, the oil pressure will increase rapidly when engine starts to vibrate.

为释放压力，系统设置了电磁换向阀，当电磁阀打开时，液压缸与蓄能器直接相连，此时液压缸单元不能建立压力，实际上，当主机运行时电磁阀断开，主机停止时，电磁阀导通。

By means of a solenoid valve in a parallel pipe branch the pressure of the system can be released. When the valve is open, the workspace is directly connected to the accumulator and the top bracing cannot build up the pressure. Practically, the valve is open when the engine is at standstill and closed when the engine is running.

5、操作 Operation

液压顶推支撑是自动运行的，但有测试、运行和手动控制，运行模式可以在电气控制箱上选择，共有三种模式。

The hydraulic top bracing system is operated automatically. For test or service purposes, manual control is also possible. The operation mode is selected at the control panel, the three possible operation modes are:

5.1 自动：液压顶推支撑是通过“备车”和“完车”信号来自动控制的，这也是常规模式，根据主机信号，液压顶推支撑将处于“运行”或“停止”，控制灯可以显示实际的运行情况。

5.1 AUTO: The top bracing system is controlled automatically by the engine telegraph order “stand by” and “finish with engine”. This is the normal operation mode Depending on the engine speed; the top bracing will be “IN SERVICE” or “OUT OF SERVICE”. The control lamps indicate the actual state.

5.2 运行：液压顶推支撑系统处于运行状态且是建有压力的，电磁阀之路处于关闭状态，当主机运行，液压顶推支撑系统建立一定的压力，此模式仅仅用于调试或信号失灵的情况下。

5.2 IN SERVICE：The top bracing system is permanently active and pressurized. The solenoid valve closes the pertaining pip branch and the top bracing cylinders builds up a pressure when the engine is running. This mode should only be used in testing or by failure in the control signal.

5.3 停止：液压顶推支撑处于停止状态，电磁阀导通，此时系统压力释放，大约维持在 7bar，为了安全考虑，此模式仅仅运用于液压顶推支撑需要维修的时候。

5.3 OUT OF SERVICE：The top bracing system pressure is released to approximately 7 bar. Due to safety precaution, this mode should always be used when servicing the top bracing.

6、安装 Installation

液压顶推支撑正常工作的前提就是液压缸单元安装点的刚性要满足要求，如果不符合，结构就必须给予加强。液压顶推支撑正确的安装长度也十分重要，以及两平行法兰的对准，其安装参数如下：

The top bracing will only work correctly if the supporting hull structure is sufficiently rigid. When this is mot the case, the structure should be sufficiently reinforced. It is important that the top bracing be installed with correct build-in

length and with parallel flanges without misalignment.

船体侧安装点刚性点A的要求（参照图DYDZ200-AZ1）：
垂直于安装点所在平面施加 127KN 力时，轴向偏移≤0.51 mm;
在安装点所在平面的水平和垂直方向施加22KN力时，最大偏移≤2mm。
Required rigidity of the casing side installation point A(refer to the diagram DYDZ200-AZ1):
Force per bracing:127KN，Max. Corresponding deflation of casing side: 0.51mm
In the horizontal and vertical direction of the top bracing cylinder, force per bracing: 22KN，Max. corresponding deflation of casing side: 2mm

安装长度公差：475+1/+3mm(参照图 DYDZ200-AZ2)，安装平行度： ≤1°(参照图 DYDZ200-AZ2)；
The parameters for the installation are: Installation tolerance : 475+1/+3mm(refer to the diagram DYDZ200-AZ)；Installation parallelism ≤1° (refer to the diagram DYDZ200-AZ)。

运行不重合度（参照图DYDZ200-DT）
Service misalignment(refer to the diagram DYDZ200-DT):
H_{max}-H_{min}≤5mm
E_{max}-E_{min}≤5mm

6.1 准备 Preparation

6.1.1 检查所有零部件是否齐全和完好，参照图 DYDZ200-GH、DYDZ200-FJ
6.1.1 Check that parts are present and in good condition, refer to the diagram DYDZ200-GH and DYDZ200-FJ.

6.1.2 检查液压顶推支撑安装点船体测结构梁与横梁在水平线上，如果没有，只要确保液压缸单元安装所必须的刚性和强度。
6.1.2 check at all top bracing positions that the hull side supporting structure is in line with a cross girder or supported otherwise to insure necessary strength and rigidity of the installation.

6.1.3 检查主机侧安装点的平面垂直于连接线，控制安装点之间的距离。
6.1.3 Check that the face of the engine fix point is cut perpendicular to the connection line. Control the distance between the fix points.

6.2 安装法兰的安装 Installation of mounting flanges

6.2.1 将安装法兰用 8 个 M20×30 的螺栓紧固在安装工具上。安装工具时确保安装长度的正确性。
6.2.1 Fasten the mounting flanges on the fitting tool, using the 8×M20×30 bolts. The tool is made with the correct build-in length.

6.2.2 在液压顶推支撑上方安装 0.5 吨的手拉葫芦，将工具提升到与面向船体侧的大安装法

兰的正确高度。
6.2.2 Rig a 0.5t chain block above the top bracing position. Rig the tool in the chain block and elevate it to the correct height with the large mounting flange facing the hull side.

6.2.3 测量船体安装点和大法兰之间的间隙和倾斜度。
6.2.3 Measure the gap and inclination between the hull fix point and the large mounting flange. See the sketch below.

6.2.3.1 如果安装长度对于工具安装来说太短，可通过对船体安装点或主机安装点进行切割或研磨来延长长度。
6.2.3.1 If the build-in length is too short for the tool to fit, extend the length by cutting or grinding the hull fix point-alternatively the engine fix point.

6.2.3.2 如果倾斜度大于 1°，对支架做一个新的垂直切割，如果安装长度变得太长，可使用垫片来弥补间隙。我们推荐，主机侧的垫片应放在液压缸单元和安装法兰之间，并将垫片点焊在安装法兰上，如需要可以更换 4 个更长的螺栓。
6.2.3.2 If the inclination is greater than 1°, make a new perpendicular cut to the supporting bracket. If the build-in length becomes too long, make a steel shim to compensate for the gap. We recommend placing the shim on the engine side between the top bracing and the mounting flange and tack weld the shim to the mounting flange, it is necessary to install longer bolts in all 4 holes.

6.2.3.3 如果间隙超过 4mm, 更换一个新的船体安装点，或者可按照 6.2.3.2 选用垫片来弥补间隙。
6.2.3.3 If the gap exceeds 4 mm, replace the hull fix point with a new one. Alternatively make a steel shim to compensate for the gap and follow the description in 6.2.3.2.

6.2.4 安装长度和平行度符合要求
6.2.4 Build-in length correct, parallelism correct
6.2.4.1 将焊接法兰点焊在主机安装点处，同时确保与支架的角度在水平和垂直方向上 90°。
6.2.4.1 Tack weld the flange to the engine fix point, while making sure that the angle to the support bracket is 90° in both horizontal and vertical direction.

6.2.4.2 将焊接法兰点焊在船体安装点处。
6.2.4.2 Tack welds the flange to the hull fix point.

6.2.4.3 移除安装工具，完成焊接工作，为了减小变形，焊接时，应尽可能远离热源。
6.2.4.3 Remove the fitting tool and complete the welding job in order to minimize deformations
It is recommended to apply as little heat as possible.

6.3 液压顶推支撑液压缸的安装 Installation of top bracing cylinders

6.3.1 将手拉葫芦安装到起吊工具的吊环上。注意：不要用液压缸单元的推力杆起吊，除非需要拆除液压顶推支撑单元，不要拆除起吊工具，否则单元会散架。

6.3.1 Rig the chain block to the lifting eye of the transport bracket. Note: Do not lift the top bracing cylinder in the distance rod. Do not remove the transport brackets (the unit will fall apart), unless it is necessary to dismantle the top-bracing unit.

6.3.2 把液压缸单元调到正确的位置,并用 4 个 M20×70 的螺栓将其安装在船体安装点处，在水平方向上调整液压缸，以便将螺栓处于槽孔的中心位置，拧紧螺栓，安装顶推支撑于船体侧。

6.3.2 Elevate the top bracing cylinder to the correct position and mount it on the hull fix point with 4×M20×70 bolts. Adjust the cylinder in the horizontal direction so that the mounting bolts are in the middle of the slotted holes. Tighten the bolts.

6.3.3 在主机侧安装点用 4 个 M20×50 的螺栓安装液压缸单元，但不要紧固。

6.3.3 Mount the top bracing cylinder on the engine fix point with the with 4×M20×50 bolts, but do tighten them.

6.3.4 拆除靠近主机侧起吊工具上的螺栓，确保零件不散架。

6.3.4 Remove the bolt nearest to the engine fix point, making sure that the parts do not fall apart.

6.3.5 为确保推力杆在水平和垂直方向成一条线，拧紧主机侧安装点的螺栓时可能需要松开船体侧部分的螺栓做最后修正，最后拧紧所有八颗紧固螺栓（扭矩：200Nm)。

6.3.5 Tighten the bolts at the engine fix point making sure the distance rod is aligned in both horizontal and vertical direction. It might be necessary to loosen the bolts at the hull part for a final correction. Finally tighten all eight installation bolts (200Nm).

6.3.6 拆除起吊工具

6.3.6 Remove the transport brackets.

6.4 液压控制单元包括蓄能器的安装 Installation of hydraulic unit including oil accumulator

6.4.1 确保液压控制单元的安装底座和安装表面都是干净并清洁的，液压控制单元和蓄能器是整体起吊。

6.4.1 Ensure that the mounting base of the hydraulic unit and the mounting surface of the hydraulic unit are clean and in good condition. The hydraulic unit and the oil accumulator are delivered as one unit.

6.4.2 在液压控制单元底部的沉孔里安装 O 形圈。

6.4.2 Install the O-ring in the counter bore at the bottom of the hydraulic unit.

6.4.3 在液压缸安装基座安装液压控制单元，用 2 个 M12×50 的螺栓安装并拧紧（扭矩：50Nm）。
6.4.3 Mount the hydraulic unit on the mounting base of the cylinder unit, Mount with 2×M12×50 and tighten the bolts（50Nm）

6.5 电气控制系统的安装 Installation of electric control system

6.5.1 电气控制系统应按照电气系统图和所提供的电气原理图进行接线和安装（电气原理图参照 DYDZ200B-DK-YL、电气接线图参照 DYDZ200B-DK-JX1/JX2）。
6.5.1 The electric control system should be installed an wired in accordance with the cabling overview and the electric principle diagrams and electric connection diagram in the supplying drawings (refer to the diagram DYDZ200B-DK-YL、DYDZ200B-DK-JX1/JX2).

6.6 液压顶推支撑的充油、补油及调整 Filling, refilling and adjustment of top bracing

6.6.1 确保电气接线正确，且压力继电器及电磁阀已经连接到电气控制箱，且通电。
6.6.1 Check the electric line, make sure that it is correct, and the pressure valve and the solenoid valve is connected to the electric control box，and power on.

6.6.2 将控制开关置于“停止”位置，此时电磁换向阀导通，工作压力释放至最小工作载荷。
6.6.2 Set the control switch ‘OUT OF SERVICE’. The solenoid valve is now open and the hydraulic pressure is released to the minimum workload.

6.6.3 利用充气工具检查蓄能器内氮气压力，如果氮气压力低于 4bar，需对蓄能器进行补充氮气，如果蓄能器内氮气压力正常（正常范围 3.8~4bar），则利用手摇泵对液压缸充油。
6.6.3 Check the pressure by nitrogen in the accumulator, if the pressure is less than 4 bar, the oil accumulator must be re-charged, if the pressure is normal(3.8~4bar), pump oil into the top bracing system using the hydraulic hand pump.

6.6.3.1 将空气排放软管与液压控制单元高处的测压接头相连，且将手摇泵软管与液压缸低处的快速接头相连。
6.6.3.1 Connect the air bleeding hose to the highest mounted minimess coupling and the hose from the hydraulic hand pump unit to the lowest mounted minimess coupling.

6.6.3.2 打开空气排放软管上的阀，以便可以排出液压缸单元内的空气。
6.6.3.2 Open the valve on the air bleeding hose and bleed the top bracing system.

6.6.3.3 取下锁紧片，调节锁紧螺母，或利用手摇泵向液压缸单元内充油，直到推力杆上的绿色位置带与缸体的边缘持平。
6.6.3.3 Unlock the locking patch, adjust the nut or pump oil into the top bracing system using the hydraulic hand pump, that the green position band on the pressure rod is leveled with the edge of the cylinder house.

6.6.3.4 紧固锁紧片。
6.6.3.4 Lock the locking patch.

6.6.3.5 确保排放软管上的球阀已打开，利用手摇泵向液压顶推支撑系统充油，
6.6.3.5 Make sure the ball valve on the bleeding hose is open. Filling the top bracing system using the hydraulic hand pump.

6.6.3.6 持续充油，直到液压顶推支撑系统里所有的空气通过排放软管排出，当所有的空气排出后，拆下排放软管并关闭阀。
6.6.3.6Continue filling oil until all air has escaped from top bracing system through the bleeding hose. When all air has escaped, disconnect the bleeding hose and close the valve.

6.6.3.7 持续缓慢地向液压顶推支撑充油直到压力表显示为 7bar。
6.6.3.7Continue filling oil slowly in to the top bracing until the pressure gauge reads 7bar.

6.6.3.8 拆开软管并检查推力杆上绿色位置带与缸体边缘持平。
6.6.3.8 Disconnect the hose and check that the green position band on the pressure rod is leveled with the edge of the cylinder house.

6.6.3.9 安装并锁紧位于液压控制单元上测压接头盖子。
6.6.3.9 Mount and tighten the lid on the minimess coupling located in the hydraulic control unit.

6.6.3.10 对其他液压顶推支撑液压缸单元重复以上顺序。
6.6.3.10 Repeat the procedure for the remaining hydraulic top bracing cylinders unit.

6.6.3.11 将电气控制箱上控制开关置于在“自动”位置上，液压顶推支撑系统准备就绪。
6.6.3.11 Set control switch in ‘AUTO’ position of the electric control box，the hydraulic top bracing system is now ready.

7、服务和维护 service and maintenance

注意：所有与主机相关的服务和维护必须在停机情形下完成。因为液压系统被加压了，所以请勿在没有排放的情况下拆卸液压顶推支撑。

Important: All service and maintenance should be done with the main engine at standstill. Do not disassemble the hydraulic top bracing unit without bleeding as the hydraulic system is pressurized.

7.1 备件 spare parts

所有的备件必须按照所提供的图纸清点完毕（参照图 DYDZ200-BJ)，与单个活塞配套的一整套的密封圈和导向环都在包含在标准交付里。

All spare parts should be ordered with reference to the supplying drawings. A set of sealing rings and guide rings for one piston is included in the standard delivery.

7.2 服务检查 service inspection

7.2.1 每台液压顶推支撑单元应该在试航后进行检查，且从此以后必须进行定期检查。
7.2.1 Inspection of each top bracing unit should be carried out after sea-trial and regularly of service hereafter.

7.2.2 根据 7.3 控制油压 Control the oil pressure according to 7.3。

7.2.3 根据 7.4 检查绿色位置带 Check the green position band according to 7.4。

7.2.4 根据 7.5 检查推力杆对齐度 Check the alignment of the distance rod according to 7.5。

7.2.5 取出橡皮保护罩并用布清洗油缸。如果有明显的泄漏和油压低于正常压力 7bar，根据 7.7 更换密封圈。如果安全阀泄油口有泄漏，应检查液压控制单元和蓄能器应是否有损坏。
7.2.5Remove the rubber protect cover and clean the cylinder with a cloth. If clear signs of leakage are observed and if oil pressure has dropped below the nominal pressure of 7 bar, the sealing rings should be replaced according to status 15. If oil is leaking from the safety valve, the hydraulic control unit and accumulator should be checked for damage.

7.3 油压的控制 control of oil pressure

7.3.1 如果压力表显示低于 7bar 但又高于 4bar，液压缸单元缺少液压油，应该根据 6.6 立即重新注油。
7.3.1 If the pressure gauge shows less than 7 bar but more than 4bar, the top bracing is missing hydraulic oil should be refilled according to 6.6.
7.3.2 如果压力表显示低于 4bar，蓄能器缺少氮气，应该根据 7.8 立即重新加压。
7.3.2 If the pressure gauge shows less than 4 bar, the oil accumulator is missing nitrogen (N2) and should be refilled according to 7.3.

7.4 调节绿色位置带 Adjusting green position band

7.4.1 推力杆上的绿色带正常情况下应该与缸体边缘持平。同时考虑到船体在各种负载条件下会导致液压活塞偏出原始调整，在绿色和红色带之间的位置是可行的。然而，值得注意的是液压顶推支撑不允许在处在红色带区域的情况下运行。
7.4.1 The green band on the distance rod should normally be in level with the edge of the cylinder house. A position between the green and the red band may be acceptable, having in mind that various loading conditions of the vessel will cause the hydraulic piston to shift away from the original adjustment. However, it is important to note that the top bracing shall never operate on the red band area.

7.4.2 根据 6.6 调整绿色带的位置
7.4.2 To adjust the position of the green band according to 6.6..
Service misalignment

7.5 推力杆不重合度 Distance rod alignment

7.5.1船体在各种负载条件下会导致船体侧和发动机侧产生位移。如果推力杆不重合度超过5mm（参照图DYDZ200-DT)，顶推支撑应该被重新校准。校准应该在正常荷载和发动机启动的情况下进行。
7.5.1 Various loading conditions of the vessel may result in displacements between the hull side and the engine side. If a misalignment of the distance rod exceeds 5mm (refer to the diagram DYDZ200-DT), the top bracing should be re-aligned. The alignment should be performed at normal loading condition and with warm engine.

7.5.2 将电气控制箱上控制开关置于“停止”位置，电磁阀打开且系统压力被释放至最小工作荷载 7bar，这个读数显示在压力表上。
7.5.2 Set the control switch ‘OUT OF SERVICE’. The solenoid valve is now open and the pressure of the system is released to the minimum workload, 7bar, indicated on the pressure gauge.

7.5.3 将空气排放软管与安装在最高处的测压接头连接，并将手摇泵的软管与安装在最低处的接头连接。
7.5.3 Connect the air bleeding hose to the highest mounted minimess coupling and the hose from the hand pump unit to the lowest mounted minimess coupling.

7.5.4 松开主机侧固定点上的 M20 螺栓并对液压缸单元进行垂直校准，完毕后紧上螺栓(扭矩 200Nm)。
7.5.4 Loosen the M20 bolts at the engine fix point and adjust the top bracing unit for vertical adjustment. Tighten the bolts (200Nm).

7.5.5 松开船体侧固定点上的 M20 螺栓并对顶推支撑进行水平校准，完毕紧上螺栓（扭矩 200Nm)。
7.5.5 Loosen the M20 bolts at the hull fix point and adjust the top bracing unit for horizontal adjustment. Tighten the bolts (200Nm).

7.5.6 按照 6.6.2.3 继续
7.5.6 Continue from 6.6.2.3.

7.6 更换密封件 Replacing sealing rings.

7.6.1 确保主机处在停机状态，将电气控制箱上控制开关置于“停止”位置。
7.6.1 Make sure that the main engine is at standstill. Set the control switch ‘OUT OF SERVICE’.

7.6.2 打开手摇泵上的溢流阀，并将手摇泵软管与安装在最低处的接头连接，打开最低接头

处的截止阀卸去系统中的压力。
7.6.2 Open the overflow valve on the hand pump, connect the hand pump hose to the lowest mounted minimess coupling. Insure that the ball valve is pointing down in an oil can. Open the ball valve to take off the pressure of the system.

7.6.3 拆下安装在最高处的测压接头并使系统中的油通过排放软管流出，断开电气控制，并拆下液压控制单元，小心移除。
7.6.3Remove the highest mounted minimess coupling and let the oil in the system run out through the bleeding hose. Disconnect the electric control system and dismount the hydraulic control unit. Carefully lift the unit away.

7.6.4 安装两个运输用起吊工具 Mount the two lifting tools for transport.

7.6.5 在顶推支撑上安装一个 0.5 吨的手拉葫芦。安装运输用起吊工具到手拉葫芦上并拆除 8 个 M20 的安装螺栓。
7.6.5 Rig a 0.5 t chain block above the top bracing. Rig the lifting tools for transport to the chain block and remove the 8×M20 installation bolts.

7.6.6 移走液压缸单元并将缸体安装面朝下放置在一个干净的表面上。
7.6.6Lift the top bracing unit and place it on a clean surface with the mounting face of the cylinder house downwards.

7.6.7 拆下运输用起吊工具并小心移走发动机侧部件（法兰、推力杆及调节螺母)。
7.6.7 Dismount the lifting tools for transport and carefully lift away the engine side parts (flange, distance rod and adjusting nut).

7.6.8 移除橡皮保护罩和船侧的挡圈并移走推力杆。
7.6.8 Remove the rubber protect cover and the retaining rings at the hull side and lift away the distance rod.

7.6.9 从工具箱里取出吊环螺钉 M10 并将其安装在活塞的中心螺纹孔内。
7.6.9 Take the lifting screw M10 from the toolbox and mount it in the centre-threaded hole in the piston.

7.6.10 提出活塞并将其放在干净的表面上。
7.6.10 Lift the piston away and land it on a clean surface.

7.6.11 更换所有的导向环和密封圈。
7.6.11 All guide rings and sealing rings are should be replaced.

7.6.12 使用润滑油润滑球付的接触面，按拆卸的相反顺序进行组装。
7.6.12 Grease the contact surface of the spherical using Molykote，assemble it according to the opposition step of disassembly .

7.6.13 根据 6.3~6.6 重新安装液压顶推支撑。
7.6.13.Reinstall the top-bracing cylinder according to 6.3~6.6.

7.7 更换蓄能器 Replacing oil accumulator

7.7.1 蓄能器通过氮气加压。如果氮气压力低于 3.84bar，蓄能器必须重新加压。
7.7.1 The oil accumulator is pressurized by nitrogen (N2). If the nitrogen pressure is below 4 bar, the accumulator must be refilled.

7.7.2 将电气控制箱上控制开关置于“停止”位置，电磁阀被打开且系统压力被释放至压力表上显示的压力。
7.7.2 Set the control switch ‘OUT OF SERVICE’. The solenoid valve is now open and the pressure of the system is released to the pressure shown on the pressure gauge.

7.7.3 打开手摇泵上的溢流阀，并将手摇泵软管与安装在最低处的接头连接，打开最低接头处的截止阀卸去系统中的压力。
7.7.3 Open the overflow valve on the hand pump, connect the hand pump hose to the lowest mounted minimess coupling. Insure that the ball valve is pointing down in an oil can. Open the ball valve to take off the pressure of the system.

7.7.4 安装充气工具在蓄能器上(参照图 DYDZ200-CQ)。
7.7.4 Mount charge tool to accumulator (refer to diagram DYDZ200-CQ).

7.7.5 检查阀 A 和 B 是否关闭。Check whether valve A and B are closed.

7.7.6 使用联接螺母 C 将加气软管安装在氮气瓶上。
7.7.6 Mount the filling hose on the nitrogen cylinder with the union nut C.

7.7.8 逆时针打开阀 A，可以在压力表 D 中读出蓄能器内部的实际氮气压力。顺时针关闭阀 A。
7.7.8 open the valve A anticlockwise，It is now possible to read the actual nitrogen pressure in the accumulator on the pressure gauge D. Close the valve A clockwise。

7.7.9 如果蓄能器需要重新用氮气加压，打开阀 B 并调节阀 A 出口压力高于 4bar 的补偿压力 1-2bar。
7.7.9 If the accumulator needs to be refilled with nitrogen, open valve B and adjust the outlet pressure on spindle A to 1-2 bar above the charging pressure 4bar.

7.7.10 保持阀 B 打开直到蓄能器被加压完毕。
7.7.10 Keep valve B open until the accumulator is filled.

7.7.11 关闭阀 B

7.7.11 Close valve B.

7.7.12 等待 5 分钟让温度稳定下来。
7.7.12 Wait five minutes for the temperature to stabilize.

7.7.13 根据值为 4bar 的补偿压力检查表 D 上显示的蓄能器的压力。
7.7.13 Check the pressure in the accumulator on gauge D according to the charging pressure 4 bar.

7.7.14 缓慢调节充气工具上排气阀 E，使压力表读数达到要求的充气压力。
7.7.14 Adjust the vent valve E on the charge tool slowly until the pressure value reaching to the required charge pressure.

7.7.15 卸下联管螺母 C 并拆除蓄能器上的充气工具。
7.7.15 Unscrew the union nut C to remove the charge tool from the accumulator.

7.7.16 连接电气部分。
7.7.16 Connect the electric control system.

8、故障分析 Trouble shooting

注意：所有与主机相关的服务和维护必须在停机情形下完成。因为液压系统被加压了，所以请勿在没有排放的情况下拆卸液压顶推支撑。

Important: All service and maintenance should be done with the main engine at standstill. Do not disassemble the hydraulic top bracing unit without bleeding as the hydraulic system is pressurized.

问题 Problem	解决方法 Solution
报警信号 Alarm signal	如果报警信号出现，蓄能器内的氮气压力小于补偿压力 4bar。根据 7.7 中所述使用氮气对蓄压器重新加压。在这以后用 6.6 所述对液压缸单元注油。 If the alarm signal is on, the N2 pressure in the oil-accumulator is less than the charging pressure, 4bar. Refill the accumulator with N2 as explained according to 7.7 and fill the hydraulic system hereafter as explained according to 6.6 .
Pressure gauge < 4 bar 压力表读数<4bar	如果压力表读数小于 4bar，参见上面“报警信号”一栏。 If the pressure gauge is less than 4 bar, see ‘Alarm signal’ above.
Pressure gauge < 7 bar 压力表读数<7bar	如果压力表读数小于 7bar 但又大于 4bar，说明液压系统缺油。根据 6.6 中所述向顶推支撑中重新注油。 If the pressure gauge is less than 7bar, but more than 4 bar, the hydraulic system is missing oil. Refill the top bracing as explained as explained according to 6.6.
Oil leakage from cylinder unit	如果液压缸单元漏油，说明密封圈受损或损坏。根据 7.6

液压缸单元漏油	中所述更换密封圈。 If the cylinder unit is leaking oil, the sealing rings are worn or broken. Replace the sealing rings as explained according to 6.6.
Oil leakage form safety valve 安全阀泄油口漏油	如果安全阀泄油口漏油，应该检查液压控制单元和蓄能器是否有缺陷。 If oil is leaking form the safety valve, the hydraulic control unit and accumulator should be checked for deficiencies.
Red band near cylinder edge 红带接近缸体边缘	如果推力杆上的红色位置带接近缸体边缘，说明顶推支撑没有经过正确调节。参见 7.4 并根据 6.6 重新调节液压顶推支撑。 If the red position band on the distance rod is near the edge of the cylinder house, the top bracing is not correctly adjusted. See 7.4 and readjust the top bracing in accordance with 6.6.
Distance rod misalignment 推力杆不对齐	如果液压顶推支撑的主机侧部分和船体部分在任何情况下不对齐超过 5°，这两部分必须 7.5 中所述重新校准。 If the engine part and hull part of the top bracing in any condition are misaligned more than 5°, the two parts should be realign as explained 7.5.
No signal on control box 控制箱无信号	如果控制箱无信号，检查电路。 If the control box is without signal, check the electric circuit.

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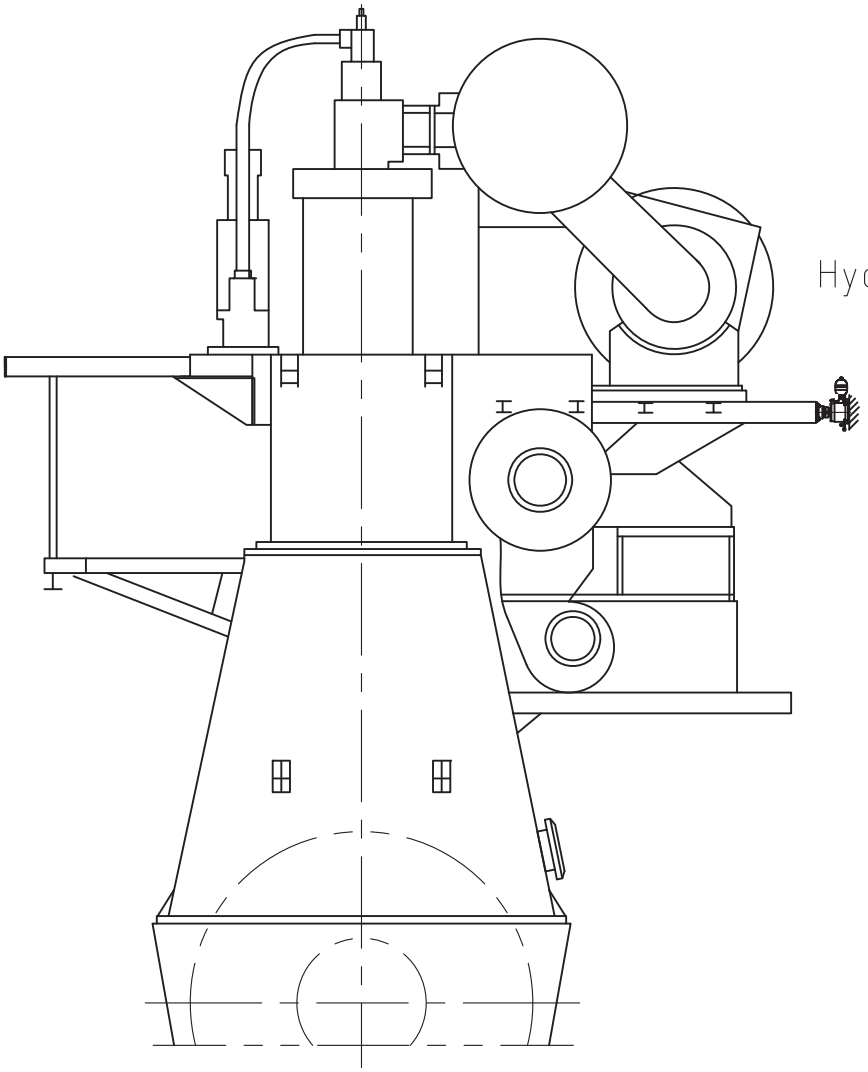
DYDZ200-BZ



Hydraulic top bracing
液压顶推支撑

Hull side
船体侧

借通用件登记

描 图

校 描

旧底图总号

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布置图
arrangement diagram

图样标记	重量	比例
		1:2
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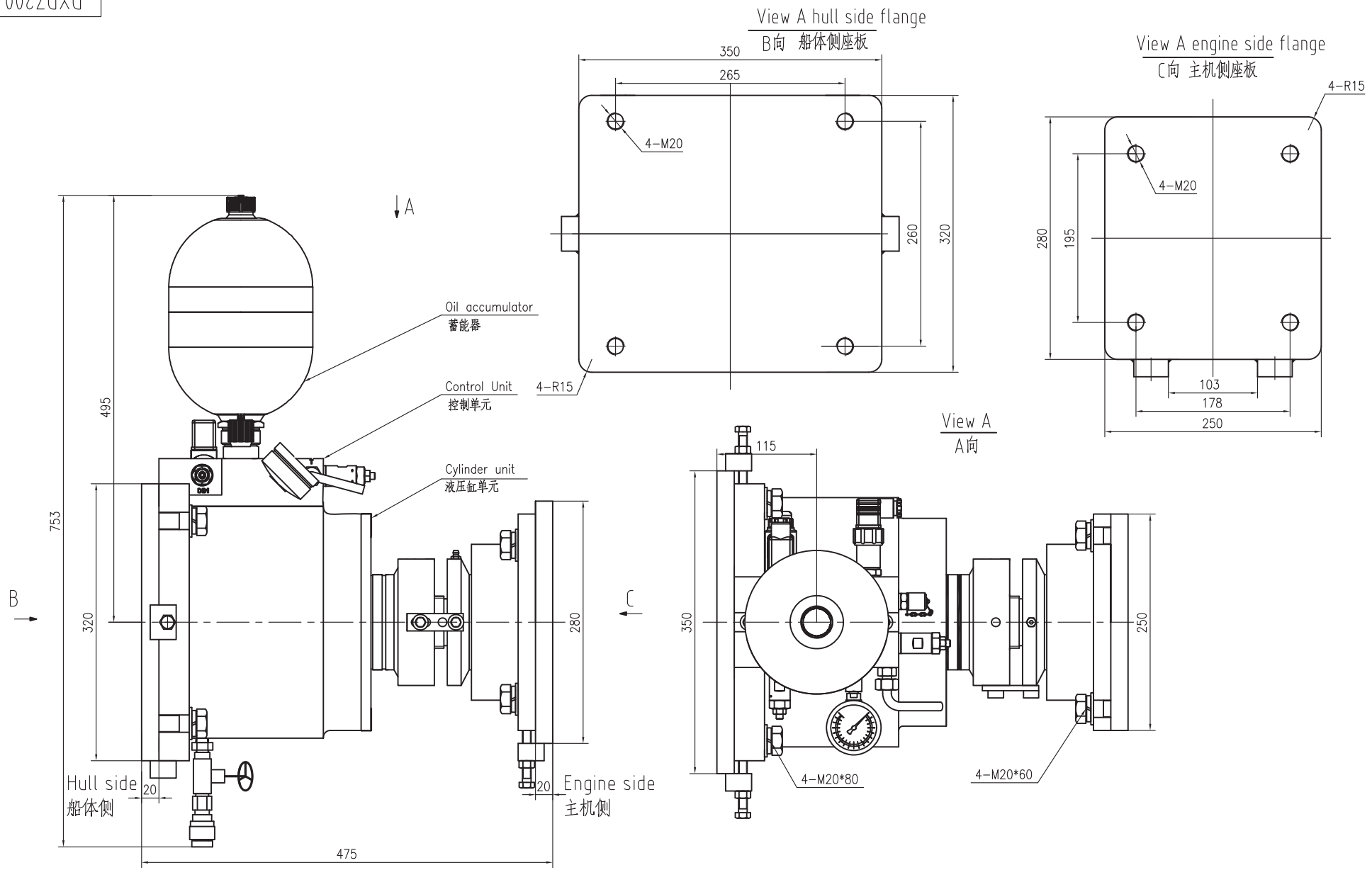
液压顶推支撑
hydraulic top bracing

DYDZ200-BZ

DYDZ200-WX



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外形尺寸图
outline dimensions diagram

图样标记	重量	比例
		1:3
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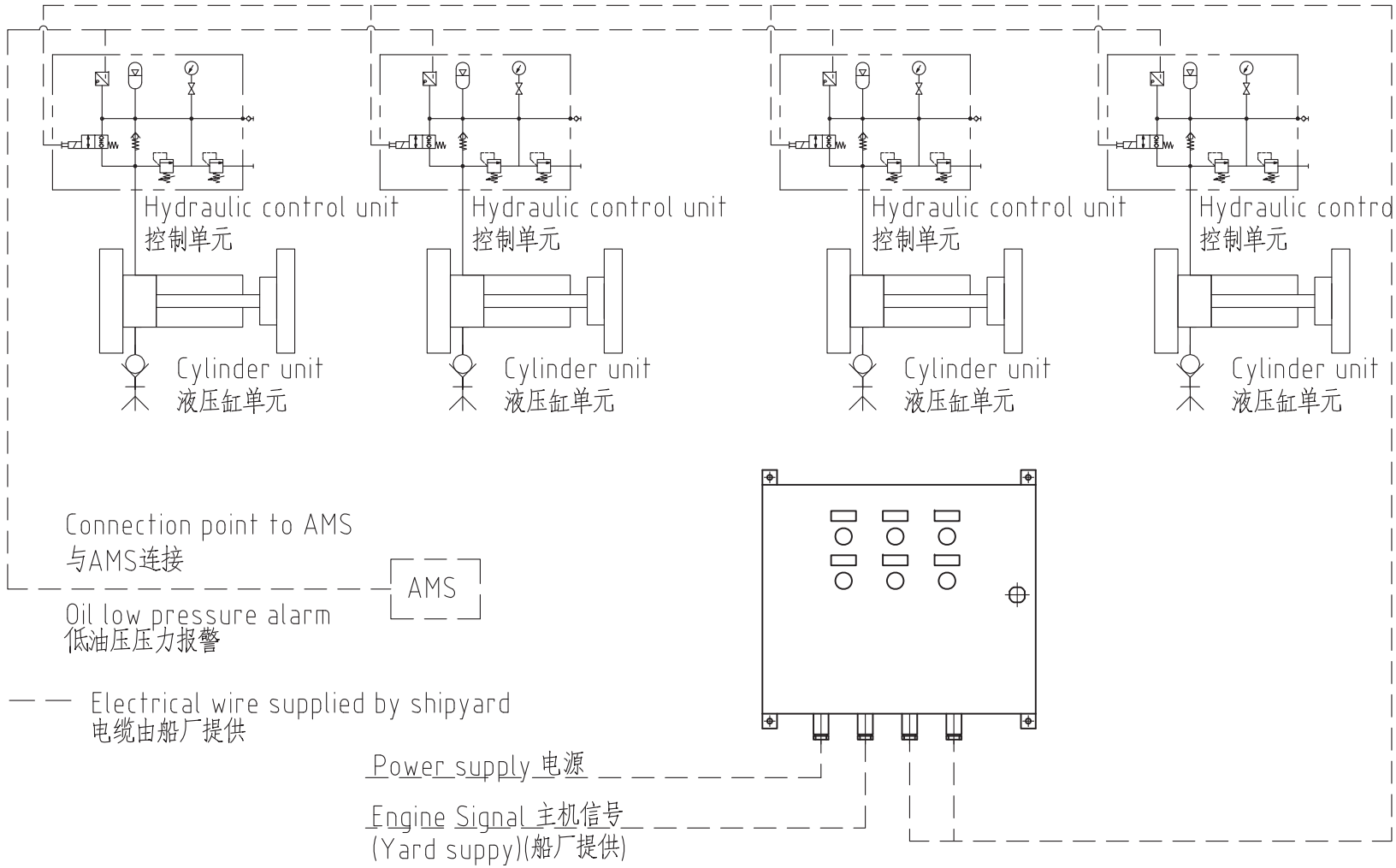
南通航海机械集团有限公司

液压顶推支撑
hydraulic top bracing

DYDZ200-WX

DYDZ200-XT



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南通航海机械集团有限公司

系统管系原理图
System Principle diagram

DYDZ200-XT

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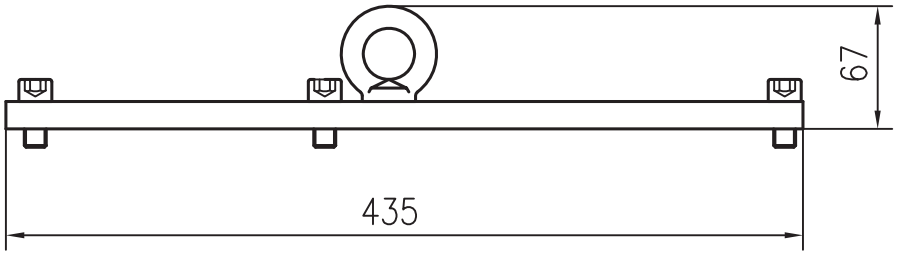
DYDZ200-QD



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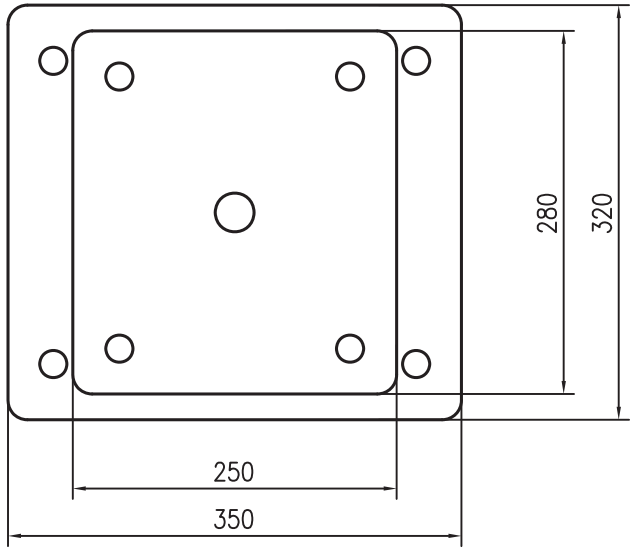
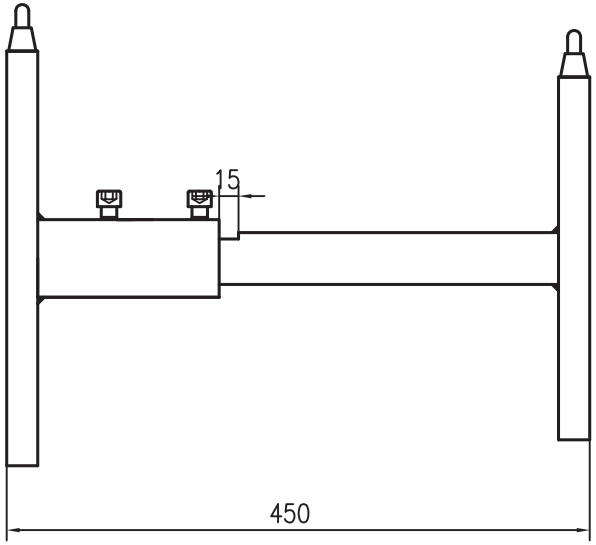
运输用起吊工具
Lifting tool for tranport

DYDZ200-QD

DYDZ200-GJ





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安装工具
Fitting tool

图样标记	重量	比例
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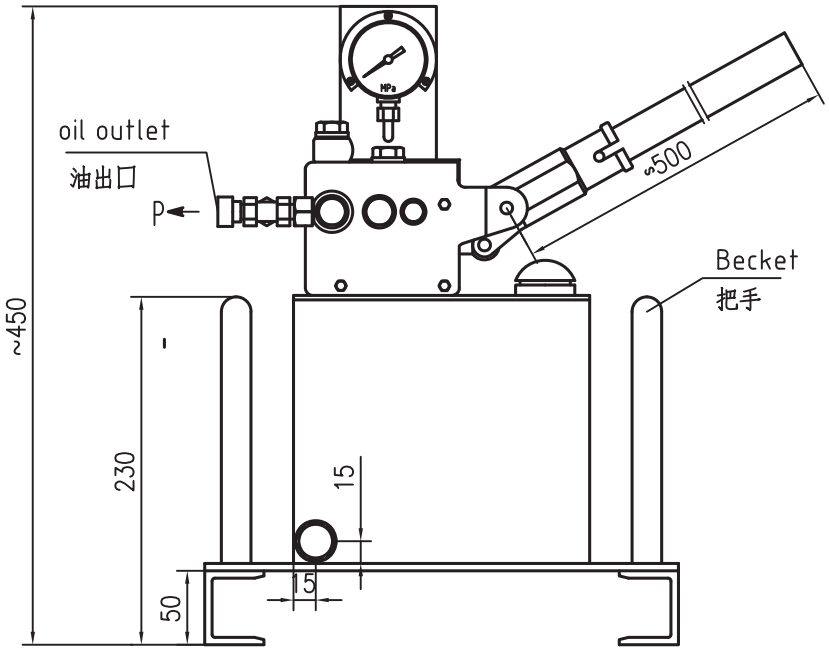
南通航海机械集团有限公司

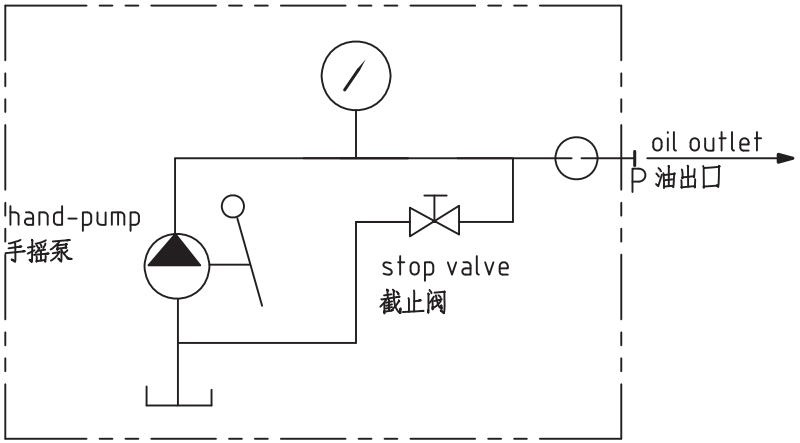
液压顶推支撑
hydraulic top bracing

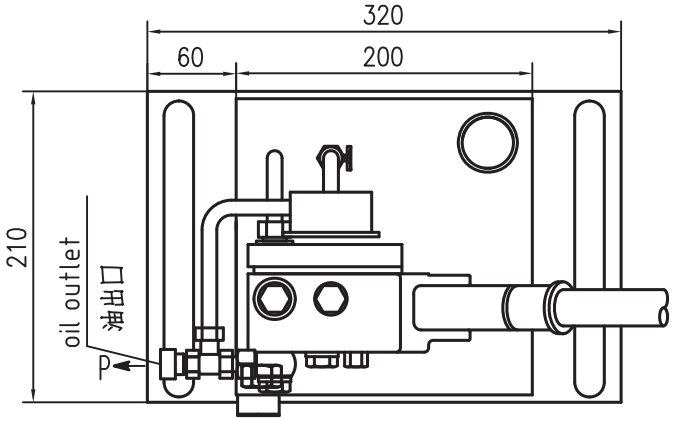
DYDZ200-GJ

GYB6-WX



pipe principle diagram
管系原理图





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外形图
outline drawing

图样标记	重量	比例
		1:3.5
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南通航海机械集团有限公司

液压手摇泵
hydraulic hand pump

GYB6-WX

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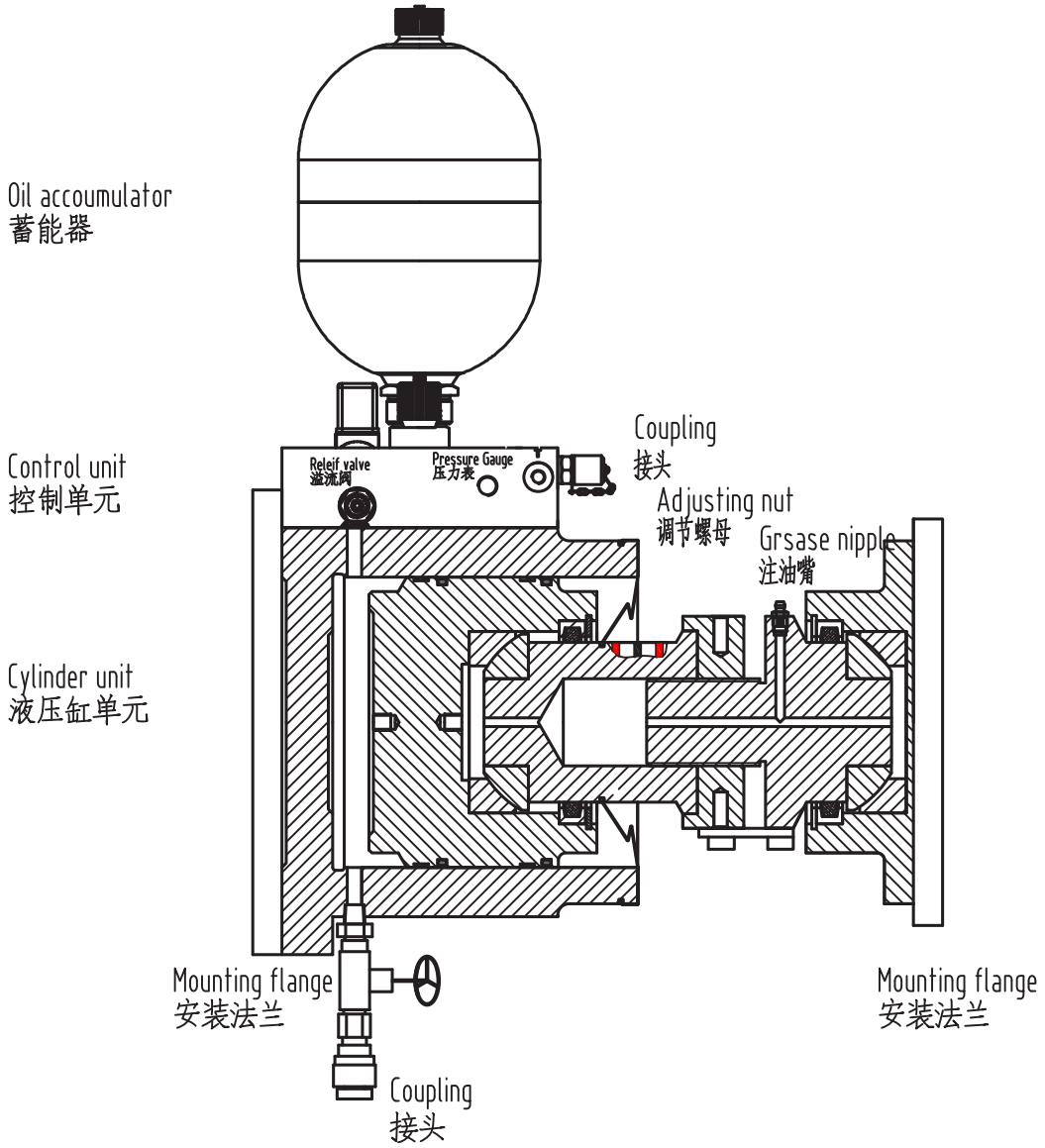
DYDZ200-ZC



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单元图
unit

图样标记	重量	比例
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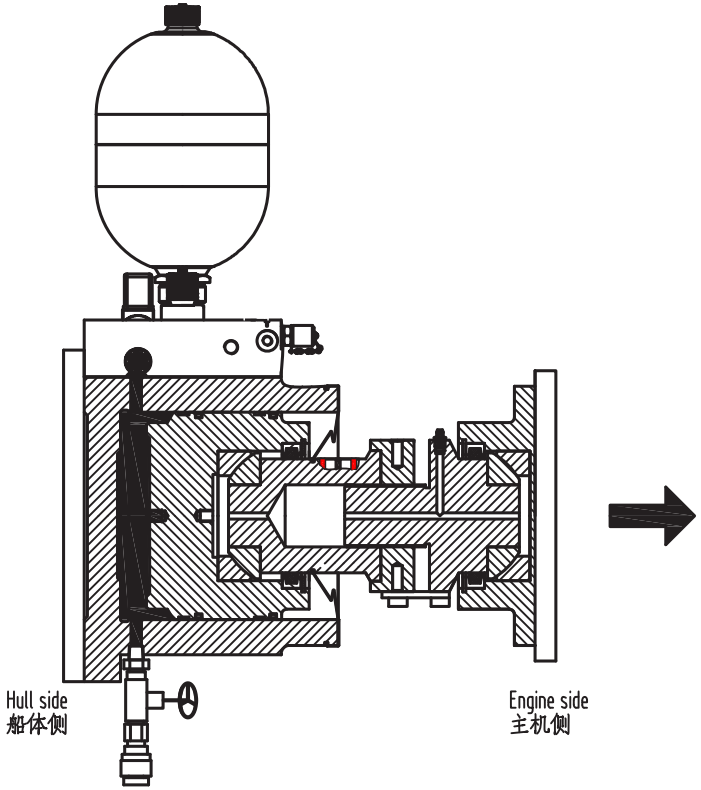
南通航海机械集团有限公司

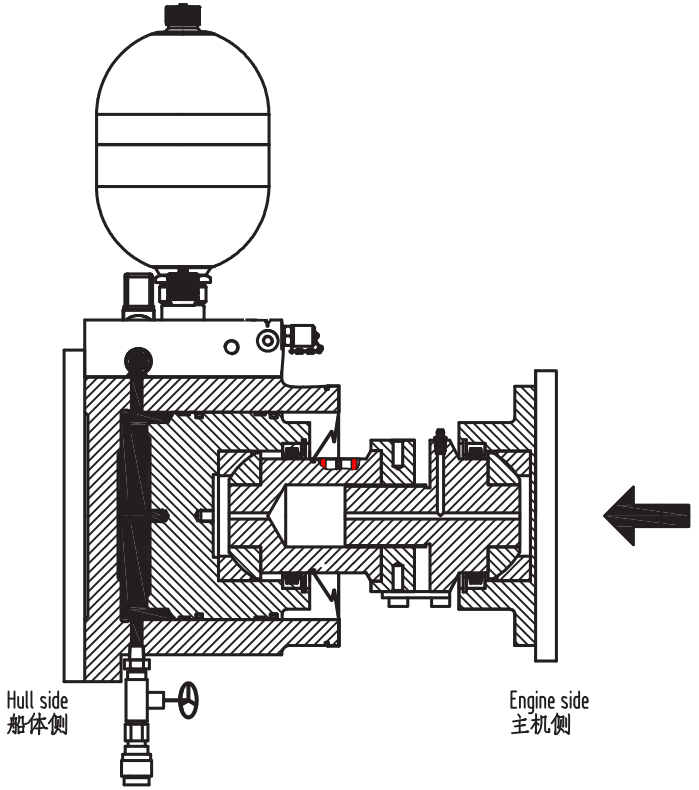
液压顶推支撑
Hydraulic top bracing

DYDZ200-ZC

DYDZ200-GZ



当船体与主机之间距离变大时，液压缸油压下降，液压油从蓄能器流向液压缸。
When the distance between hull an engine increase,
oil flows into the cylinder under pressure from the oil accumulator,



当船体与主机之间距离变小时，液压缸液压油压力上升，单向阀阻止液压油进入蓄能器，
如果压力达到最大设定值，此时安全阀打开，将油引至蓄能器，将主机振动控制在允许范围内。
When the distance between hull an engine decreases,
a non-return valve prevents the oil form flowing back to the
and the pressure on the engine rises, of the pressure reaches
the preset maximum value, the relief valve allows the oil to flow
back to the accumulator, maintaining the force on the engine and
hull structure below the specified level.

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日 期

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工作原理
working principle

图样标记	重量	比例
		1:5
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南通航海机械集团有限公司

液压顶推支撑
hydraulic top bracing

DYDZ200-GZ

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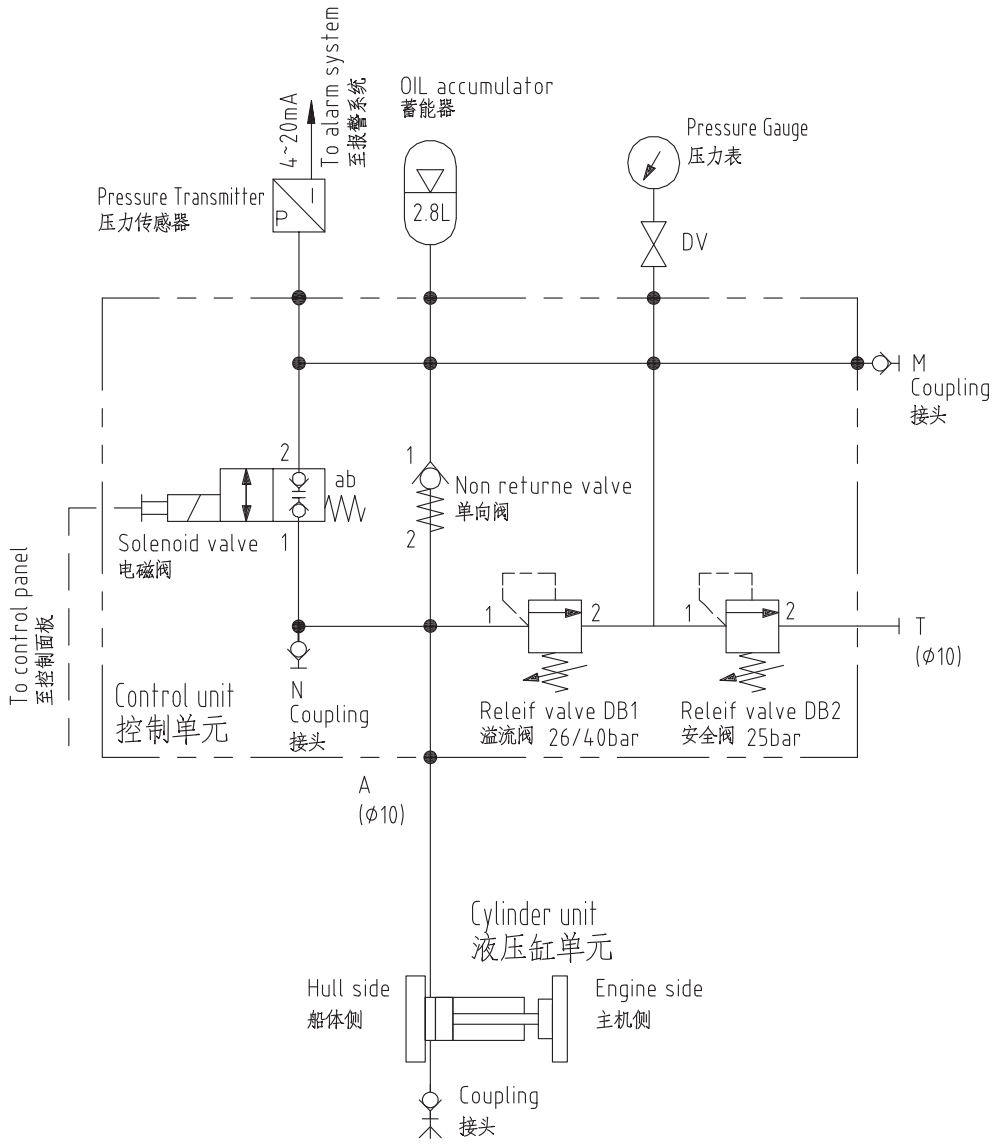
DYDZ200-KZ-YL

Principle diagram
原理图



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审核						
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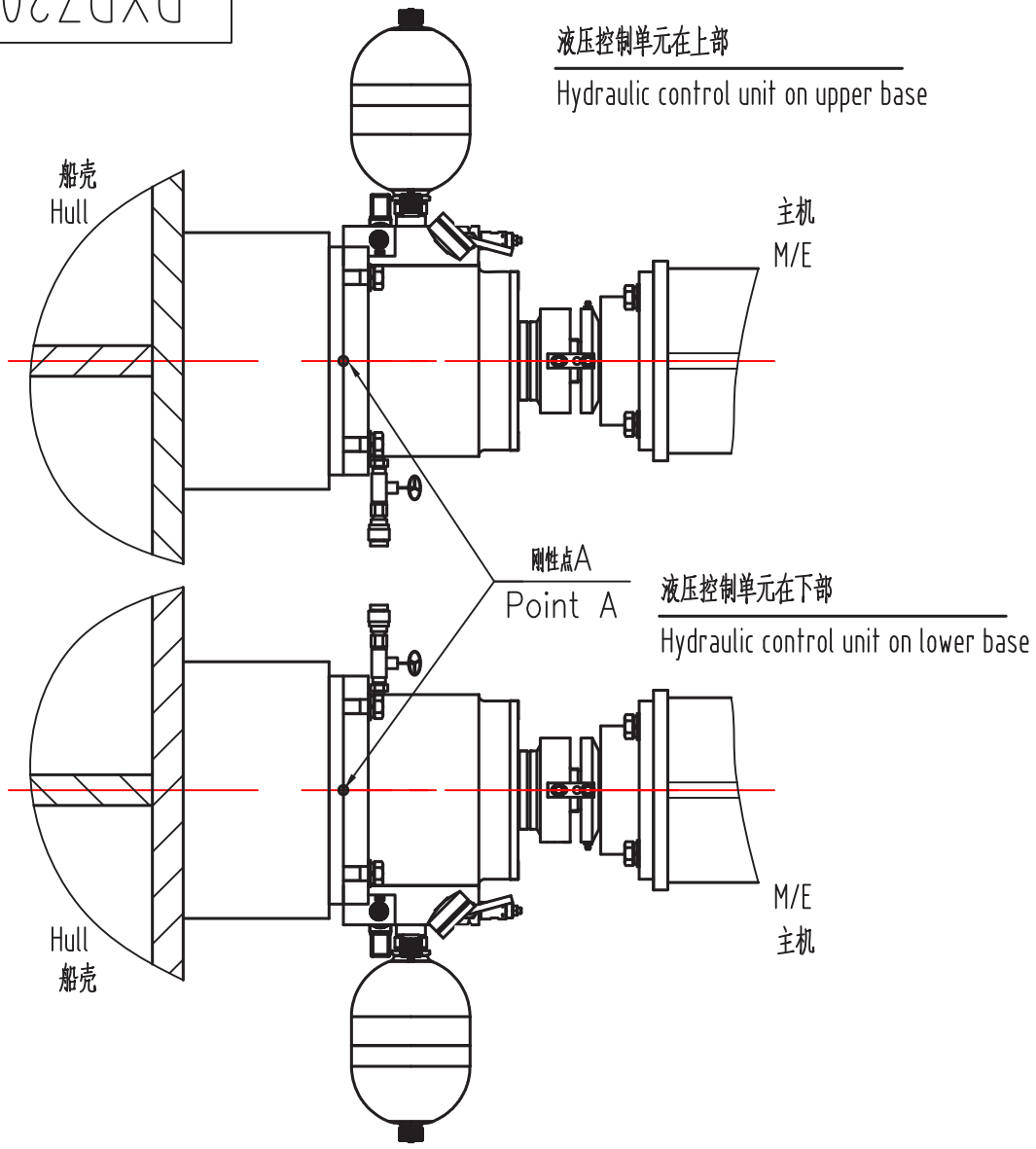
南通航海机械集团有限公司

液压控制单元原理图
hydraulic control unit diagram

DYDZ200-KZ-YL

DYDZ200-AZ1



船体侧安装点刚性点A的要求

Required rigidity of the casing side installation point A

垂直于安装点所在平面施加 127KN 力时，轴向偏移≤0.51 mm;

Force per bracing:127KN，Max. Correcponding deflation of casing side: 0.51mm

在安装点所在平面的水平和垂直方向施加22KN力时，最大偏移≤2mm。

In the horizontal and vertical direction of the top bracing cylinder,
force per bracing: 22KN，Max. correcponding deflation of casing side: 2mm

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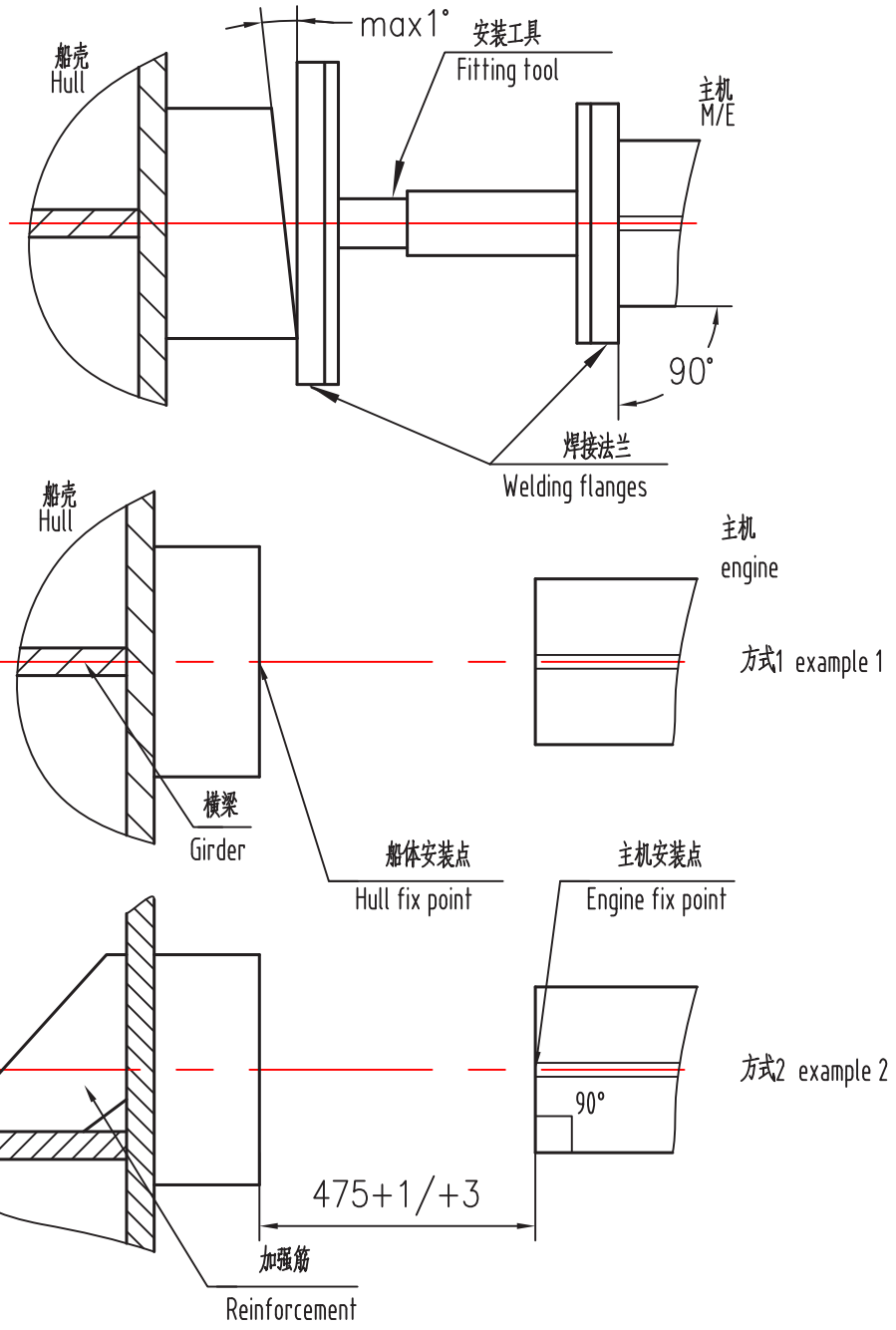
审核						
工艺		日期		共 页	第 页	

南通航海机械集团有限公司

安装要求1
Required of installation

DYDZ200-AZ1

DYDZ200-AZ2



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工艺		日期	

图样标记	重量	比例
		1:4
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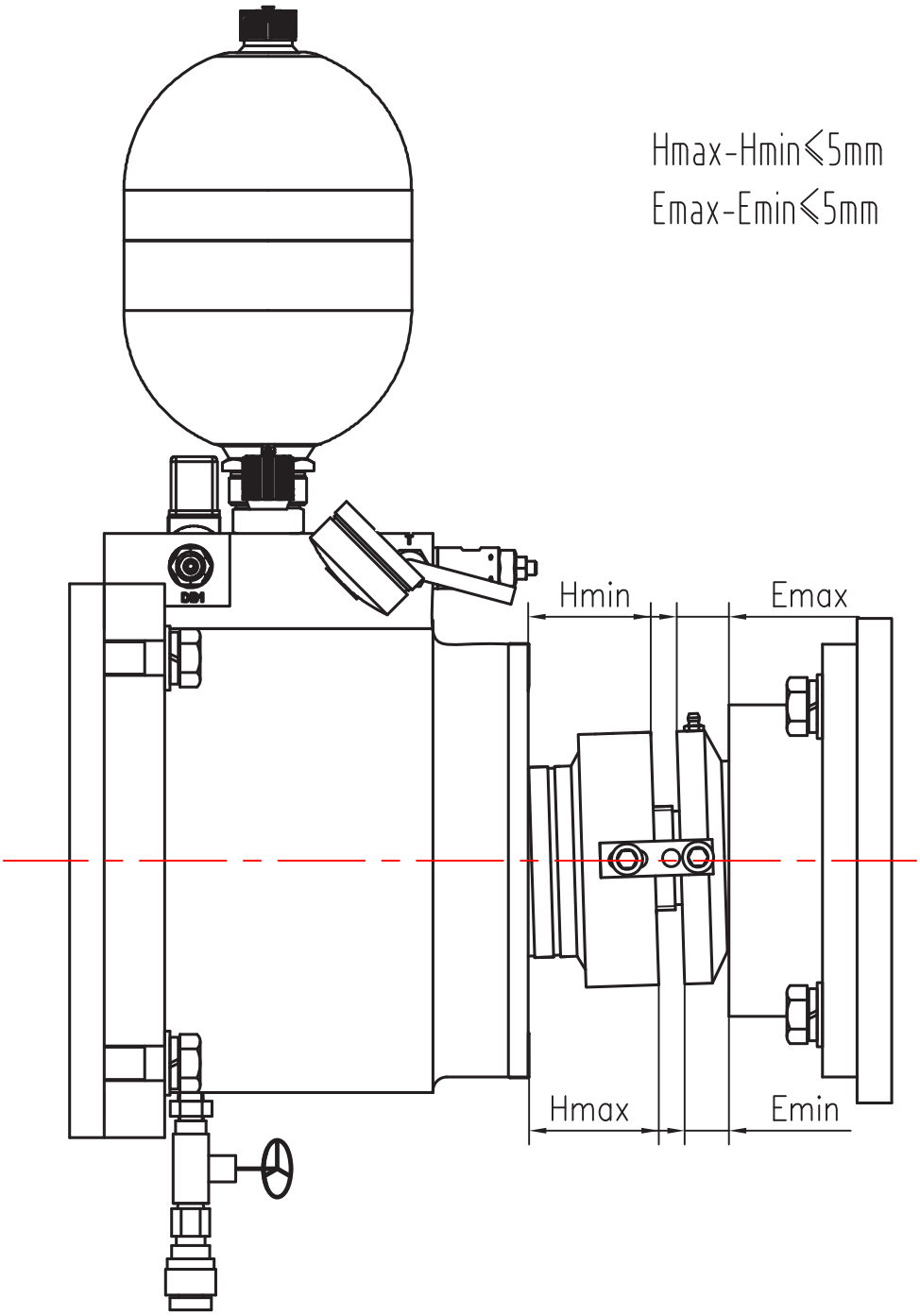
南通航海机械集团有限公司

安装要求2
Required of installation 2

DYDZ200-AZ2

DYDZ200-DT



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校对		审定	
审核			
工艺		日期	

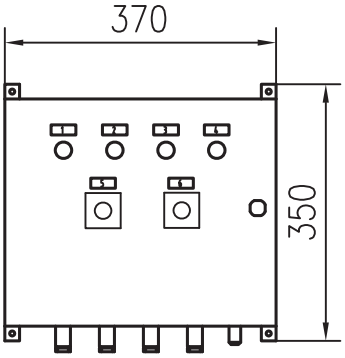
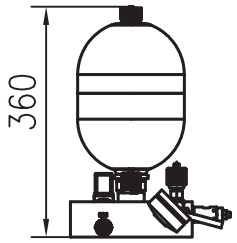
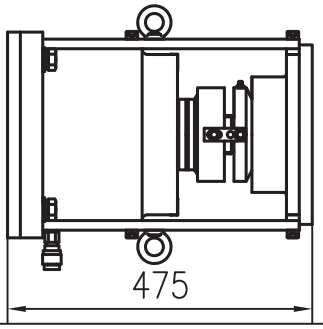
图样标记	重量	比例
		1:4
共 页	第 页	

南通航海机械集团有限公司

运行不重合度
Service misalignment

DYDZ200-DT

DYDZ200-GH

NO. 序号	Code 代号	Name 名称	Naterial 材料	Qty. 数量	Remark 标记
3	DYDZ200-DK	Electric control box 电气控制箱	component 组件	1	
2	DYDZ200-FK	Control unit and accumulator 控制单元与蓄能器	component 组件	4	
1	DYDZ200-YYG	Cylinder unit 液压缸单元	component 组件	4	

借通用件登记

描 图

校 描

旧底图总号

签 字

日 期

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审核			
工艺		日期	

供货范围
scope of supply

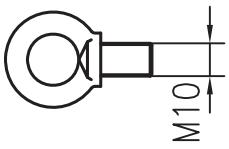
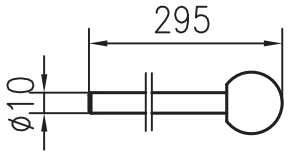
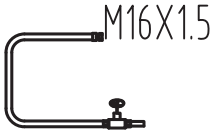
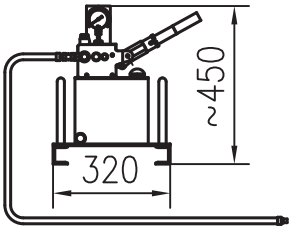
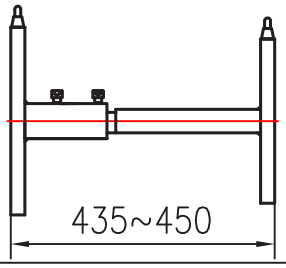
图样标记	重量	比例
		1:1
共 页	第 页	

南通航海机械集团有限公司

液压顶推支撑
hydraulic top bracing

DYDZ200-GH

DYDZ200-FJ

NO. 序号	Code 代号	Name 名称	Naterial 材料	Qty. 数量	Remark 标记
5	GB/T 827	regulation pole 吊环螺栓M10	Q235A	1	
4	YDZZ240A-12	regulation pole 调节杆	component 组件	2	
3	RG	Drain hose 空气排放软管	component 组件	1	
2	GYB6	Hand pump (with hose &coupling) 手摇泵(含软管、接头)	component 组件	1	
1	DYDZ200-GJ	Fitting tool 安装工具	component 组件	1	

借通用件登记

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审核			
工艺		日期	

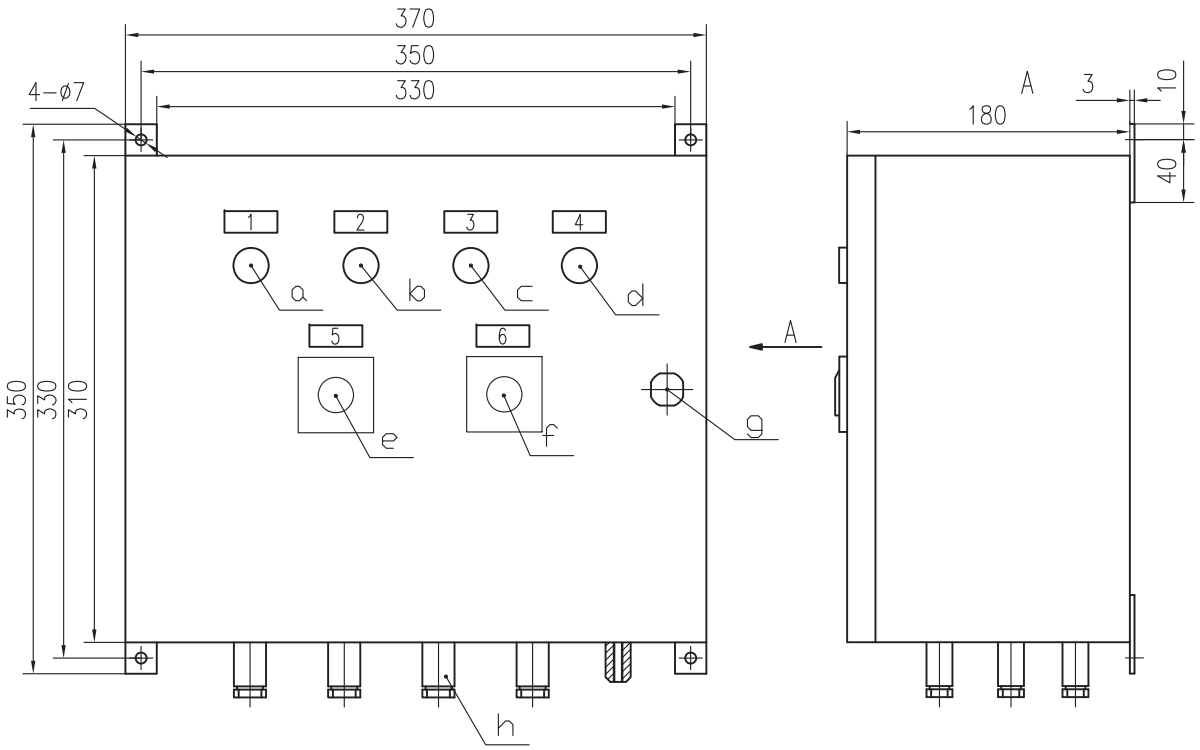
工具、附件清单
Stool & accessories list

图样标记	重量	比例
		1:1
共 页	第 页	

南通航海机械集团有限公司

液压顶推支撑
hydraulic top bracing

DYDZ200-FJ



铭牌对照表：
nameplate：

代号No.	字　样 printed words
1	SOURCE　电源
2	OUT OF SERVICE 停止
3	IN SERVICE　运行
4	LAMP TEST 试灯
5	SOURCE SWITCH　电源开关
6	OUT OF SERVICE AUTO IN SERVICE　停止 自动 运行

元器件对照表 elements list：

代号No.	名　称 Name	数量Quan.	备　注 Remarks
a	指示灯 signal lamp	1	AD16-22D DC24V 白 WHITE
b	指示灯 signal lamp	1	AD16-22D DC24V 红 RED
c	指示灯 signal lamp	1	AD16-22D DC24V 绿 GREEN
d	按钮　press button	1	LA39-20/K
e	选择开关select switch	1	LW42A2-1001
f	选择开关select switch	1	LW42A2-2024
g	门锁　Lock	1	MS721
h	填料函 cable glands	11	HSK-GM(M20*1.5)(电缆外径10-14)

说明：电控箱防护等级为IP44

Note:The protection class of the control box is IP44

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设　计		标准化		
校　对				
审　核				
工　艺		日　期		

独立式液压顶推支撑

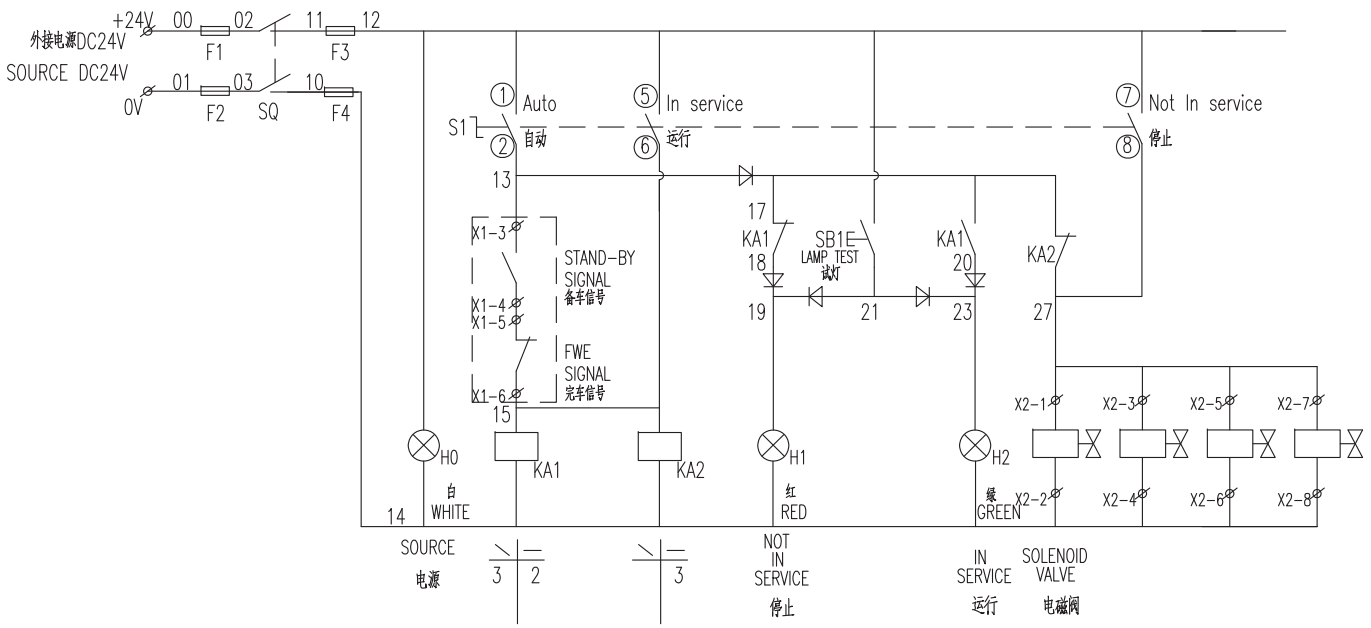
图样标记	重　量	比　例
		1:3.3
共　页	第　页	

南通航海机械集团有限公司

电控箱外形图

DYDZ200B-DK-WX

DYDZ200B-DK-YL



LW42A2-1001(上海天逸)

	0	1
1-2		×
3-4		×
	关	开
	OFF	ON

SQ电源开关
SOURCE SWITCH

LW42A2-2024(上海天逸)

	1	0	2
1-2		×	×
3-4		×	
5-6			×
7-8	×		
	停止	自动	运行
	OUT OF SERVICE	AUTO	IN SERVICE

S1转换开关
SELECT SWITCH

借通用件登记
描　图
校　描
旧底图总号
签　字
日　期

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审核				
工艺		日期		

独立式液压顶推支撑

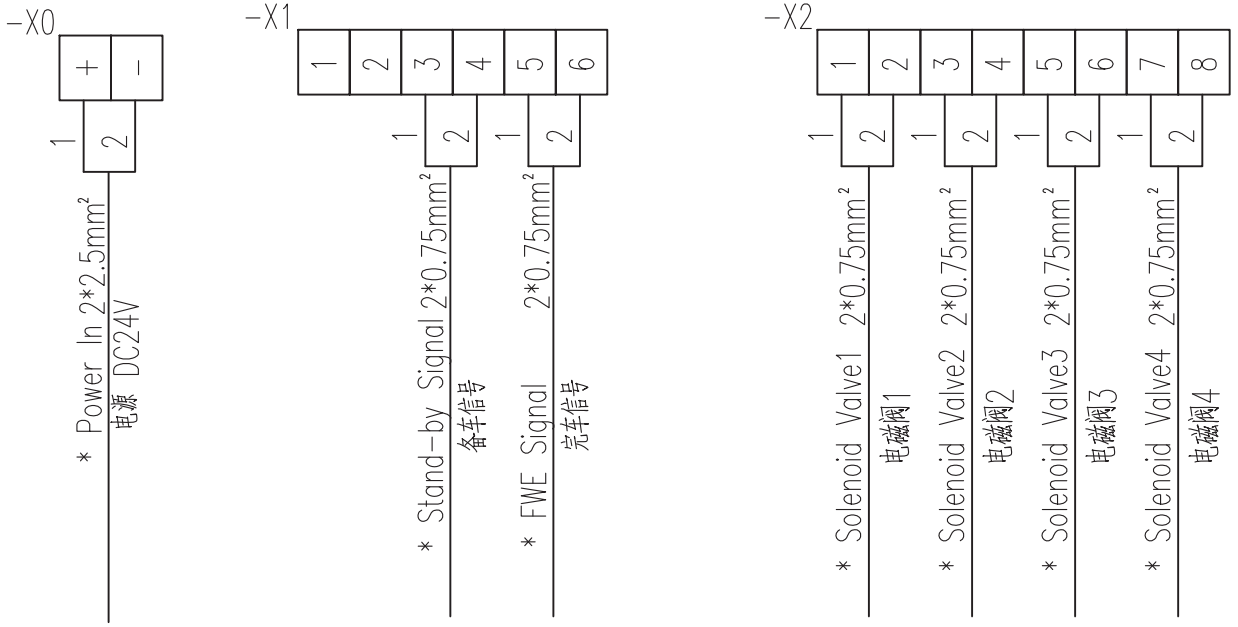
南通航海机械集团有限公司

电气原理图

图样标记	重量	比例
		1.2:1
共　页	第　页	

DYDZ200B-DK-YL

DYDZ200B-DK-JX1



说明：

NOTE:

“*” 部分由船厂接线

“*” part supply by shipyard

借通用件登记

描　图

校　描

旧底图总号

签　字

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校对			
审核			
工艺		日期	

独立式液压顶推支撑

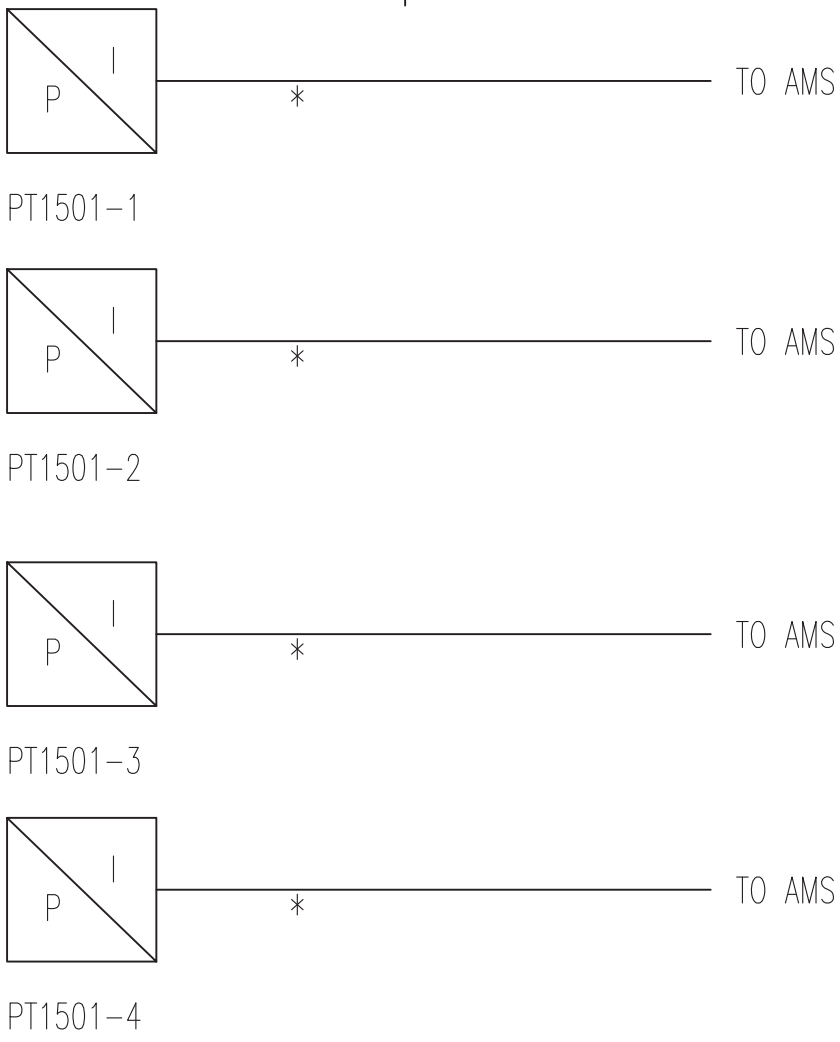
南通航海机械集团有限公司

电气接线图1

图样标记	重量	比例
		1:1.5
共　页	第　页	

DYDZ200B-DK-JX1

DYDZ200B-DK-JX2



借通用件登记

描　图

校　描

旧底图总号

签　字

日　期

说明："*"部分由船厂接线,压力传感器提供4-20mA信号至AMS

Note: "*" part supply by ship Yard ,pressure transmitter supply 4-20mA to AMS

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校对				
审核				
工艺		日期		

独立式液压顶推支撑

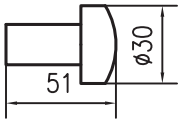
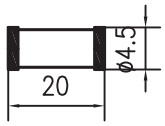
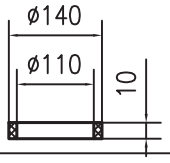
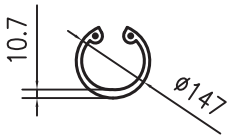
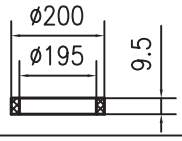
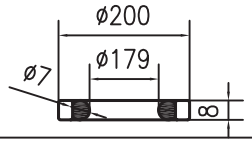
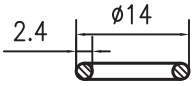
南通航海机械集团有限公司

电气接线图2

图样标记	重量	比例
		1:1
共　页	第　页	

DYDZ200B-DK-JX2

DYDZ200-BJ

NO. 序号	Code 代号	Name 名称	Naterial 材料	Qty. 数量	Remark 标记
7		indicator lamp red、green、white 1pc 指示灯(红绿白各一)	component 组件	3	
6		Fuse 熔芯 2A	component 组件	4	
5	JB/ZQ4606-86	Dust seal 防尘圈110	Wool 半粗羊毛	8	
4	GB893-76	Block ring 挡圈140	65Mn	8	
3	GST5909-2000	Slide ring 斯来圈	PTFE 聚四氟乙烯	8	
2	GSF2000-01	Combined ring 格来圈	PTFE 聚四氟乙烯	8	
1	GB1235-76	"O" ring O型密封圈	NBR 丁晴橡胶	4	

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审核			
工艺		日期	

备件清单
Spare parts

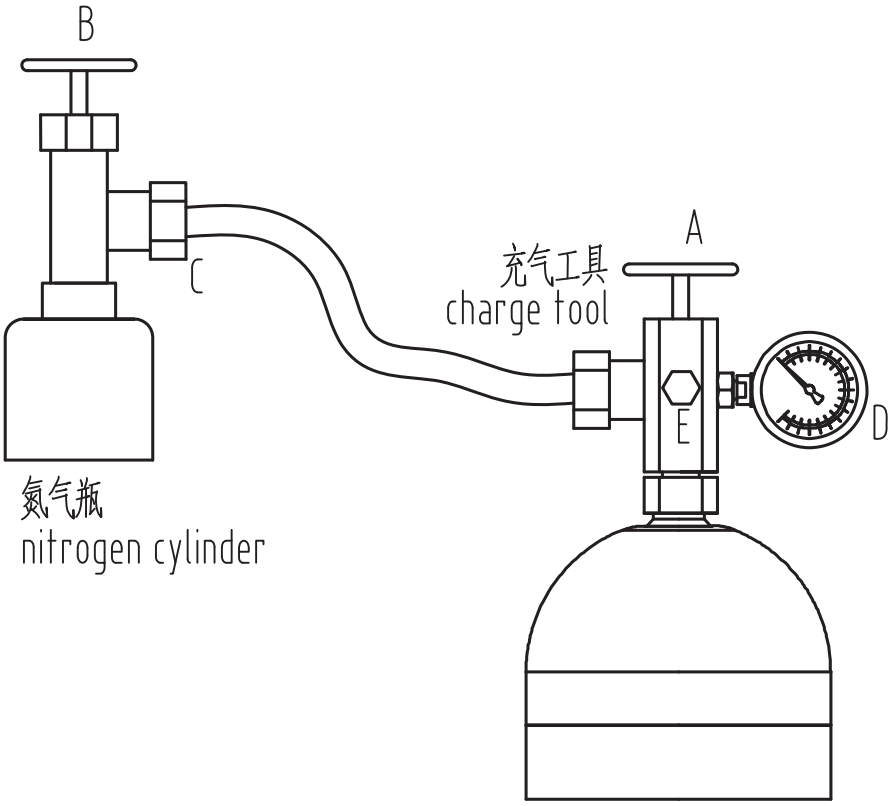
图样标记	重量	比例
		1:1
共 页	第 页	

南通航海机械集团有限公司

液压顶推支撑
hydraulic top bracing

DYDZ200-BJ

DYDZ200-CQ



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审核			
工艺		日期	

图样标记	重量	比例
		1:4
共 页	第 页	

南通航海机械集团有限公司

充气工具使用说明
Explanation of charge tool's use

DYDZ200-CQ