

目 录

CONTENTS

1、概 要	/1
2、固定式空冷器	/1-2
概述	
空冷器的安装和拆卸	
3、可拆式空冷器	/2-3
概述	
空冷器的安装和拆卸	
4、试运行	/3-4
概述	
冷却水流速	
冷却水流速的控制	
5、保护膜	/4
6、停 用	/4
7、运行控制	/5
概述	
性能试验	
8、清 洗	/5-6
概述	
水侧的清洗	
机械清洗	
水力清洗	
化学清洗	
不挪动空冷器进行化学清洗	
拆卸空冷器进行化学清洗	
气侧的清洗	
水压清洗	
化学清洗	
9、管 漏	/7-8
概述	
对个别管子的压力测试	
空冷器的压力测试	
在水下进行空气压力测试	
堵塞管子	
个别管子的更换	
插入另一根芯管	
空冷器修理后的压力测试	

1、General	/9
2、Block cooler	/9-10
General	
Installation and removal of cooler	
3、Removable stack cooler	/10-11
General	
Installation and removal of cooler	
4、Commissioning	/11
General	
Cooling water velocity	
Control of cooling water velocity	
5、Protective film	/12
6、Standstill	/12
7、Service control	/12-13
General	
Performance test	
8、Cleaning	/13-14
General	
Cleaning of the water side	
Mechanical cleaning	
Hydraulic cleaning	
Chemical cleaning	
Chemical cleaning -In situ	
Chemical cleaning -Cooler removed	
Cleaning of the air-side	
Hydraulic cleaning	
Chemical cleaning	
9、Tube leaks	/14-15
General	
Pressure test of individual tubes	
Pressure test of cooler	
Pressure test with air under water	
Plugging of tubes	
Replacement of single tubes	
Insertion of a second core tube	
Pressure test after repair	

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，也可以悬挂安装在风道中。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KLINGERSIL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部。

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,也可以悬挂安装在风道中。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。

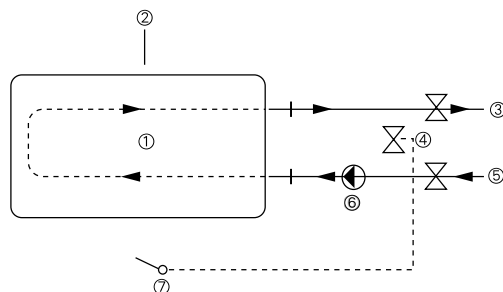
管 材	最小流速	最大流速
CuZn28Sn(SOMS71)	1.0m/s	2.0m/s
CuZn20Al(SOMS76)	1.0m/s	2.2m/s
CuNi30Fe(CuNi70/30)	1.5m/s	3.0m/s
CuNi10Fe(CuNi90/10)	1.5m/s	3.0m/s
Cu/SB or SF	1.0m/s	2.0m/s
Steel	2.0m/s	2.5m/s

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恒定。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。



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 ($\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$)，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 $\geq 500\text{mg/l}$)，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，因为象铵化合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。

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。

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测。

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。

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 from air side trunk and remove.

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

TIGHTENING TORQUE(Nm)
FOR GALVANIZED SCREWS WITH CLASS OF STRENGTH 8.8
WITH NORMAL METRIC THREADS.
THREADS AND CONNECTING SURFACES FROM SCREWS
AND NUTS ARE OILED

SIZE	WITHOUT GASKET OR KLINGERSIL- GASKET	WITHOUT GASKET OR KLINGERSIL-GASKET WITH NORD-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

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

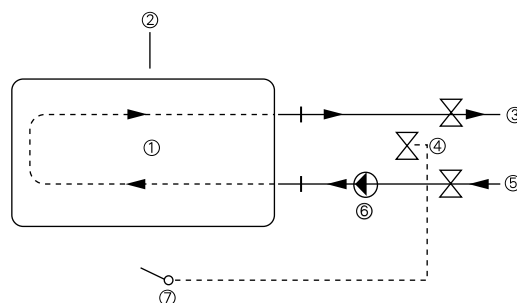
Never operate at min. Velocity for a prolonged period of time. The nominal water flow stated in the performance data sheet for the cooler in question should be maintained. Frequent fluctuation of the water velocity impede the formation of a protective film on the tube inside, which are vital for corrosion 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 ($\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$) 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 $>500\text{mg/l}$) 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

The performance guarantee given by GEA is mainly 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 vented 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, hydraulic 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 circulating 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 dismantled. For chemical cleaning we recommend to use suitable 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 or 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.

If the cooler is to be tested without the use of a pressure gauge it has to be dismantled 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 accumulated 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 un-

finned 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（例如舷外冷却系统），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 $\phi 3\text{mm}$ ）的高压喷枪来清除冷却管内的沉积物，压力推荐用 $6\text{MPa} \sim 8\text{MPa}$ ，注意冷却管两端均要敞开。

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）。

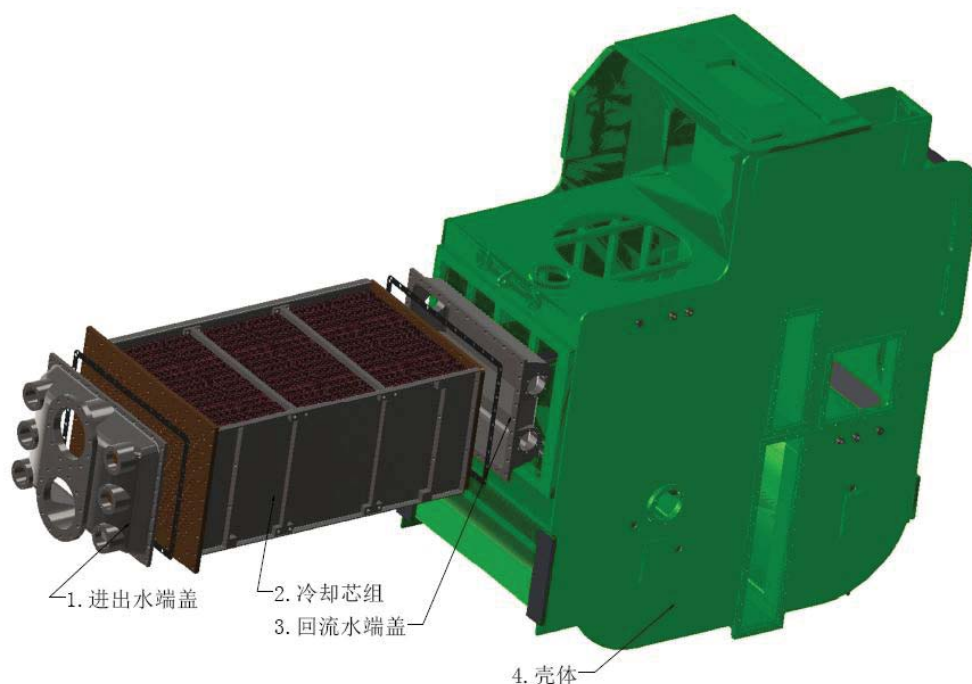
3.3 化学清洗：我们建议在空冷器拆卸下来后对空冷器气侧进行化学清洗。使用化学品清洗时，应由胜任的公司进行，此方法要特别注意的是所使用的清洁剂应对翅片材料无腐蚀性，必要时用压缩空气吹干翅片。

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。

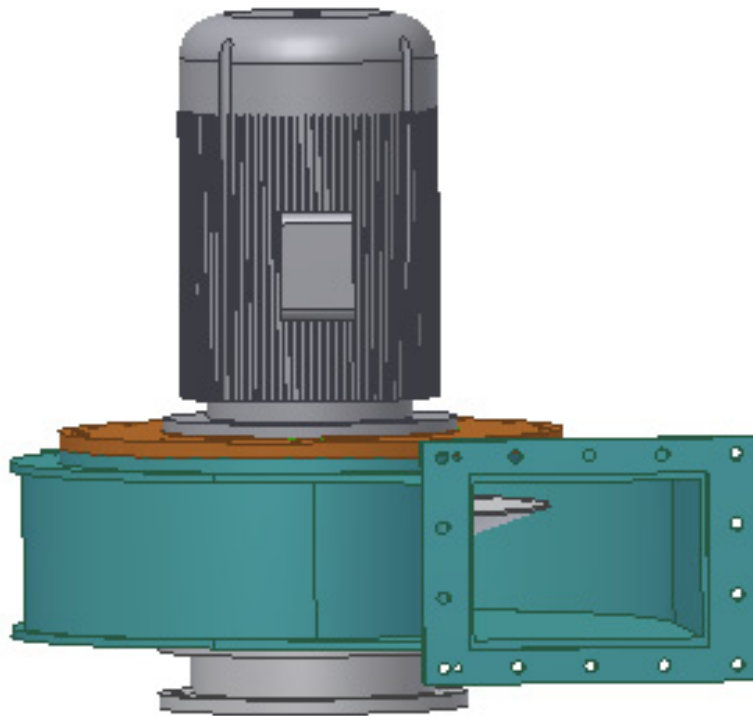
4.3.3 建议拆检防蚀锌块盖板的同时，应观察空冷器端盖水腔内部是否有异物、杂物进入，防止异物堵塞冷却管，以及损害空冷器工作效率。如果发现空冷器端盖水腔内部有异物，及应立即检查弦外冷却水进水口的过滤装置是否完好。

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。

船用辅助鼓风机使用说明书

适用于分体式离心辅助鼓风机

Operation Instruction of Marine Auxiliary Blower
For split-body and centrifugal type



上海齐耀系统工程有限公司
QIYAO POWER SYSTEMS CO., LTD

1 概述

分体式船用辅助鼓风机，是一种电机直接带动叶轮的离心式风机，用于 MDT、WIN GD、MHI 等各型船用柴油机的辅助进气。

2 结构

分体式船用辅助鼓风机按客户订货要求供货，主要结构有以下三种（图 1）：

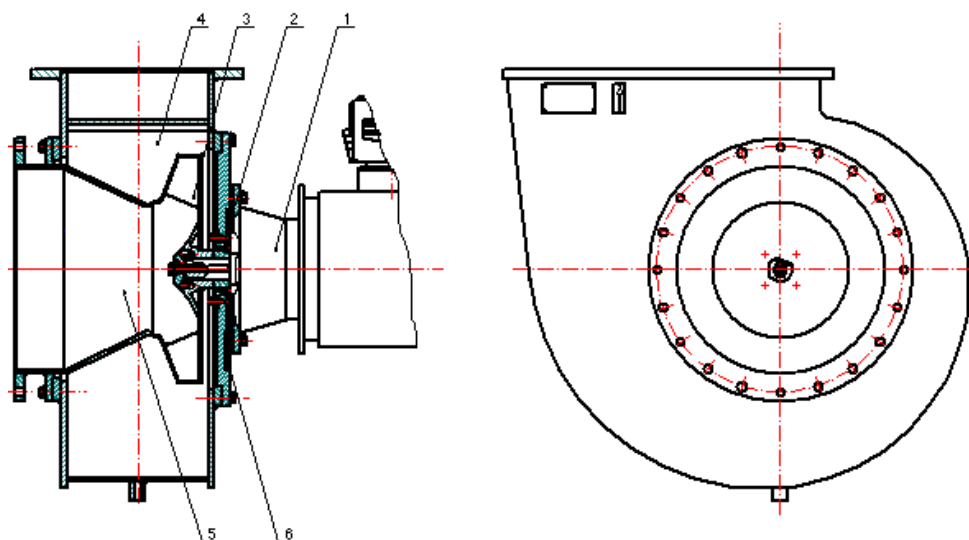


图 1.a(单出口带蜗壳)

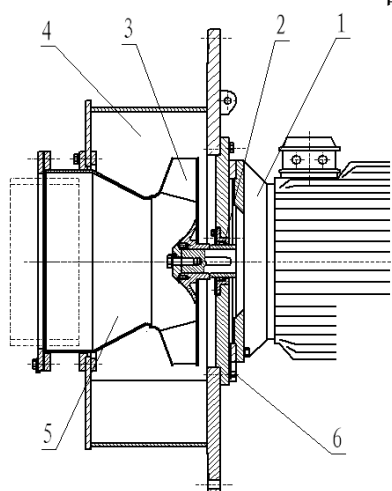


图 1.b（三出口）

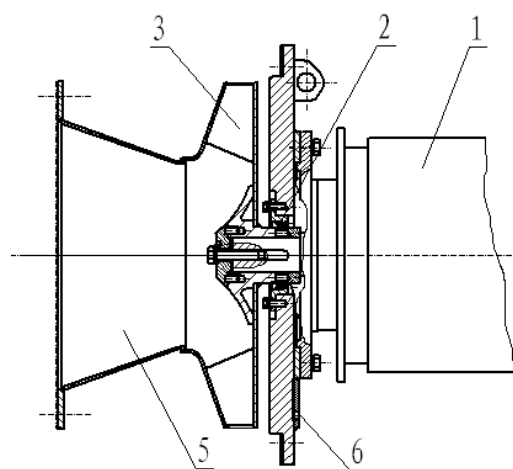


图 1.c（不带蜗壳供货）

1—电机

2—气封

3—叶轮

4—壳体

5—进气锥弧管

6—排气孔

分体式船用辅助鼓风机的叶轮由轮毂直接安装在电机轴上，通过平键联接，叶轮与进口集流管采用套口方式连接。密封采用进口具有热弹性的 PS 气封。风机结构紧凑、密封优良，维修时无须拆开机壳与柴油机的连接便可取出叶轮，维修方便。

产品制造、检验和试验均按照国家有关风机标准。性能符合要求，工作可靠，运行平稳。

3 主要技术指标

3.1 性能参数与性能曲线：辅助鼓风机的性能是指订货图中选择的满足主机需求的静压-流量要求，各型辅助鼓风机运行特性符合所需的静压-流量(性能运行特性曲线举例示意如图 2)，具体型号设计完全可满足客户订货图中对性能的要求。

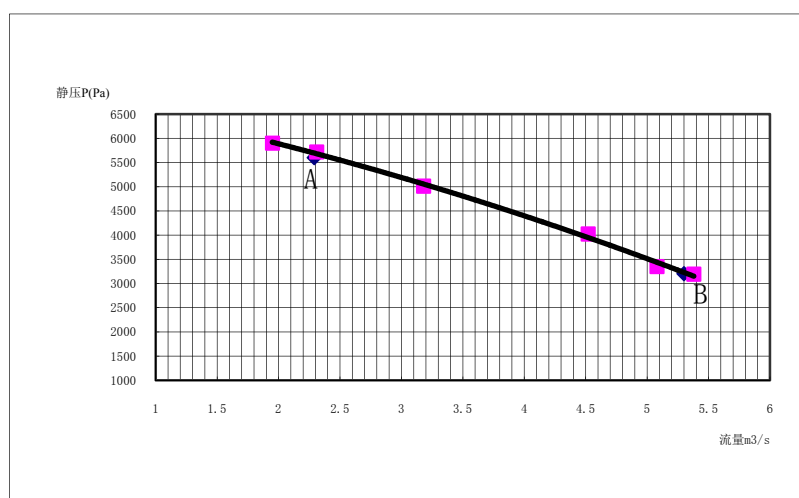


图 2（性能特性曲线举例）

3.2 安装尺寸（图 3）

辅助鼓风机的安装尺寸是指风机安装到主机相关管道的接口尺寸，主要是进口锥管安装和风机出口法兰或壳体连接板二个安装面。具体型号根据客户订货图要求设计，完全符合安装要求。

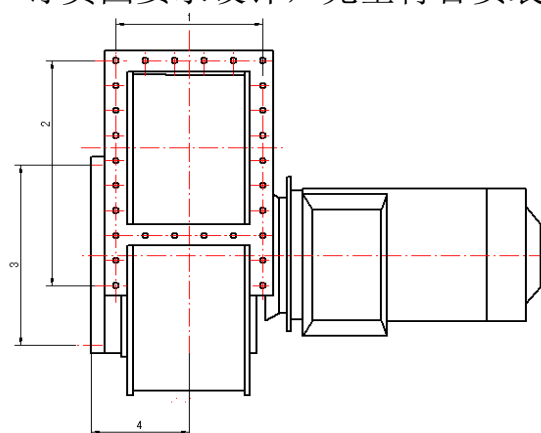


图 3.a（单出口带壳体）

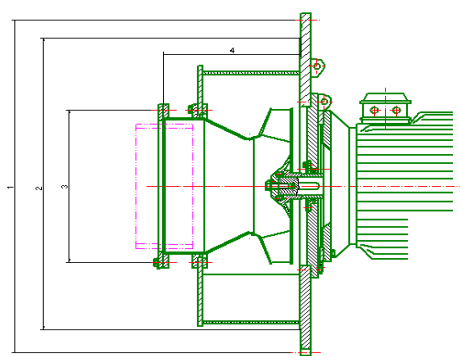


图 3.b（三出口）

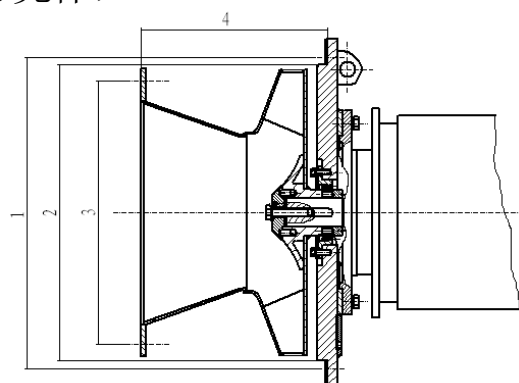


图 3.c（不带蜗壳供货）

4 使用、维护

- 4.1 安装、起吊风机时应使用设计的专用起吊孔，注意安全操作。
- 4.2 注意区分顺时针和逆时针的风机叶轮以及电机的接线，风机叶轮旋转应与方向指示牌及壳体出风口一致。
- 4.3 使用中应注意：
 - 4.3.1 监察风机的振动情况是否正常($v \leq 6.3 \text{mm/s}$)，振动过大影响风机寿命和性能，否则需修复叶轮平衡或更换新叶轮。
 - 4.3.2 监察电机、电压、电流参数等是否正常，超过要求应停机检查，进行必要的维护维修。
 - 4.3.3 运行中检查各处是否有漏气、异响，如需要应检查和更换相关密封件。
- 4.4 使用随机提供工具备件箱中的专用叶轮拆卸工具小心拆卸叶轮，经修理的叶轮应进行动平衡校正或更换新的叶轮，以保证风机工作平稳。
- 4.5 如需更换电机轴上的密封圈，注意按其说明，安装时涂适当润滑油脂，安装方向正确，不可碰坏损伤。

5 工具备件清单

每套风机都会随机附带有一份相应的工具备件清单。

1 Application

The split-body type marine auxiliary blower is used for most models of MDT、WIN GD、MHI diesel engine and so on.

2 Main construction

There are three types supplied by us according to the demands of clients (see Fig. 1)

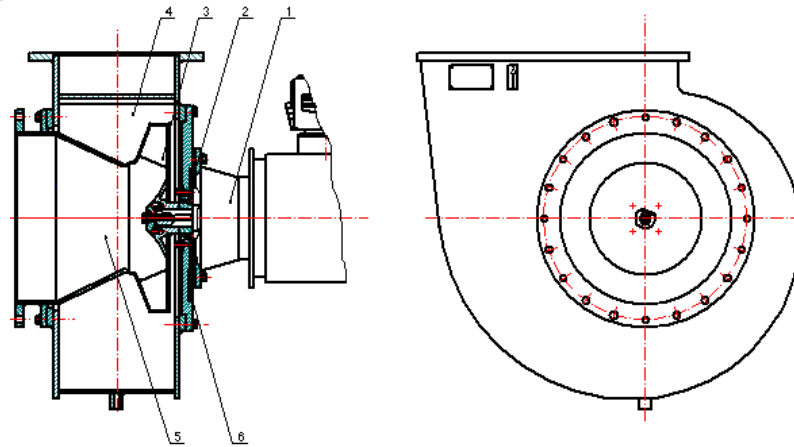


Fig. 1.a (type of single outlet with shell)

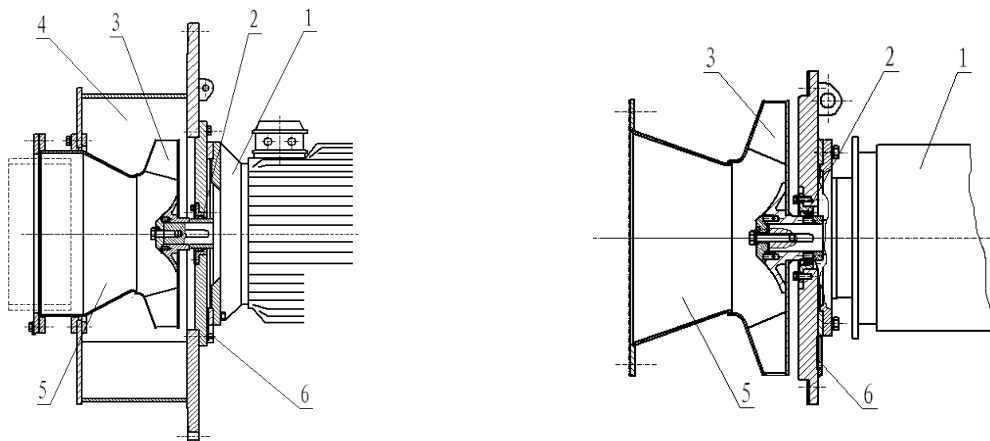


Fig. 1.b (type of three outlets)

Fig. 1.c (type of without shell)

1——electric motor

2——PS-seal

3——impeller

4——auxiliary blower shell

5——air passing in tube

6——leaking out hole

These auxiliary blowers are composed of air passing in tube 5, blower shell 4, impeller 3, PS-seal 2, electric motor 1 and so on. The impeller is connected with the shaft of electric motor through key directly, using PS-seal for sealing. The characteristic of such construction is being high revolving speed, more small external size and good command for sealing.

When maintain and check the auxiliary blower, it needn't dismount it from the diesel engine. It's quite convenient to take out the impeller with the electric motor together while maintaining and checking. They are according to certain Blower Industry Standard of China when designing, manufacturing and doing experiments. It has more advantages such as convenience for maintaining and checking, reliable running and so on.

3 Main technical parameter

3.1. Function curve (see Fig. 2 for example)

The function of the blowers is designed according with the drawings afforded by clients. The running character curve is according with the demands of main engine.

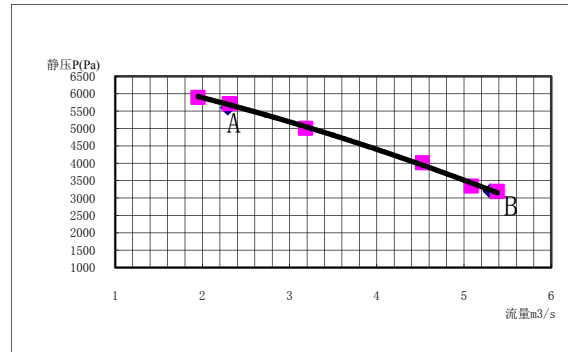


Fig. 2(function curve for example)

3.2 Installation dimensions (see Fig. 3)

The installation dimensions of the blower are also according with these drawings afforded by clients. They include the dimensions on the connecting face of the inlet tube and the blower shell or the connecting plate to shell.

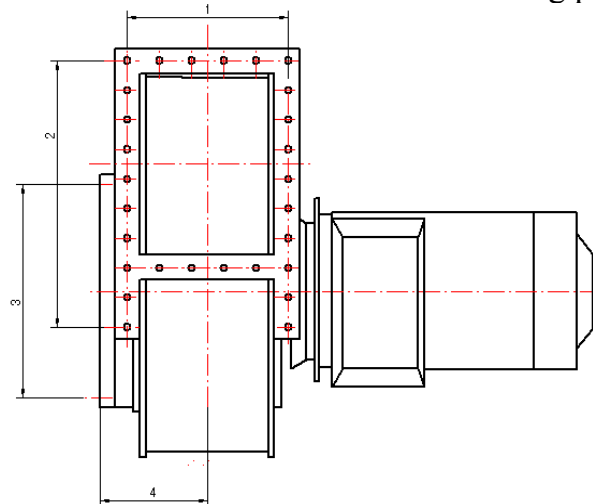


Fig. 3.a(type of single outlet with shell)

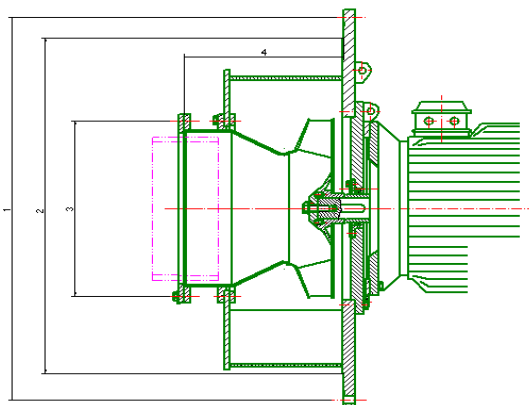


Fig. 3.b (type of three outlets)

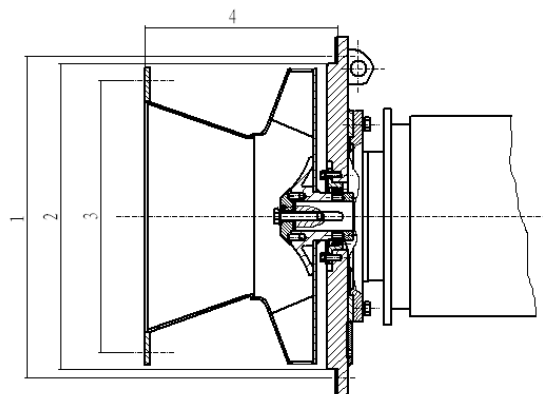


Fig. 3.(type of without shell)

4 Operation and maintenance

4.1. When lifting the auxiliary blower, please use the lifting hole being specially designed.

4.2. When supplying the power source, please be attention that the revolving direction should be the same as the direction plate.

4.3. Cautions:

4.3.1. Whether it is normal or not of vibration($v \leq 6.3 \text{ mm/s}$). The old impeller may be repaired or changed by a new one if the vibration is over the demands.

4.3.2. Whether it is normal or not of motors' rated voltage and current. Otherwise it needs to be checked carefully.

4.3.3. Whether air leaking or not by checking the connect face and leaking out hole. Otherwise some parts such as PS -seal need to be changed.

4.4. Please dismount the impeller by special tools in spare parts box, carefully mounting and dismounting PS-seal.

4.5. When change the PS-seal, please put some grease on it and don't do any damage to the sealing lip. To be sure that the installation direction of seal is correct.

5. List of tools and spare parts

There are always some tools and spare parts in the spare box with the equipment according to the list paper.

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辅助鼓风机 CFG5166E

设计性能报告

FOR 6G60ME-C9.5 主机

编制: 马化全

校对: 马平

审核: 张如伟

上海齐耀系统工程有限公司配套部

1. 订货图要求

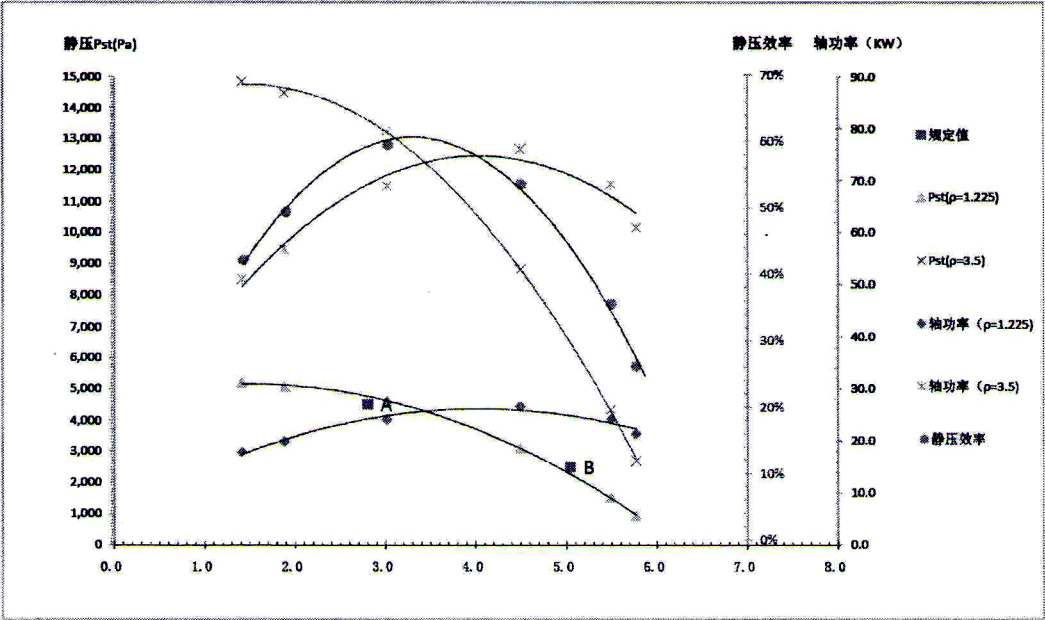
根据订货图 1H-04488-11（右旋风机:No.1）和 1H-04489-11（左旋风机:No.2），推荐功率 75.0KW（实际选择 87.0KW），性能要求：空气密度 $\rho = 1.225 \text{ kg/m}^3$ 时， $Q_A = 2.80 \text{ m}^3/\text{s}$ ， $P_A = 4500 \text{ Pa}$ ； $Q_B = 5.04 \text{ m}^3/\text{s}$ ， $P_B = 2500 \text{ Pa}$ 。

最大运行背压： 1.70 bar（绝对压力）；最大运行空气密度： $\rho = 3.5 \text{ kg/m}^3$ 。

2. 评估

（1）辅助鼓风机外形尺寸见认可图。

（2）设计性能



根据上图（详见附件曲线图）可知：

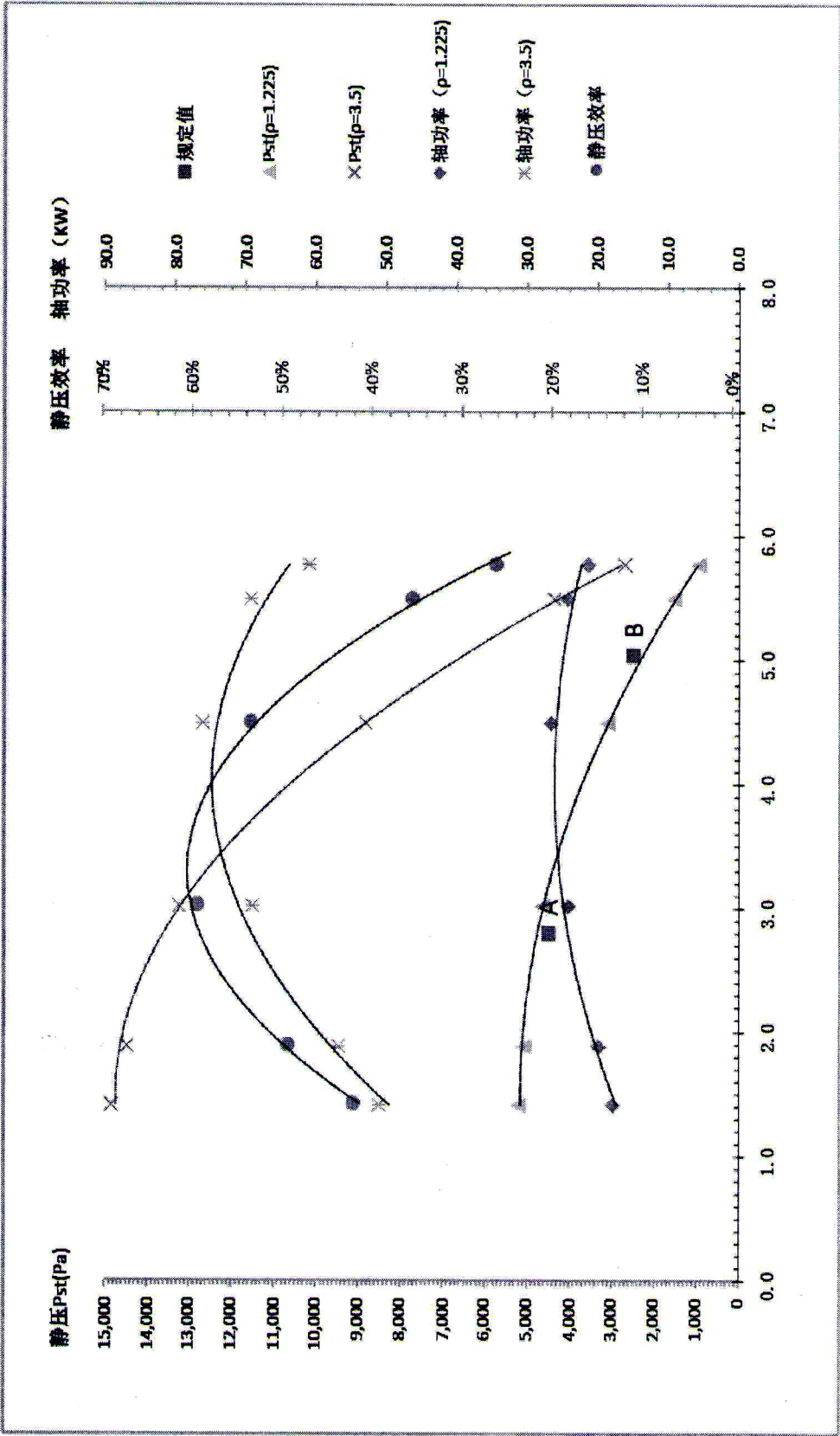
- a. $\rho = 1.225 \text{ kg/m}^3$ 时，静压-流量： $P_A = 4500 \text{ Pa}$ ， $Q_A = 2.90 \text{ m}^3/\text{s}$ ； $P_B = 2500 \text{ Pa}$ ， $Q_B = 5.02 \text{ m}^3/\text{s}$ ，满足要求。
- b. A、B 点间风机静压效率约在 47%~60%之间。
- c. 最大运行空气密度 $\rho = 3.5 \text{ kg/m}^3$ 时，马达功率需求约在 68.0~76KW 之间，选择 87.0KW 的电机满足功率要求。

3. 结论：

CFG5166E 辅助鼓风机设计可满足 DMD 订货图各方面的要求。

附件

CFG5166E (6G60ME-C9.5) 辅助鼓风机理论性能曲线图



密度要求:	m³/s	Pa
ρ=1.225kg/m³	规定A点	4500
	规定B点	2500

図 面 来 歴 PLAN HISTORY										CMD																																																														
										TEC329																																																														
										6G60ME-C																																																														
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SERVICE MANUAL

EXHAUST VALVE & SEAT
GRINDING MACHINE

TYPE YGS-B



Yamashina Seiki Co., Ltd.



Precautions for Safety Operations

- This manual refers to operations and operation precautions of our Grinding Machine.
Before you use this device, be sure to carefully read through this manual for the complete understanding of the device.
The operation should be carried out by experienced operators.
- Please keep this manual at an easily accessible place so that the operator can use it whenever he or she is going to operate the device.
- This manual basically classifies and indicates the degree of harm or damage, which may occur against any improper operation of the device, in the three categories of “DANGER”, “WARNING” and “CAUTION”.
The definition of terms and the attention symbols are as follows.

 DANGER	Should an improper handling is attempted, such critical risks which could result in a fatal injuries are impending.
 WARNING	Should an improper handling is attempted, such dangerous possibilities which could result in a serious injuries are expected.
 CAUTION	Should an improper handling is attempted, such possibilities that could result in physical damage or injuries, or only material damages are expected.

Note that even in case of the “CAUTION” items, there might result in significant injuries depending on the situation. Be sure to understand and observe these descriptions since either of these symbols important cautions.



DANGER

- Never touch the terminals in the control box with the electric power being supplied.
Be sure to provide grounding to avoid electrical shocks.
- Since the grinding chips may spread in sparks, be sure to move such materials that may easily take fire or may easily be damaged to the area where no danger is anticipated.
- Be sure to always use the grindstone cover during the operation.
- When the grinder is improperly operated, the grindstone may be broken, thus causing fatal or serious injuries.

 WARNING

- The grindstone should not be used whenever it is accidentally dropped, hit with something hard, or when it is found to be unusual during the inspection.
- Do not touch the rotating grindstone with your fingers or a part of your body.
- Do not take your steps, during the operation, into the area in the rotational direction of the grindstone.
- The rotational direction of the grindstone should be the same as the arrow indicates.
When it is reversely rotated, the grindstone may come off, thus resulting in an accident.
- Be sure to put such protective devices as goggles and a dust mask during the operation.
- For the grindstone, please use the genuine parts which are specified by YAMASHINA.
Never use unauthorized parts since they may be a cause of unexpected accidents.
- Before starting the daily work, a trial operation should be performed for one minute or over, and in case the grindstone is replaced, it should be for three minutes or over.
During this period of time, the operator should stand by at a safe place since the grindstone may be broken during this performance.

 CAUTION

- Those who have no sufficient experience in the operation of the grinder should not try to replace the grindstone or make the trial operations.
- For the handling of grindstone, be sure to observe the three principles,
“No Rolling, No Dropping and No Hitting.”
- Grindstones should be stored on tool shelf, etc. in a dry area.
- The cutting amount and feeding speeds should conform to the specified number.
Otherwise, an abnormal wear of the grindstone or abnormal grinding of works.
- When you notice, during the operation, the operation of machine is not smooth or something is wrong with the machine, immediately stop the operation and inspect it, or repair it, as required.
- In case the grindstone is mounted on the flange, nuts should not be overtightened.
- Do not enter into the area where sparks are available.
- For moving the machine, hoist it by using eyebolts.
- The legs of the machine should be welded to the deck.
- Always pay attention to maintain the machine in good condition and keep it clean.

I . Introduction

1 . Summary

Thank you very much for your purchase on "YASEC Grinding Machine" this time.

This operation manual is issued to set forth the recommendations and procedures to be read any understood before use for maintaining and servicing this model including operational instructions and the capacity of the model, such that this model can be effectively and safety operated.

The grinding wheel is equipped with a fine angle adjusting device.

2 . Specification

Grinding wheel spindle speed	4800min ⁻¹
Work spindle speed	8.5min ⁻¹
Wheel size (Dia×Width×Bore)	φ 90×t10× φ 16
Slide angle adjusting range	29.9° ~30.6°
Wheel motor	AC 1 φ , 3 φ , 100/220/440V, 60Hz, 400W
Work motor	AC 1 φ , 3 φ , 100/220/440V, 60Hz, 100W

3 . Notes upon use

It is highly recommended for operating a grinding machine safely with the grinding wheel to follow the procedures described below, since any improper use may cause extremely dangerous accident.

- When a new grinding wheel is replaced, run it idly for more than 3 minutes in order to make sure there is no unusual noises or vibrations on the machine.
During this operation, wait at a place of safety and watch it carefully, in order to avoid any possible accident which may be encountered, such as cracking of the wheel.
- Run it idly for more than one minute and make sure there is no abnormality before you start the operation.
- Keep the cutting depth and feed speed below the specified values, respectively, otherwise resulting in the abnormal abrasion or crack of the grinding wheel, or the abnormal cutting on a work.
- Fix the wheel cover whenever in use.
- Keep your hands or body away from the wheel running.
- Wear a protective glasses when you work on the machine to protect your eyes.
- Keep anything which is inflammable or easy to be damaged, away from the place near the machine, since the sparks of ground metal powder are scattered around.

- Use maker specified parts of consumption such as a grinding wheel, other wise unexpected accident may occurs.
- Stop the machine immediately when you realize during operation that it does not work normally, and then check it and repair it if necessary.
- Keep the machine clean regularly.

II. Grinding procedures

1. Vertical slide unit

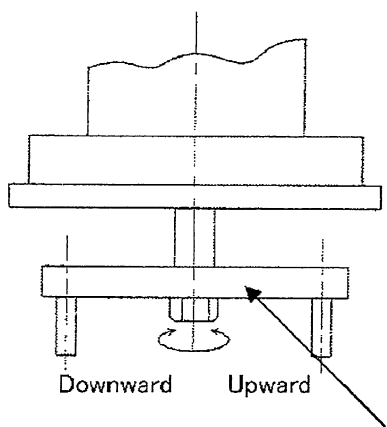


Fig. 1 Vertical handle and cut scale

- Turn the vertical slide handle clockwise, the vertical slide unit moves downward.
(As shown in Fig.1)
- One graduation of the micro collar corresponds to the cutting depth 0.005 mm.
- After having set the depth of cut for the grinding wheel tighten the clamping lever (24) at the side of slide pipe housing(19) to prevent shifing during grinding.

2. Mounting valve spindle

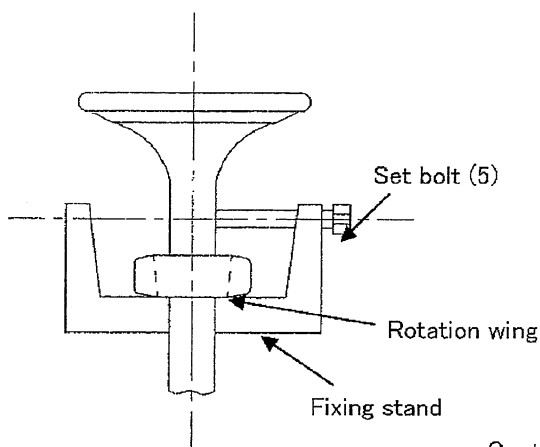


Fig. 2

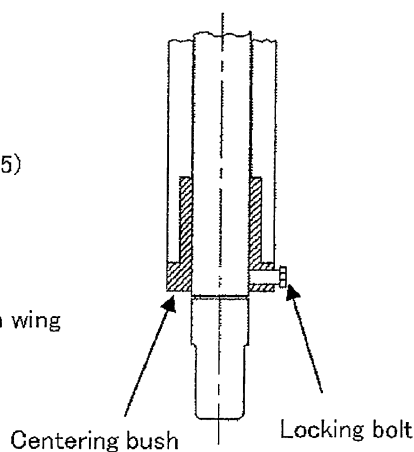


Fig. 3

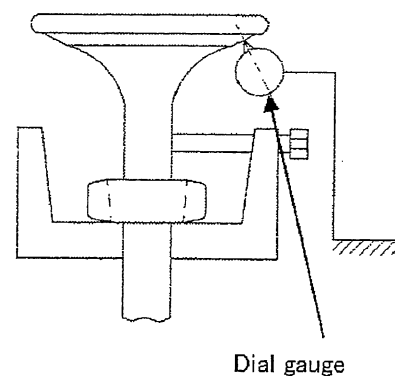


Fig. 4

3.

- Loosen three set bolts(5) that each bolt does not touch the rotation wing, until the each tip is aligned with the internal diameter.
- Make sure that no bolt of the locking bolt at the bottom project in the hole in its center.
- Insert the valve spindle from above until it hits the rotation wing.
- Lightly tighten the locking bolt at the side of centering bush.
- Lightly tighten the three set bolts.

- Set a dial gauge to the seat surface of valve spindle. (As shown in Fig.4)
- Set to the spindle start cam switch on the control box. The valve spindle will rotate counter clockwise when viewed from above.
- Centering should be carried out with a dial gauge in accordance with the following procedures.

- a) Slightly tighten three centering bolts in the valve spindle mounting, so that the each height of the three bolts sticking out, L1, L2, and L3 are visually adjusted to be equal each other. (As shown in Fig.5)
- b) Read the Max. and Min. with the dial gauge, and mark it at each point.
- c) Calculates the following equation.

$$(\text{Max. value} - \text{Min. value}) / 2 = A/2$$

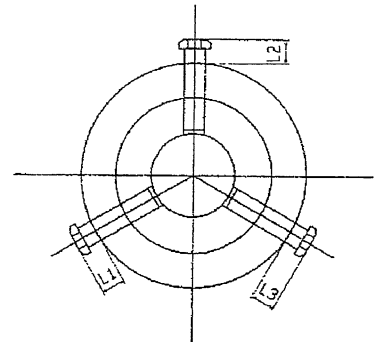


Fig. 5

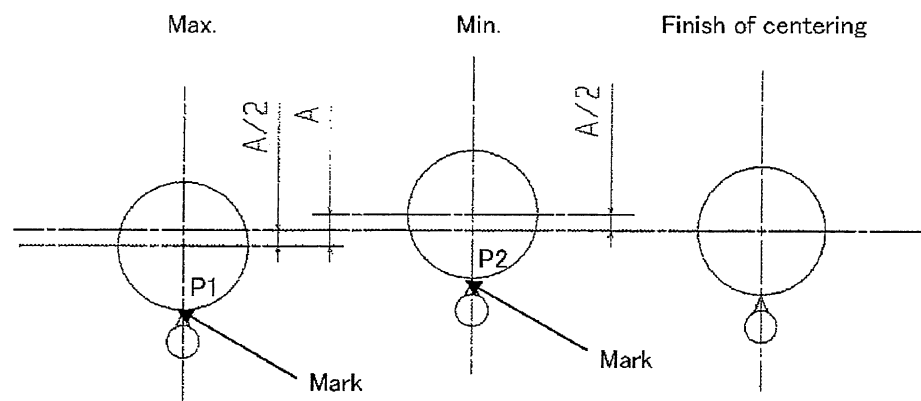


Fig. 6

- d) Rotate the work spindle for positioning, so that the contact of the dial gauge comes to the position P2 in Fig.7. (As shown in Fig.8)
- e) Slightly loosen the centering bolts (b), (c), located in the direction of the contact,

and tighten the bolt (a) to move a thing in the direction of the contact by A/2. (As shown in Fig.8)

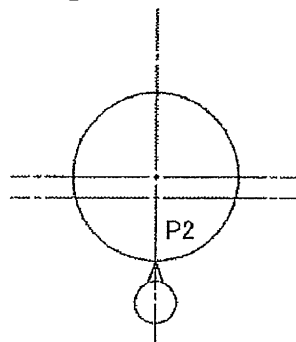


Fig. 7

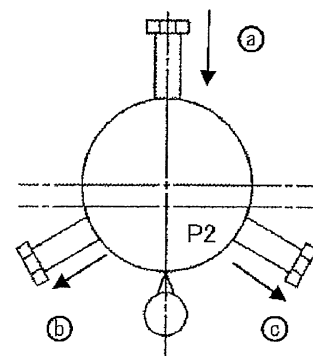


Fig. 8

In this manner, move the thing in the direction of the Min. valve by the valve of the equation : $(\text{Max. valve} - \text{Min. valve}) / 2$, and then by repeating this 4~5 times, so that the deflection indicated on the dial gauge may be less than 0.04 mm.

4. Fine angle adjusting device and adjusting method

For the seat surface of a valve spindle and seat is able to be ideal form, the fine angle adjusting device is provide for "YASEC" grinding machine.

Reference angle (Same as the valve angle) is a position where the marked line of the preserve plate(28) meet with the marked line of the slide shroud(35). (As shown in Fig.9)

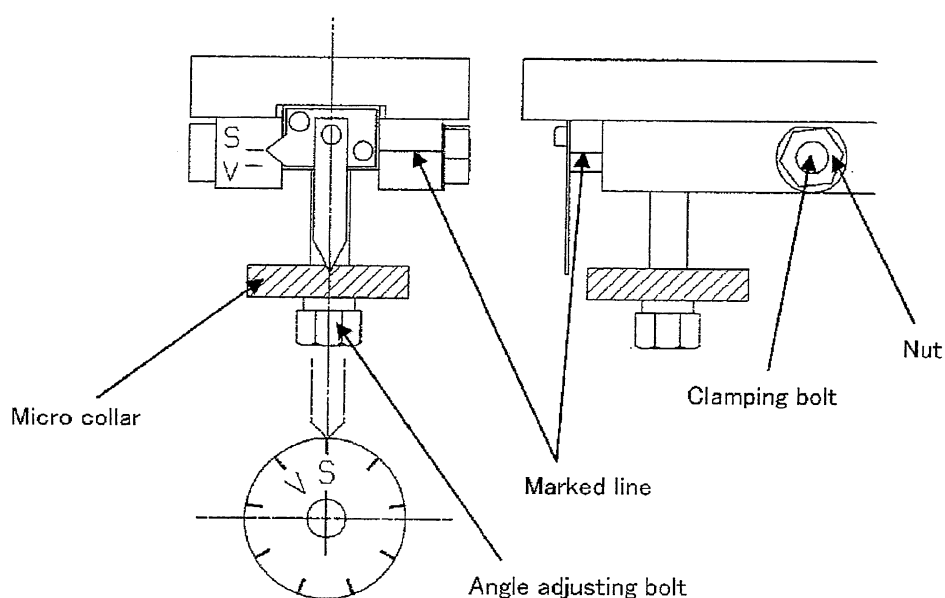


Fig. 9

5.

The mark S on micro collar is to correspond with the pointer B(78) in this state.

Set the mark V on the micro collar(71) to correspond with the pointer B(78) for "Valve spindle grinding" operation.

Set the mark S on the micro collar(71) to correspond with the pointer B(78) for "Valve seat grinding" operation.

The positions S and V of the position plate(76) represent only approximate positions, so when the operation is shifted from the valve spindle to the valve seat and vice versa, the each setting should be carried out by the S and V on the micro collar(71) and the pointer B(78).

Sometimes try to make sure that the lower end of the preserve plate(26) at the position of the mark S on the micro collar(71) is to correspond with the marking off.

Positioning with the micro collar should be carried out in the direction of pushing up the angle adjusting bolt(72).

When valve spindle or valve seat surface to be grind is required to set at angles other than reference angle the fine adjusting can be readily carried out with the following procedures.

(Un-usual operation)

- Slightly loosen the nut of the wheel spindle way, clamping bolt.
- Rotate the micro collar of angle adjusting bolts from the mark S or V position by required graduation. The one graduation of micro collar denotes 0.05. This operation should be carried out in pushing up.
- Make sure that there is no gap at the end of the of angle adjusting bolt.
- Tighten the nut of the wheel spindle way fixing bolt. (Only one part on the upper side)

6. Mounting valve seat

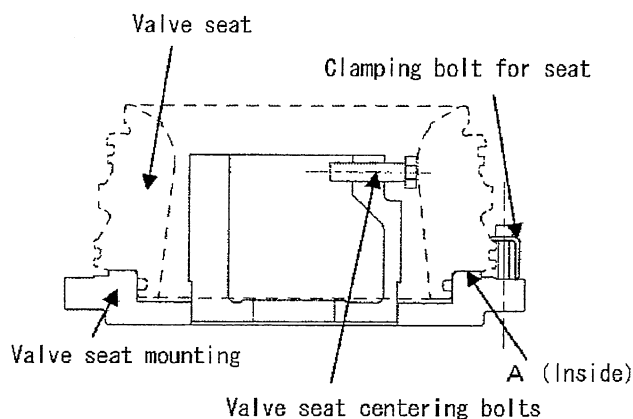


Fig.10

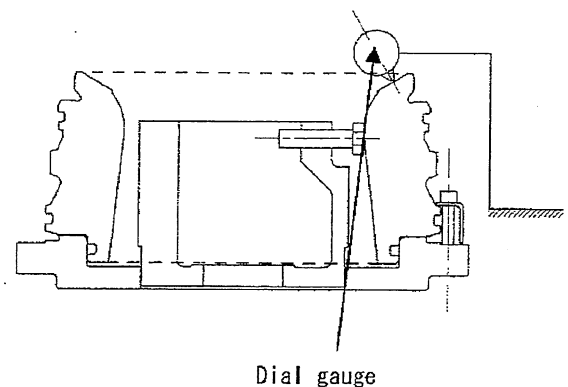


Fig.11

- Removed the value seat from the valve cage and clean it. The portion A to be in contact with the valve seat mounting should be especially carefully cleaned.
- Mount the valve seat on its mounting.
- Set a dial gauge to the seat surface.(As shown in Fig.11)
- Strain the valve seat slightly with the hexagon portions of three centering bolts in the valve spindle mounting.
- Switch on the valve seat for starting on the control box. The valve seat will rotate clockwise when viewed from above.
- Make centering by the centering bolt so that the deflection indicated on the dial gauge may be less than 0.04 mm.
- Switch off for stop.
- The centering operation is in the same way as with the valve spindle.
- Fixing the valve seat with clamping piece and M10 hexagon socket head cap screws.
- Rotate it once more to confirm that the deflection is small enough.

7. Grinding valve spindle

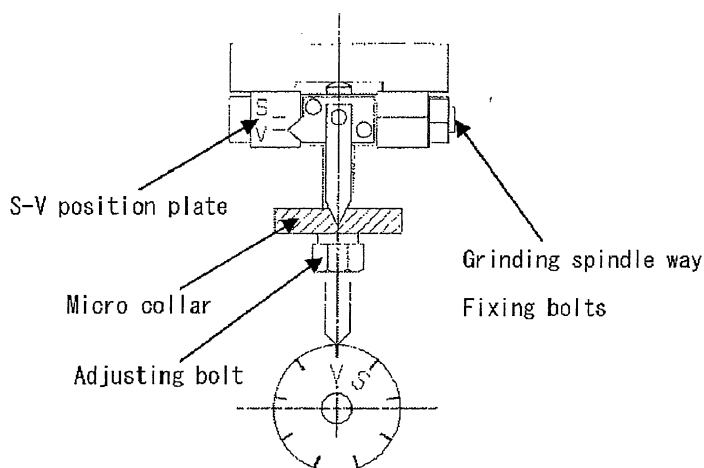


Fig.12

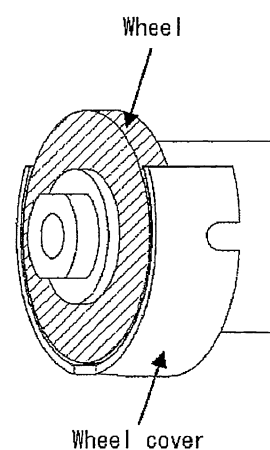


Fig.13

- Slightly loosen the nut of the wheel spindle way(33) clamping bolt(34).
- Rotate the micro collar of adjusting bolt for fine angle from the valve seat position to the right direction to corresponded with V on the micro collar.
While the mark of 30.5° on the S-V position plate(76) is in agreement with the pointer A(77). (As shown in Fig. 12)
- Tighten the nut of the wheel spindle way fixing bolt.
- Attach the opening of the wheel cover upward. (As shown in Fig.13)
- Switch on the wheel spindle starting.
- Switch on the work spindle starting.
- Down the vertical slide, so that the wheel is below the extended line of the work spindle seat surface.
- The wheel is made to be advanced, and it has the wheel under the seat.
- Feed the vertical slide until the wheel comes in contact with its seat surface slightly.
Then feed the wheel slide at specified speed onto the surface at the full length to make sure that the wheel has an even contact with the seat surface.
Check for the angle again when there is any between the wheel surface and the seat surface, or the contact pressure is relatively high.
When the angle seat is correct, adjust the vertical slide to grind the higher position compared with the others.
- Feed the wheel slide forward by the depth of cut to less than 0.01 mm (2 graduation) stroke to perform a rough grinding by repeating it several times or approx. Several times in accordance with the state of the seat surface.

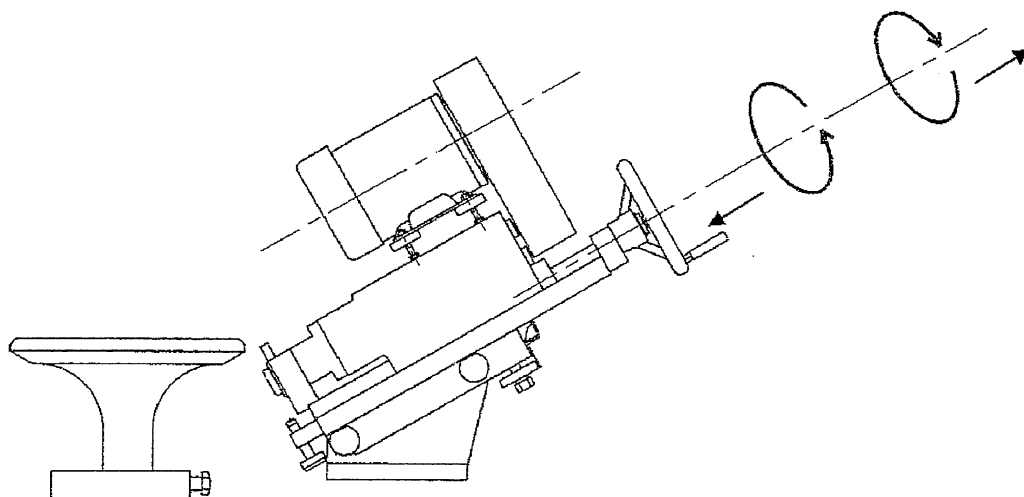


Fig.14

- The feed speed of the wheel slide for the rough grinding is approx. 1/3 revolution with the wheel feed handle (0.67 mm/rev) as per the revolution of work spindle.
- It is confirmed that a rough grinding was done to all aspects of the seat.
- Feed the wheel slide forward by the depth of cut to 0.005 mm (1 graduation) stroke to perform a finish grinding by repeating it several times or approx. Several times in accordance with the state of the seat surface.
- The feed speed of the wheel slide for the finish grinding is approx. 1/6 revolution with the wheel feed handle (0.33 mm/rev) as per the revolution of work spindle.

8. Grinding valve seat

- Re-mount the wheel covers turned downward.
- Slightly loosen the nut of the wheel spindle way(33) clamping bolt(34). (Only one part on the upper side.)

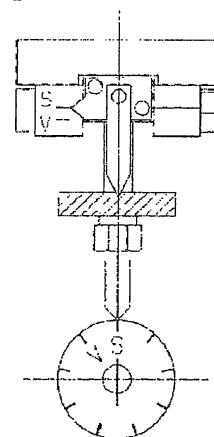


Fig.15

- Once lower the S-V position plate(76) of angle adjusting bolt and fit it to correspond with the S of the micro collar in the direction of pushing up. (While the mark on the S-V position plate(76) is to correspond with the pointer A(77))
- Grinding in the same way as with the valve spindle.

9. General remarks for grinding operation

- Max cutting feed capacity is 0.01 mm. (An ordinary grinding wheel)
Grinding with an excessive cutting feed may cause the following trouble, therefore an effective grinding operation can not be secured.
 - 1) The wheel surface is loading and the grinding operation can not be properly carried out.
 - 2) The increase in the diameter of the wheel with the increase in the temperature of the wheel results in the increase in cutting feed, and such vicious circle finally causes the crack on the wheel.
 - 3) Cracks on the circumference of the wheel.
- The feed speed for rough grinding should be at approx. 1/3 revolution with the wheel feed handle (Feed screw pitch is 2 mm, so the feed is 0.67 mm for one revolution of a work) for one revolution of a work.
The feed operation should be carried out sequentially.
- Cutting feed for finish grinding is at 0.005 mm. (1 graduation)
- The feed for the finish grinding is at approx. 1/6 revolution of a work.
- Stop the grinding operation at once when the wheel surface is loading (Metallic noises occur in the grinding noises) . Then take the wheel off from the grinding surface by the use of the vertical handle, and carry out dressing truing with a diamond dresser. (As shown in III-1 for procedures)。
- Check the wheel, when the amount of cutting feed or the wheel surface is loading by the temperature of the wheel surface increases drastically. (not less than room temperature +20°C)
- Set to appropriate values of the amount and rate for cutting feed again when the wheel is loading only by two or three times operation. (As shown in item 1, 2 for the appropriate values)
- Set this adjustment from the beginning after there is a period of idle time (for 10 minutes at room temperature not less than 25°C for 5 minutes at temperature less than of 20°C) since the diameter of the wheel decreases.

III. Dressing and truing for the grinding wheel

1. Dressing

This operation is carried out when the surface of the wheel is loading.

2. Truing

This operation is carried out when the surface of the grinding wheel is deformed by abrasion.

“Dressing” and “Truing” jobs can be performed simultaneously with a diamond tool.

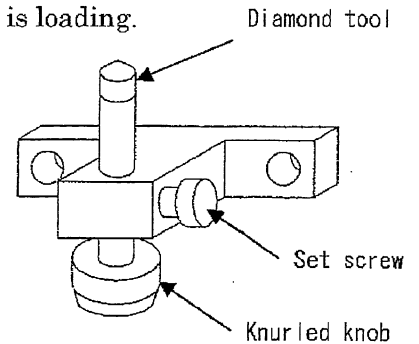


Fig.16

- Truing operation should be carried out when the grinding wheel is replaced or retightened.
- Move forward the wheel slide to bring the wheel to beside the diamond tool.
- Adjust the knurled knob so that the diamond tool tip cuts the surface of the wheel about 0.01 ~ 0.03 mm.
- In state that the wheel turning stops, rotate the wheel for truing operation, by which a cutting depth of approx. 0.01 mm is obtained.
- Tighten the set screw to fix the diamond tool, move forward and reverse wheel slide for truing operation.
- The diamond tool is threaded in M12 and pitched in 1.75, i.e., one revolution makes a cutting depth of 1.75 mm. Generally the preferable cutting feed is approx. 0.05 ~ 0.09 mm evolution.
- When the wheel is replaced with a new one, first try to rotate it for about three minutes, and retightened for about two minutes to check to see if it is free from crack or any other defects, and then start dressing. Read the items described in I — 3 carefully.
- The nuts of the wheel set bolt is left-hand thread.
- Feed rate for tooling and dressing can be feed at approx. 10 ~ 15 seconds per stroke. When the speed is too slow, the surface of wheel is easily flattened.

IV. Various adjustment and maintenance

1. Adjusting belts

- When the V-belt is found to slip, restoring them.
- Loosen four nuts.
- Since the mounts are threaded, adjust four "I" dimensions according to the belt length.
- Tighten four nuts.

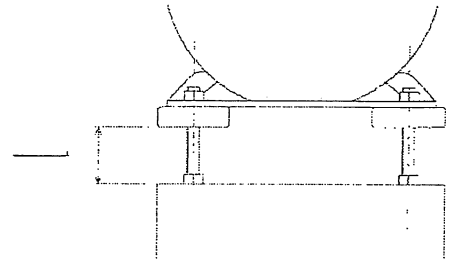


Fig.17

2. Vibration isolating mounts

In order to prevent and absorb the vibration of the grinding machine, vibration isolating mounts is supplied as an accessory.

When operating the grinding machine, loosen the fixing nut ④ so that the weight of the grinding machine is changed on the rubber.

In case of removal or non-operation for long time of the grinding machine.

Tighten the bolt and nut so that the weight is not applied to the rubber.

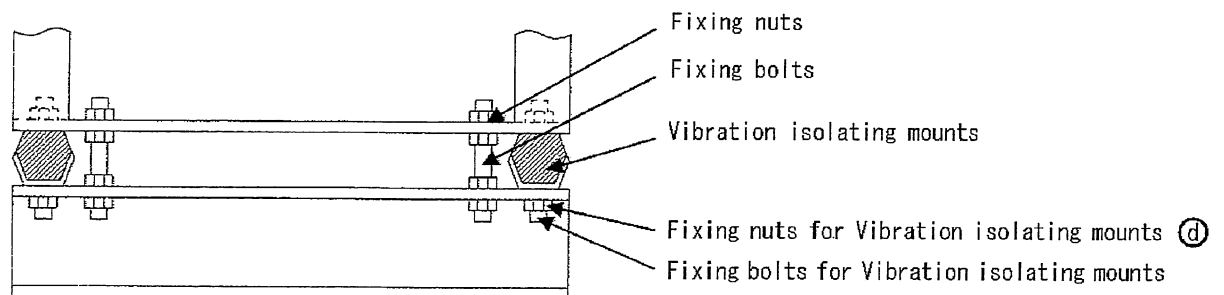


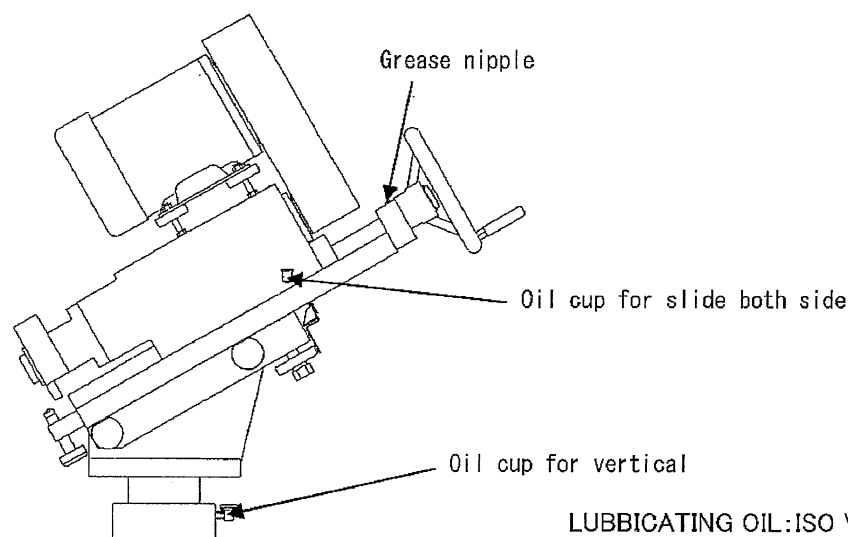
Fig.18

3. Maintenance and inspection

The grinding machine will operate semi-permanently expect replacement of the wheel and belts, and in order to operate a machine in good condition, however, special attention should be paid to the following.

- Make sure that the wheel spindle rotates clockwise when view from the wheel side.
- Special care should be taken for rust proofing.

- Supply a lubrication oil into 2 oil cups provided at the both side of the wheel spindle slide portion, one oil cup at the vertical slide, and grease nipple on the feed screw bracket before a grinding operation starts. (As shown in Fig.19)
- Tapered roller bearings 4th-grade are used for the wheel spindle.
When the necessity of disassembly arises, return the machine to our factory.
- Adjust the jib with the adjust bolts provided at the slide, when the wheel spindle slide is excessively light or heavy.
- Clean the wheel spindle slide way carefully after used.
- It is highly recommended to carry out periodical maintenance services including the check and adjustment for the grinding wheel spindle angle at the first 5 year and then every 3 year, made by us for pay, such that the machine can be used comfortably and safety.
- Advice us the type and manufacture number of the model marked on the plate, and the serial number and name of each part listed on the part table at the end of this manual when you place your order of parts on us for replacement.
It should be noted that it will be unwarrantable if any parts other than the maker specified part are used.



LUBRICATING OIL: ISO VG 68

Interval : It is Before a Work Start

Fig.19

PARTS LIST

No.	NAME	材質・型番	No.	NAME	材質・型番
1	Work spindle housing	FC200	37	Motor adjust nuts	SS400
2	Work spindle	SS400	38	Stud bolt	SS400
3	Valve seat mounting	FC200	39	Hexagon socket head bolt	SCM
4	Valve spindle mounting	FC200	40	Key	S45C
5	Valve spindle & seat set bolts	SS400	41	Motor pulley	S45C
6	Valve seat clamping piece	SPC	42	belt	—
7	Centering bush	FC200	43	Pulley cover	SPC
8	Rocking bolt	PBB	44	Slide feed screw	S45C
9	Bearing	—	45	Feed screw nut	S45C
10	Bearing nut	—	46	Feed screw bracket	FC200
11	Washer	—	47	Thrust bearing	—
12	Work pulley	FC200	48	Key	S45C
13	Key	S45C	49	Washer	—
14	Geared motor pulley	FC200	50	Handle clamping nut	—
15	Geared motor	—	51	Wheel handle	—
16	Geared motor mount	SS400	52	GRINDING WHEEL housing	FC200
17	Geared motor stud	SS400	53	Wheel cover adapter	FC200
18	Geared motor pulley cover	SPC	54	Wheel cover	SPC
19	Slide pipe housing	FC200	55	Wheel (GRINDING WHEEL)	—
20	Slide pipe	SS400	56	Spindle	S45C
21	Differential screw	SPCC	57	Wheel clamping nut	S45C
22	Nuts for vertical	SS400	58	Wheel washer	S45C
23	Slide key	S45C	59	Tapered roller bearing	—
24	Clamping lever	—	60	Bearing puller	SS400
25	Handle and cut scale	DURACON	61	Inside of front seal ring	SS400
26	Cut scale knob	SPCC	62	Outside of front seal ring	SS400
27	Reference plate	SPC	63	Rear seal ring	SS400
28	Preserve plate	SS400	64	Outer wheel cover	SS400
29	Diamond tool	—	65	Spindle pulley	S45C
30	Diamond tool holder	SS400	66	Key	S45C
31	Diamond tool knob	SS400	67	Handle clamping nut	—
32	Hexagon socket head bolt	SCM	68	Washer	—
33	GRINDING WHEEL spindle way	FC200	69	Handle clamping nut	—
34	Clamping bolt	SS400	70	Washer	—
35	Slide shroud	FC200	71	Micro collar	DURACON
36	Motor	—	72	Angle adjusting bolt	S45C

No.	NAME	材質・型番	No.	NAME	材質・型番
73	Jib adjusting bolt	SS400	82	Leg	SS400
74	Fixing nut	S20C	83	Fixing bolt	SS400
75	Jib	FC200	84	Control box	—
76	S-V position plate	ALP			
77	Pointer	ALP			
78	Pointer	SPC			
79	belt	—			
80	Base	SS400			
81	Vibration isolating mounts	RUBBER			

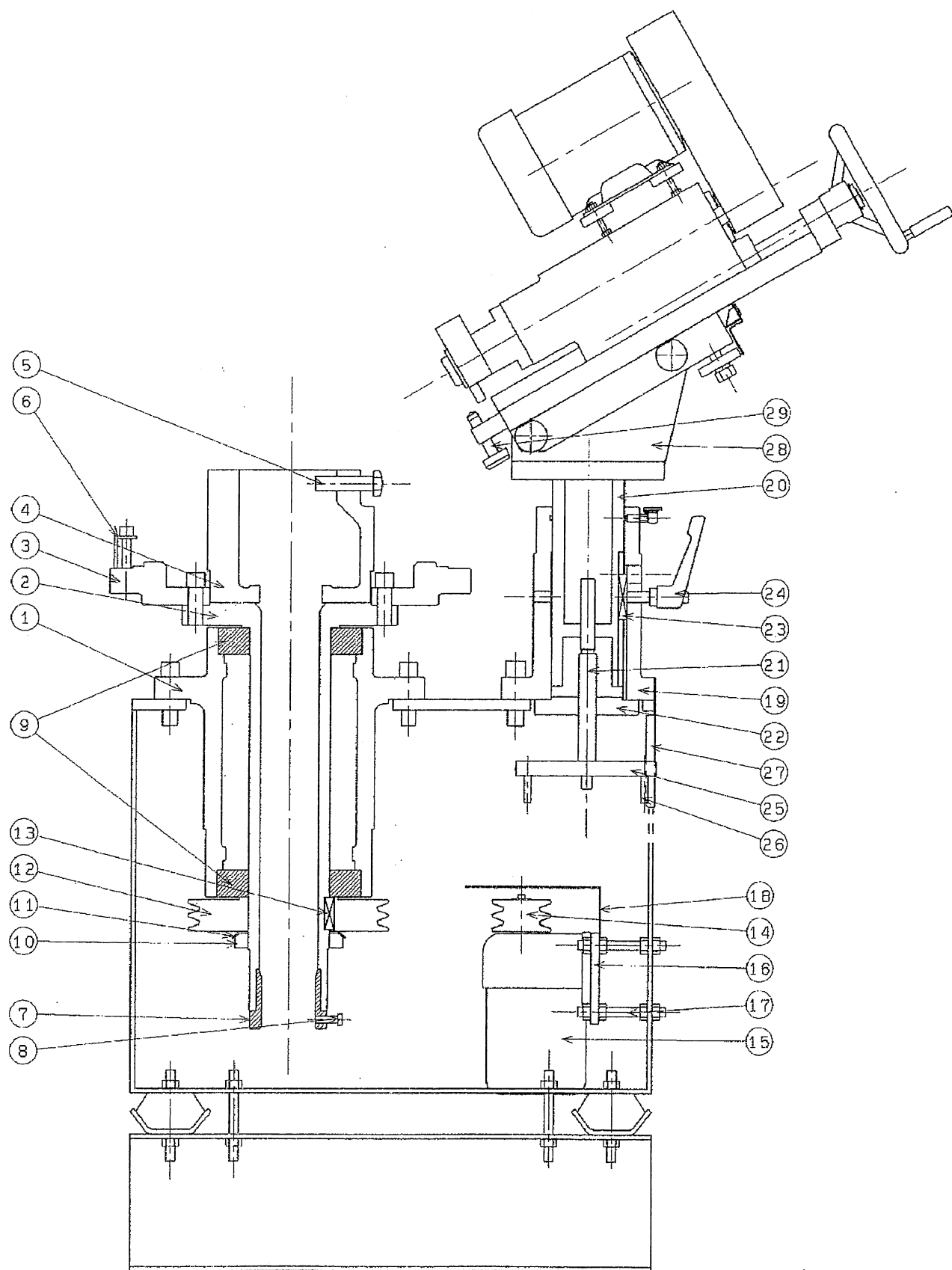


Fig.20

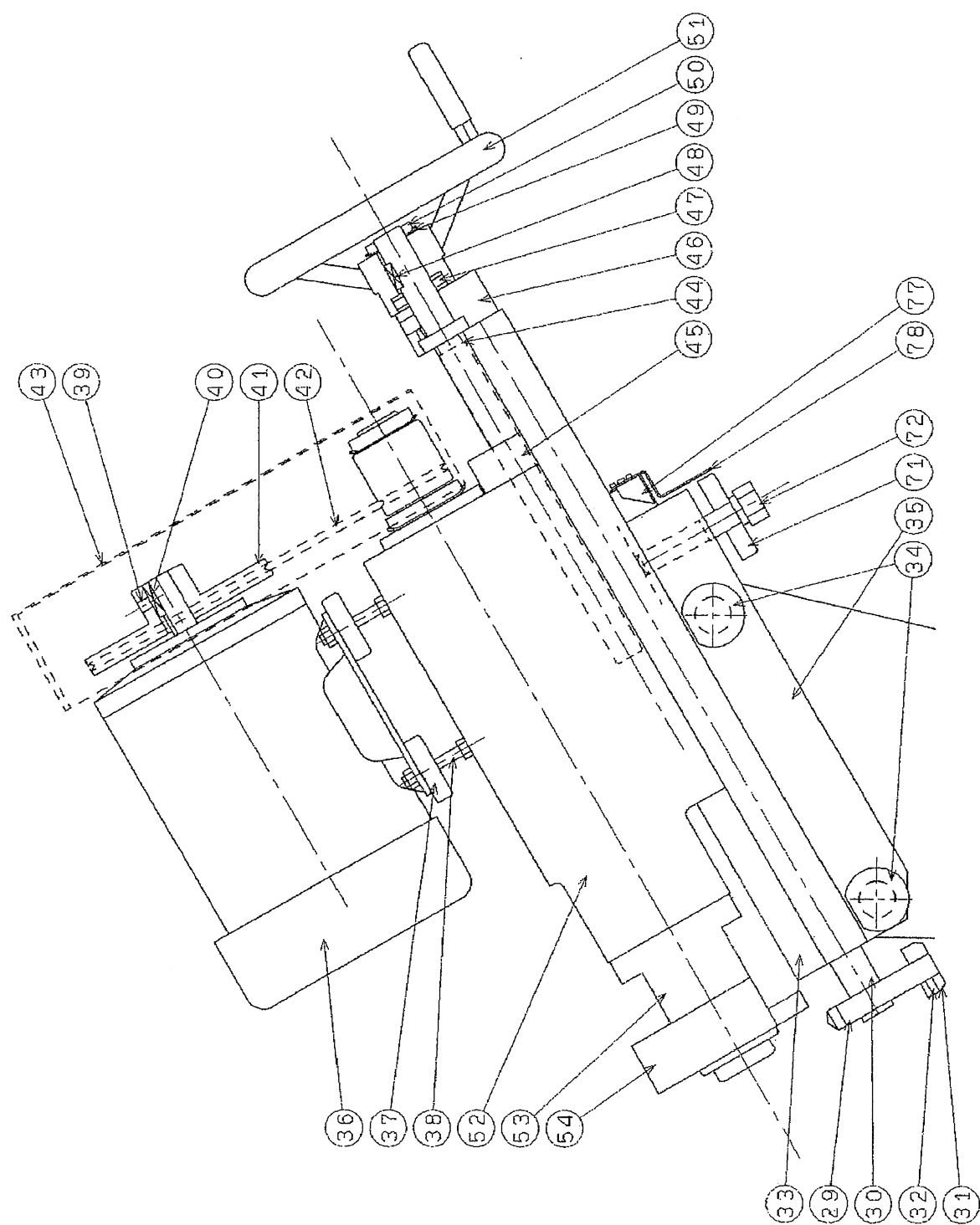


Fig.21

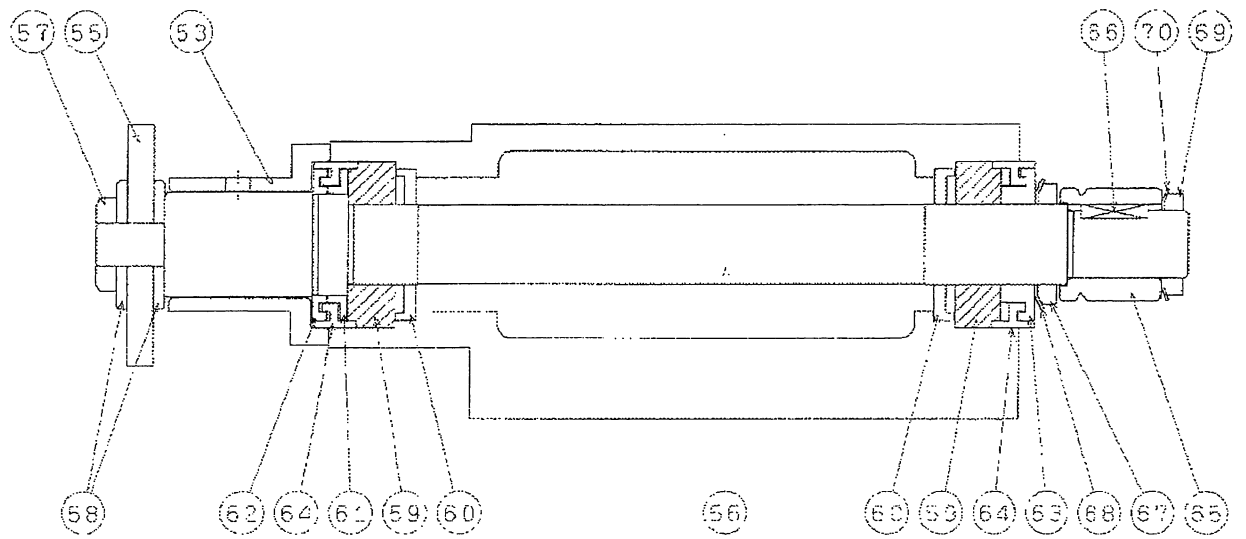


Fig.22

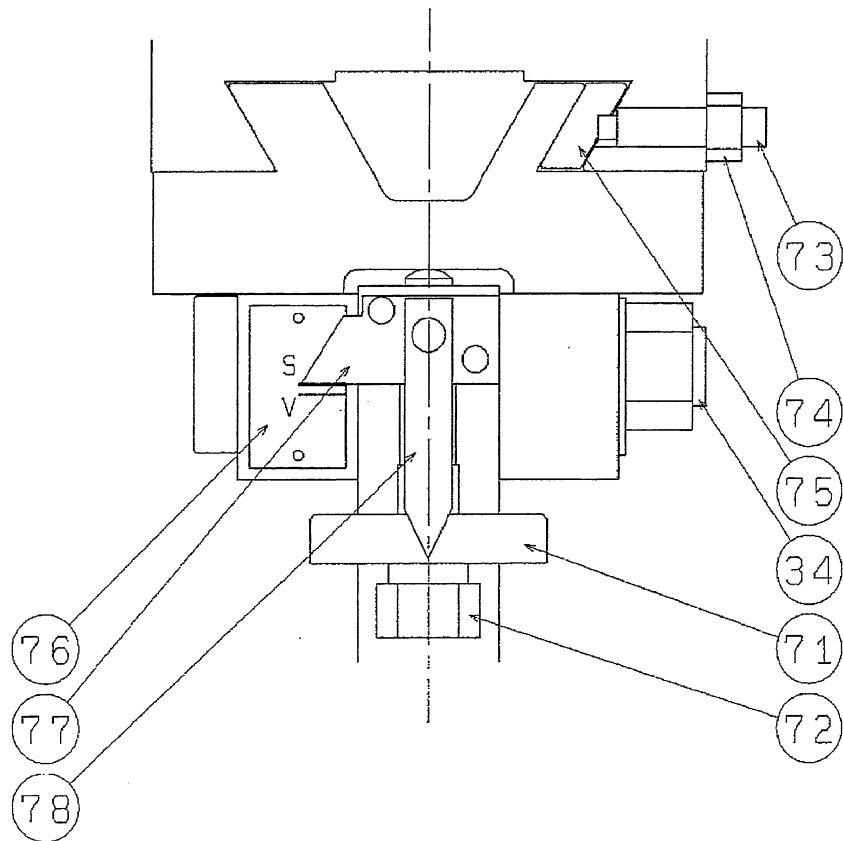


Fig.23

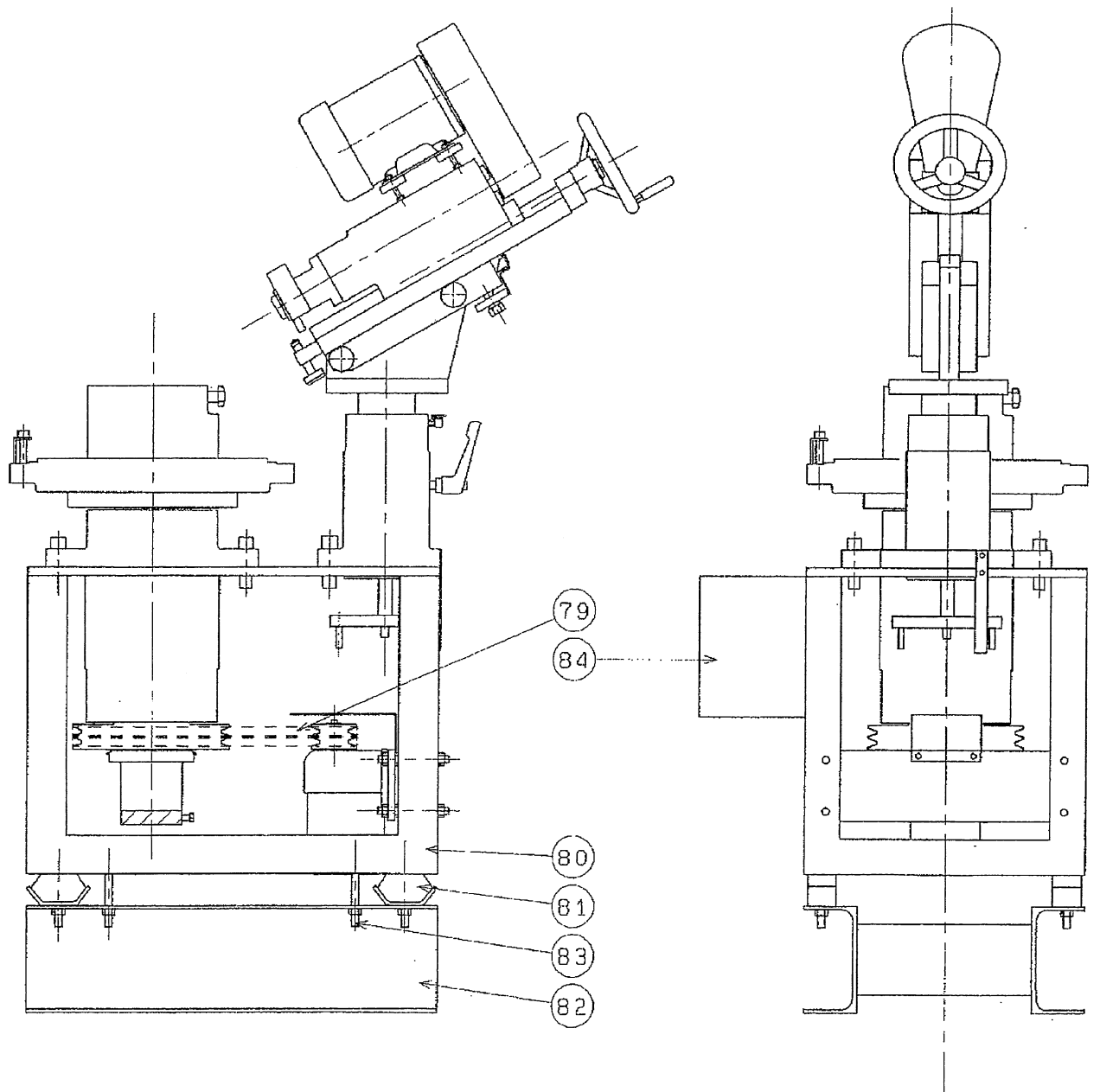


Fig.24



山科精器株式会社

油機事業部 URL:<http://www.yasec.co.jp>

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Osaka Business Office

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Higashiyodogawa-ku, Osaka 533-0031, Japan
Tel: +81-6-6325-1201 Fax: +81-6-6325-1207

Tokyo Business Office

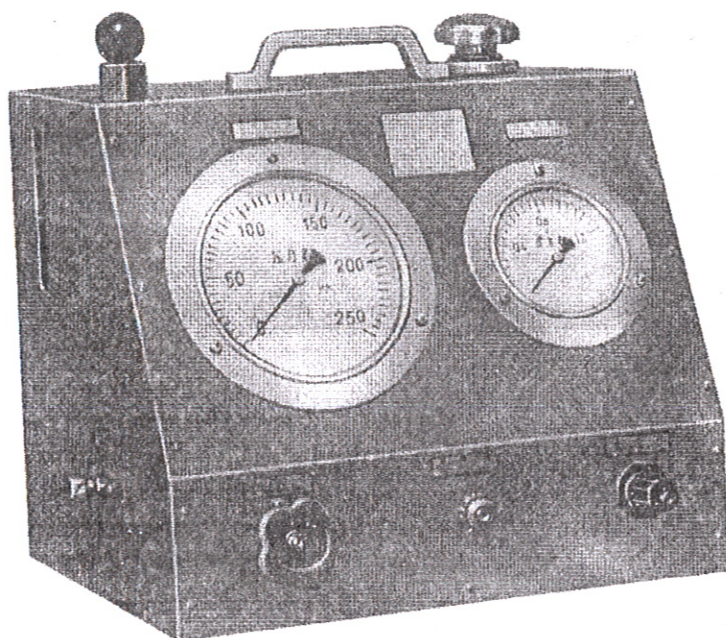
Address: 18-2, Suda-cho Park build, Kandasuda-cho 1-chome,
Chiyoda-ku, Tokyo 101-0041, Japan



- ご注意**
- ・正しく安全にお使いいただくために、ご使用前に必ず注意事項をよくお読み下さい。
 - ・改良のために予告なしに内容を変更する場合がありますので、あらかじめご了承ください。
- CAUTION**
- ・Please read instructions before use carefully by all means to have you use it safely definitely.
 - ・Specifications are subject to change without notice for improvement. Approve it beforehand.

HPU-225 型风动液压泵

使用说明书



High Pressure Pump

HPU - 225 INSTRUCTION BOOK

常州市陆氏船舶机械有限公司

常州市西林乡张家工业园区 电话:0519-3888619 传真:0519-3888352 邮编:213024

制造商: 常州市船舶机械厂

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TEL: (0519) 3888619、3888617

FAX: (0519) 3888352

P. C: 213024

Maker: CHANGZHOU SHHIP PING

MEXHANICAL FACTORY

Add: 6 GONGYEYUAN ZHANGJIA

XILINXIANG CHANGZHOU

JIANGSU

WEIGHT	:28KILOS EMPTY
DIMENSIONS	:430 × 370 × 415
OUTPUT PRESSURE	:MAX.225MPa 9.0 BAR AIR INPUT
OUTPUT PRESSURE	:MAX.180MPa 7.0 BAR AIR INPUT
PUMPING SPEED	:APPROX.450CYCLES/MIN.AT8.0 BAR AIR INPUT
TANK CAPACITY	:APPROX4.5LITRES
AIR CONSUMPTION	:1.05 LITRES/MIN.AT8.0 BAR AIR INPUT
MAX.FLOWAT NO PRESSURE	:APPROX.0.35LITRES/MIN AT8.0 BAR AIR INPUT
DISPLACEMENT PER CYCLE	:0.8CM ³ 0.049CU.IN.

重量	:28Kg
尺寸	:430 × 370 × 415 毫米
输出油压	:最大 225MPa(输入空气压力 0.9MPa)
输出油压	:最大 180MPa(输入空气压力 0.7MPa)
泵工作速度	:约 450 次循环 / 每分钟, 输入压力 0.8MPa
油箱容量	:约 4.5
空气消耗量	:1.05 升 / 每分钟, 输入压力 0.8MPa
最大流量在没有压力	:约 0.35 升 / 每分钟, 输入压力 0.8MPa
每次循环排出量	:0.8 毫升 -0.049 立方英寸

PRELIMINARY

Operating instruction

for

Pump unit Type HPU

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

The various control instruments and manoeuvring handles are fitted with a number. These numbers are mentioned in this instruction and 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 in the right side of the top panel.

OLL : Any good hydraulic oil may be used.

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

b) The handle of the regulator valve 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 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:

Compressed air is led through a flexible hose and is connected to the stud marked "air inlet" on the right side of the cabinet ,This stud has an 1/2" B.S. P.female thread. The hydraulic system is connected to the stud marked "high pressure outlet" found on the left side of the cabinet.This stud has a 1/4" B. S.P.female thread.The pump is now ready for use.

The pump may also be operated by hand if compressed air is not available. A handle is placed in a retainer on the top panel,It may easily be fitted to the pump through the slot in the left side plate by pressing it into the bushing found inside the slot.

START OF PUMP:

a)Stop valve is turned slowly anti-clockwise.where by compressed air enters into the pump unit,which commences to work .The stop valve is also acting as a regular valve for the pumping speed.

b)The regulator valve.which is used for adjusting the pressure is now turned clockwise and the hydraulic pressure may now be read on the manometer for pressure control.This manometer shows the hydraulic high pressure in Mpa.

c)The oil return valve 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 high pressure reached can be read at the manometer for working pressure found on the left side of the instrument panel. The pump stops automatically,

when the required high pressure has been established and holds it infinitely. The pump starts automatically again if a pressure drop occurs in the hydraulic system..

d) High pressure may be relieved from the system by opening the oil return valve it to be turned anti-clockwise. The excessive oil in the secondary high pressure system will thereby return to the oil tank in the pump unit.

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

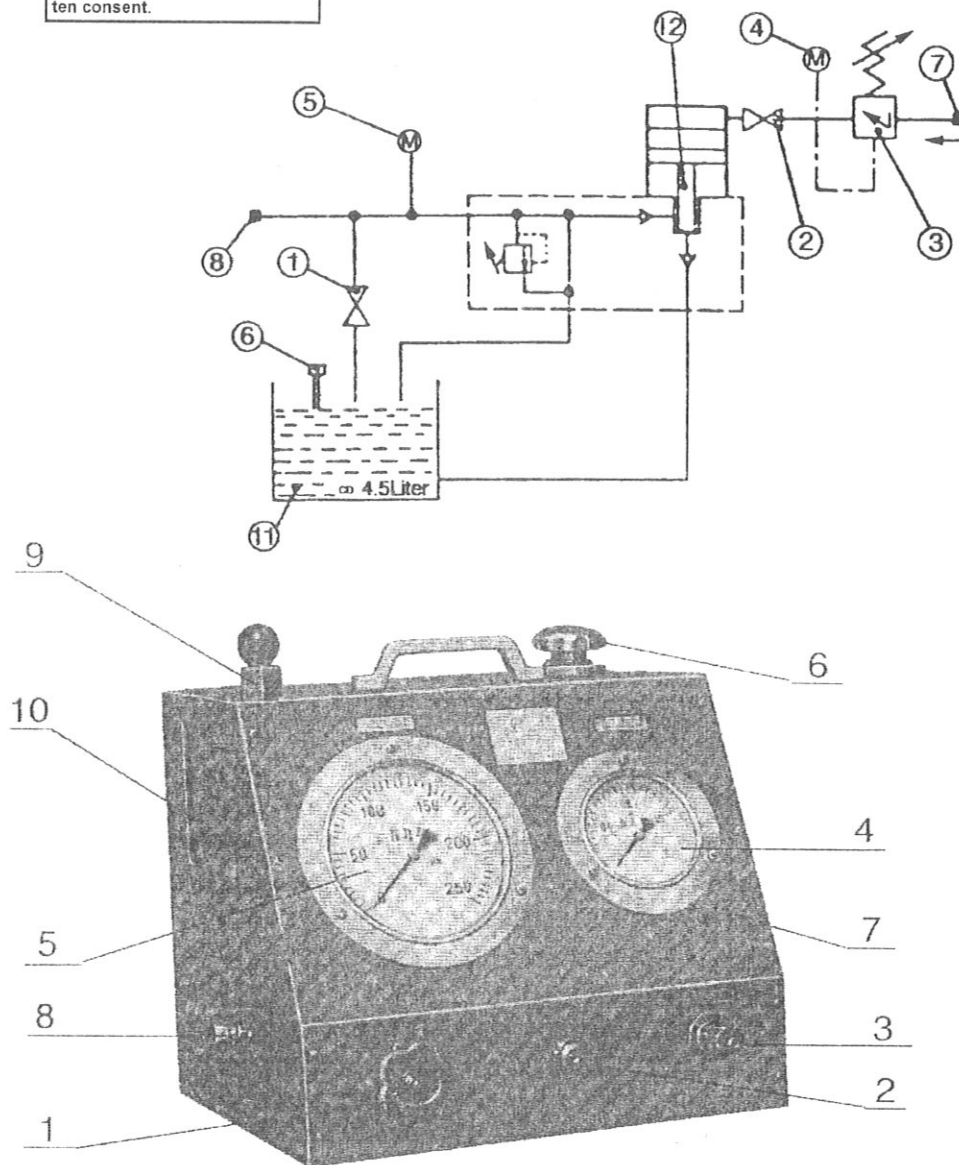
CLEANING OF FILTER:

The filter in the filler cap is removed and cleaned when by refilling the oil starts running through slowly.

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. In order to facilitate the ordering of spares, there are listed.

This drawing is the property of
IBOBEL PEDERSEL and is not
allowed to be used or disclosed
to a third party without our writ-
ten consent.



- 1、回油阀
- 2、调节阀
- 3、调压阀
- 4、空气压力表
- 5、工作压力表
- 6、滤清器

- 7、空气进口座
- 8、高压出油口
- 9、手柄
- 10、手动液压泵
- 11、油箱
- 12、工作泵

- Pos 1 OIL RETURN VALVE
- 2 STOP VALVE (CYCLING VALVE)
- 3 PRESSURE CONTROL VALVE
- 4 MANOMETER FOR PRESSURE CONTROL
- 5 MANOMETER FOR WORKING PRESSURE
- 6 FILLER CAP

- Pos 7 STUD MARKED "AIR INLET"
- 8 STUD MARKED "HIGH PRESSURE OUTLET"
- 9 LEVER FOR HAND PUMPING
- 10 SLOT WITH BUSHING FOR LEVER
- 11 OIL TANK
- 12 PUMP A2 250

HPU-225 型风动液压泵

操 作 说 明 书

在使用本风动液压泵之前,操作人员必须仔细阅读本说明书,并按顺序细心操作以免损坏压力表。

A、在连接液压泵之前:

- a) 按逆时针方向旋开加油滤清器盖,给油箱加油,(可采用任何一种好的液压油)加至油箱 90%。并将盖按顺时针方向旋紧。
- b) 逆时针方向打开回油阀。
- c) 逆时针旋转调压阀手柄 4 至 5 圈,可避免起动压力太高。
- d) 顺时针旋转调节阀并使其闭合,这样可保证刚接上压缩空气时液压泵不工作。

B、连接液压泵:

压缩空气由挠性管输送并接到泵壳右部标有“空气进口”的 G1/2”接头上(标准锥管内螺纹接头)。液压系统接到泵壳左部标有“压力油出口” G1/4”接头上(标准锥管内螺纹接头)。

如果压缩空气出了故障,依靠手动液压泵仍然能够工作,手柄放在顶板上的导槽内。手柄很容易被安装在左侧板槽内的套筒中。

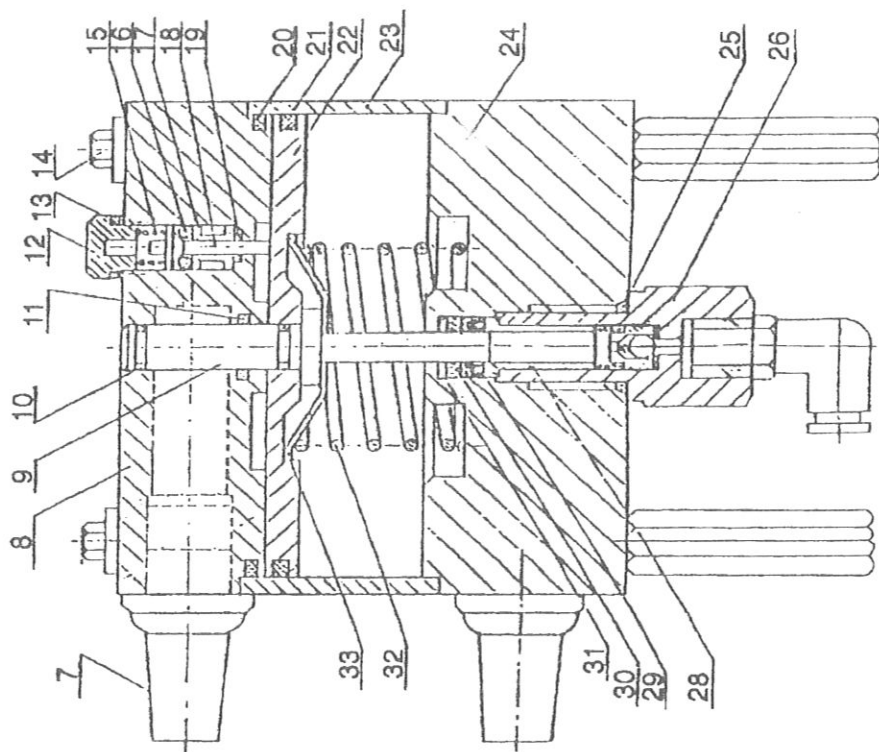
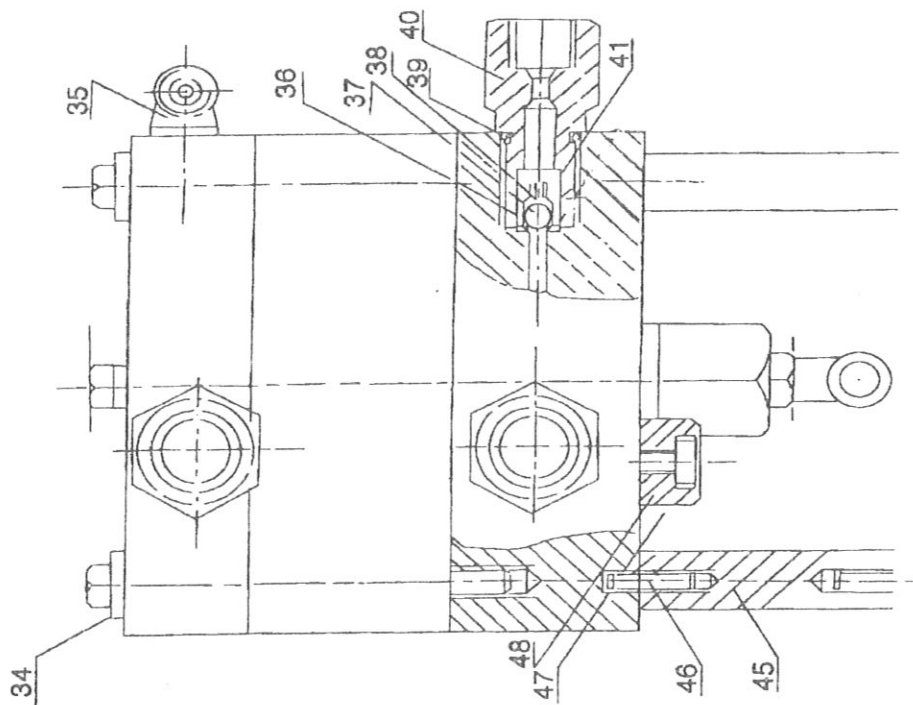
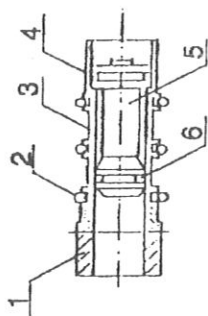
C、起动液压泵：

- a) 顺时针旋转调压阀，这时压缩空气的压力可以在空气压力表上读出，这个压力表的单位是 Mpa.
- b) 缓慢地逆时针旋转调节阀，当压缩空气进入液压泵随即开始工作，压力油通过回油阀回油箱。调节阀也可以作为液压泵工作速度的调节阀。
- c) 顺时针关闭回油阀，这时高压油通过压力油出口进入液压系统，油压可以从面板左部的工作压力表中读出。当达到所需的压力时，液压泵就会自动停止工作并保持油压。如果油压系统产生压力降，液压泵就会自动工作。如果工作压力表上的读数与用户实际所需的工作压力有误差时，此时可调节调压阀手柄利用调节空气压力达到所需的工作压力。

D、使用结束，按逆时针缓慢旋转回油阀手柄，系统中的高压油被放回到油箱中去，同时按顺时针旋转调节阀使液压泵停止工作。当调节阀关闭后压缩空气管就可以拆除，液压泵即可移作它用。

E、清洗油滤器：当再次加油开始起动并缓慢运转时，可以取下滤帽内的滤网并清洗。

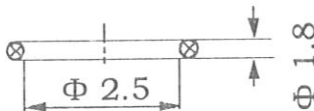
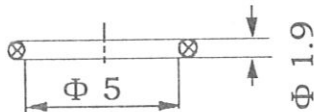
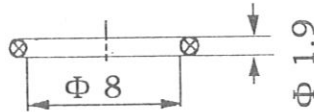
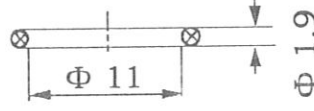
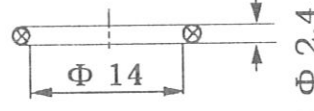
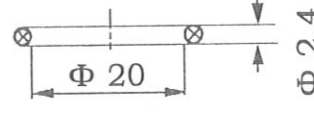
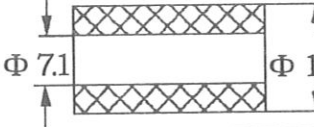
F、备件：即使液压泵是最坚固的并且是最可靠的设备，在使用一段时间后，也需要更换一些易损件，例如 O 形密封圈，V 形密封圈和专门用于压力转换的弹簧，为了便于订购，我们列有清单。



订货号 Order No	名 称 Descrtiption		图 号 Specifcation	数 盘 Quant
1	Spacer	垫 圈	HPU225-1-1	1
2	O-ring	O 形圈	d14 × 2.4	3
3	Sleeve	套 阀	HPU225-1-2	1
4	O- ring	O 形圈	d11 × 1.9	1
5	Spool	滑 阀	HPU225-1-3	1
6	O-ring	O 形圈	d8 × 1.9	1
7	Silencer	消音器	BSL-0.4G1/2"	2
8	Top cap	顶 盖	HPU 225-1-4	1
9	plunger	柱塞杆	HPU 225-1-5	1
10	O-ring	O 形圈	d8 × 1.9	3
11	O-ring	O 形圈	d11 × 1.9	1
12	Plug	螺 塞	HPU 225-1-6	1
13	O-ring	O 形圈	d8 × 1.9	1
14	Bolt	螺 栓	GB5782-86	4
15	Spring	弹 簧	Φ 7.1 × Φ 0.75 × 14	1
16	O-ring	O 形圈	d5 × 1.9	1
17	Tube	管	HPU 225-1-8	1
18	Pilot valve	导 阀	HPU 225-1-9	1
19	O-ring	O 形圈	d2.5 × 1.8	1
20	O-ring	O 形圈	d115 × 1.9	1
21	O-ring	O 形圈	d112 × 4	1
22	Air piston	空气活塞	HPU 225-1-10	1
23	Cylinder tube	气 缸	HPU 225-1-11	1
24	Bpttpm cap	底 盖	HPU 225-1-12	1
25	O-ring	O 形圈	d20 × 2.4	1
26	Fitting oilin	进油口	HPU 225-1-13	1
27	Fitting oilin	进油接头	JPL 0803-G3/8"	1
28	Spacer	定位架	HPU 225-1-14	1
29	Seal	V密封垫	Φ 17 × Φ 7.1 × 8	1
30	Back-upring	支持环	HPU 225-1-16	1
31	Support ring	支承环	HPU 225-1-17	1
32	Spring	弹 簧	Φ 56 × Φ 3.8 × 98	1
33	Spring support	弹簧支承	HPU 225-19	1
34	Washer	垫 圈	GB96-85	4
35	Studsair in	进空气接头	PL 0802-G 1/4"	1
36	Cage	罩	HPU 225-1-20	2
37	Ball	球	Φ 6.5	2
38	Spring	弹 簧	Φ 3.5 × Φ 0.25 × 8	2
39	O-ring	O 形圈	d14 × 2.4	1
40	Fitting oilout	出油口	HPU 225-1-22	1
41	Spring	弹 簧	Φ 9.8 × Φ 1 × 10	2
45	Supporter	支 承	HPU 225-1-25	4
46	Screw	螺 钉	GB 78-85	4
47	Screw	螺 钉	GB 70-80	1
48	Tigntening bush	定位块	HPU 225-1-26	1

高压泵备件清单

Spare parts for high pressure pump
type HPU-225

Item No. 序号	Ord No. 定货号	Name 名称	Drawing 图形	Material 材料	Oty 数量
1	19	O-ring O 形密封圈		NBR	1
2	16	O-ring O 形密封圈		NBR	1
3	10	O-ring O 形密封圈		NBR	3
4	11	O-ring O 形密封圈		NBR	1
5	2	O-ring O 形密封圈		NBR	4
6	25	O-ring O 形密封圈		NBR	1
7	29	V-Sealing V 形密封圈		PU	1

HDP1100-D2

使用说明

FUEL VALVE TEST PUMP UNIT

INSTRUCTIONS FOR USE



常州市陆氏船舶机械有限公司
CHANGZHOU LU SHI MARINE MECHANICAL CO.,LTD

Description and operating instruction for test pump unit for marine diesel engine fuel valve

Operation instructions

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

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 drawing showing the complete pump unit furthermore these numbers are found on the control panel of the pump unit .

Please read this instruction of use carefully before using the pump unit and follow the instructions given very carefully . read also the section "Overhaul of Fuel Valves" in the instruction manual.

Main technical data

1. Output pressure: Max.80Mpa at 0.7Mpa air input.
2. Air consumption:12 Litres / cycle at 0.7Mpa and no output pressure.
3. Max. flow at no pressure: 40 ML / cycle at an air input of 0.4Mpa.
4. pumping speed: 20 cycle / min at 0.4Mpa up air input , and no output pressure.
5. Tank capacity: 8 Litres
6. Dimensions: 750×480×1250mm
7. Weight: 90 kgs empty.

Control panel description

1. FULL STROKE PUSH BUTTON.
2. Pressure relief valve
3. Pressure control valve
4. Filter
5. Switch (OPENING PRESSURE / VENTING PRESSURE / RESET)
6. Manometer for primary air pressure
7. Digital instrument: WORKING PRESSURE
8. Digital instrument: VENTING+OPENING PRESSURE
9. H.P outlet
10. Air inlet with snap coupling
11. Oil inlet
12. Pump

Pre-testing preparations

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 safe test 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 : 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 WORKING PRESSURE (8) is $\approx$ 150 bar
- ※Turn pressure control valve (3) quickly counter-clockwise to switch off air supply
- ※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) . the pump stops automatically
- ※Open pressure relief valve (2) – turn it counter-clockwise

Test B : 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 $\approx$ 150 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 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

Test C : 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 $\approx$ 150 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 B
- ※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 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 OPENING PRESSURE position
- ※Adjust pressure control valve (3) until WORKING PRESSURE (8) is $\approx$ 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
- ※close pressure control valve (3) – turn it counter-clockwise
- ※open pressure relief valve (2) – turn it counter-clockwise

HDP1100-D2型船用柴油机 喷油器试验装置

一、使用说明：

本产品具有功率大、体积小、结构紧、操作简便等优点，该试验装置主要用于现代大功率船用柴油机测量其喷油器喷雾状况，是大功率柴油机必备的检测工具。

二、主要技术数据：

- 1、输出压力：输入空气压力在0.7Mpa时最大输出压力为80Mpa。
- 2、空气耗量：输入空气压力在0.7Mpa时空气耗量为12L/每循环。
- 3、燃油最大流量：在输出压力下，输入空气压力为0.4Mpa时，40ML/每循环流量。
- 4、泵速：输入空气压力为0.4Mpa时，约20次/min（输出压力为0）。
- 5、油箱容积：8L
- 6、外形尺寸：750×480×1250 长×宽×高 毫米
- 7、重量（净）：90公斤

三、外观图名称：

- 1、全冲程泵油阀
- 2、节流阀
- 3、风压调节阀
- 4、滤油器
- 5、压力传感器
- 6、输入空气压力表
- 7、8、工作压力显示器
- 9、燃油出口接座
- 10、空气快速接头
- 11、加燃油处
- 12、高压油泵

四、使用前的准备：

- 1、通过加燃油处（11）把柴油机清洁燃油加入油箱，在通气前必须按逆时针方向旋转节流阀（2），用来打开、回油、按逆时针方向旋转风压调节阀（3）关闭空气，使用时只能缓慢顺时针旋转打开风压调节阀（3）直到所需的空气压力。
- 2、空气输入用软管引导到箱体右侧“空气进口”座（10），开机前在快速接头进口处，用油壶注入适量14号柴机油，利用风气吹入该机各活动部位。
- 3、将喷油器安装在该装置左边的托架上，把高压挠性管一端接在喷油器上，另一端M10接在“燃油出口接座”（9）上，至此喷油器方可投入试验。

七、试压检查泄漏:

- 1、首先关闭节流阀（2）。用G1/4螺塞堵上燃油出口接座。
- 2、打开风压调节阀（3）、工作压力表（7）指针上升到35-80Mpa以上时，关闭风压调节阀（3）、工作压力表（7、8）指针稳定在5分钟内允许下降1Mpa为正常，如果各管路接头等未发现泄漏现象而工作压力表（7、8）指针不能稳定则须检查节流阀（2），高压油缸两端的输入和输出接头的凡尔线密封性，检查节流阀（2）有无泄漏，在有压力情况下关闭节流阀（2），拆开节流阀联通油箱的回油管，如果油管中有油滴漏，则须研磨节流阀凡尔线。
- 3、检查输入和输出接头，拆开两接头检查凡尔线，研磨或清除杂物卡钢球，检查钢球锈腐损坏更换钢球。

八、润滑说明:

气缸使用前必须在机内空气管路中注入适量14号柴油预先润滑，否则将使气缸工作效率降低。各气阀应该经常润滑，在运动的构件及阀芯上涂上一层薄润滑脂。如果空气驱动的主要零件拆卸后，装配时也应应在气缸的整个内壁和活塞O型圈上涂上一层薄薄的清洁的润滑脂以保护及防锈。

九、备件:

尽管该试验装置具有耐用可靠的特点，某些零部件诸如气缸内的O型圈等容易磨损，这些易损件均需备件予以更换。下面是高压泵的简图。图上标有各型密封件的编号和安装位置。并附备件一览表如下:

五、HDP1100-D2型喷油器试验台的使用

测试A：开启压力试验

将开关 (5) 置于“复位”的位置。关闭节流阀 (2)。开关 (5) 置于“开启压力”的位置。调整节流阀 (3) 直到工作压力 (8) 显示的压力在 100–140bar。~~按下全冲程 (1)~~ 旋转调节阀 (3) 增加压力，达到“开启压力”。开启压力值显示在表 (7) 上，泵自动停止。逆时针旋转调节阀 (3)，逆时针旋转节流阀 (2)。重复实验几次，直到获得 2 个相近的数据 (+/- 10bar)。

测试B：泄漏测试(密封性试验)

将开关 (5) 置于“复位”的位置。关闭节流阀 (2)。开关 (5) 置于“开启压力”的位置。调整调节阀 (3) 直到工作压力 (8) 显示的压力在 100–140bar。~~按下全冲程 (1)~~ 旋转调节阀 (3) 调整压力，直到工作压力 (8) 表上显示的压力低于“测试A”中测得的开启压力10–20bar。逆时针旋转调节阀 (3)。逆时针旋转节流阀 (2)。

测试C：泄去功能

将开关 (5) 置于“复位”的位置。关闭节流阀 (2)。开关 (5) 置于“泄放压力”的位置。调整调节阀 (3) 直到系统自动关闭VPU泵 (约150bar)。表 (8) 上显示的压力将慢慢下降。当内部泄漏滑阀打开，泄去压力显示在“泄去+开启压力表” (7) 上。逆时针旋转调节阀 (3)。逆时针旋转节流阀 (2)。

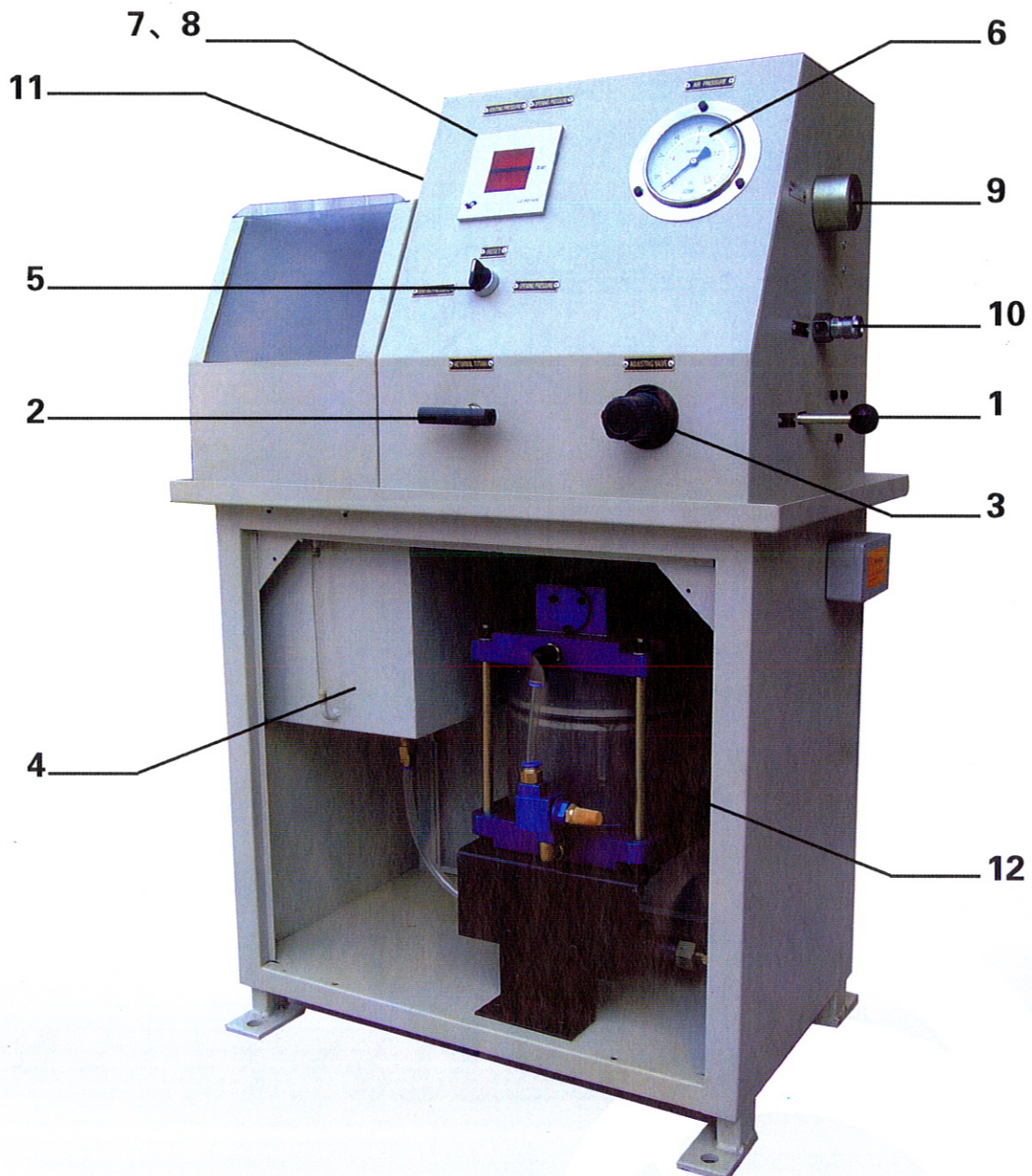
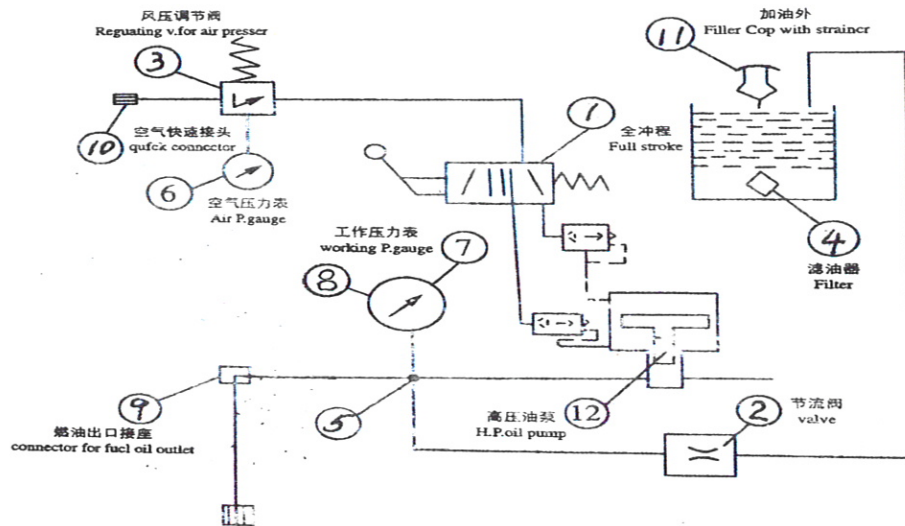
测试D：O型圈密封性试验

将开关 (5) 置于“复位”的位置。关闭节流阀 (2)。用螺塞闷牢回油孔，开关 (5) 置于“泄放压力”的位置。调整调节阀 (3) 工作压力 (8) 约 100bar。旋转调节阀 (3) 降低压力表 (6) 读数为 0bar。从工作压力表 (8) 读出的压力。显示的压力值应保持几分钟，逆时针旋转节流阀 (2)。

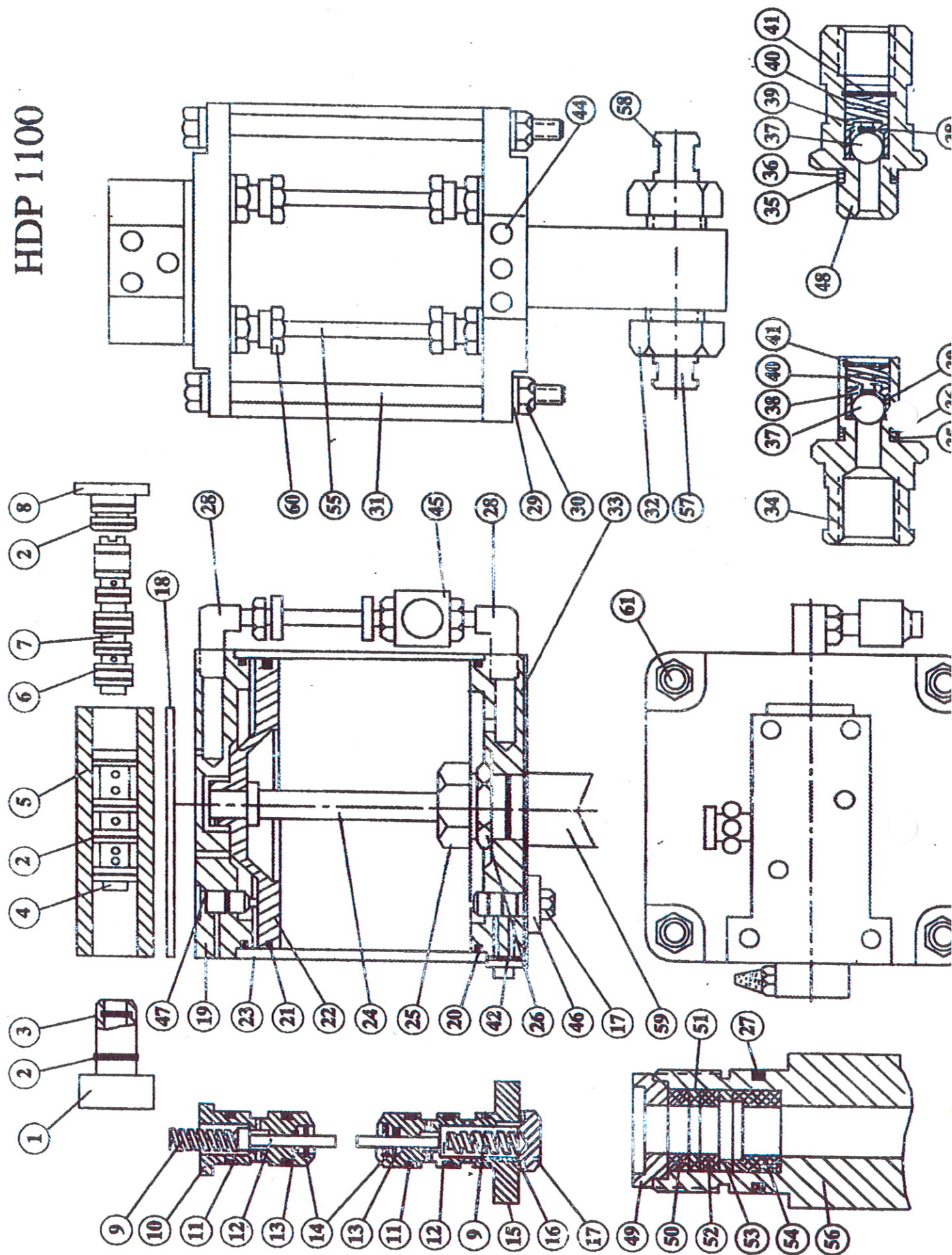
六、维修与保养：

- 1、气源必须有有效的气水分离器。
- 2、柴油必须严格过滤后注入油箱。
- 3、各管路、接头、保持完整整洁，无泄漏。
- 4、油箱内过滤器每月清洗一次。
- 5、油箱内部吸入式过滤器，在吸油量跟不上时，必须及时调节新过滤器。
- 6、气缸内活塞工作时如发现排气中有柴油泄漏现象应调换高压油缸中Y型高压密封圈。
- 7、仪表必须经常检查，保持清晰灵敏，如发现呆滞和损坏，应及时更换检查和修理。
- 8、气压在超过0.15Mpa时仍不运转，必须检验换向阀芯与阀套有配合间隙，标准为+0.01/+0.03，如有损坏及磨损，应及时更换O型密封圈。

Diagram



HDP 1100



订货号		名称	图号	数量
Order No		name	Specification	QTY
1	Plug	气控阀方端盖	HDP-4-1	1
2	O-ring	O型圈	d26.5 × 1.8	7
3	O-ring	O型圈	d15 × 1.8	1
4	Sleeve	衬套	HDP-4-5	1
5	Valveseat	气控阀座	HDP-4-4	1
6	O-ring	O型圈	d18 × 1.8	8
7	Spool	阀芯	HDP-4-6	1
8	Plug	气控阀圆端盖	HDP-4-2	1
9	Spring	弹簧	φ 8.1 × φ 1 × 31	2
10	Valvebody	上限位阀座	HDP-3-4	1
11	O-ring	O型圈	d14 × 1.9	5
12	Valve	上下限位阀	HDP-3-4	各1
13	O-ring	O型圈	d3.4 × 1.9	2
14	Washer	内挡圈	φ 10	2
15	Valvebody	下限位阀座	HDP-3-18	1
16	O-ring	O型圈	d12 × 2	1
17	Plug	螺塞	HDP-3-17	1
18	Seal	密封垫	HDP-4-8	1
19	Topcap	气缸上盖	HDP-3-1	1
20	O-ring	O型圈	d200 × 3.53	2
21	O-ring	O型圈	d190 × 7	1
22	Airpiston	气活塞	HDP-3-6	1
23	Cylindertude	气缸	HDP-3-19	1
24	Piston	活塞	HDP-3-5	1
25	Glandnut	上螺母	HDP-2-9	1
26	Nut	扁螺母	HDP-2-14	1
27	O-ring	O型圈	d37.8 × 3.5	1
28	Fitting	接头	HDP-3-8	2
29	Washer	垫圈	φ 12	12
30	Nut	六角螺母	M12	12

31	Pinbolt	双头螺杆	HDP-3-9	2
32	Glandnut	螺母	HDP-2-3	2
33	Bottoncap	气缸下盖	HDP-3-16	1
34	Fittinginlet	进油接头体	HDP-2-1	1
35	Back-npying	挡圈	HDP-2-2	4
36	O-ring	O型圈	d15 × 2.5	2
37	Ball	钢珠	φ 1/2"	2
38	Scying	弹簧	φ 8 × φ 0.3 × 12	2
39	Retainer	单向阀座	HDP-2-4	2
40	Spring	弹簧	φ 16.9 × φ 1.2 × φ 14.5	2
41	Washer	孔用弹性挡圈	φ 17	2
42	Seal	密封垫	HDP-3-12	1
43	Plug	盖板	HDP-3-11	1
44	Screw	内六角螺钉	M5 × 16	3
45	Silencer	单向消音器	HDP-2-23-0	2
46	Pilotvalveassy	下限阀	HDP-3-18-0	1
47	Pilotvalveassy	上限阀	HDP-3-4-0	1
48	Fittinginiet	出油阀体	HDP-2-17	1
49	Bearing	封圈	HDP-2-8	1
50	Spacer	调整轴套	HDP-2-10	1
51	Back-uoring	垫圈	HDP-2-11	1
52	Scal	V型圈	UN20	1
53	Supportring	支承环	HDP-2-13	1
54	Bearing	下导套	HDP-2-15	1
55	Airtube	空气导管	HDP-3-13	2
56	Cylinderhead	高压油缸体	HDP-2-7	1
57	Jnletvalveassy	进油阀	HDP-2-1-0	1
58	Outletvalveassy	出油阀	HDP-2-17-0	1
59	Pistonvodpackingassy	高压油泵	HDP-2-0	1
60	Fitting	接头	G1/8"	4
61	Pindolt	双头螺杆	0 HDP-3-21	2

Instruction

The instruction (LC-PD1600) that can display OPENING PRESSURE and VENTING PRESSURE accurately with the pressure sensor made by Germany.

Specification

1、Measuring ranges:

OPENING PRESSURE:0-1400bar

VENTING PRESSURE:0-160bar

with the function of maximum value of measurements hold.

2、Accuracy: I (1%H+2个字), II: pressure value of measurement

3、Power Supply:110VAC或220VAC, $\pm 20\%$ 。

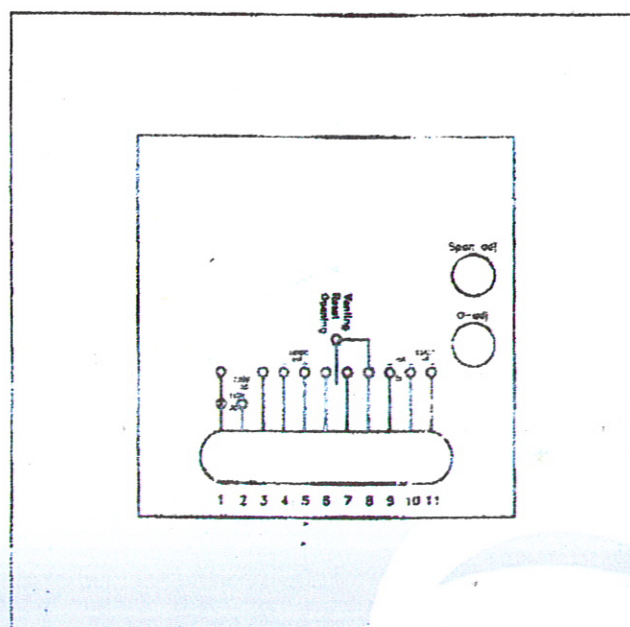
Wiring Diagram:

1	2	3	4	5	6	7	8	9	10	11
N	110 VAC	220 VAC	CND	+24 VDC	OPENING PRESSURE	VENTING PRESSURE	RESET	GND	Sensor(-)	Sensor(+)

N:Zero line.

Warning 1

Please connect accurately according to the wiring diagram



接线面板图

制造商：常州市陆氏船舶机械有限公司

Maker: CHANGZHOU LU SHI MARINE MECHANICAL CO., LTD

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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



安全劝告

Safety recommendations

- 1、 简介 Description
- 2、 技术参数 Techical Data
- 3、 操作指导 Operating instructions
- 4、 保 养 Maintenance
 - 4.1换 油 Replacing the oil
 - 4.2清 洁 Cleanliness
 - 4.3调换零件 Replacement parts

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.

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 17.5cm^3 ），到达压力后流量自动降至每行程 1.25cm^3 。

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(17.5cm^3 per stroke) until switching pressure is reached . from then on the flow is automatically reduced to 1.25cm^3 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.



- 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 use clean ,recommended hydraulic oils.

4.2 cleanliness

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

制造商：常州市陆氏船舶机械有限公司

Maker: CHANGZHOU LU SHI MARINE MECHANICAL CO., LTD

地址：江苏常州市西林乡张家村工业园区6号

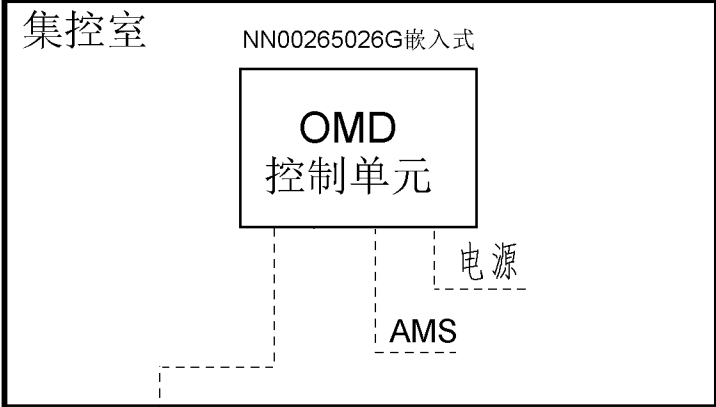
Add: No. 6 GONGYEYUAN ZHANGJIANG XILINXIANG CHANGZHOU JIANGSU

Tel: 0519-3888619

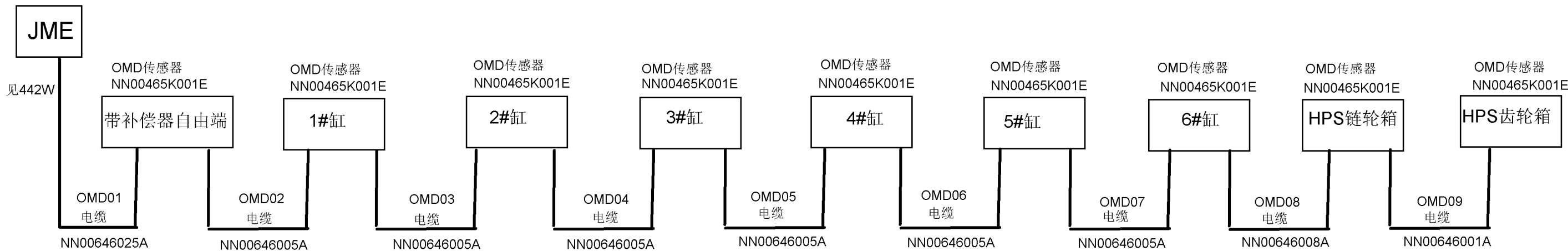
Fax: 0519-3888352

Pc: 213024

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114000 DWT OIL TANKER		台 份 Set No.		29#30#33#		
		工程编号 Engine No.		CE0500A/501A/531A		
		船 厂 Shipyard		China shipping industry Yard		
		船 号 Hull No.		CIS114K-01/02/03/04/05		
		船级社 Classification Society		ABS		
CMD-MAN B&W 6G60ME-C MK9.5 OIL MIST DETECTOR E-10 油雾探测器 (MD-SX, SENSOR TYPE)						
						5
						4
						3
						2
The vendor of OMD is changed to DAIHATSU.						1
修 改 说 明 Corrected Description						
						5
						4
						3
						2
王勇 2016-8-10 魏守刚 2016-8-12 杜清 2016-8-12						1
王勇 2015-11-12 杜清 2015-11-16 焦雷 2015-11-17						0
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 上海中船三井造船柴油机有限公司 CSSC-MES Diesel Co., Ltd.				文件编号 Document No.	D6518229-5.	



油 雾 探 测 器



厂商：DAIHATSU DIESEL MFG.CO.,LTD

型号：MD-SX

组成：控制单元1个：NN00265026G嵌入式
传感器 9个：NN00465K001E插头式
电缆 9根：NN00646001A 1根
NN00646008A 1根
NN00646005A 6根
NN00646025A 1根

其他：见技术协议

Date	Des.	Chk.	APRD.	A.C.	Revision change	CSD No.	Rev.
				-			03
				-			02
				-			01
20160726	侯冻	宁军		-	CE0500A		00
Basic Standards (MBD SB):					similar. Drawing No.:		
EN21F-m Tolerances					EN21C Surf. roughness		
Material / Blank:					Final User Material:	MAKER	Mass (kg): 50.000
Scale:	Size: A3	Product Type: 6G60ME - C9.5			Page No.: 01 (01)	Projection: 	
Info. No.:		Item Name:				Item Id.:	
Final User Info. No.: 539Q		Final User Description: 油雾探测器				Final User Ident. No.: 2H-23785	



**OIL MIST DETECTOR
INSTRUCTION MANUAL
MD-SX
(Sensor type)**

Safety Precautions on Operation of Oil Mist Detector

This Manual describes cautionary items for installation and operation of the oil mist detector for sake of safe use.

Please operate the equipment adequately while following the cautionary items.

The degree of hazard and damage likely to result from wrong use, neglecting the indicated cautions, is explained in this Manual using symbol marks shown below.

The symbol marks mean as follows.



..... **CAUTION** State likely to cause damage of light or middle degree is indicated, unless the state is avoided or prevented.



1. Caution for electric shock

- (1) Voltage is left in the internal terminal block, even if the body POWER turned OFF.

Please switch off the controller every time when sensor is replaced or disconnected from sensor connector, otherwise, it may cause not only the electric shock but the breakdown of the equipments.

- (2) Especially, when 100 V AC is used for signal output contacts, please be careful for electric shock from the terminal block.



2. Caution against current leakage

- (1) To prevent electric leakage, please be sure to ground the equipment.

* The specification may be changed for improvement with no advance notice.

CONTENTS

1. OVERVIEW	1
2. FEATURES	1
3. CONSTITUTION	2
4. OUTLINE	4
5. SPECIFICATIONS	8
5.1 Sensor unit	8
5.2 Controller	9
6. DISPLAY AND FUNCTIONS OF SENSOR UNIT	10
6.1 Description of function	10
6.2 “POWER” LED	10
6.3 “ALARM” LED	10
6.4 “FAILURE” LED	10
7. DISPLAY AND FUNCTIONS OF CONTROLLER	11
7.1 Mist indicator	11
7.2 “RUN” LED	11
7.3 “SYSTEM FAILURE” LED	12
7.4 “PRE ALARM” and “HIGH ALARM” LEDs	12
7.5 [STEP] keys and [ENTER] key	13
7.6 [INITIAL SET] key switch	13
7.7 [TEST] key switch	13
7.8 [MODE] key switch	14
8. INSTALLATION	15
8.1 Sensor unit	15
8.2 Controller	18
9. WIRING	19
9.1 CABLE	20
9.2 Wiring of the sensor	22
• 9.3 Wiring of the controller	23
9.4 Setting of resistance for detecting disconnection	26
9.5 Wiring of the gland type sensors	27
9.6 Cautions in wiring	27
10. INITIAL SETUP	29
10.1 Initial setup of sensor units	29
10.2 Initial setup of controller	30
11. OPERATION	31
11.1 Checks before turning the power on	31
11.2 Steps from the first power ON to practical operation	31
11.3 Full load (mist density level) setting	33
11.4 Initial reset	34
11.5 Alarm operation check	34
12. TEST METHOD AND OPERATION CHECK (FOR IACS M10.13)	36
13. APPROXIMATE VALUE OF MIST DENSITY	37
14. MAINTENANCE	38
15. TROUBLESHOOTING	40
15.1 TROUBLESHOOTING by controller indicate	40
15.2 Sensor fail code at LCD on the controller	43
15.3 Sensor clean code at LCD on the controller	43
15.4 TROUBLESHOOTING by sensor unit indicate	44
16. APPENDIX	45
16.1 Parts list	45
16.2 Anti-vibration bracket mounting drawing (OPTION)	48
16.3 Sensor cleaning procedure	48
16.4 Attention of using LOOP wiring for sensor cable routing	53

1. OVERVIEW

This equipment consists of “sensor units” that are directly mounted through the wall on the crankcase side of a diesel engine or gas engine (or EGR system : option) that collectively controls the units by communication means and “controller”.

This equipment was developed by applying new techniques and ideas based on our long-term accumulated techniques related to detection of oil mist density. For detection of mist by the sensor units, the equipment uses a natural diffusion system that does not require mechanically moving parts, such as a suction mechanism, driving air or piping. Compact design, improved reliability and easy maintenance are realized by the use of the light scattering system for detection of mist density.

The maximum number of detection points is 16. Except for the ship engine with classifications approved, this system can use the sensor for the 8 cylinders (max.) on two engines. The system is very flexible for controller layout and installations.

Since the controller has key switches and an LCD, the operability is improved, and the conditions of the whole equipment including the sensor units can be monitored by the self-diagnostic function.

The oil mist density in the crankcase is constantly monitored. When the oil mist density exceeds the setting owing to overheated bearings, an alarm will be given, and a signal will be output to the outside. Not only on low-speed engines, but also on middle- to high-speed engines, serious failures can be found early or predicted.

2. FEATURES

- (1) For mist detection by the sensor units, a natural diffusion system is used.
This eliminates the necessity of such fan suction mechanism, piping and driving air that the conventional systems required.
- (2) The mist detection section consists of a light emitting element (LED) and a light receiving element (PD: photodiode). The use of the light scattering detecting technique reduced the equipment size and realized high-sensitivity detection excelling in stability.
- (3) The sensor units do not have mechanically moving parts. They are light and excel in durability and vibration resistance.
- (4) Output variations due to changes in temperature are automatically corrected.
In addition any adjustment is not necessary for the sensitivity deterioration by contamination. It can be used for the long term by cleaning sensor hood.
(Please refer to 16.3 sensor cleaning procedure)
- (5) The use of a single-chip microcomputer ensures high-performance stable detection.
- (6) The use of data communication techniques realizes daisy chain wiring-saved connection for power supply lines and communication lines between sensor units and between the controller and each sensor unit.
- (7) The mist indicator on the controller consists of 16 LEDs in three colors and is clear. For alarm detection, a two-stage system (pre-alarm and high-alarm) is used.
- (8) The controller is provided with key switches and an LCD to improve the operability.
- (9) It is possible to connect an external output unit for an external monitor. (Option)
- (10) Since the connector is used for wiring connection of the sensors, wiring work is easy.
(Connector type)

3. CONSTITUTION

It is possible to install MD-SX oil mist detection system for ONE engine or TWO engines.

- (1) In case of install MD-SX system for one engine. (For ship: refer to IACS UR M10.12)

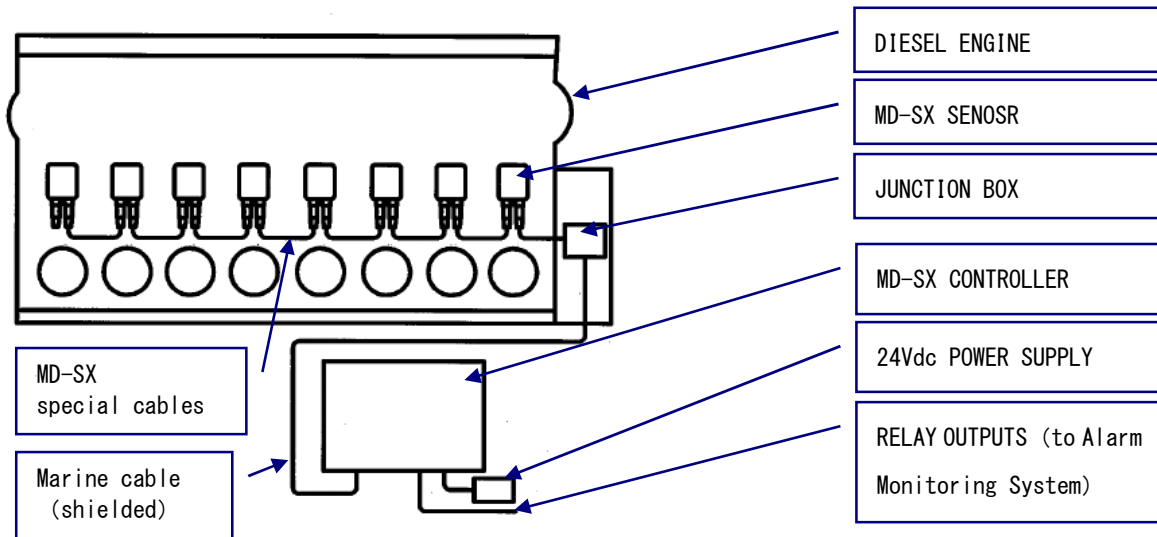


Fig. 1 Install MD-SX system on one engine

- (2) In case of install MD-SX system for two engines. (For land or ship use without classification approved)

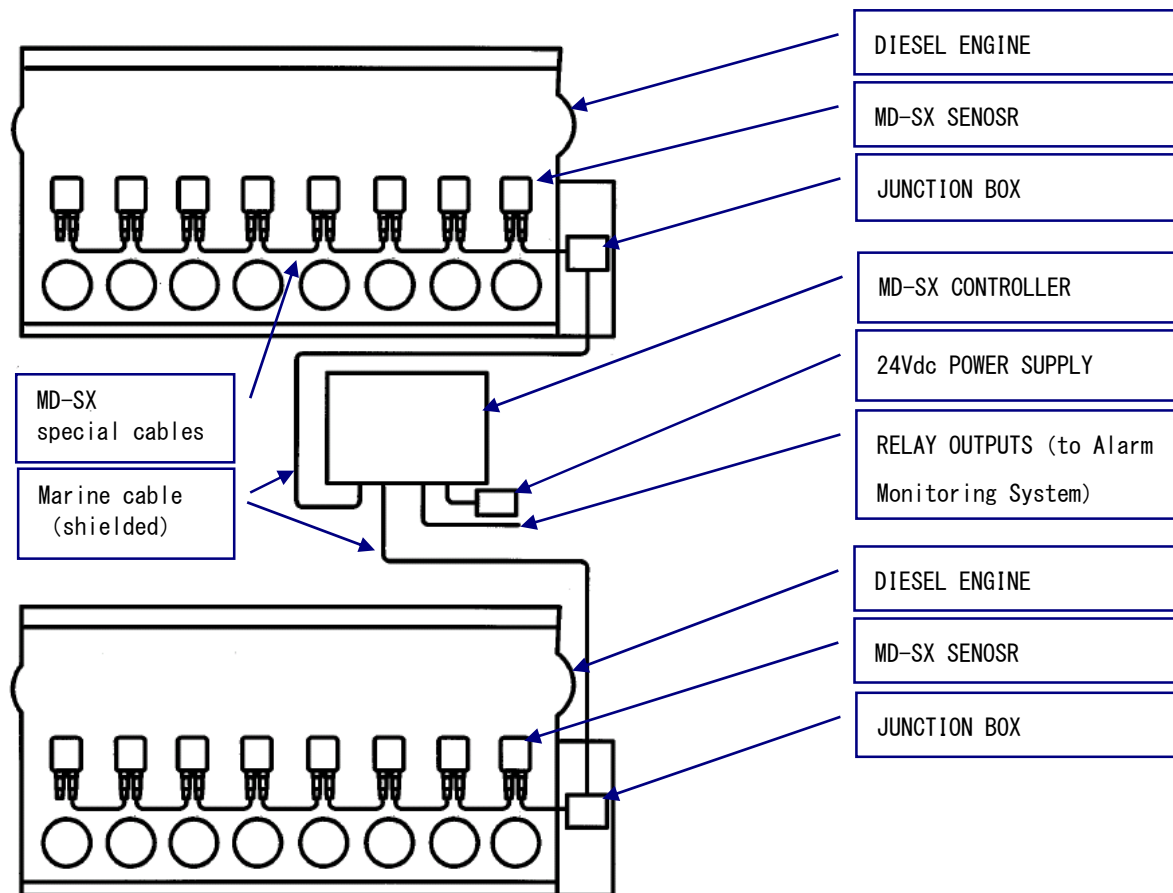
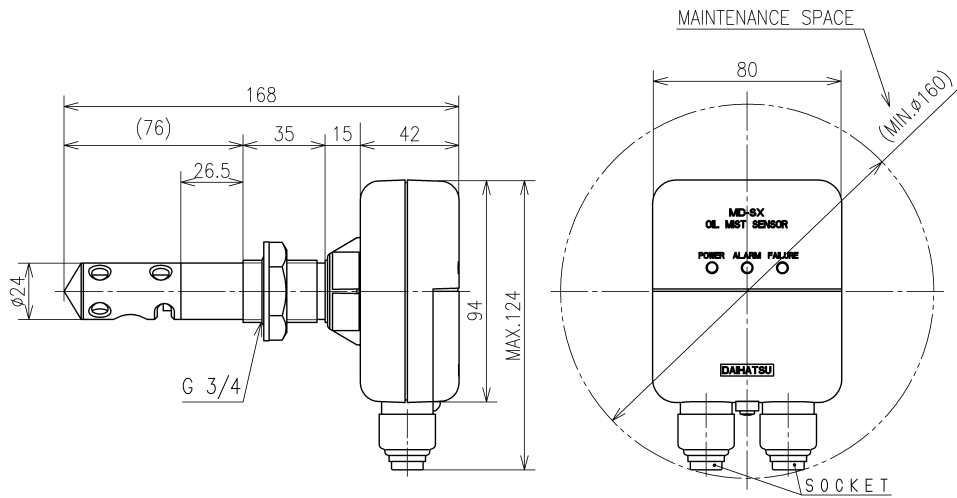


Fig. 2 Install MD-SX system on two engines

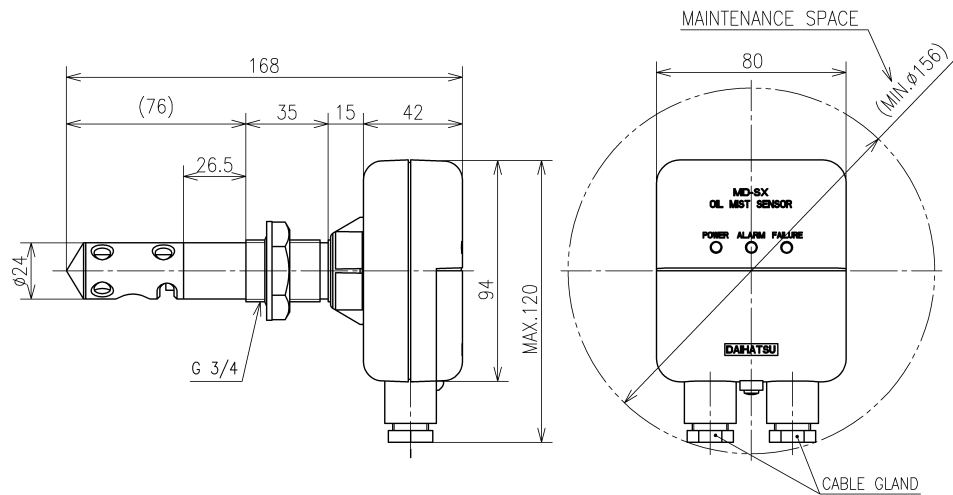
- **16 sensors** can be installed for one engine at the maximum.
 - **16 sensors** can be installed in total at the maximum for two engines, **8 sensors** each for an engine.*
 - Wire the sensors in daisy chain system (connection-in-a-row system) for each engine.
 - Limit the total length of the telecommunication cable from the sensor of an end to a controller is less than **150 m** (for use of Daihatsu option cables). In case of the total wire length exceed 150 m, please ask the wiring method to Daihatsu.
 - The wiring between sensors and controller shall be used Daihatsu option cables (the cable with connectors).
 - (Note: When installing a junction box between a controller and sensors, a general cable for ships can be used between the controller and the junction box.)
 - Mount the sensor directly on the engine frame.
 - Use the specified rubber cushions to isolate the controller from vibration if it is directly mounted on the engine body.
 - Before using the mounting method described above, please contact us.
-
- For ship use, it may be limited by the shipping classification society with one oil mist detector system 1 formula per engine. Please follow the rule of each shipping classification society.
 - For sensor wiring method, The loop wiring also applicable other than daisy chain method (Please refer to 16.4 Attention of using LOOP wiring for sensor cable routing)

4. OUTLINE

(1) DOWN WARD SENSOR UNIT STANDARD TYPE (CONNECTOR TYPE)



CABLE GLAND TYPE



FLYING-LEAD TYPE

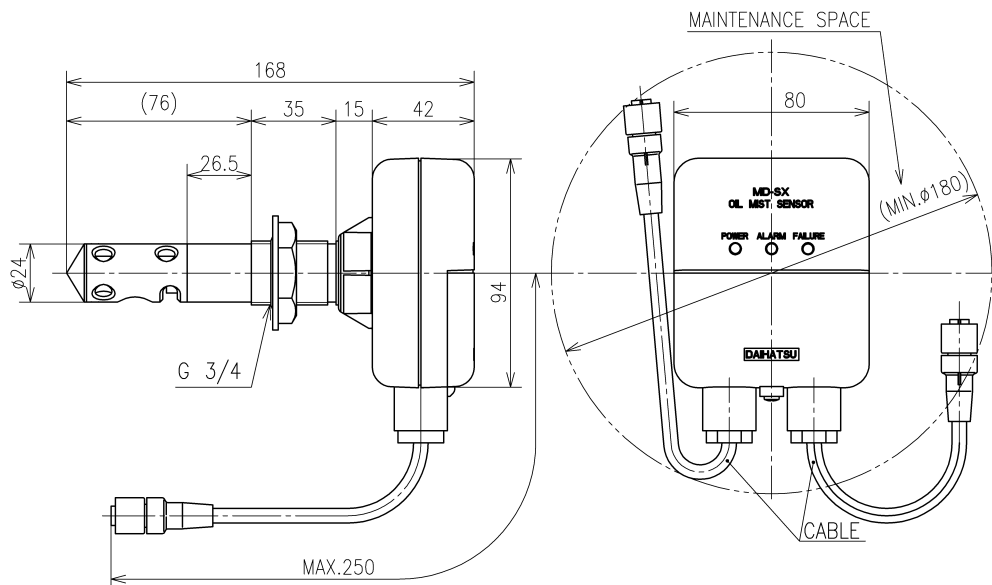
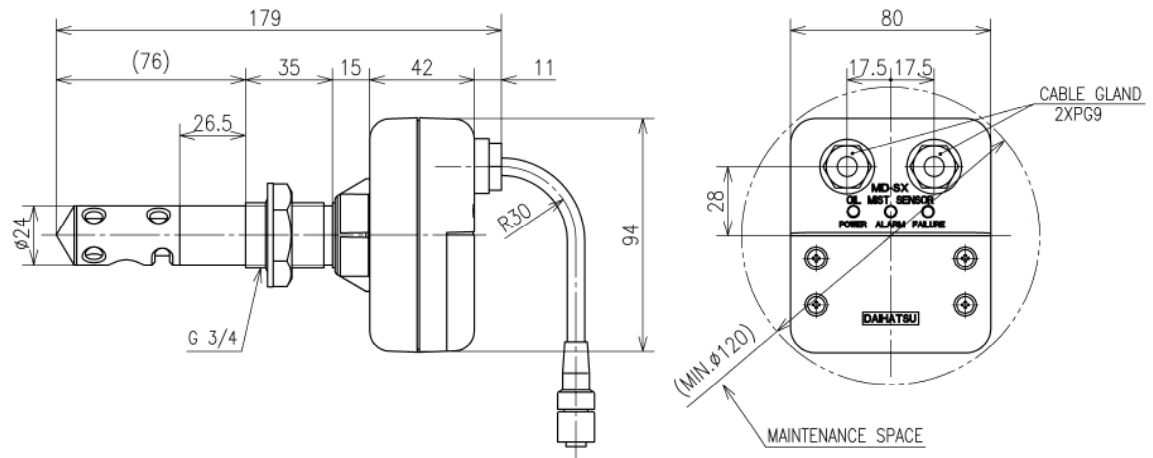


Fig. 3 MD-SX OUTLINE OF DOWN WARD SENSOR UNIT

(2)HORIZONTAL CABLE SENSOR UNIT
STANDARD TYPE (CONNECTOR TYPE)



FLYING-LEAD TYPE

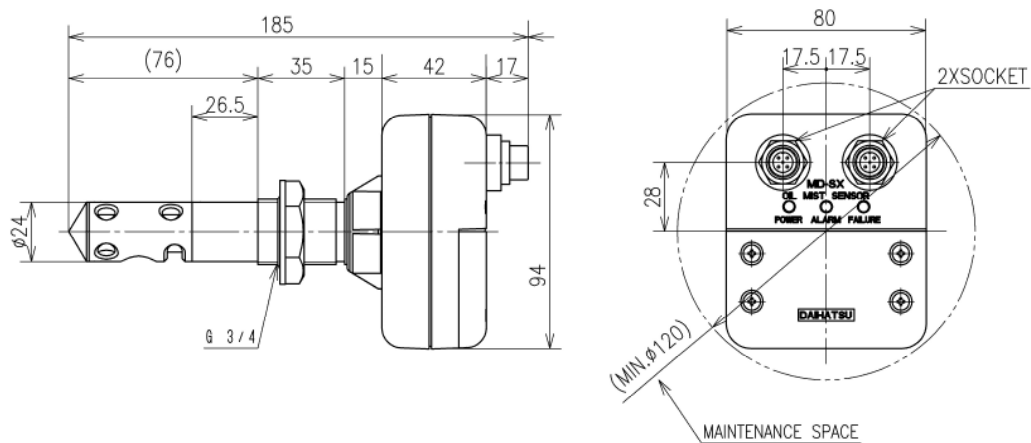
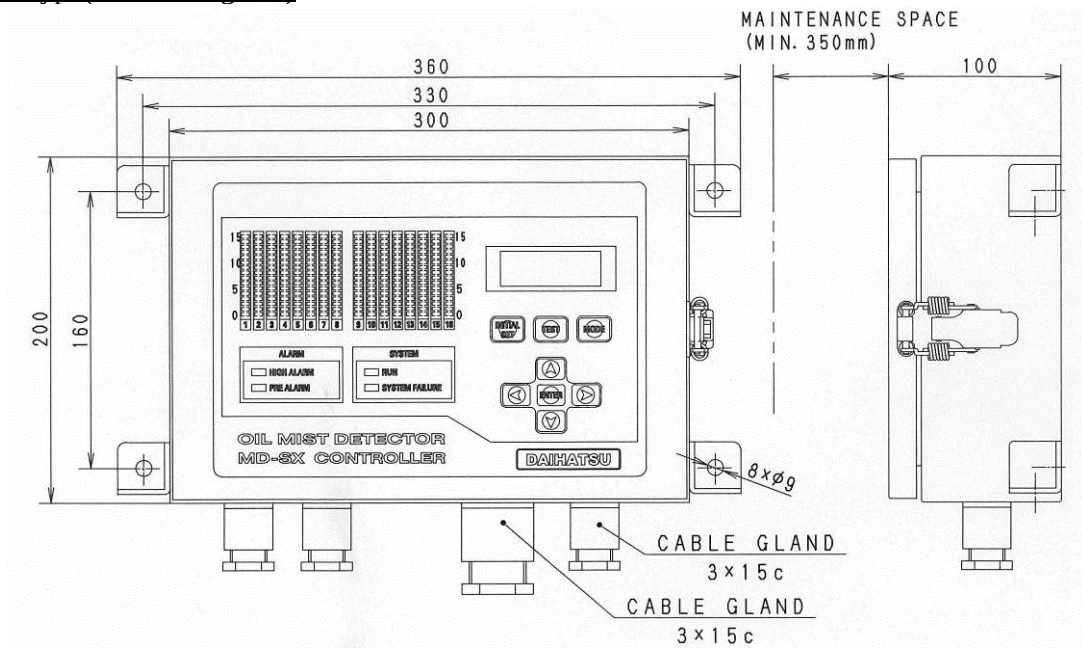


Fig. 4 OUTLINE OF HORIZONTAL CABLE SENSOR UNIT.

(2) CONTROLLER

Wall mount type(with cable gland)



Wall mount type(with cable comb)

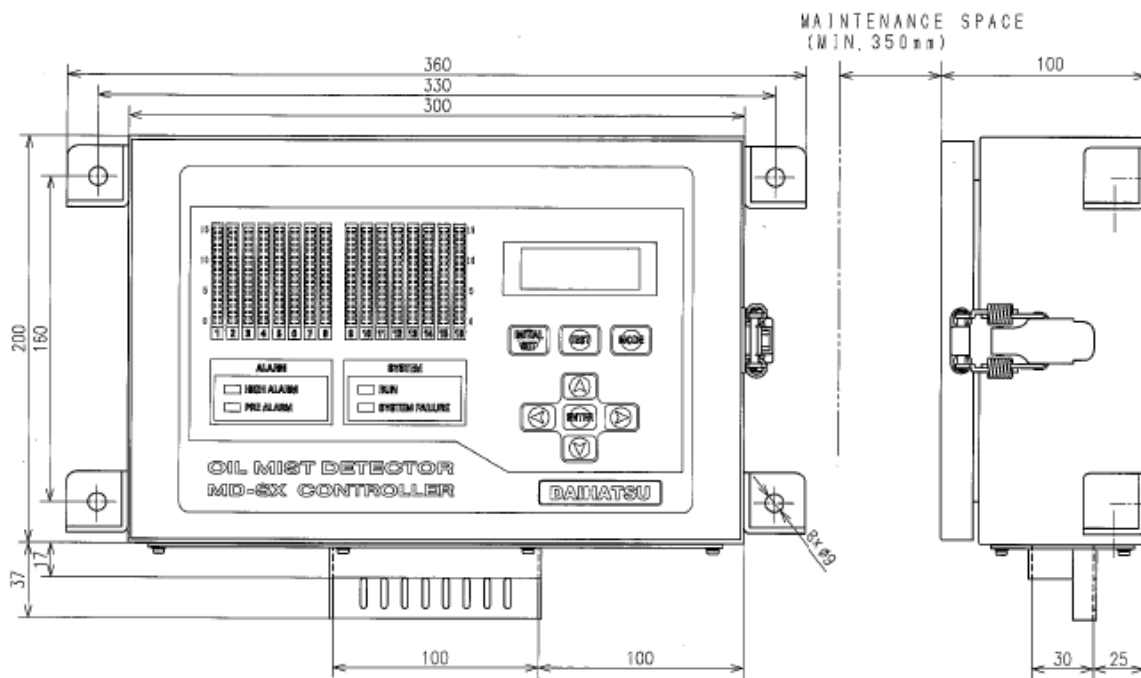


Fig. 5 Controller outside

Flush mount type

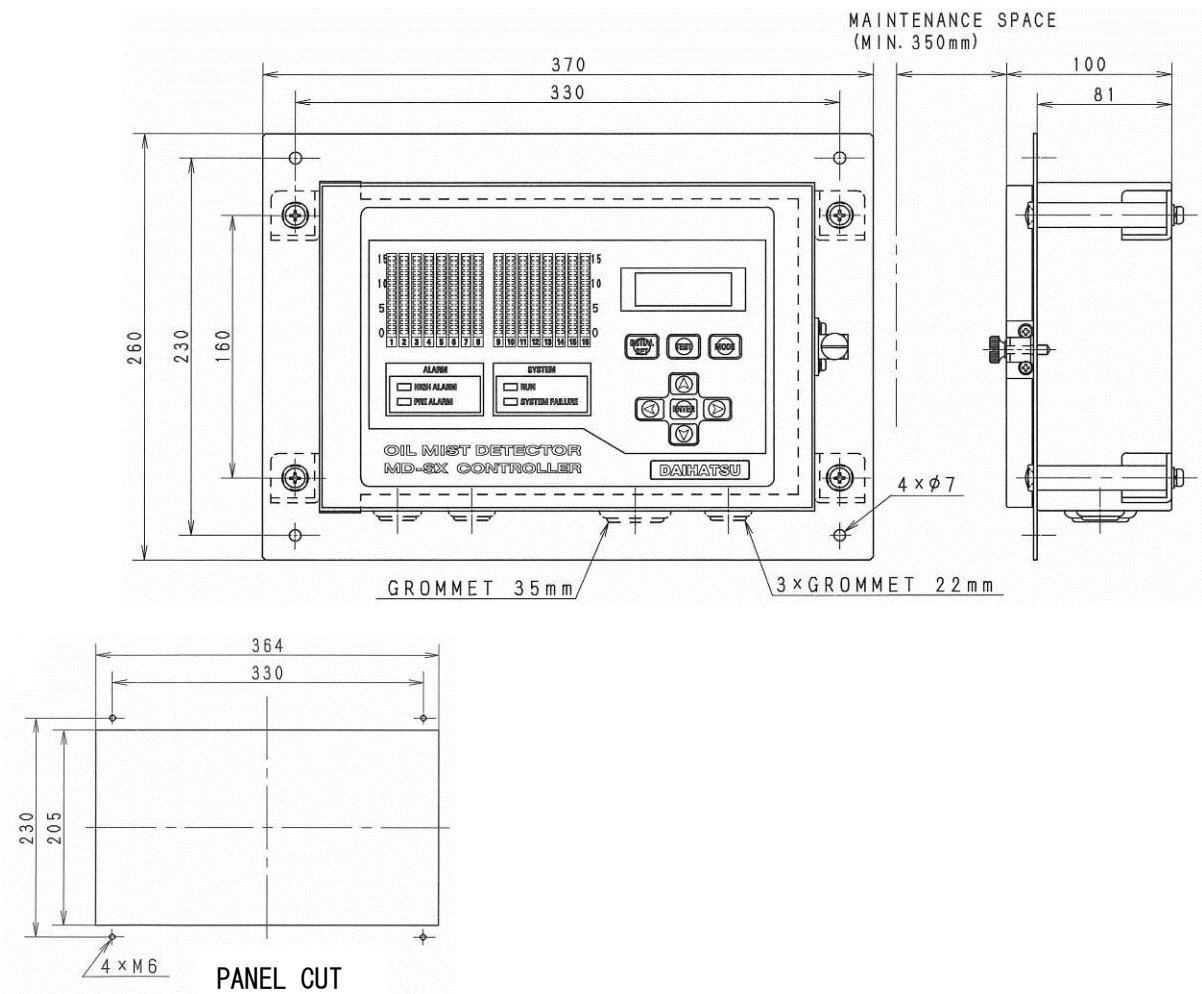


Fig. 6 Controller outside

5. SPECIFICATIONS

5.1 Sensor unit

No.	MODEL MD-SX SENSOR UNIT	
(1)	Function	Oil mist concentration detection Mist level signal conversion and output
(2)	Detection point	1 point/1 unit
(3)	Mist detection	Natural diffusion system
(4)	Detection concentration	0 - 2.0 mg/L (0 - 0.5 mg/L : for EGR system)
(5)	Detection system	Optical system (Optical dispersion system)
(6)	Detection interval	Continuous
(7)	Display	3 LEDs “POWER” (Green) : Power status (Lighting) “ALARM” (Red) : PRE ALARM (Blink) HIGH ALARM (Lighting) “FAILURE” (Yellow) : Comm. and Sensor failure (Lighting)
(8)	Data communications	Serial interface: RS-485 (Half Duplex) conformity (Sensor unit - controller)
(9)	Initial-setting operation	Rotary switch: Communication node (16CH) “0” - “F” Dip switch : Terminator “ON”/“OFF”
(10)	External connection (Sensor unit - Controller)	Sensor line : MD-SX option cables (Daisy chain) Total length: 150 m max. Connection method : Connector (Standard type) Clamp-type terminal (Cable gland type)
(11)	Power supply	24 V DC (+30% to -25%) (supply from controller)
(12)	Power consumption	60 mA (max.)/1 unit
(13)	Outline dimensions	80 W × 124 H × 168 D mm (Standard: connector type) 80 W × 120 H × 168 D mm (Cable gland type)
(14)	Installation	Screw size: G 3/4 (with a seal washer) Vertical direction : Level or less than 15° of facing down Rotation direction : Less than ±5°
(15)	Protection against dust and waterproofing	Protection class: IP 55
(16)	Weight	Approx. 450 g (Standard connector type, Cable gland type) Approx. 500 g (Fling - lead type)
(17)	Paint color	Munsell N1.0 (Black) (Case part)
(18)	Environmental conditions	Ambient temperature: (For operation) 5 - 55°C 5 - 80°C (Engine insertion part) (For storage) -20 - 80°C Humidity : Max. 80%RH (without dew condensation) Atmosphere : No corrosive gas Vibration : Amplitude: ±1.6 mm or less (2 to 25 Hz), 4 G or less (25 to 2 kHz)

5.2 Controller

No.	MODEL MD-SX CONTROLLER	
(1)	Function	Mist level indication and alarm monitoring
(2)	Number of sensor unit connection	16 units (max.) (16 units/1 engine or each 8 units ×2 engines)
(3)	Detection time	Continuous (Response time: 1 sec or less/16 points)
(4)	Detection concentration	0 - 2.0 mg/L
(5)	Operation	Key switch input
(6)	Display	1) Mist level: 3-color bar-graph indication (16 LEDs) 2) 4 LEDs “RUN” (Green) : Detection (Lighting)/Mode set up (Blink) “PRE ALARM” (Red) : (On at mist level LED: “(10)” and over) “HIGH ALARM” (Red) : (On at mist level LED: “(15)”) “SYSTEM FAILURE” (Orange) 3) LCD: 60 × 22 mm 20 letters × 4 lines (with back light)
(7)	Contact outputs	1) Alarm (2 contacts for each engines) “PRE ALARM”, “HIGH ALARM” 2) Failure output (1 contact) “SYSTEM FAILURE”
(8)	Contact specification	Relay contact output (1 form C) Contact capacity: 125 V AC 0.4 A / 30 V DC 2 A (Resistance load)
(9)	Data communications	Serial interface: RS-485 (Half Duplex) conformity (Sensor units and external unit)
(10)	External connection	Sensor line : Daihatsu option cables or specified cable for ships (To install a junction box: AWG15 × 4 cables) Contact output line : Cable outer dia. = 18 mm or less (for one engine) Cable outer dia. = 18 mm or less (for two engines) Power line : Cable outer dia. = 13 mm or less Connection method : Clamp-type terminal connection
(11)	Power supply	24 V DC (+30% to –25%)
(12)	Power consumption	1.5A (max.) (Internal: 0.5A, Sensor units supply: 1.0A)
(13)	Outline dimensions	360 W × 200 H × 100 D mm (Wall mount type) 370 W × 260 H × 100 D mm (Flush mount type)
(14)	Protection against dust and waterproofing	Protection class: IP 55
(15)	Weight	Approx. 5.0 kg (Wall mount type with cable gland) Approx. 5.6 kg (Wall mount type with cable comb) Approx. 5.8 kg (Flush mount type)
(16)	Paint color	Munsell N1.0 (Black)
(17)	Environmental conditions	Ambient temperature : (For operation) 5 - 55°C (For storage) –20 - 80°C Humidity : Max.80%RH (Without dew condensation) Atmosphere : No corrosive gas Vibration : 1 G or less (If vibration is more than 1 G, adopt a vibration-proof device.)

6. DISPLAY AND FUNCTIONS OF SENSOR UNIT

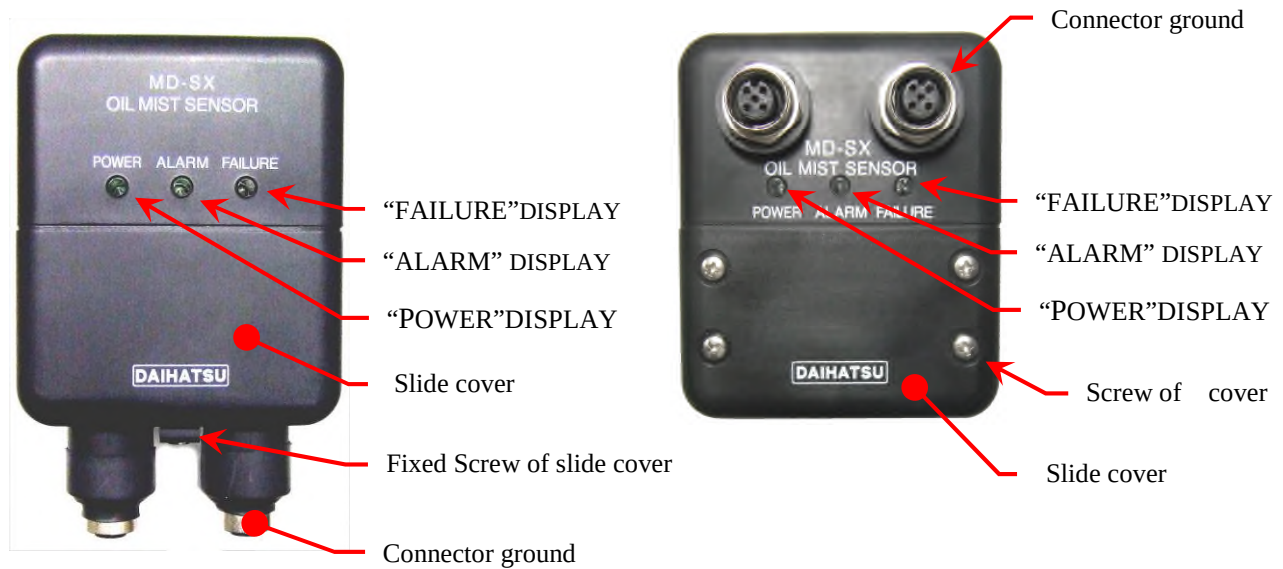


Fig. 7 Sensor unit

Each sensor unit has three status indicating lamps (LEDs); POWER (green), ALARM (red), and FAILURE (yellow).

6.1 Description of function

The light emitted from the LED of the sensor unit is diffused and reflected by the oil mist in the sensor hood, and then received by the photo receiver diode (PD). After amplification and A-D conversion, the output from the photo receiver is input to the CPU for arithmetic operation, and then transferred to the controller as the oil mist density data.

6.2 "POWER" LED

This lamp is located on the left of the surface of the sensor unit case. When the green LED is on, this means that power is being supplied from the controller and the CPU is working normally.

6.3 "ALARM" LED

The controller detects the alarm status based on the oil mist density detected by the sensor unit. There are two alarm statuses, "PRE ALARM" and "HIGH ALARM". Upon occurrence of any alarm, the red LED in the center of the case surface flashes (PRE ALARM) or lights (HIGH ALARM) according to the signal from the controller.

6.4 "FAILURE" LED

The sensor unit has a self-diagnosis function. If any trouble is found, the yellow LED on the right of the case surface will turn on.

Upon occurrence of a light receiving or emitting element output trouble, a CPU trouble, a thermistor trouble or a circuit trouble, the LED lights.

In addition, when the controller is set in the test mode, the LED of all sensor units becomes blinking.

7. DISPLAY AND FUNCTIONS OF CONTROLLER

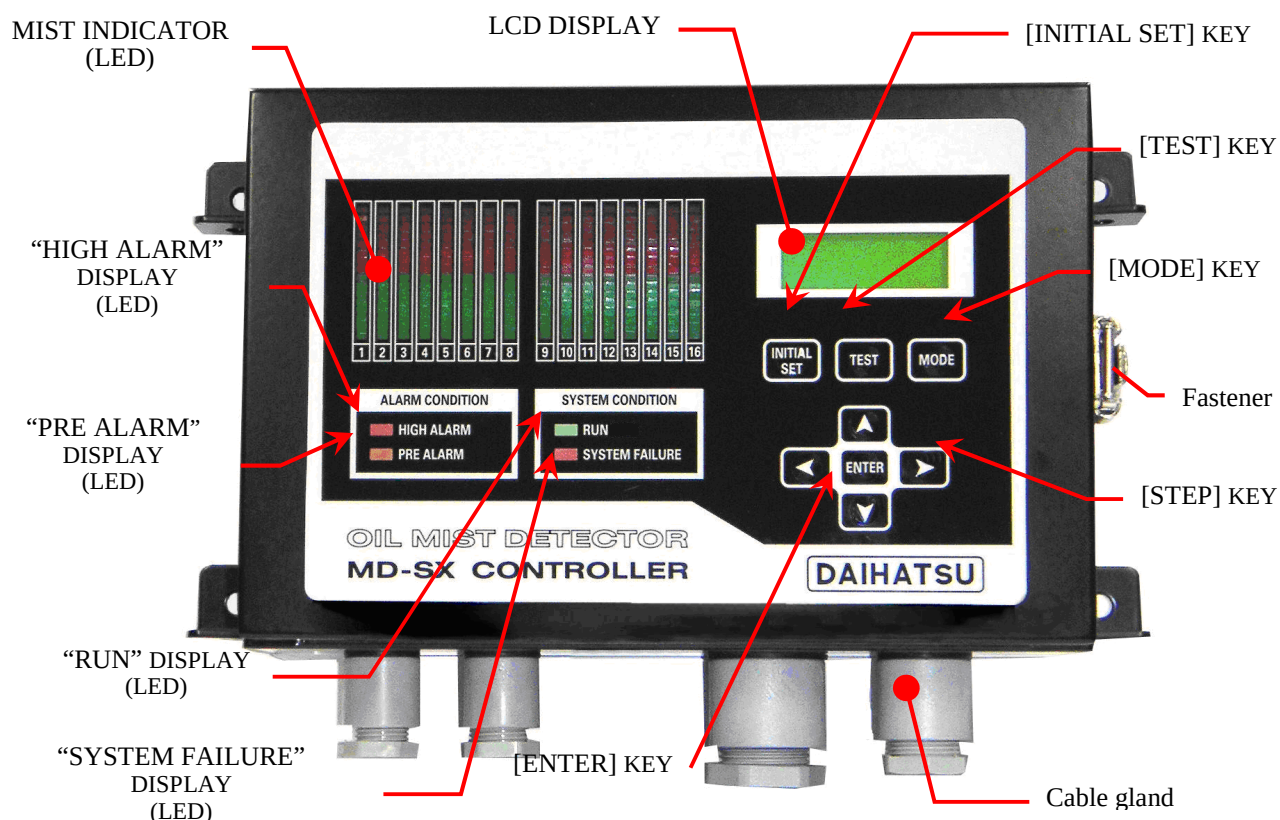


Fig. 8 Controller face of a board

The controller has not only operation key switches and an LCD indicator for displaying the status, but also 16-ch mist indicators that show the oil mist density level with 16 LEDs in three colors, green, orange and red.

It has also lamps (LEDs), "RUN" (green) and "SYSTEM FAILURE" (red), that indicate the system operation status and alarm indicating lamps (LEDs), "PRE ALARM" (orange) and "HIGH ALARM" (red). These devices have the following functions.

7.1 Mist indicator

The controller transfers oil mist density data with the sensor units (up to 16 units can be connected) and indicates the oil mist density levels based on the data with 16-level bar graph LEDs in three colors, green (No.0 to No.7), orange (No.8 to No.10) and red (No.11 to No.15).

When only the mist indicator LED No.0 (green) is flashing, this means that the controller has not been initialized (Full-load setting) as specified.

Initialize the controller as stated in [10.2 Initial setup of controller] or [11 Operation].

7.2 "RUN" LED

When this LED is on, the power supply is normal, and the controller CPU is working normally. If the controller has not been initialized as specified or is not in the normal mode, the LED is flashing.

Usually, when key operation does not have 10 minutes or more in the modes other than the mode, it usually returns to the mode automatically.

7.3 “SYSTEM FAILURE” LED

When a controller CPU trouble occurs, a hardware trouble is detected by the self-diagnostic function of any sensor unit or a communication trouble between the controller and a sensor, the LED will be turn on, and the “SYSTEM FAILURE” output relay will be activated.

- (1) After receiving a sensor unit trouble signal, the controller will turn off the LED Nos. 1 to 7 (green) of the mist indicator for the relevant sensor and make the LED Nos. 8 to 10 (orange) flash. Then, you can identify the defective sensor unit.

The defective sensor unit will be automatically excluded from the calculation of deviation (mean value).

- (2) When a cable is disconnected, a communication trouble will be detected on the sensor units in the downstream of the disconnected point. In this case, mist indicator LED Nos. 0 to 7 (green) will go out, and the LED Nos. 8 to 10 (orange) will flash. Then, you can identify the cable disconnection point.

- (3) After the communication recovers normally, “SYSTEM FAILURE” will be automatically restored. Even after recovery, the error message will be continuously displayed on the LCD until the system is reset by the ENTER key.

System failures other than communication troubles are self-held. Turn off power with the power switch in the controller, and remove the cause of the trouble.

After recovery from the trouble, turn on the power switch in the controller to reset.

- (4) When a CPU trouble occurs, “SYSTEM FAILURE” will be output.

As for the details, see Section [15.Troubleshooting].

7.4 “PRE ALARM” and “HIGH ALARM” LEDs

There are two alarm statuses, “PRE ALARM” and “HIGH ALARM”. Upon occurrence of an alarm, the indicating lamp (LED) and the output relay function.

The status message is displayed on the indicating LCD.

The mist indicator lamps are in the following conditions when an alarm occurs and when the alarm is cleared.

	Operation point	Restoration point
“PRE ALARM”	No. 10 or above or At the time of deviation unusual generating	No. 8 or below or At the time of a deviation unusual return
“HIGH ALARM”	No. 15 (self-holding)	After mist density decreases Press the ENTER key for restoration.

Any deviation of the sensor level indicates the deviation alarm message of “PRE ALARM” when the level of the sensor in question deviates by more than 4 levels from the average level of all the sensors indicated on the mist indicator.

The “PRE ALARM” message is not continuously indicated, but automatically reset when the oil mist density level goes down.

The message indicator is automatically reset when the deviation goes below the level 4 from the average level.

“HIGH ALARM” is self-held, and all lamps (up to No.15) of the mist indicator are kept on.

When the mist density is lowered to the normal range, press the ENTER key to reset the “HIGH ALARM”.

As for the specifications for external output of the output relay, see Section [9.3 Wiring of the controller].

7.5 [STEP] keys and [ENTER] key

Use the arrow keys to move the cursor on the LCD or to increase or decrease the set values.

Use the ENTER key to reset the alarm to the normal mode.

In the setting status of each mode, also use the ENTER key to determine the set data at the cursor position.

7.6 [INITIAL SET] key switch

The [INITIAL SET] key switch is to (store the mist density data under the maximum load in the controller) when setting the full load. You can display the setting change screen by pressing the key long (for more than 3 seconds).

7.7 [TEST] key switch

You can select the test mode by pressing the [TEST] key switch.

The “FAILURE” message blinks for each of the sensor units as communication is disconnected between the sensor units and the controller when the test mode is selected. The “RUN” message on the controller also blinks. The test mode has the following functions:

1. Alarm operation check
2. Function check
 - 1) LED/LCD ALL ON : To check that the LCD screen and LED lamps properly operate by turning all of them on.
 - 2) SWITCH CHECK : To check that the key switches properly operate
 - 3) OUTPUT CHECK : To forcibly turn the contacts on and off to check the function.

The 「1. ALARM OPERATION CHECK」 is to detect mist in the sensor and to check if the system properly operates. You can check the proper operation of the system by temporarily lowering the alarm setting-off level of one sensor unit to detect the “PRE ALARM” and “HIGH ALARM” set off at the density level of oil mist generated during the engine in operation. See the [11.5 ALARM OPERATION CHECK] for the detailed procedure.

The 「2. FUNCTION CHECK」 is to check if the individual displays and switches properly function.



The alarm output relays (external output) are operational in the test mode.

But avoid checking the functions in the test mode during the engine in operation. If there is no other way than to check in the test mode, take necessary actions such as disconnecting the wire for the external output or grounding the external output circuit.

(Always reconnect the wire after it is disconnected.)

7.8 [MODE] key switch

You can select the mode change screen for the modes of 「1. STATUS」, 「2. INITIAL RESET」, and 「3. CONFIGURE」 by pressing the [MODE] key switch.

1. STATUS
 - 1) CONTROLLER : To display the controller data on the LCD screen in a batch
 - 2) SENSOR : To display the current status of the connected sensor
 - 3) MIST/ALARM LEVEL : To digitally display the set mist quantity(full-scale 0-1023)
(mg corresponding value and temperature of sensor can be displayed.)
 - 4) SOFTWARE VER. : To display the version of the software currently set in the system
 - 5) WORKING MODE : To display that the oil mist detector version is now used.
 - 6) ALARM HISTORY : To display that the history of the generated alarm is displayed.
(History is deleted in power supply OFF.)
2. INITIAL RESET
3. CONFIGURE (A password must be input for the change.)
 - 1) CONTROLLER : To change the basic settings for controller display and communication, etc.
 - 2) SET ENG/SENSOR : To set the number of the engines and sensors
 - 3) ISOLATE SENSOR : To temporarily disconnect and connect a sensor when the sensor fails
 - 4) EXCEPTED FROM AVE. : To set a specific item to be excluded from the average computing
 - 5) INITIAL VALUE SET : To manually set the alarm setting-off level

The 「1. STATUS」 mode is to display the current status of the system, but does not change the setting.

The 「2. INITIAL RESET」 is to reset the initial setting (for the engine and sensor quantity and the exclusion from the average computing). The resetting procedure is in the same sequence as for the initial setting and in the interactive manner.

The 「3. CONFIGURE」 mode is to change the detailed setting for individual functions. A password “9999” must be input for the change. Do not make the password public to prevent changing by anyone. Do not change the settings unless definitely necessary.

8. INSTALLATION

8.1 Sensor unit

- (1) Use the sensor unit under environmental conditions meeting the following specifications



When mounting the sensor unit, select a place where vibration can be 4 G or less (2 Hz to 2 kHz).
When selecting the sensor mounting place, also check that the mist suction port of the sensor hood cannot be continuously blocked by a large quantity of oil.

By rotatory direction of a crankshaft and structure of the engine inside, the heavy splash of lubrication oil occurs, and there may be the case that the oil mist is hard to come in to a detecting element.
Please install it by a recommended method.

The recommended installation position of the MD-SX sensors is upper place from clank shaft and side of figure below.

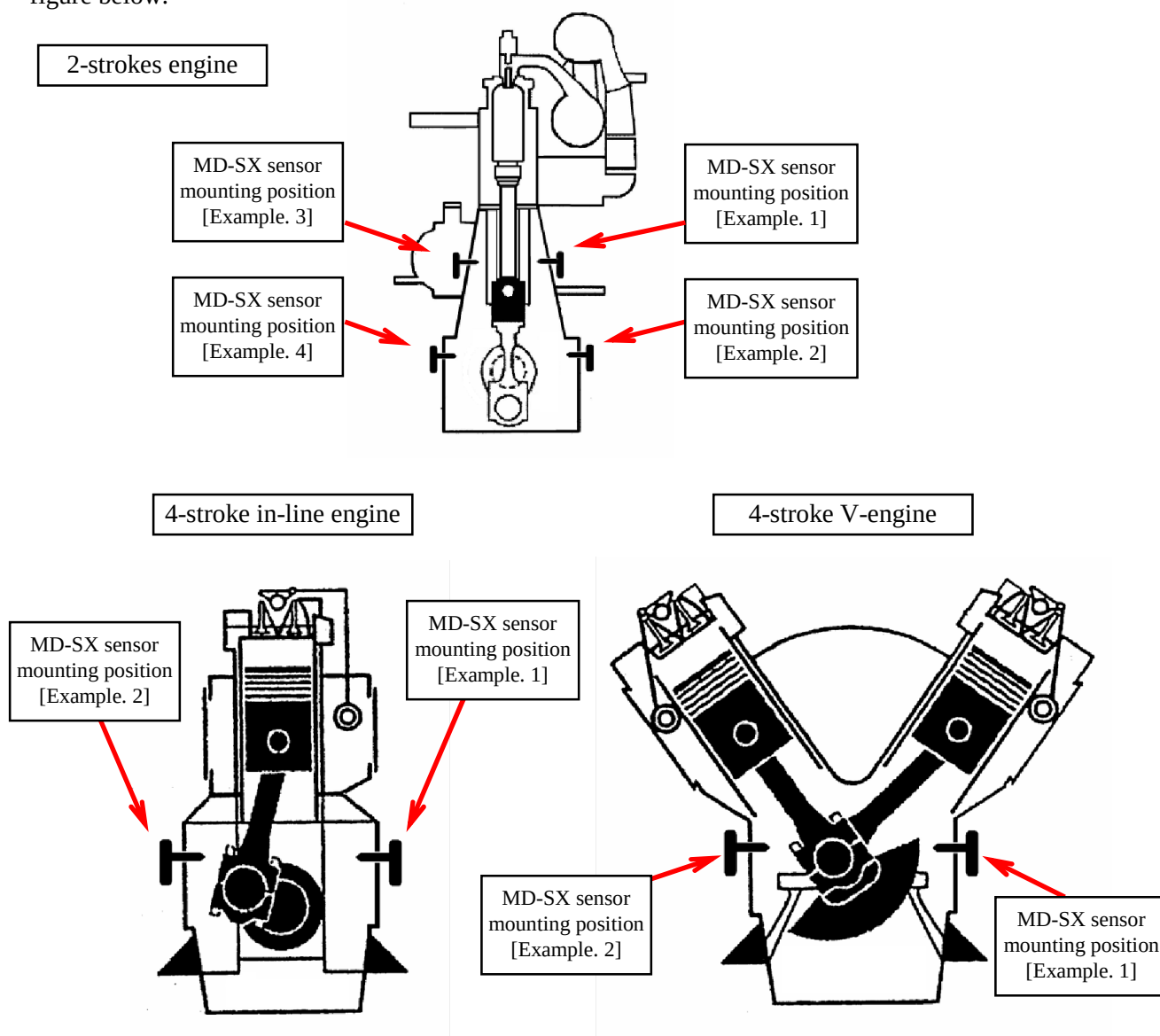


Fig. 9 Recommended attachment position of the sensor unit

(2) Mounting conditions

- 1) Horizontal or downward (front declined) within 15°

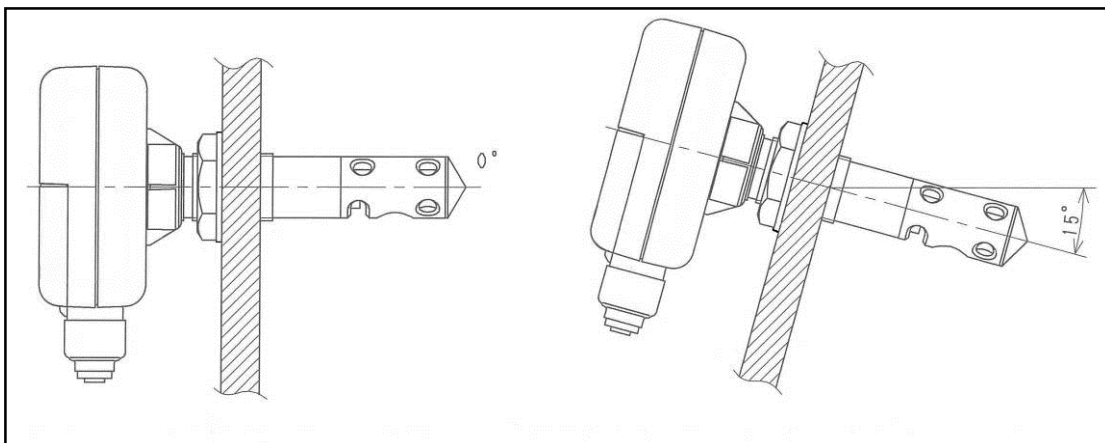


Fig. 10 Tilt tolerance for horizontal direction

- 2) Rotation direction within $\pm 5^\circ$

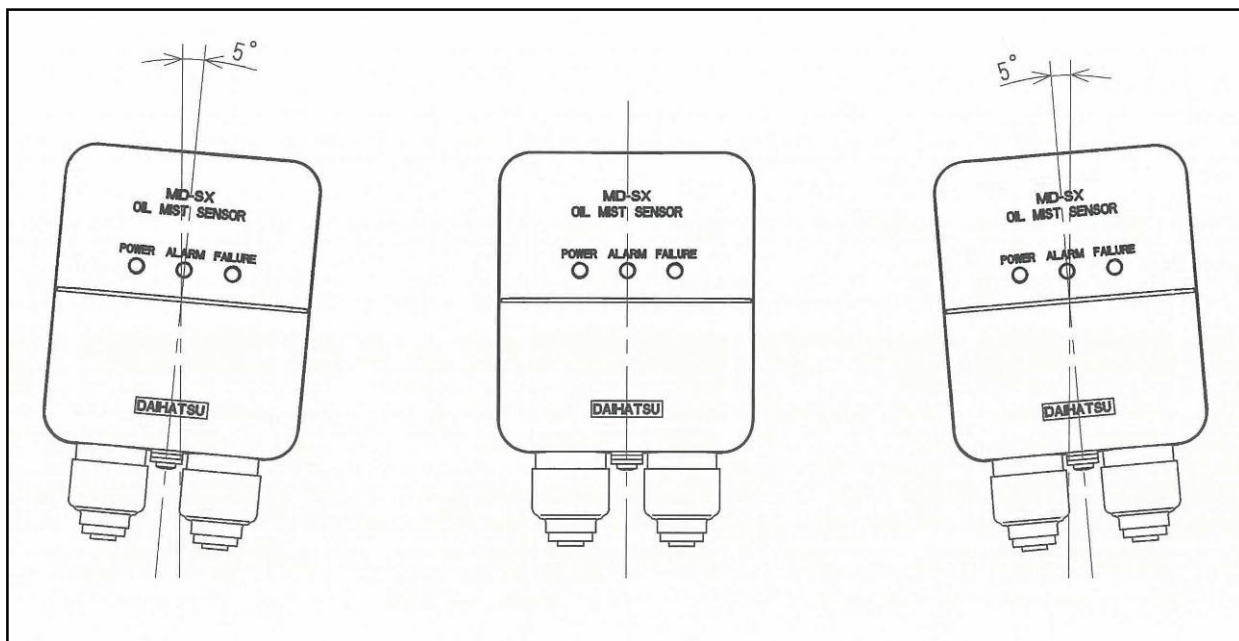


Fig. 11 Tilt tolerance for the rotation direction

- (3) Insert the hood of the sensor unit into the crankcase through the threaded portion (thread size: G3/4) of the engine frame, screw in the hood to the specified length (threaded portion length of 15 mm: 10 turns or more) after winding a sealing tape, and secure the hood with the lock nut through the supplied sealing washer.

Note: • If the screw part is not rolled up by seal tape, Oil leak will be occurred from screw part to engine outside.

- If you use the special sealing washer (optional), it is not necessary to wind the sealing tape. If you need this special sealing washer, please contact us

- (4) Although the threaded portion is made of stainless steel and has sufficient strength, the case and the front hood are made of plastics. When handling them, take care not to give undue force to them.
- (5) Please do not install an obstacle to a radius of less than 100 mm from an installation hole of a sensor. On sensor installation work, a sensor hits the obstacle, and there is the case that cannot screw.

(6) When MD-SX sensor unit install on engine with the following condition, MD-SX sensor should be avoided to install on these place.

- Oil comes from upper part like a waterfall continuously.
- Oil comes from lower part like a fountain continuously.
- Oil comes from the inside structure to reflect oil heavily.
- There is the structure like oil pool, and the sensor hood sinks.



In case the sensor is installed such a place, mist inlet holes of the hood may be blocked by oil and MD-SX may not detect mist density surely. Then, oil comes into mist detection area in hood from the mist inlet holes. As a result it may cause sensitivity abnormal or miss-alarms (HIGH and/or PRE- ALARM).

When MD-SX sensor unit can not install on the recommended place by the limit of engine design, Daihatsu recommend using the cover structure or the protection pipe to cover the hood part of MD-SX sensor from heavy scattering oil. Please refer to the below drawings for protection method or ask Daihatsu in the details.

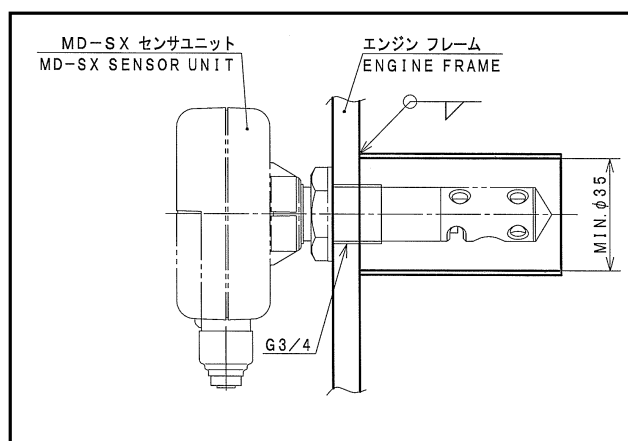


Fig.12 (Sample 1) Protection pipe

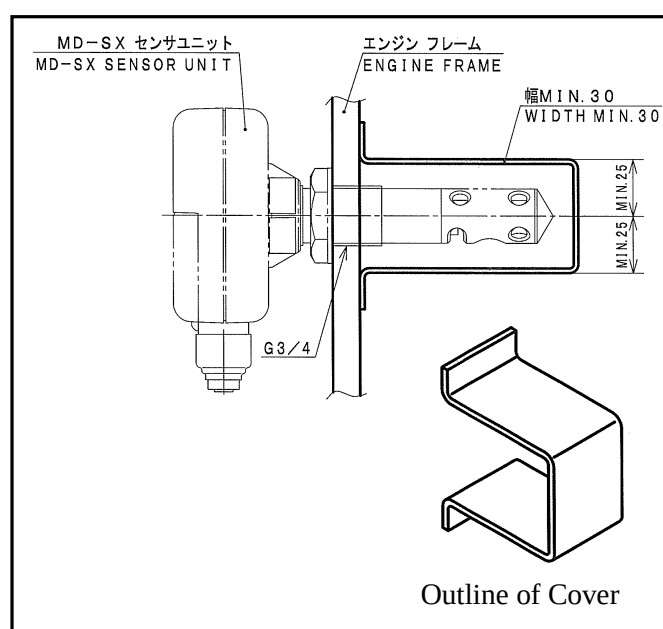


Fig.13 (Sample 2) Cover structure

(7) In case of fitting sensor to a gear case except the engine crankcase, a chain case, the part of fuel oil supply unit, please measure the vibration value of the sensor fitting part up to frequency 2KHz beforehand, then please fit the sensor after confirmed the specification is satisfied.

In case of exceeding the vibration value from the specified value of sensor, please fit the sensor after executed the anti-vibration measures.



If the sensor is fitted to the place the vibration value is large, or the space the engine outside is narrow where the external force seems to suffer from the sensor connector,

Please adopt the flying lead type sensor or the ground type sensor.

When the connection is not enough between the sensor connector and cable connector by the large Vibration or external force to the sensor, it may cause communication abnormal and/or the breakdown of sensors. Please fix the cable within 200mm from a sensor connection to avoid the above troubles.

8.2 Controller

- (1) Use the controller under environmental conditions meeting the following specifications.



The vibration acceleration applied to the mounting place shall be 1G or less.
If the acceleration exceeds 1G, mount the controller using the separately supplied antivibration bracket or equivalent brackets through the specified rubber vibration insulators.

Install the IACS M10 at a safe place far away from the engine room.

- (2) When the controller is mounted on a wall or a panel
When the controller is installed on a place where the vibration acceleration is low (1G or less), it is unnecessary to use antivibration means.
Install the controller directly on the wall or panel using the bracket mounting holes (9 mm in diameter) in the controller main body.
Or please apply a controller of a flush mount type.
- (3) When the controller is mounted on the engine main body
When the controller is installed on a place, such as the engine main body, where the vibration acceleration exceeds 1G, use the specified rubber vibration insulators.
Fit the rubber vibration insulators in the vertical direction in which load will be applied to the insulators and the insulators will be compressed.

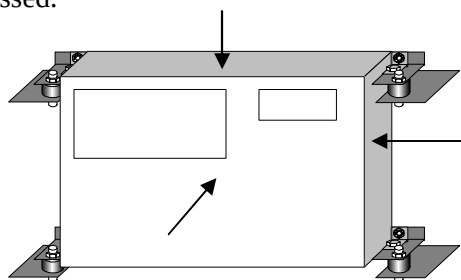
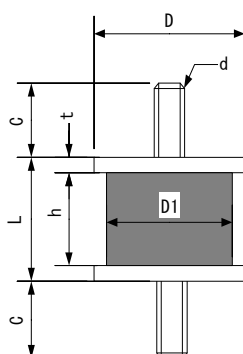


Fig. 14 Antvibration rubber attachment outline

* Install the controller in such a way that the case vibration acceleration from the three directions indicated by the arrows (in the center of the case) is 1G or less.



	Dimensions						
	D	D1	L	h	d	t	C
A5002	21	16	16	12.8	M6	1.6	19

Fig. 15 Round rubber vibration insulator M6 (with a spring washers and two nuts)

- (4) The rubber vibration insulators have been selected to ensure that the vibration acceleration becomes 1G or less on a low-speed engine (the vibration frequency caused by the rotational speed or the number of cylinders is approximately 30 Hz or less).
When exceeding 1G, or in installing in middle speed or high speed engine, please consult to our company.

9. WIRING

One MD-SX oil mist detector can serve two engines at the maximum.

Pay attention to the followings when wiring the detector.

Note) For ship use of oil mist detection system, IACS recommend the system institutions. (IACS UR M10.12 regulation : “Each engine is to be provided with oil mist detector.”) Please obey the rule of each shipping classification society.

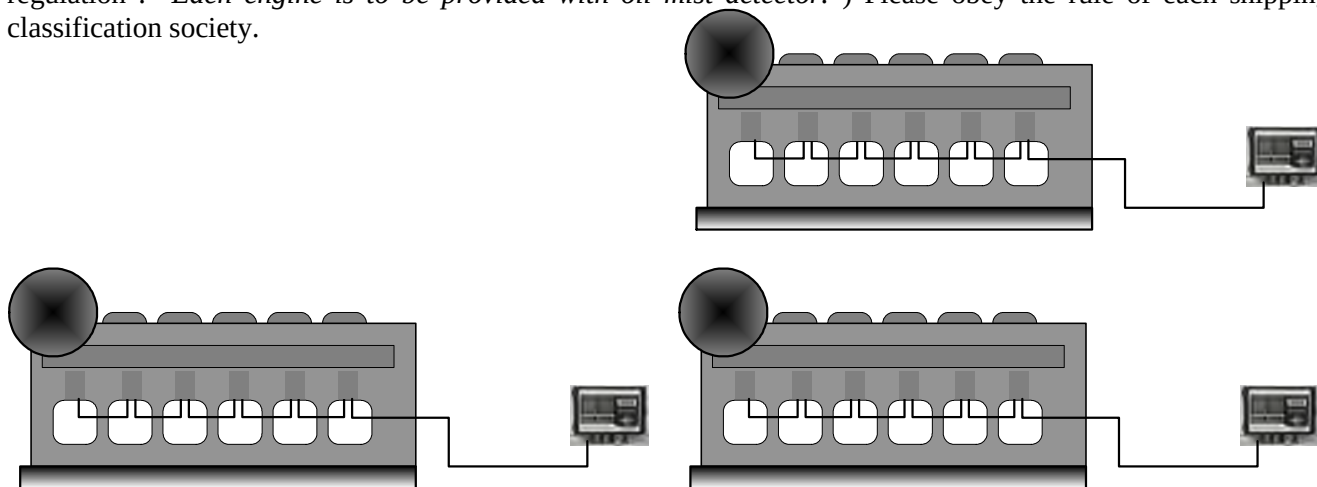


Fig. 16 Wiring layout to install one oil mist detecting system on one engine

Fig. 17 Wiring layout to install two oil mist detecting system on two “each” engines

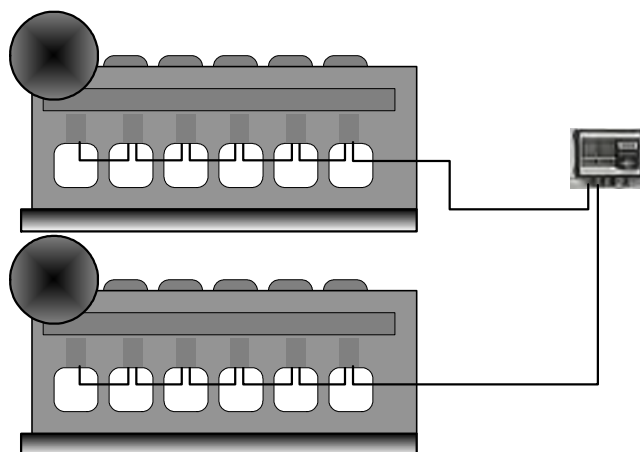


Fig. 18 Wiring layout to install one oil mist detecting system on two engines
(without classification)

- 16 sensors can be installed for one engine at the maximum.
- 16 sensors can be installed in total at the maximum for two engines, 8 sensors each for an engine.*
- Wire the sensors in daisy chain system (connection-in-a-row system) for each engine.
- Use the Daihatsu option cables for the wiring between sensors and a controller. For one engine, limit the total length of the wires within 150 m from the end sensor and the controller. Even if two engines are used, the total length of the cable should be within 150 m for each engine.
- A general cable for ships (batch shielded cable with 4 or more cores) can be used between the junction box (terminal box) and controller when the junction box is on the engine body. If the wire diameter is in the range of 1 to 1.5 mm² (AWG18 to AWG14), the total length of the wires can be extended within 200 m.
- Securely fix the wires for the sensors on the engine body to prevent its vibration.

It may be one of factor the communication abnormal.

- Connect only one end of the sensor wire with the controller.
- Set the termination setting DIP switch ON for the terminal sensor, and OFF for other sensors.
- Set the node setting switches in different settings from each other for sensors on a same engine. It is acceptable to have the sensor nodes in the same setting as on other engines.

9.1 CABLE

- (1) Use a “cable with both-ends connector” for wiring between sensor units (for standard type sensors). And use a “cable with a single-sided connector” between a sensor unit and a controller.

Minimum Bend Radius of cables : 30mm

- 1) Cable with both-ends connector ... Between a sensor and a sensor
(The lineup of wiring length: 1 to 10 m by 1 m, the lineup of wiring length: 15 to 50 m by 5 m.)

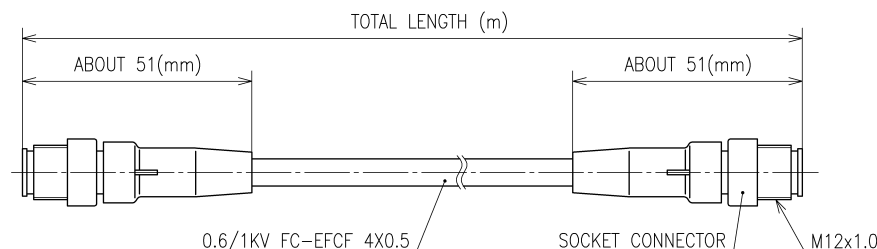


Fig. 19 Cable with both-ends connector

- 2) Cable with single-sided connector ... Between a sensor and controller
(The lineup of wiring length: 2 to 15 m by 1 m, the lineup of wiring length: 20 to 50 m by 5 m.)

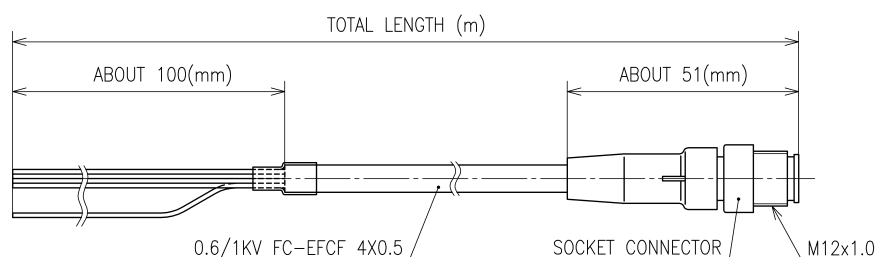


Fig. 20 Cable with single-sided connector

Notes) Daihatsu diesel can provide this special cable.
In the case of ordering, please specify necessary length.
When you need it anything other than normal length, please consult with Daihatsu.
Shape of a connector can be changed. But connection is compatible entirely.

- (2) A general cable for ships (batch shielded cable with 4 or more cores) can be used between the junction box (terminal box) and controller when the junction box is installed on the engine body.
But use a Daihatsu option cable for the wiring between sensor units, and between a sensor unit and a junction box.

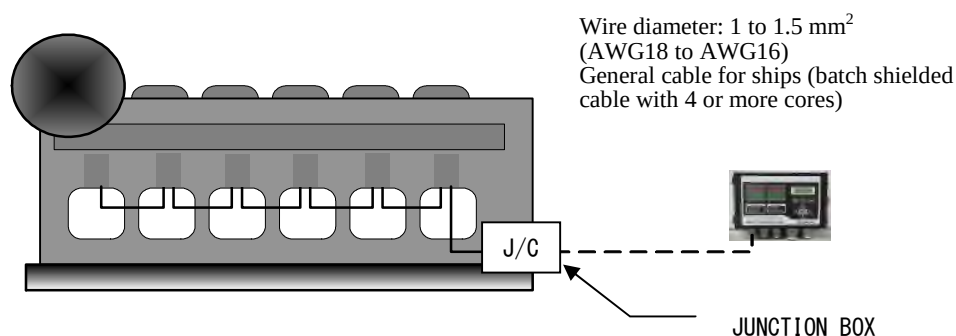
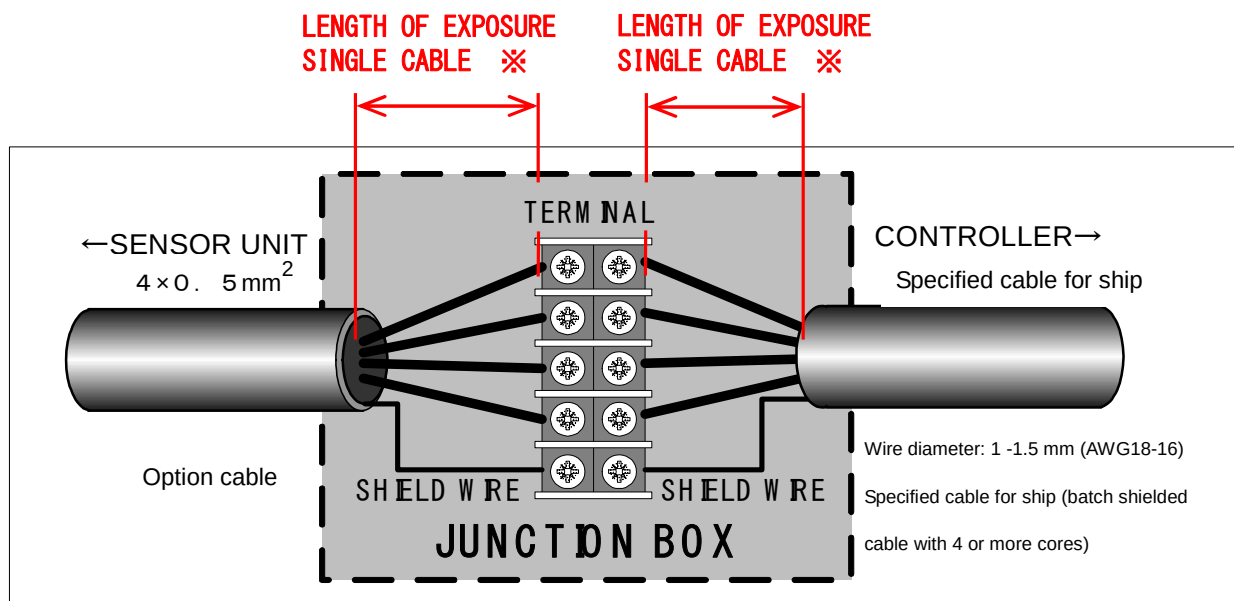


Fig. 21 In case of install the junction box between the controller and sensors on engine



**Fig. 22 Specification for connection with the junction box
(Terminal box)**

Install 5 terminals in a same junction box for the engine control signal line and above wiring lines.

Caution) The shield wiring terminal in junction box connects only the shield of the cable and please do not be connected to other shield line terminals or the grounding terminal. It causes the missworking of the equipment by noises.

※Please minimize to less than 100mm for the length of single cable including shield Cable which exposes from outer skin.

The color of cable jacket of Daihatsu optional cables are shown at this table.

When you connect the Daihatsu optional cable to the general cable for ships, distinguish the power supply lines and the communication lines with a color of cable jacket, and connect it without wrong.

Table) Relation between Wire Colors and Corresponding Functions

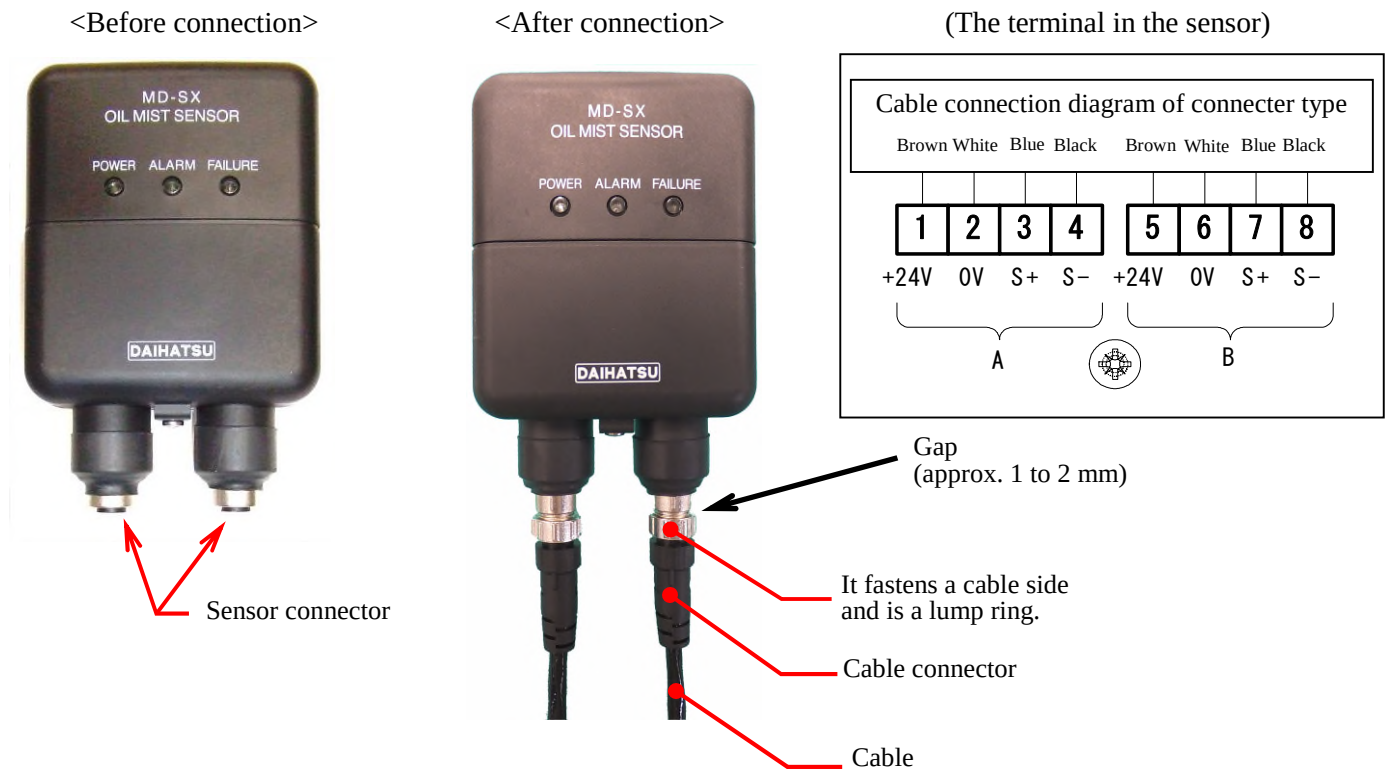
Daihatsu option cable (4x0.5)		
Wire color	Name	Signal type
Brown	+24 V	Power supply line
Blue	0 V	
Gray	S+	Communication line
Black	S-	
Shield wire		Shielded wire



※ When the equipment is installed, replaced works or during wiring, cabling works, please execute not only the switching off the controller but also the switching off the outer terminal of the controller and the power supply all together

9.2 Wiring of the sensor

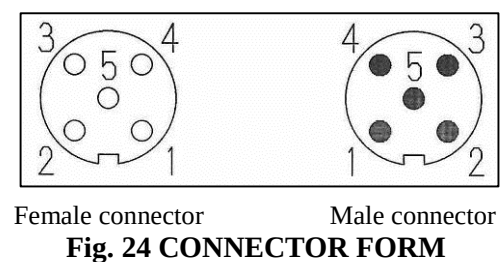
- (1) Cable for connection : Daihatsu option cables
[Cable with both-ends connector] or [Cable with single-sided connector]
- (2) Connection topology : Daisy chain
- (3) Connection method : Connector - Connector



Cable connection diagram of connector type

Fig. 23 Connection of sensor and wiring (Connector)

- (4) Connection method of connectors
The connectors have polarity.
The sensor side is female connector.
The wiring side is male connector.



- 1) The connectors have a position to fit.
Connect the cable connector to the sensor connector while checking that the inner pins of the cable connector can be inserted into the holes of the sensor connector.
Notes) Please do not look for the fit position after putting connectors together.
The connector pins may be broken, and the broken pins may cause imperfect contact.
- 2) Tighten a cable side fixing ring with your hand enough.
After tightening, there will be a gap of approximately 1 to 2 mm between the sensor connector and the cable connector. This gap will not cause any problems.
Notes) Please set the termination and node settings to the sensors necessarily after wiring work was over. And attach a dust cover (option) to an unused connector of a sensor unit of end.

9.3 Wiring of the controller

- (1) Wiring: Use the following cables for wiring.
- Grounding line : 1.5 mm² (AWG14) 1 wire
 - Power supply (24 V DC) : 1.5 mm² (AWG14) 1 wire
 - Communication line:
 (Between the sensor units and controller) Daihatsu option cable (4 × 0.5mm²) 4 lines
 (When a junction box is installed) 1.5 mm² (AWG15)
 - For contact outputs : In case of one engine : 3 contacts
 In case of two engines : 5 contacts
- (2) Terminal connection: Clamp type terminal block

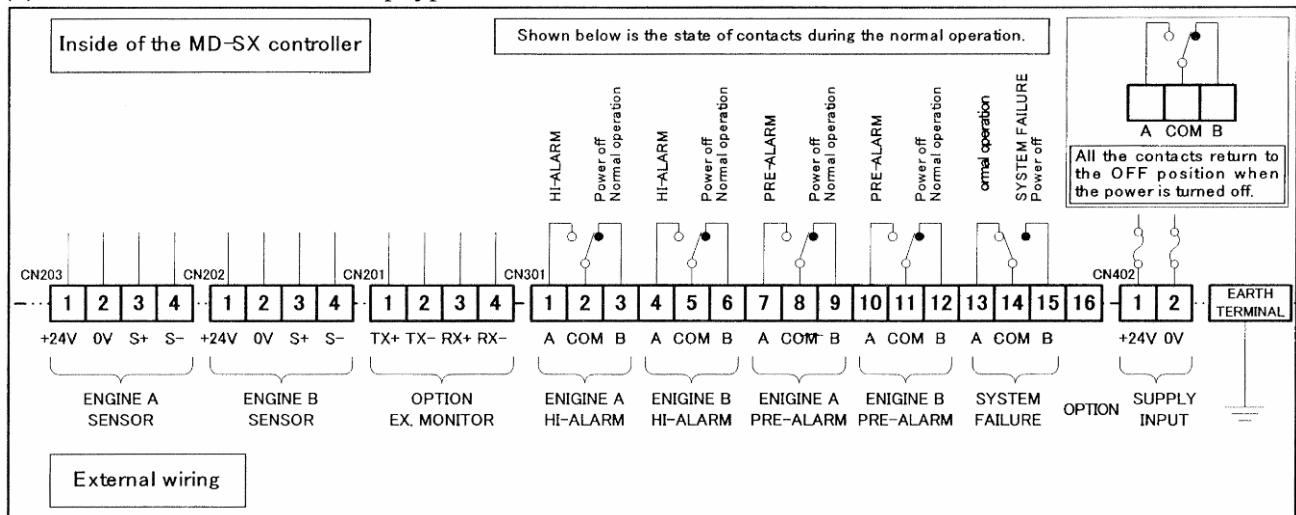


Fig. 25 Controller terminal arrangement diagram

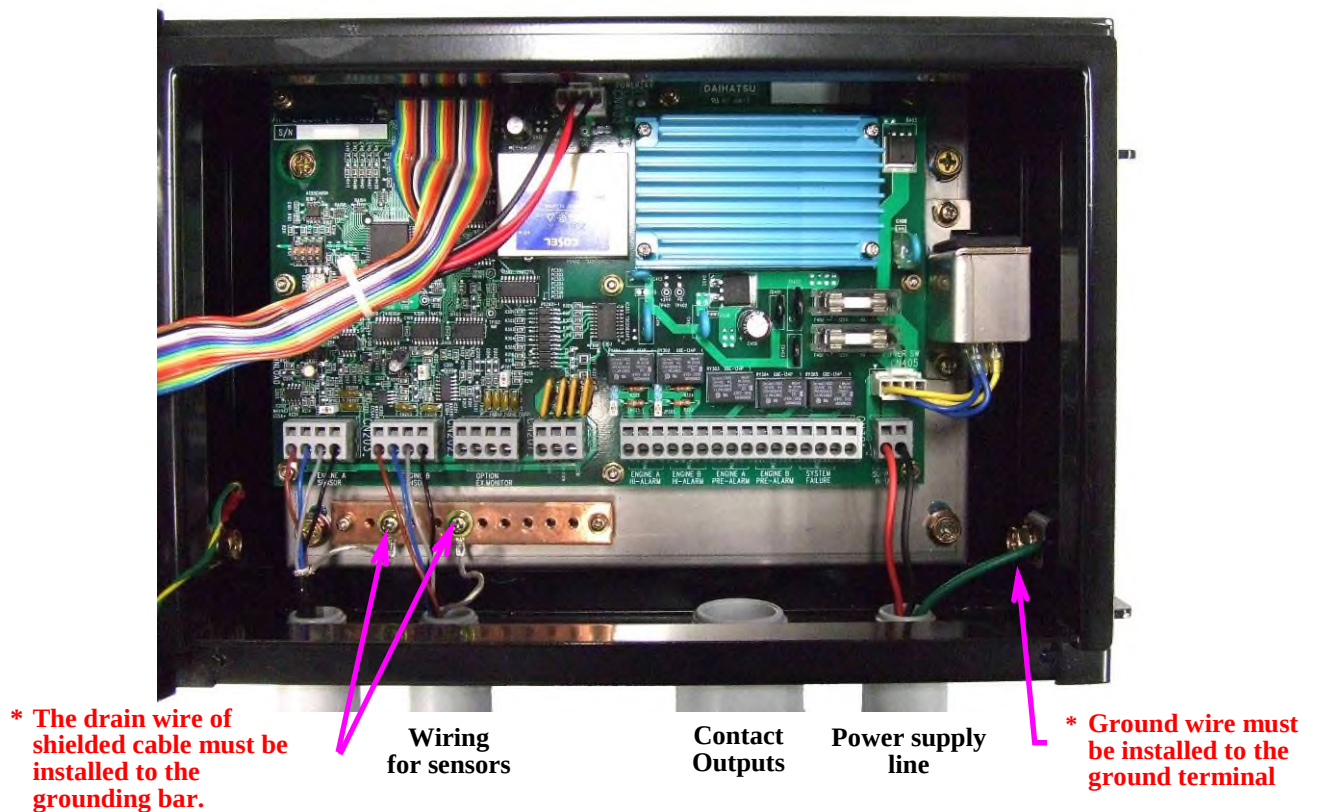


Fig. 26 Schematic drawing of the controller external wiring connections (for two engines)

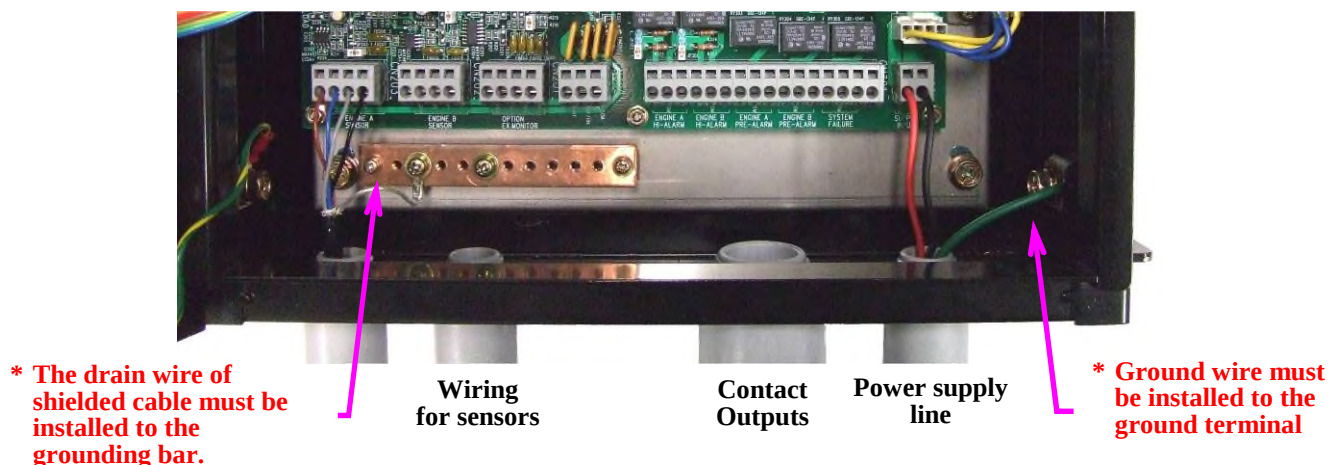


Fig.25 Schematic drawing of the controller external wiring connections (for one engine)

- Connect the sensor wires on the [ENGINE A SENSOR] side when one engine is involved.
- Connect the sensor wires respectively with the [ENGINE A SENSOR] for one engine and with the [ENGINE B SENSOR] for another engine when two engines are involved.
- Always pull the shielded-conductor cable out and connect it with the grounding bar installed in front of the terminal block inside the controller for sensor wires.
- Always connect the grounding wire with the grounding terminal at the lower right side inside the controller frame for grounding the system.
- The terminal block is of the clamp type. See the wiring instruction manual to correctly wire the controller.
- Do not connect to the [OPTION EX. MONITOR] and the [OPTION] terminals.
- Isolate wires for the controller from those for the motor, and solenoid valves and for the power supply lines to prevent noise impacts.
- As various sizes of marine use gland packing suitable for the wiring are supplied with the detector, use the correct size gland packing.
- Refer to the next chapter to set the wire disconnection detecting resistor if the resistor is required to detect disconnection in the alarm setting off wire as the wire disconnection detecting resistor is installed in the control unit.

Note) The drain wire of shielded cable for communication line to the sensors must be connected the grounding bar. The ground wire for power line must be connected to ground terminal. Otherwise the detecting performance may be deteriorated.

※Please minimize to less than 100mm for the length of single cable including shield Cable which exposes from outer skin.

(3) Cable gland and selection of the correct type gland

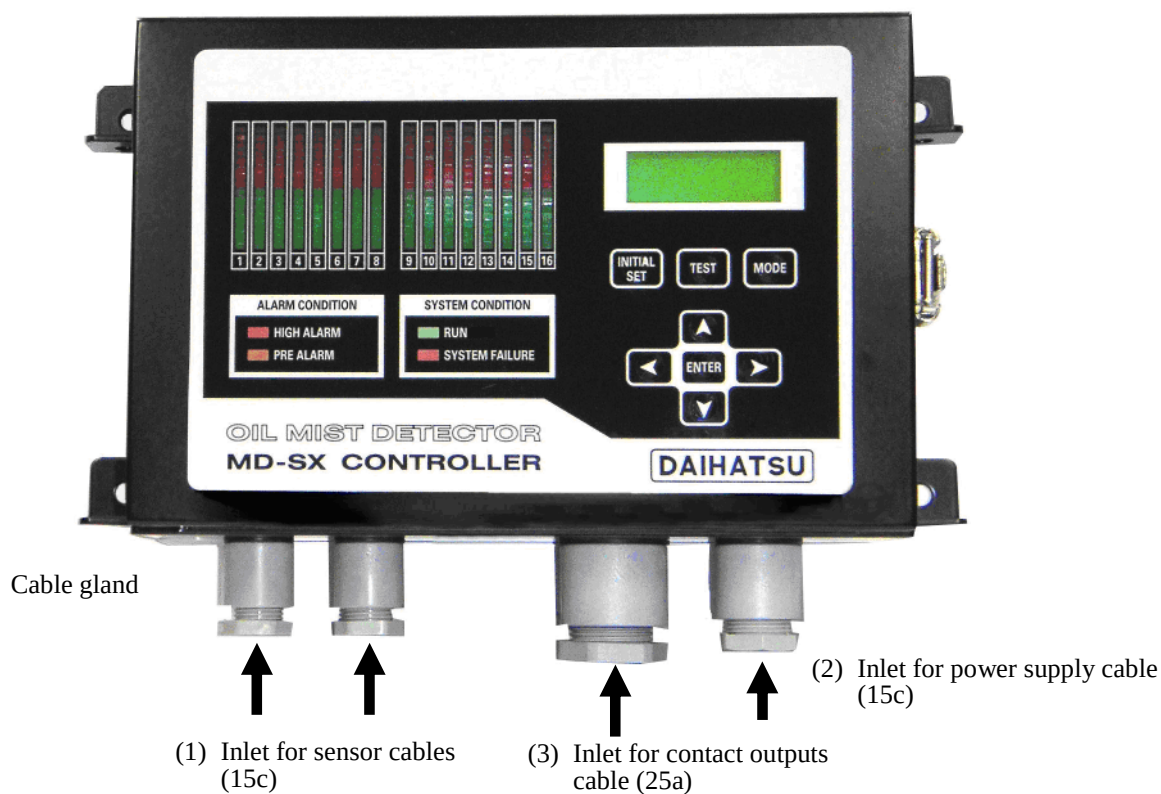


Fig. 28 Controller cable inlet hole

Cable gland :	For sensor units	:	Cable gland	15c × 2 sets
	For power supply	:	Cable gland	15c × 1 set
	For contact outputs	:	Cable gland	25a × 1 set

The rubber packing of the cable gland should be different in size depending on the wire diameter to be connected with the controller.

As suitable sizes of the rubber packing are supplied with the detector, select the correct size when replacing as follows.

- 1) For sensor units line: Gland size 15c
 - Option cable “4x0.5mm²” : Change the packing to the supplied packing (bore diameter 7 mm).
 - Cable for ships : Installed packing (bore diameter 13 mm)
- 2) For power supply line: Gland size 15c
 - A packing with the bore diameter 13 mm should be incorporated in the wiring gland.
- 3) For contact outputs line: Gland size 25a
 - A packing with the bore diameter 16 mm should be incorporated. Or a packing with the bore diameter 18 mm is supplied with the controller.

9.4 Setting of resistance for detecting disconnection

The setting of the resistance for detecting disconnection of the controller safety circuit (High-alarm) can be changed by changing the specified jumper positions on the board.

The jumper has been normally fitted to the pins 1 and 2 (open) before shipment.

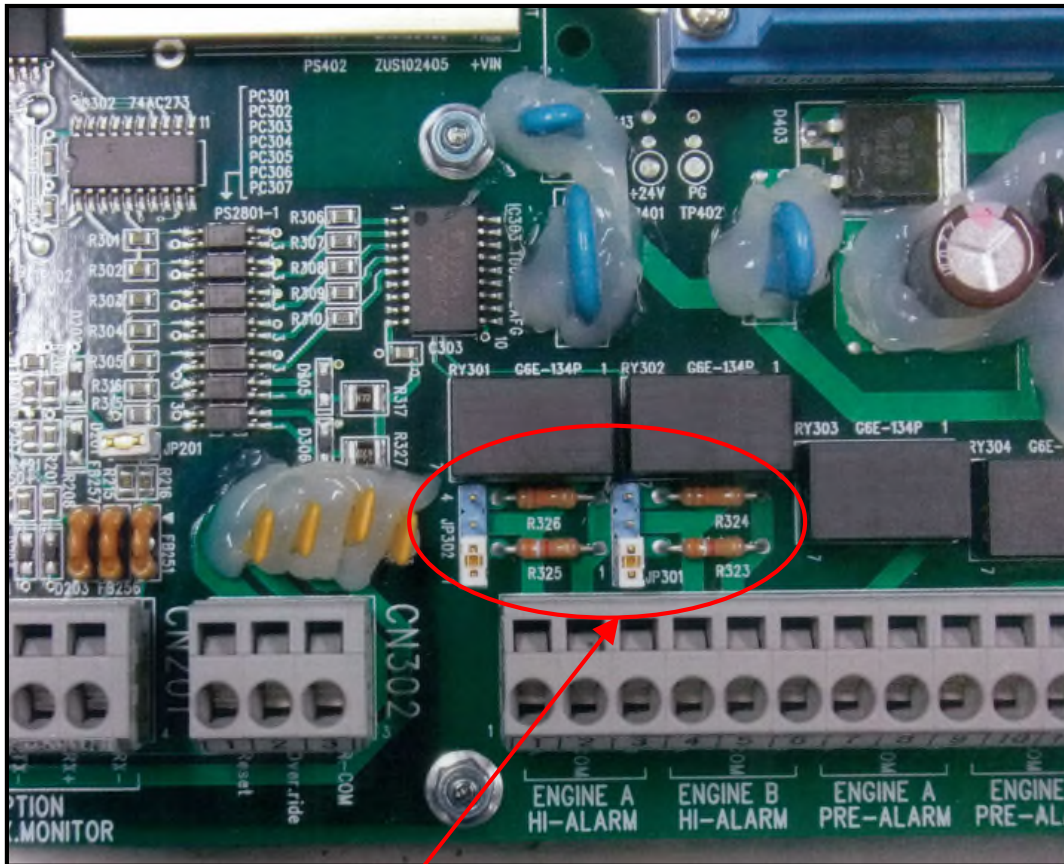


Fig. 29 Resistance for disconnection detection (The mounting part of a jumper setup)

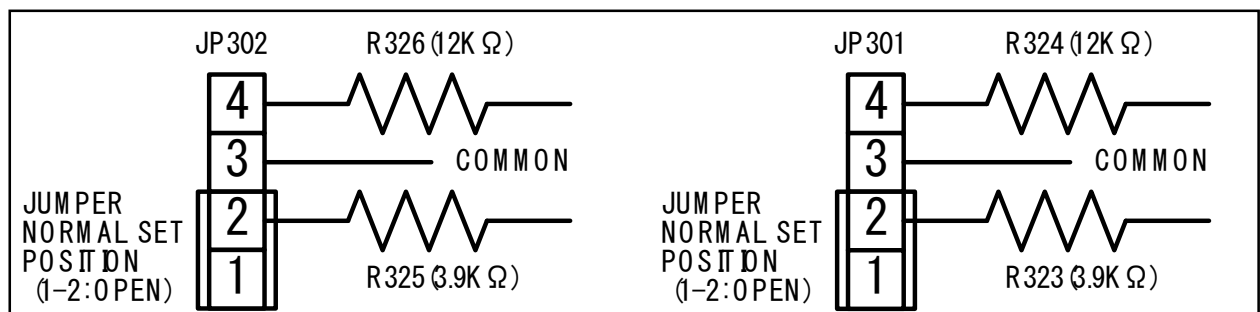


Fig.30 The circuit of resistance for disconnection detection

The jumper settings are shown below. Set the jumper according to the specified resistance value.

JP302 (ENGINE-A HIGH ALARM)	JP301 (ENGINE-B HIGH ALARM)
Jumper between 1 and 2: Open	Jumper between 1 and 2: Open
Jumper between 2 and 3: 3.9 k Ω (R325)	Jumper between 2 and 3: 3.9 k Ω (R323)
Jumper between 3 and 4: 12 k Ω (R326)	Jumper between 3 and 4: 12 k Ω (R324)

9.5 Wiring of the gland type sensors

Using the sensor of “gland type”, connection work for “Terminal Block” is necessary. The connection and method of wiring work for Terminal Block, please refer to [9.6 Cautions in wiring].

- (1) Loose screw fastening the slide cover and slide the slide cover to reveal the terminal block.
- (2) Wiring connection refer to Figure 26 [SENSOR TERMINAL BLOCK LAYOUT].
- (3) Set the termination and node settings to the sensors necessarily after wiring work was over.

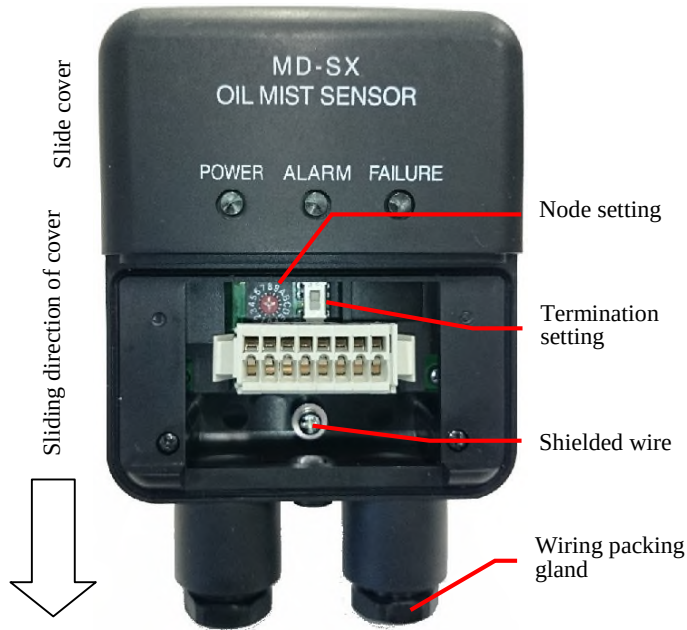


Fig. 31 Cable connection diagram (gland type)

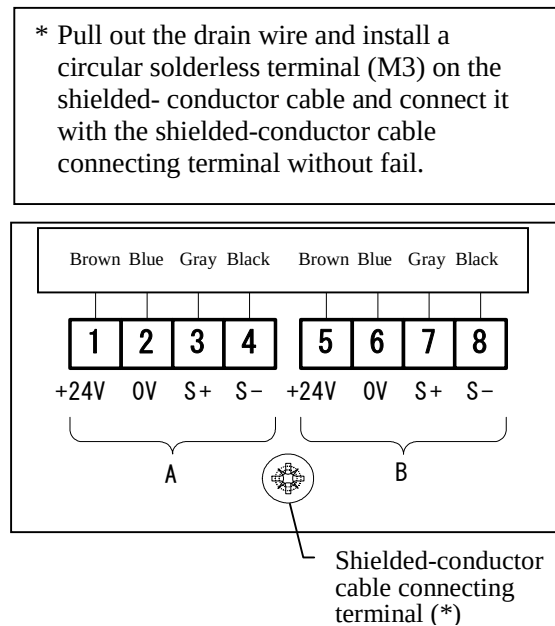


Fig.32 Sensor terminal block layout

9.6 Cautions in wiring

The solderless terminal is not required for other connection terminal blocks as the clamp type (no screw) terminal blocks are used for them. See the wiring instruction for correct wiring as follows.

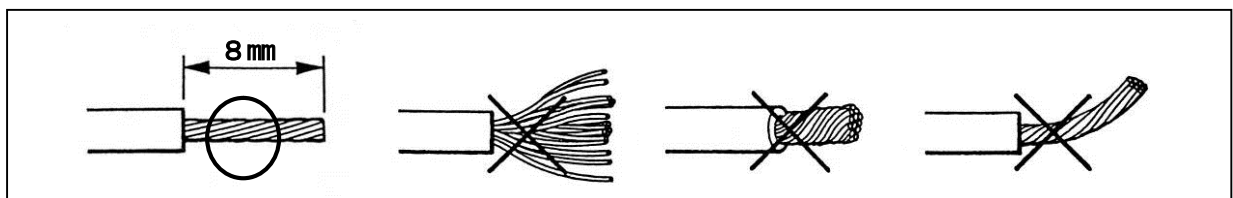
As connectors are equipped with the sensor unit terminal blocks, remove the connectors by pinching the locking devices on both ends of the connector and pulling the connector out if they make wiring difficult.

Connect the shielding wire to a “shielded-conductor cable connecting terminal” in a sensor unit with circle solderless terminal.

- (1) Wire end treatment for cables to be connected with the control unit and sensor terminal block:

Always bare wiring cable ends in correct length.

Bare the wiring cable end again if the core wires loosen, too tightly twisted, or bent.

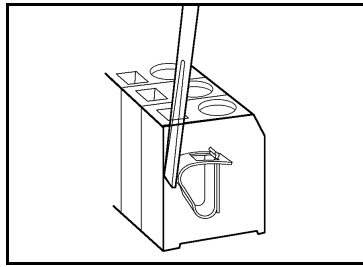


- Wire size to be used
 - Sensor cable: $4 \times 0.5 \text{ mm}^2$

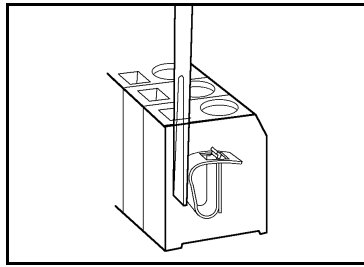
Fig.33 Wire terminal treatment

(2) Wiring procedure

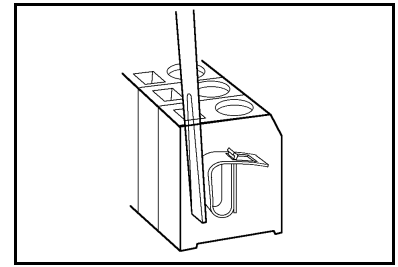
Use the supplied special tool or 2.5 to 3.5 mm wide flat tip screwdriver.



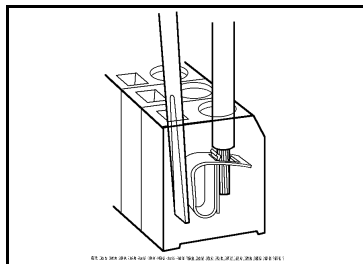
1) Insert the screwdriver at an angle in the setting slot (square hole).



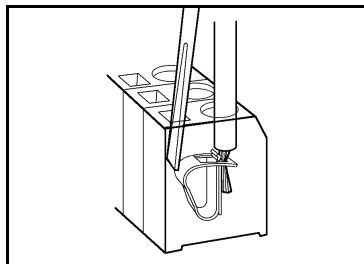
2) Straighten up and insert the screwdriver to the full depth.



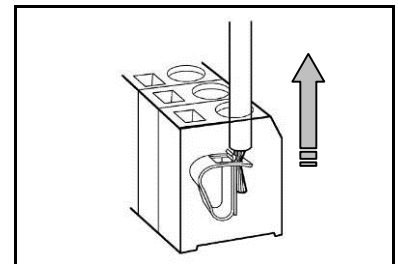
3) If properly inserted, the screwdriver can stay straight in the slot when hand is take off.



4) Insert a properly bared cable in the cable hole (round). You can smoothly insert the cable by sliding it along the edge of the hole.



5) Insert the cable until it hits the bottom, and pull the screwdriver.



6) Lightly pull the cable to check it is securely installed. (Do not pull it too hard.)

Fig. 34 Connector wiring point figure

* Insert a screwdriver in the same way as to install the wire if the wire must be pulled out.

Cautions in use

1. Always bare the cable end in the specified length with care not to damage the core conductor. Using the cable bared in the wrong length at the end or with the core damaged may cause insulation defect, poor contact, or wire disconnection.
2. Lightly pull the cables one by one to check they are not easily pulled out after wiring. Using the system without making sure the cables are tightly connected may cause poor contacts or wire disconnections.
3. Be careful the cable tension (twisting stress) is not directly applied to the cable conductor and contact points of the terminal block. If the cable tension is directly applied, cable poor contacts or disconnection may result.
4. Use correct bore diameter cable gland packing to securely tighten the packing to fix cables in place. Loosely tightened packing may cause damage and disconnection in the cables by vibration during use, resulting in poor wire connection.
5. Do not apply excessive force when loosening the spring, otherwise the housing may be damaged.

10. INITIAL SETUP

10.1 Initial setup of sensor units

After fitting the sensor units on the engine, initialize the units while the controller power is off.

Remove the lid of the sensor unit case, and operate the internal setting switches.

How to take off the cover : for slide type Slide the cover to downward.

: for screw type loosen the screw on four parts.

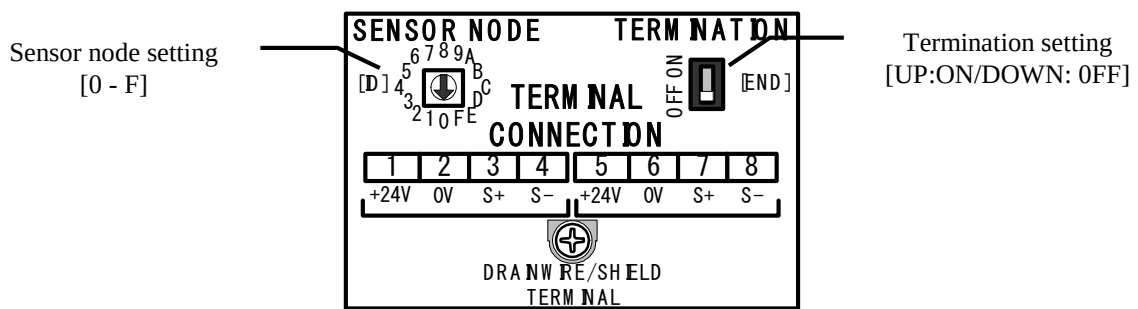


Fig. 35 Sensor terminal outline

(1) Sensor (communication) node setting:

Setting necessary for the controller to recognize each sensor unit.

Set the rotary switch (16 channels) in the sensor unit to the specified position ("0" to "F").

Please set the node number from "0" sequentially from a No. 1 cylinder not to overlap.

When one engine is connected

Controller channel	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Rotary switch setting position (Node No.)	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F

When two engines are connected

Engine	ENGINE A								ENGINE B							
Controller channel	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Rotary switch setting position (Node No.)	0	1	2	3	4	5	6	7	0	1	2	3	4	5	6	7

(2) Termination (terminator) [ON/OFF] setting:

Only turn on last connected sensor from the controller to "ON" .

* After the completion of setting of the internal switches, fit the slide cover to the sensor unit case.

10.2 Initial setup of controller

After the completion of the initial setup of the sensor units, initialize the controller with power on the controller. Refer to [11. OPERATION] for the operation procedure of the controller from initial setup to run.

Initial setting menu is displayed interactively on the Liquid Crystal Display (LCD).

Please set it up in order.

(1) **Initial setup:**

Set the following parameters for conditions of connection of the sensor units using the key switches.

- 1) Number of engines to be monitored by the controller (1 engine or 2 engines)
- 2) Number of connected sensor units
- 3) Sensor units to be excluded from calculation of mean values

(2) **Full-load setting:**

By the full load setting during operation of the engine(s) under the maximum load, you can adjust the maximum mist density during normal engine operation to the standard value (No. 3 on the mist indicator). The alarm value will be optimized by this setting.

If the full load is not set, the No. 0 mist indicator lamp of each channel will flash.

* About Full load setting

The oil mist concentration in crankcase of a diesel engine varies significantly depending on the difference of the engine type, each cylinder and operating conditions.

Therefore, normally, the full-load setting is performed based on the maximum mist concentration during normal operation of the engine, such as the engine running under the maximum load. Some engines might be occurred between 75% and 100% load, so that “PRE ALARM” is detected at about three times higher mist concentration and “HIGH ALARM” is detected at about five times higher mist concentration.

The alarm setting values are automatically set the optimal value by the “Full load setting” operation for all sensor units.

* The full load of the controller is set to the default value before delivery from our plant.

(When the digital value is “100”, the “PRE-ALARM” value will be set to approximately 0.6 mg/L, and the “HIGH ALARM” value will be set to 1.0 mg/L.)

※ After full load setting of the controller at maximum load, please do the full load setting of the controller on the operating condition again in case of indicating more than 3rd position out of 15th position of the mist indicator on the controller without engine abnormal.

11. OPERATION

Described in this item are steps from the first power ON, initial setting, and full load setting to the actual operation.

For the other operation functions and details, refer to the "MD-SX OPERATION MANUAL" (Q7LT333380F).

11.1 Checks before turning the power on

Always check the followings before turning the power on for the first time.

- If the system is correctly wired according to the specification
- If the sensors and controller are correctly installed
- If the required 24 V DC power is properly supplied
- If the sensors are correctly set for node and termination

11.2 Steps from the first power ON to practical operation

Shown below is the flow diagram for settings to be made from the power ON to the actual operation

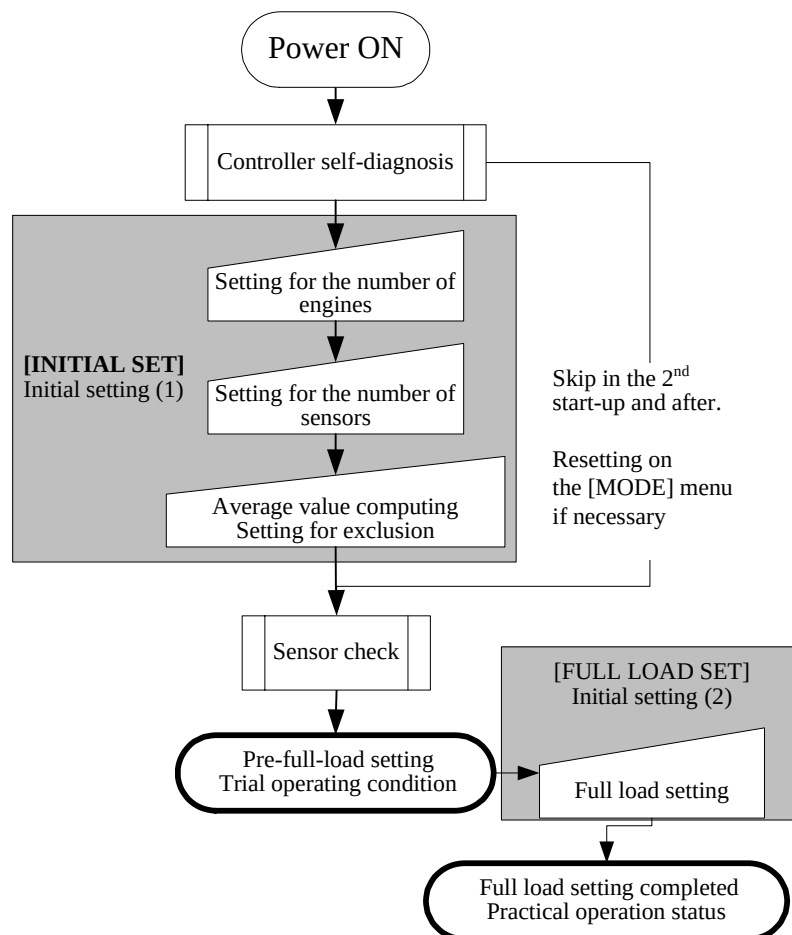


Fig. 36 The flow of steps when starting

(1) Power ON

Unlock the snap type lock or the knurled lock on the right side of the controller, and then open the panel front side toward the left side.
Turn the power switch on.

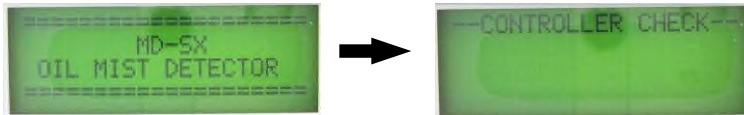
The power is supplied to the system and the controller begins the self-diagnosis after the power switch is turned on.

All the LED lamps are lighted for 3 seconds during the controller check (self-diagnosis).

The initial setting screen is displayed on the LCD unit. Proceed with settings as the setting screen progressively indicates.

(2) Controller check

The controller checks itself (controller self-diagnosis) after the power is turned on.



(3) Initial setting: To set the number of engines and sensors

After the power is turned on for the first time, the initial setting must be carried out (the initial setting screen is displayed).

After the completion of initial setting, the initial setting process is skipped and the system jumps to the trial or normal operating condition when the power is turned on next time and after as the initial setting is not repeatedly required.

- 1) Set the number of engines to be monitored by selecting 1 or 2 engines and defining the selected number by pressing the [ENTER] key.



- 2) Set the number of sensors to be installed per engine. Use the upward and downward arrow keys to select a number and define the selected number by pressing the [ENTER] key. When two engines are involved, identify the engines with ENG.A and ENG.B respectively at first.



(4) Initial setting: To select a sensor to be excluded from the average value computing

To select a sensor to be excluded from the average value computing

If it is necessary to monitor the chain case, the corresponding sensor should be excluded from the average value computing. This is because the mist density of the chain case may differ from that of the crankcase, and in this case, the deviation alarm may not be activated correctly.

- 1) Use the arrow key to move the cursor to the sensor to be excluded from the average computation, and press the [ENTER] key to turn [0][1] dark. The [0] represents the item to be excluded from and [1] represents the items to be included in the average computing. Turn the [0] dark for the sensor to be excluded, move the cursor to the [ENT] position, and press the [ENTER] key to define the selection.



- 2) Move to the next process when the initial setting complete message is displayed.



(5) Sensor check

Try to communicate with the sensors set on the controller, and one of the following messages is displayed.

[*]: Sensor in trouble

[1]: Sensor in normal condition. The sensor is recognized.

[−]: No sensor is connected.

Move to the screen showing the troubling location if any of the sensors is in trouble. If not, move to the next process.



If a sensor is in trouble

(6) Full load setting is yet to be carried out and the system is in the trial operating condition.

The MD-SX detector can properly operate only when [full load setting] is carried out for the mist density under the full load. If the screen as shown below is displayed, it indicates [full load setting] is yet to be carried out and the system is operating with the alarm setting-off value set as the initial value. The alarm condition can be detected in this condition, but always apply full load on the system to properly set for the full load.



11.3 Full load (mist density level) setting

The full load misty density level must be set in practical operation mode to properly operate the detector.

Operate the installed engines under full load for a certain time. When the operation is stabilized, set the full load.

If the engines are not to be operated steadily under full load, set the mist density level under the highest load in normal operation.

- 1) Press the [INITIAL SET] key for 3 seconds or longer under the full load running.



- 2) Select the SET item and define the selection by pressing the [ENTER] key, and the “setting complete” message is displayed. If the CANCEL item is selected, the setting screen is closed and the detector returns to the trial operating mode.



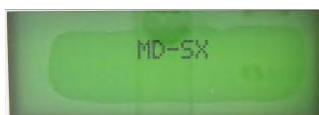
The full load mist density level setting is necessary for each engine when two engines are involved.



You can confirm by selecting the “4. status” item on the engine selection screen if the full load setting is completed for each engine when two engines are involved.



When the mist density is set under full load as the last setting item, the detector becomes operational in practical condition.



* You can repeatedly set the full load.

Operate the installed engines under full load. When the engine operation is stabilized, set the full load.

11.4 Initial reset

This is the function to repeat the initial setting carried out when the MD-SX is turned on for the first time. For instance, when the initial setting is improperly carried out, the number of sensors or of engines must be changed, or the computed average value must be changed, you can carry out the initial setting again from the beginning with this function.

- (1) Press the [MODE] key to display the menu below.

Select the 「2. INITIAL RESET」 item.



- (2) Select the "OK" twice and now you can carry out the initial setting from the beginning (setting of the number of engines.)



- (3) Set the number of engines, number of sensors, and items to be excluded from average value computing according to the displayed menu.



11.5 Alarm operation check

This is the function to check if the MD-SX properly detects mist and if the system properly operates.

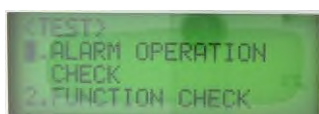
You can check if the system properly operates by temporarily setting one sensor unit at the alarm setting-off level lower than normal to force the system to set off "PRE ALARM" and "HIGH ALARM" with the normal oil mist density during the engine in operation.

The alarm operation check can be carried out also during an engine stop. Unite a setting value with the same value as a current value. (An alarm comes out instantly.)

The display automatically returns to the normal operation screen if the system is not operated for 10 minutes after the start of the ALARM OPERATION CHECK.

- (1) Press the [TEST] key to display the following menu.

Select the 「1. ALARM OPERATION CHECK」 and press the [ENTER] key to define the selection.



- (2) Select a sensor to temporarily lower the setting value by scrolling the screen with the upward and downward arrow keys.

Select the sensor and press the [ENTER] key to define the selection.



- (3) Set the HIGH ALARM level for the selected sensor.

The value currently detected is displayed (5 is displayed as an example here), and the value of about 10 above the currently displayed value (15 as an example here) is automatically set as the HIGH ALARM level.

Increase or decrease the automatically set value as required with the upward and downward arrow keys and press the [ENTER] key to define the final value.

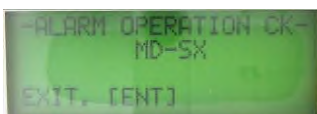


- (4) The currently detected value and set value are displayed. Select the 「1. CHECK」 and press the [ENTER] key to start the test.



- (5) The 「ALARM OPERATION OK」 message is displayed during the test process, showing the detector is in the test process.

Press the [ENTER] key to suspend the test process if the process must be stopped.



- (6) Check the 「PRE ALARM」 and 「HIGH ALARM」 messages are displayed if the mist density exceeds the set level at the specified sensor.

Press the [ENTER] key to return to the normal operating screen.



12. TEST METHOD AND OPERATION CHECK (FOR IACS M10.13)

To check the HIGH ALARM and PRE ALARM functions or to check operation of sensors, refer to Section [11 OPERATION].

Sensors are calibrated before delivery from our plant. So the scales will not be changed.

At starting and stopping the engine during daily operation, check whether the mist levels indicated by the controller are increased. By this check, you can judge whether the sensors are operating properly.

When the engine can not be operated, the working condition of the sensor can be confirmed by the density difference between lubrication oil priming pump works and stops.

It can be checked the change of the mist level on the controller LCD when the engine working and stopped in daily operation check. If the mist level of engine working is increased more than that of engine stop, the oil mist detector can be judged normal.

However, if you have to check a sensor only without operating the engine, remove the sensor, correctly connect the cable, and then turn on the power of the controller.

After that, using the spray type smoke tester, directly spray the smoke to the removed sensor. Check whether the sensor can correctly detect the smoke.

In that work, sensor can be reacted earlier by reducing smoke leaving from sensor inside when all holes of sensor hood, except for the hole smoke is inserted are blocked by hand like photo34.



Fig.37 Spray test

13. APPROXIMATE VALUE OF MIST DENSITY

(1) Mist density

- 1) The oil mist density is expressed as the weight (mg) of oil contained in 1 liter of air.
It has been experimentally verified that 50 mg/L is the lower explosion limit of oil mist.
- 2) The oil mist density of an engine considerably varies depending on the engine type and operating conditions.
The specified “full-load setting” operation is performed to automatically set the sensitivity based on the maximum mist density during normal operation.
- 3) The oil mist detector is provided to detect overheat of bearings that can cause explosion of the crankcase at an early stage rather than to alert workers to the danger of the explosion.
Normally, the alarm can be given at 1.5 to 2.0% of the lower explosion limit density. The alarm is given in the early stage when the mist density starts increasing abnormally from the oil mist density during normal operation.

(2) Confirmation of mist density

The controller can indicate the mist density of 0 to 2 mg/L in the level of 「0」 to 「1023」 to inform you of the approximately calculated oil mist density besides indicating the oil mist level.

Some types of controllers can directly indicate the mist density in mg/L.

[Digital value of density / mg/L converted value / temperature of sensor fitted] can be displayed as follows;

- ① Press MODE key
 - ② 1. Chose STATUS
 - ③ 1. Chose MIST/ALARM LEVEL
 - ④ 1. Chose MIST/ALARM LEVEL : Display the digital value
「Value」×0.002=mg/L (Approximately)
2. Chose CONVERT TO [MG/L] : Display the mg/L converted value
3. Chose TEMPERATURE : Display temperature of sensor fitted part
- ※④ Function 2,3 may not be displayed if the version of controller is old version.

14. MAINTENANCE



Since the sensor unit is the maintenance-free type. After installing and starting operation of the sensor unit, it is not necessary to provide maintenance services for 3 years basically.

MD-SX sensor does not need the renewal parts.

Regarding the contamination of the lens surface, it is necessary to be cleaned the sensor hood section when the error code 17 which means the sensitivity decreased occurred and daily operation check.

Please refer to [16.3 Sensor cleaning procedure].

During engine operation, if the sensor unit is removed for maintenance or inspection, the alarm will be activated, and the engine protective relay may trip.

And please switch off the power of controller whenever the sensor is removed

To prevent activation of the alarm, disconnect the external output line from the controller, or take the other measures.

When disconnect the external wires from the terminal block, record the wire numbers so that they will be reconnected correctly. If necessary, mark the wires with the terminal block numbers.

If any problem is found as the result of inspection, see Section [15. Troubleshooting,] and take necessary measures.

(1) Checking for abnormalities (Check as needed.)

- 1) Check that excessive vibrations are not applied to the sensor units and they are fitted securely.
If the sensor unit is vibrated or loose, tighten the sensor unit.
- 2) Check for oil leak from the sensor unit mounting screws. If the oil leaks, reinstall the sensor unit while referring to Section [8 INSTALLATION].
- 3) Check that the controller main body does not show abnormal heat generation, vibrations or noises.
If a problem is detected, check the wiring conditions of the terminals and the input power supply voltage.

(2) Confirmation of indication of mist indicator LEDs (Check as needed.)

- 1) Periodically check the engine load factor at the start of the engine and during normal operation and the correlation between the load factor and the mist indicator LEDs.
- 2) Check that the mist indicator indicates “2” to “3” while the engine is operating at the rated conditions.
If the indication is improper, particularly if the indication of the mist indicator is remarkably high (in the yellow range), the engine may be disordered. In this case, check the engine.
If the engine is not defective, operate the engine with the full load, and check the engine again with the full load. In addition, set the full load again.

(3) Loosing of screws of various parts (Check every six months.)

- 1) Check for loosing of the rubber vibration insulators (if the rubber is fitted), and bolts for mounting the controller. If the rubber or the bolts are loose, tighten them.
- 2) Check for loosing of wire connections on the terminal block in the controller.
Check for loosing of the board mounting screws and wire connectors.
If screws or connectors are loose, tighten them.

(4) Check of operations of alarm LEDs and output relay (Check every six months.)

- 1) Check the operations of the alarm output relay according to 11.5 [Alarm operation check.]
In the test mode, you can check the indications of the mist indicator LEDs and the operations upon occurrence of PRE ALARM and HIGH ALARM.
- 2) Since noise, etc. can activate the HIGH ALARM function. To prevent such an alarm activation error, the HIGH ALARM function will be activated after confirmation and then held.

(5) Check of operations of “SYSTEM FAILURE” LED and output relay (Check when necessary.)

It is unnecessary to check the operations of these devices during normal handling. If the external output must be checked, its operation can be checked by simulating a nonconforming state as stated below.

- 1) Turn off the power switch in the controller, and temporarily disconnect the input wire on one side of the communication line to a sensor unit (No. 4 of terminal block CN203: TRX-).
- 2) Turn on the power switch, and a “System failure” will occur.
- 3) The “SYSTEM FAILURE” LED will light, and the output relay will function.
The mist indicator LED Nos. 10 to 12 will flash to indicate the system failure status.
- 4) The output relay is held. It can be restored by turning off power.
Turn off the power switch, and reconnect the disconnected wire correctly to restore the relay.

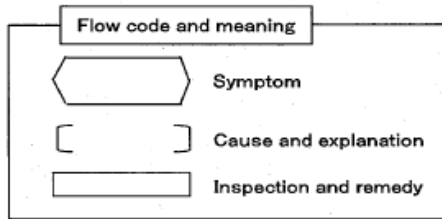
(6) Other check and maintenance

- 1) The service life of sensor units and controller depends on working conditions and environment (temperature and humidity). To obtain stable output, it is recommended to ask manufacturer’s inspection every eight (8) years, and please replace the new sensors if the engineer recommends to replace the sensors due to deterioration.
- 2) If a sensor unit is used for 3 years or more, clean the unit using the cleaning agent specified by Daihatsu, and then check the alarming operation of the sensor unit using a smoke tester.
- 3) The power switch shall be kept on to keep them in working state.
- 4) Watch out for the places where the sensor units and the controller are stored. If they are stored for a long term or during construction period, put vinyl sheets, or the like, over them to protect them from water, dust, and dirt.

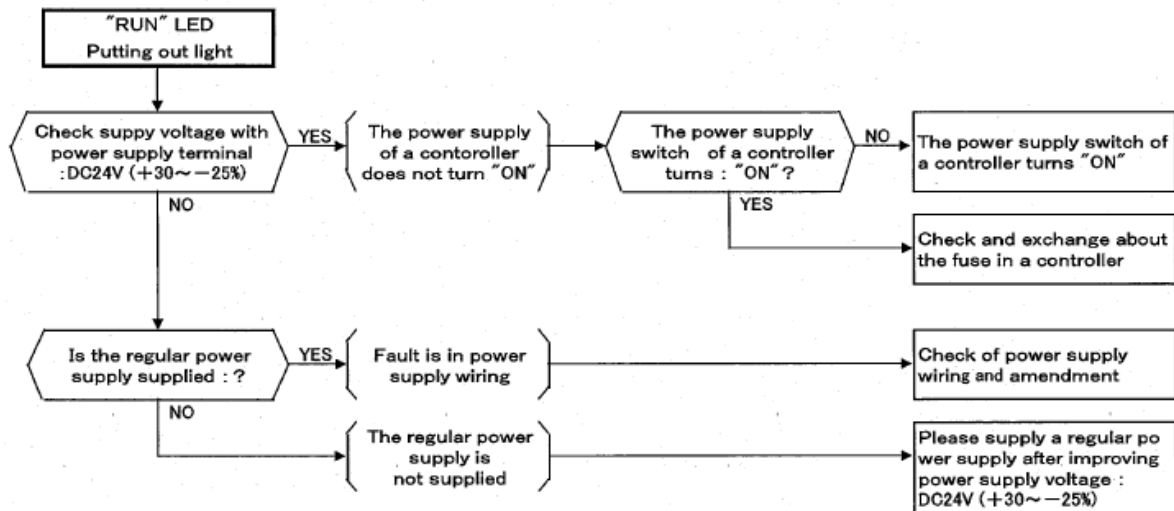
Note) When use of the MD-SX oil mist detecting system becomes it over eight years, you should ask DAIHATSU for system operation check and maintenance by Daihatsu engineer.

15. TROUBLESHOOTING

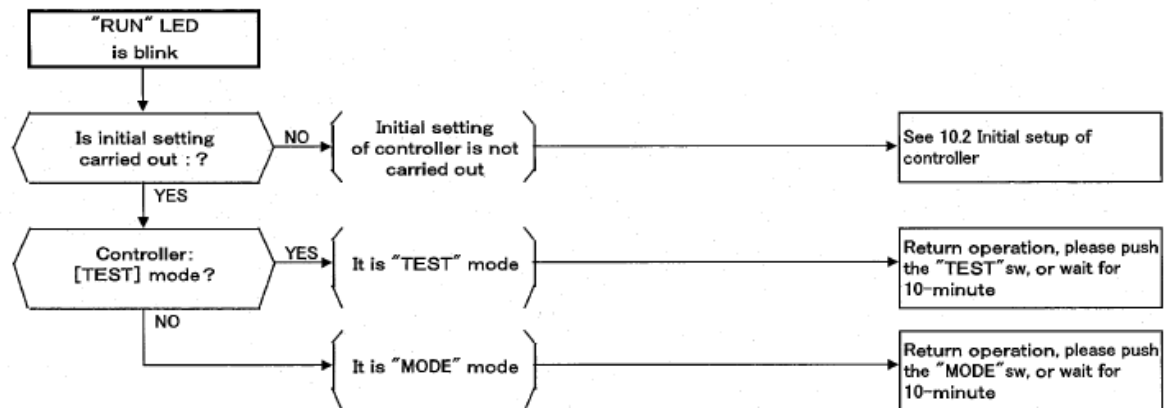
15.1 TROUBLESHOOTING by controller indicate



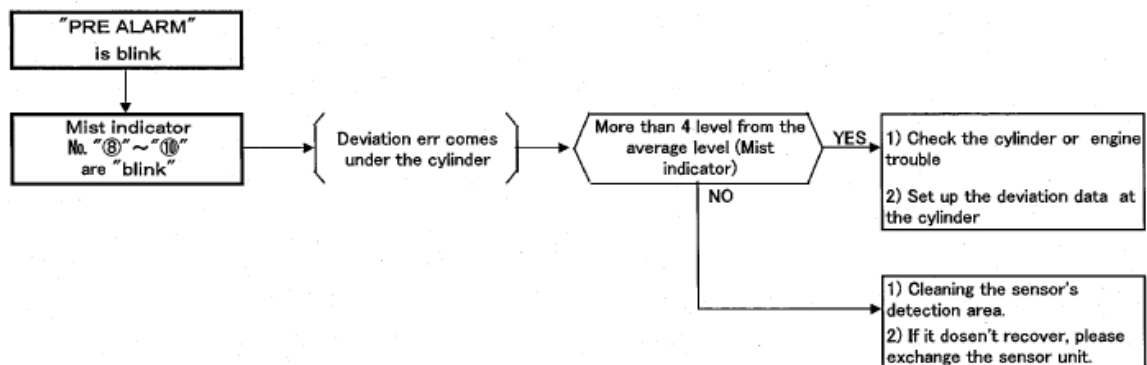
(1). In the case of "RUN" LED putting out light



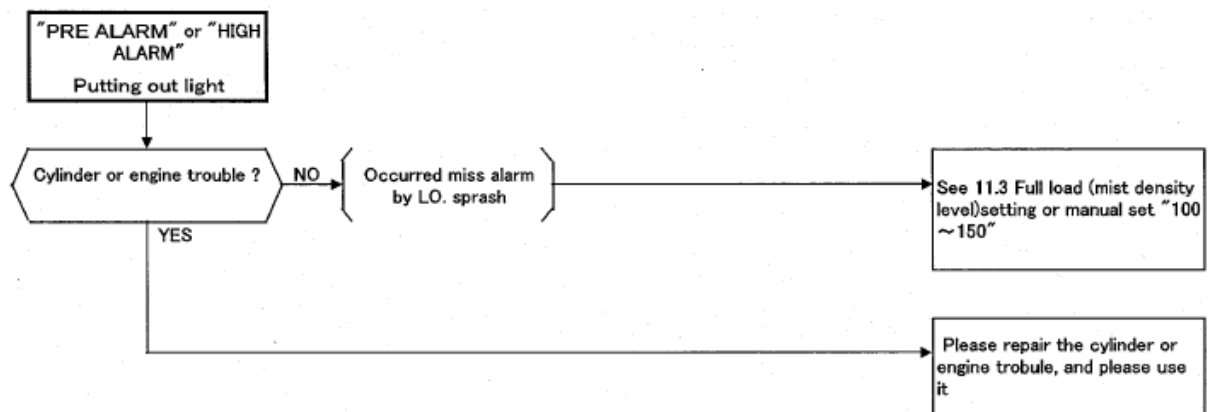
(2). In the case of "RUN" LED is blink



(3). In the case of "PRE ALARM" LED is blink LED

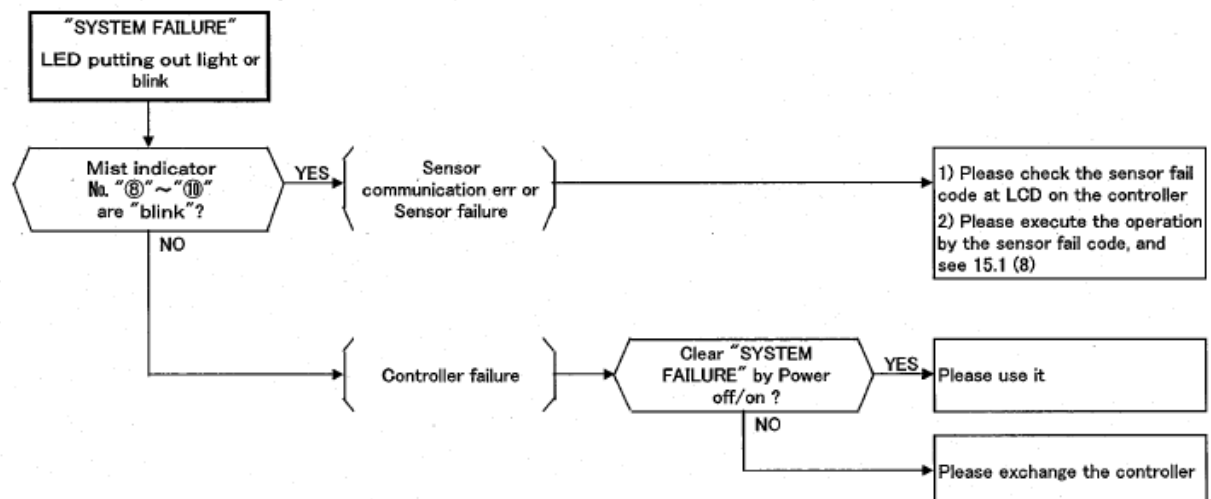


(4). In the case of "PRE ALARM" or "HIGH ALARM" LED putting out light

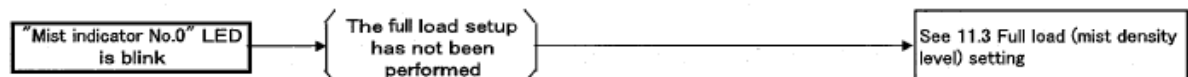


(5). In the case of "SYSTEM FAILURE" LED putting out light or blink

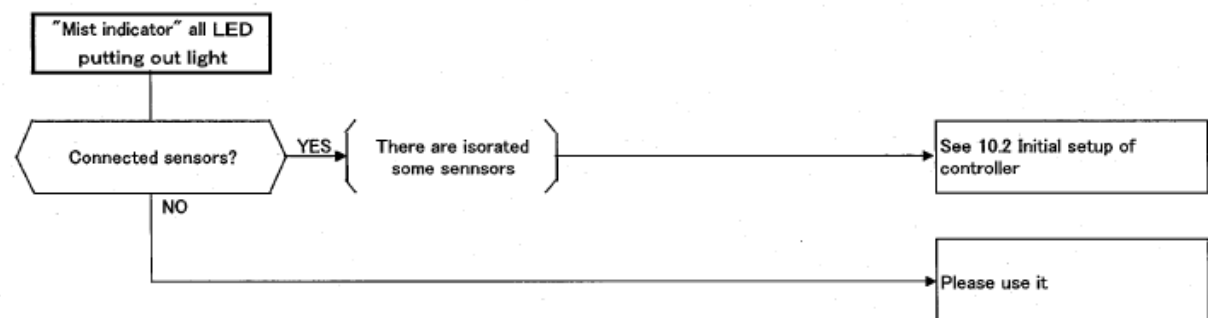
※ Please check the sensor fail code at LCD on the controller.



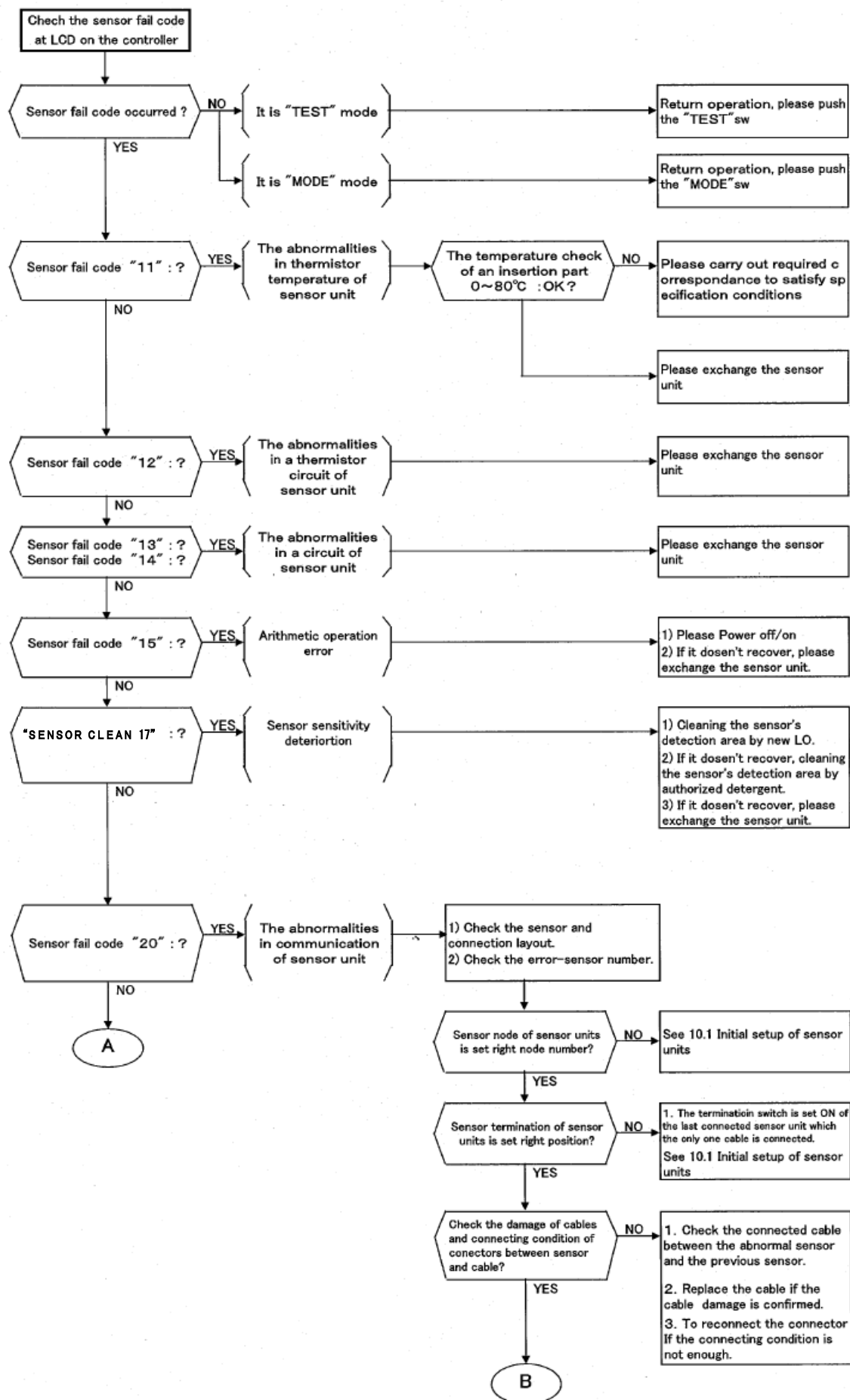
(6). In the case of "Mist indicator No.0" LED is blink

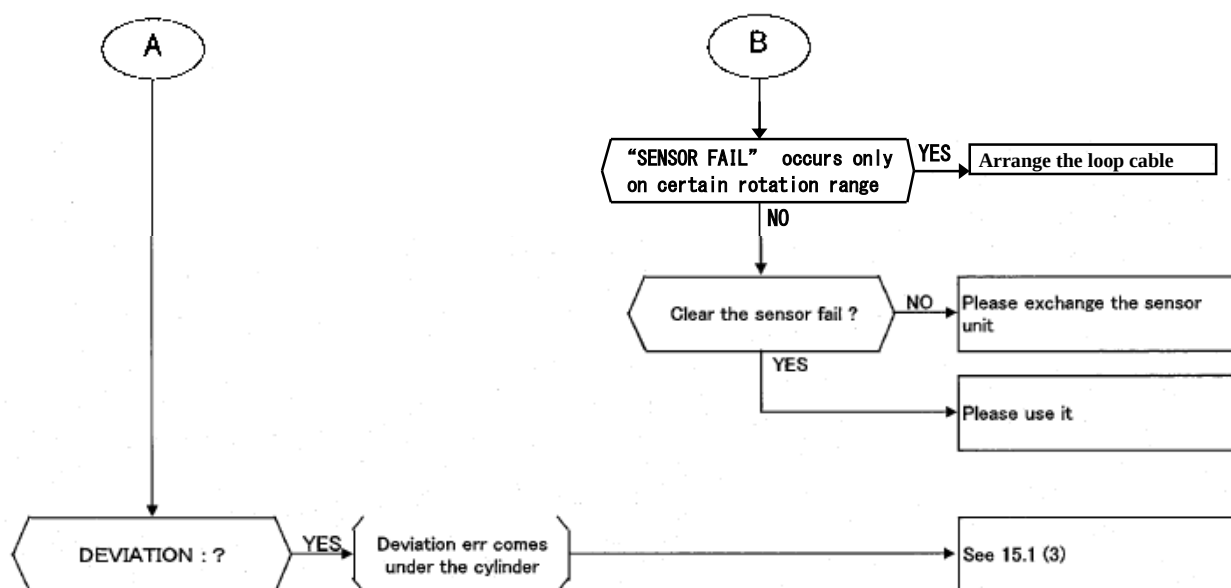


(7). In the case of "Mist indicator" all LED putting out light



(8). In the case, occurred "sensor fail code" at LCD on the controller





15.2 Sensor fail code at LCD on the controller

No.	Outline	Remedy
11	The abnormalities in thermistor temperature of sensor unit	Please check the temperature of an insertion part. If it has no problem of an insertion part, please exchange the sensor unit.
12	The abnormalities in a thermistor circuit of sensor unit	Please exchange the sensor unit.
13	EEPROM error	Please exchange the sensor unit.
14	The abnormalities in a circuit of sensor unit	Please exchange the sensor unit.
15	Arithmetic operation	Please exchange the sensor unit.
20	The abnormalities In communication Of sensor unit	Check the cable condition and connecting condition between sensor and cable. In case sensor fail occurs only on certain rotation range. Arrange the loop cable. In case no recover, replace the sensor unit.

15.3 Sensor clean code at LCD on the controller

No.	Outline	Remedy
17	Sensor sensitivity deterioration	Wash the sensor part of sensor unit. To check the sensor sensitivity after washing please use sensor checker available as optional parts. In case no recover, replace the sensor unit.

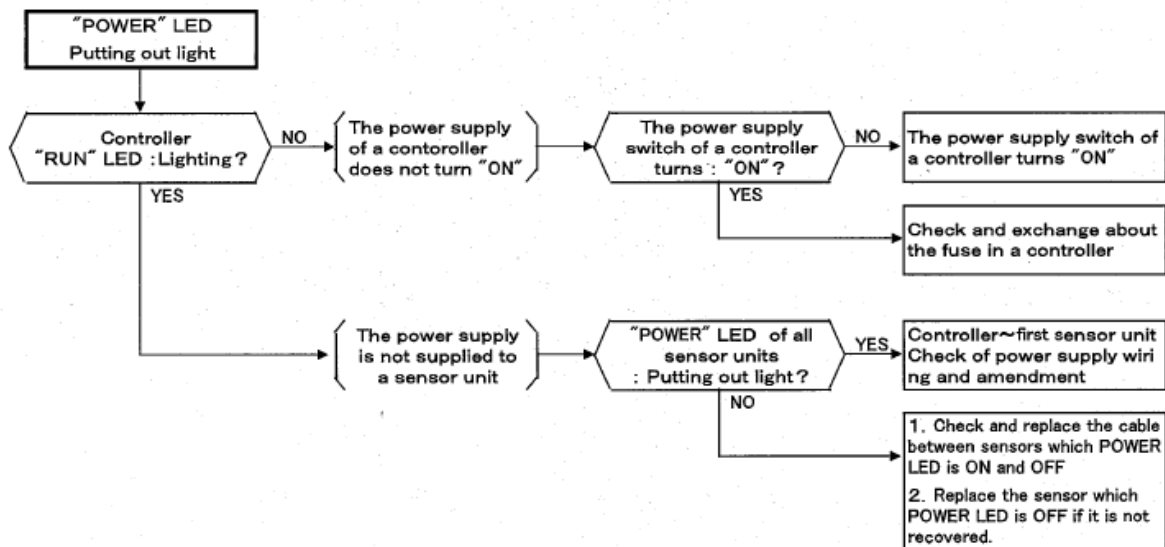
15.4 TROUBLESHOOTING by sensor unit indicate

First, please observe the sensor unit and check whether the damage is found or not.

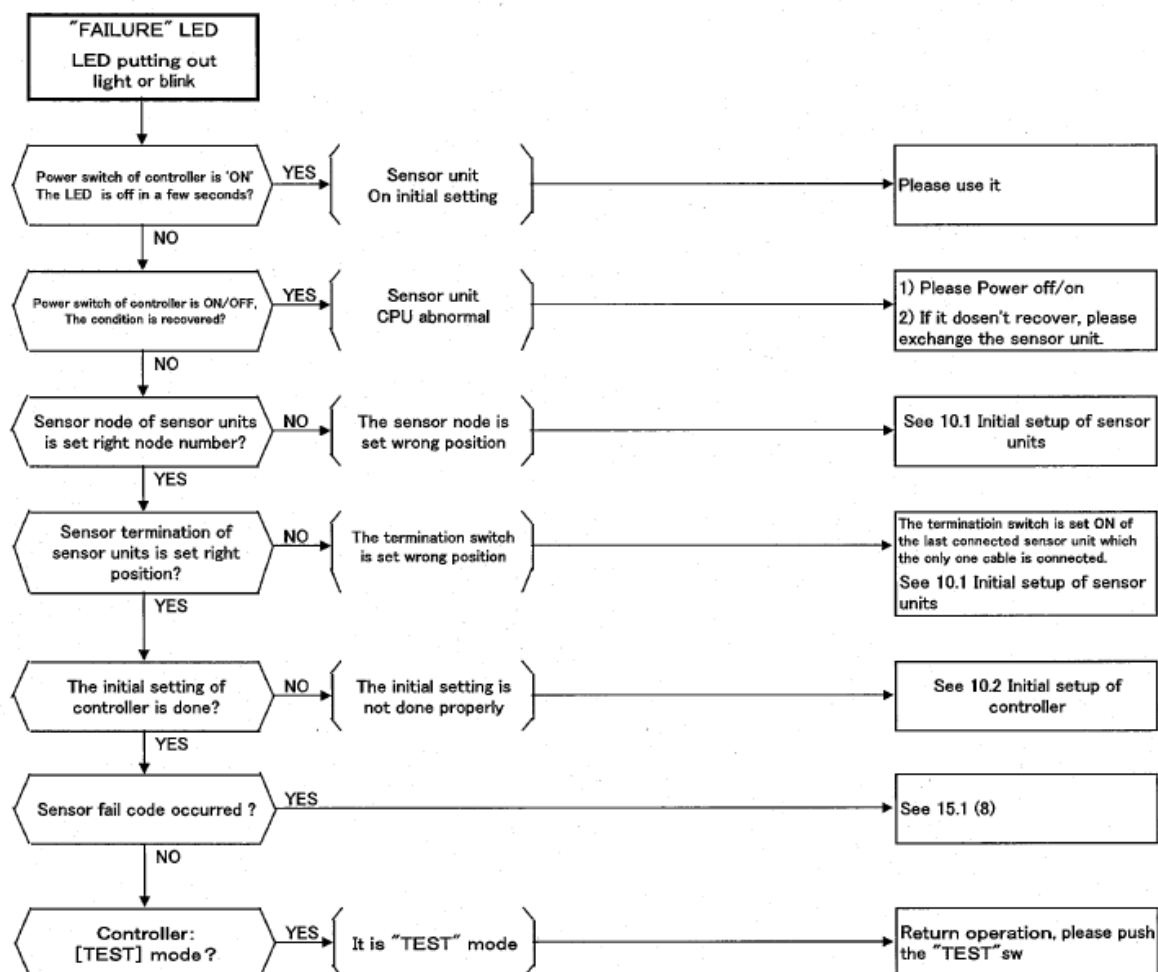
If the damage is found, please replace the new sensor.

Next, please follow the below trouble shooting flow after checking whether cabling is done properly from the controller and abnormal sensor.

(1). In the case of "POWER" LED putting out light



(2). In the case of "FAILURE" LED putting out light or blink



16. APPENDIX

16.1 Parts list

1) DOWN WARD CABLE SENSOR UNIT (Standard : Connector type)

Number	Parts Number	Name of Parts	Quantity
1	NN00465001C	ASSY.: MD-SX: SENSOR UNIT (CONNECTOR TYPE)	*

DOWN WARD CABLE SENSOR UNIT (Gland type)

Number	Parts Number	Name of Parts	Quantity
2	NN00465002B	ASSY: MD-SX: SENSOR UNIT (GRAND TYPE)	*

DOWN WARD CABLE SENSOR UNIT (Fling - lead type)

Number	Parts Number	Name of Parts	Quantity
3	NN00465007B	ASSY: MD-SX: SENSOR UNIT (FLYING LEAD TYPE)	*

2) HORIZONTAL CABLE SENSOR UNIT (Standard : Connector type)

Number	Parts Number	Name of Parts	Quantity
1	NN00465037A	ASSY.:MD-SXHORIZONTALWIRING:SENSOR(FLYING LEAD)	※

HORIZONTAL CABLE SENSOR UNIT (Connector type)

Number	Parts Number	Name of Parts	Quantity
2	NN00465035A	ASSY.:MD-SX HORIZONTAL WIRING:SENSOR(CONNECTOR)	※

3) STANDARD SPARE PARTS/ACCESSORIES for SENSOR UNIT

Number	Parts Number	Name of Parts	Quantity
1	NN00465009A	PCHS: SEAL WASHER (Special type , use without seal tape)	*
2	NN00264003A	NUT: MD-SX SENSOR	
3	NN00264060A	PCHS: MD-SX: SEALING CAP	

4) CONTROLLER (Wall mount type with cable gland)

Number	Parts Number	Name of Parts	Quantity
1	NN00265001B	ASSY.: MD-SX: CONTROLLER	1

CONTROLLER (Wall mount type with cable comb)

Number	Parts Number	Name of Parts	Quantity
2	NN00265039B	ASSY.: MD-SX: CONTROLLER	1

CONTROLLER (Flush mount type)

Number	Parts Number	Name of Parts	Quantity
3	NN00265026G	ASSY.: MD-SX: CONTROLLER FLUSH MOUNT TYPE	1

5) **Standard spare parts/Accessories for CONTROLLER**

Number	Parts Number	Name of Parts	Quantity
1	NN00265002A	PCHS: DRIVER: 210-119S	1
2	NN00265003A	PCHS: FUSE 20L: 6A-125V	2
3	NN00265004A	PCHS: GASKET 15c: CABLE GLAND	2
4	NN00265005A	PCHS: GASKET 25b: CABLE GLAND	1
5	NN00265006A	PCHS: NUMBER SEAL: MD-SX	1

6) **Ant vibration attachment parts (Option)**

Number	Parts Number	Name of Parts	Quantity
1	NN00272003A	ASSY: MD-SX SETTING: CONTROLLER	1
	(NN00272001A)	BRACKET: 1: MD-SX	4
	(NN00272002A)	BRACKET: 2: MD-SX	4
	(AE01166003A)	ISORATION RUBBER: 1M:	4
		SPRING WASHER M6 (Accessory)	8
		NUT M6 ×1.0 (Accessory)	8
	(X249006010Z)	+MACHINE SCREW ASSY M6×1.0×10	8

7) **Wiring material (Specification article: Option)**

Number	Parts Number	Name of Parts	Qty.
1	NN00646001A	CABLE.: MD-SX:BOTH SIDES CONNECTOR 1M	*
2	NN00646002A	CABLE.: MD-SX:BOTH SIDES CONNECTOR 2M	*
3	NN00646003A	CABLE.: MD-SX:BOTH SIDES CONNECTOR 3M	*
4	NN00646004A	CABLE.: MD-SX:BOTH SIDES CONNECTOR 4M	*
5	NN00646005A	CABLE.: MD-SX:BOTH SIDES CONNECTOR 5M	*
6	NN00646006A	CABLE.: MD-SX:BOTH SIDES CONNECTOR 6M	*
7	NN00646007A	CABLE.: MD-SX:BOTH SIDES CONNECTOR 7M	*
8	NN00646008A	CABLE.: MD-SX:BOTH SIDES CONNECTOR 8M	*
9	NN00646009A	CABLE.: MD-SX:BOTH SIDES CONNECTOR 9M	*
10	NN00646010A	CABLE.: MD-SX:BOTH SIDES CONNECTOR 10M	*
11	NN00646011A	CABLE.: MD-SX:BOTH SIDES CONNECTOR 15M	*
12	NN00646012A	CABLE.: MD-SX:BOTH SIDES CONNECTOR 20M	*
13	NN00646013A	CABLE.: MD-SX:BOTH SIDES CONNECTOR 25M	*
14	NN00646014A	CABLE.: MD-SX:BOTH SIDES CONNECTOR 30M	*
15	NN00646015A	CABLE.: MD-SX:BOTH SIDES CONNECTOR 35M	*
16	NN00646016A	CABLE.: MD-SX:BOTH SIDES CONNECTOR 40M	*
17	NN00646017A	CABLE.: MD-SX:BOTH SIDES CONNECTOR 45M	*
18	NN00646018A	CABLE.: MD-SX:BOTH SIDES CONNECTOR 50M	*

8) Wiring material (Specification article: Option)

Number	Parts Number	Name of Parts	Qty.
1	NN00646019A	CABLE.: MD-SX: ONE SIDE CONNECTOR 2M	*
2	NN00646020A	CABLE.: MD-SX: ONE SIDE CONNECTOR 3M	*
3	NN00646021A	CABLE.: MD-SX: ONE SIDE CONNECTOR 4M	*
4	NN00646022A	CABLE.: MD-SX: ONE SIDE CONNECTOR 5M	*
5	NN00646023A	CABLE.: MD-SX: ONE SIDE CONNECTOR 6M	*
6	NN00646024A	CABLE.: MD-SX: ONE SIDE CONNECTOR 7M	*
7	NN00646025A	CABLE.: MD-SX: ONE SIDE CONNECTOR 8M	*
8	NN00646026A	CABLE.: MD-SX: ONE SIDE CONNECTOR 9M	*
9	NN00646027A	CABLE.: MD-SX: ONE SIDE CONNECTOR 10M	*
10	NN00646028A	CABLE.: MD-SX: ONE SIDE CONNECTOR 11M	*
11	NN00646029A	CABLE.: MD-SX: ONE SIDE CONNECTOR 12M	*
12	NN00646030A	CABLE.: MD-SX: ONE SIDE CONNECTOR 13M	*
13	NN00646031A	CABLE.: MD-SX: ONE SIDE CONNECTOR 14M	*
14	NN00646032A	CABLE.: MD-SX: ONE SIDE CONNECTOR 15M	*
15	NN00646033A	CABLE.: MD-SX: ONE SIDE CONNECTOR 20M	*
16	NN00646034A	CABLE.: MD-SX: ONE SIDE CONNECTOR 25M	*
17	NN00646035A	CABLE.: MD-SX: ONE SIDE CONNECTOR 30M	*
18	NN00646036A	CABLE.: MD-SX: ONE SIDE CONNECTOR 35M	*
19	NN00646037A	CABLE.: MD-SX: ONE SIDE CONNECTOR 40M	*
20	NN00646038A	CABLE.: MD-SX: ONE SIDE CONNECTOR 45M	*
21	NN00646039A	CABLE.: MD-SX: ONE SIDE CONNECTOR 50M	*

* Order your nearest distributor specifying the necessary length.

9) MD-SX SENSOR CHECKER(OPTION)

Number	Parts Number	Name of Parts	Quantity
1	NN00465022A	PCHS : MD-SX : SENSOR CHECKER	1

10) MD-SX SENSOR CLEANER (OPTION)

Number	Parts Number	Name of Parts	Quantity
1	9VB2002005Z	CLEANING LIQUID KIT 1L SC-1000(FOR MD-SX)	1
2	9VB2580002Z	YUNISOL H 4L(CLEANING LIQUID FOR MD-SX SENSOR)	1

16.2 Anti-vibration bracket mounting drawing (OPTION)

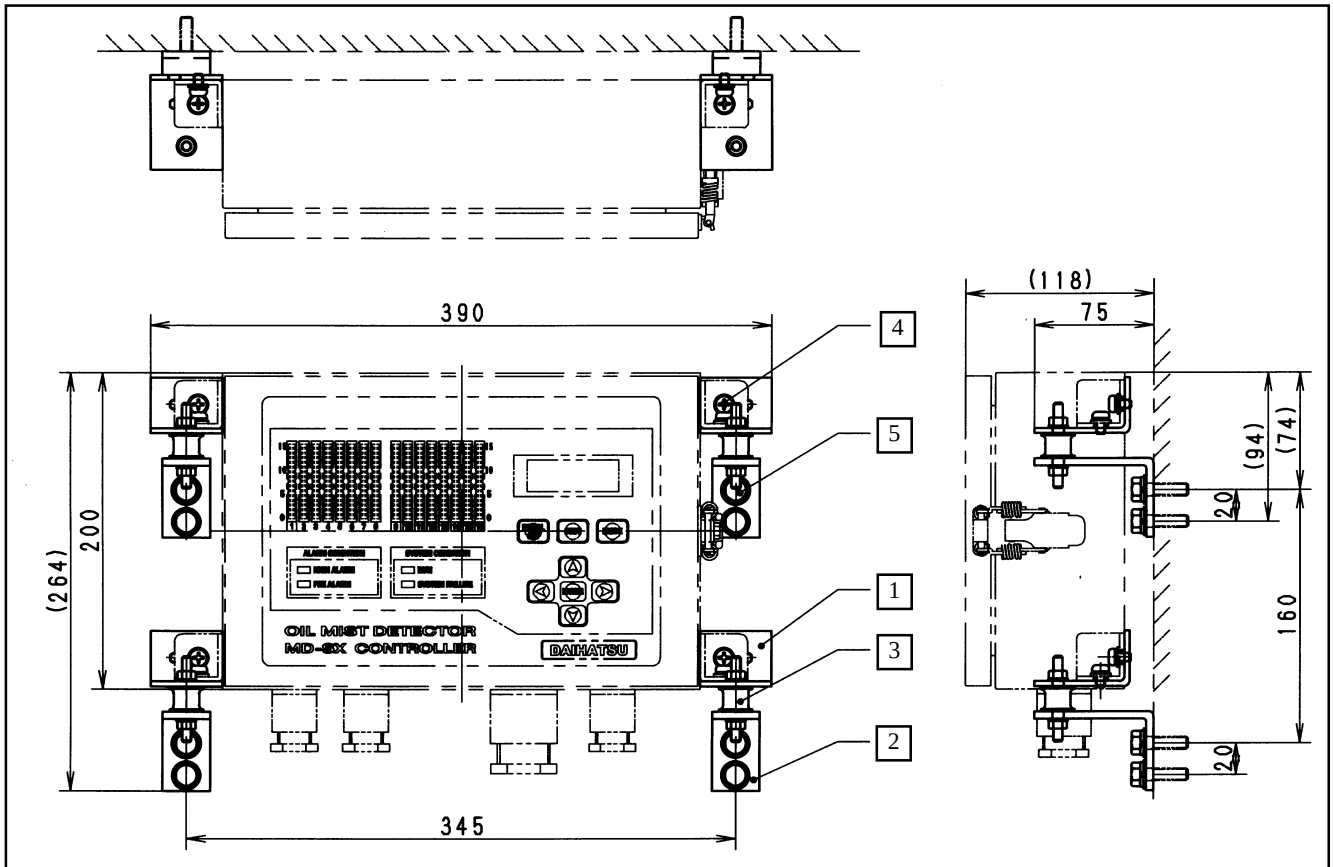


Fig.38 Anti-vibration bracket OUTLINE

No.	Parts No.	Name of parts	Qty.
1	NN00272001A	BRACKET: 1: MD-SX	4
2	NN00272002A	BRACKET: 2: MD-SX	4
3	AE01166003A	ISORATION RUBBER: 1M:	4
		SPRING WASHER M6 (Accessory)	8
		NUT M6 × 1.0 (Accessory)	8
4	X249006010ZZ	+MACHINE SCREW ASSY M6 × 1.0 × 10	8
5		ATTACHMENT BOLT M8	8

16.3 Sensor cleaning procedure

The sensor and the internal lens surface can be cleaned automatically by replacing to new oil from existing system oil. Please replace the system oil periodically in following to the system oil control of engine.

also, you can recover the lowered sensitivity of sensor by applying the washing method of our recommend(Yunisol H and SC-1000) instructed on the page 49~52,for the arrangement of cleaner, please contact us.

Regarding the function of sensitivity decreased, the sensor manufactured before July 2008 does not have the function in order not to be required by Classification. By replacing the sensor manufactured after July 2008, the function will be effective.

Sensor cleaning procedure by Yunisol H

1. SAFETY AND HANDLING

- A) This cleaning method will be applied to oil mist sensor on the 2or4 cycle engine with heavy contamination of lubricant oil
- B) The cleaning agent is used with the stock solution. Please note that the effect decreases when diluting it with the washing oil and water.
- C) Prohibit fire strictly. Wear protective glove, protective glasses and protective mask.
After handling, wash well hands and face and rinse your mouth.
Do not put it on eyes, skins, and clothes. Do not eat, drink or smoke during work.
Do not breathe in dispersed steam (dust). Use only in the adequate ventilation if it contacts with eyes, should be wash with fresh water immediately, and get medical care if necessary.
- D) In total time for sensor cleaning , please do it with less than three minutes. Dipping time to "Yunisol H" is less than one minute. Time for cleaning in bottle is less than one minute. Do not keep on having soaked sensor in "Yunisol H" for a long time. Do not the sensor cleaning more than three times. After washing, a rinse is necessary by all means. The item mentioned above causes the sensor trouble;; please carry it out by all means.**
- E) 【Disposal 】 Dispose of contents/container to waste in accordance with local/regional/ national/ international regulations (to be specified) regulations (to be specified) .

2. Procedure of the sensor cleaning

※Please never break down the probe of sensor.



- 1) Prepare for the following article
 - ① Use rubber glove
 - ② Container for the sensor cleaning; Bottle with more than 250mL of capacity.(two pieces)
 - ③ Yunisol H (Transparent Liquid) 200mL/sensor.
 - ④ Fresh water for sensor rinses 200mL/sensor.
 - ⑤ Syringe or dropper for Yunisol H

2) Use only in the adequate ventilation.



3) Make a sensor the state of the photograph.

- 4) Inject cleaning liquid (undiluted solution) of approximately 2mL with a spuit from an opening of hood of the sensor for the cleaning of the sensor lens.
※Do not spill cleaning liquid.

5) After dropping cleaning liquid, leave for only one minute.
※Dipping time to cleaning liquid is less than one minute.
Do not dip it into the cleaning liquid for a long time.



A dirt stands out an instant.



- 6) Slanting the vessel like photo, soak the probe in a way to release air in the probe, shake the probe right and left about less than 30 seconds.
※Same as the work of past cleaning agent (SC-1000).
※When a sensor is dirty, the transparent " Yunisol H " become black in an instant.
※Change it for a new " Yunisol H ", and, clean it epeatedly.
But, Do not this work more than twice.

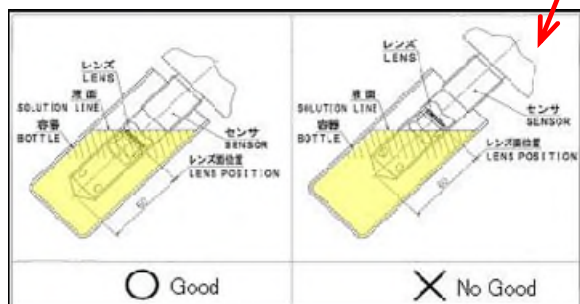
7) Wipe off a dirt and the cleaner which attached to a sensor with tender cloth neatly.

8) Rinse out a dirt and "Yunisol H" which attached with water neatly.

※Rinse it out so that "Yunisol H" is not left in the sensor inside.

- 9) For drying, do an air blow for the inside from the probe hole. After drying or air blow, leave the sensor like photo for approx.30 minutes for the liquid to flow out.
State after having cleaned a sensor

10) Just install it in the engine and use it again.



Cleaning Procedure for Oil Mist Sensor MD-SX

Cleaning and Operation Control of MD-SX Sensor

This cleaning method will be applied to oil mist sensor on the 2cycle engine, with less contamination of lubricant oil. In daily checking, change of mist density level between engine running and engine stopping has become extremely small (check by digital value on LCD), or for sensors which have detector function for sensitivity deterioration, when SENSOR FAIL 17 is shown on LCD, practice cleaning. (Refer to attached "Judgment standard for sensor cleaning".) After cleaning, make sure to confirm digital value on LCD goes up to 1023 in testing by smoke spray or a strip of white paper.

For sensors which have detector function for sensitivity deterioration, make sure "SENSOR FAIL 17" is not shown. In case the sensor would not recover after cleaning some times, replace with new one. If the sensor which is used for 2~3 years in normal operation, please consult with us.



- ① Cleaning tools (Photo is one example)
 1) Cleaning liquid
 2) Syringe 3) Cleaning vessel (Cup etc.)



- ② Cleaning liquid
 1) Cleaning liquid designated by Daihatsu Diesel.
 (Product Name: SAFE CARE SC-1000
 Aqueous Cleaner Concentrate)
 Supplier: GEMTEC Product (USA)
 Infinity Enterprises, Inc (Japan)



- ③ Preparation for cleaning sensor lens
 Place the sensor on the table like photo.



- ④ Sucking cleaning liquid with syringe.



- ⑤ From oval hole on probe, drop approx. 2ml of undiluted cleaning liquid onto lens surface using syringe.



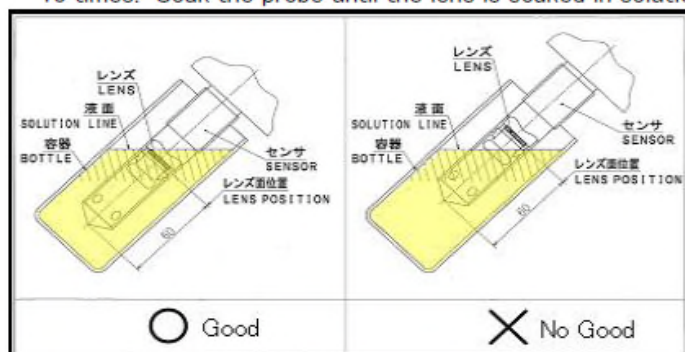
- ⑥ After dropping cleaning liquid, leave for several hours (In case of heavy contamination, leave for more than 24 hours.)



- ⑦ Preparing approx.10cm depth of new lubricating oil or approx. 5% concentration solvent of cleaning liquid in a clean vessel.



- ⑧ Slanting the vessel like photo, soak the probe in a way to release air in the probe, shake the probe right and left about 10 times. Soak the probe until the lens is soaked in solution.



- ⑨ After drying or air blow, leave the sensor like photo for approx.30 minutes for the solvent to flow out.

How to confirm the good sensitivity of sensor.
Check the indication "Good!", "LV1", "LV2" by connecting optional sensor.
It confirms it by the following methods when there is no checker.



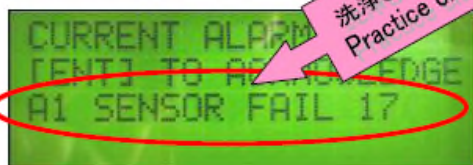
- ⑩⑪ After having dried, prepare a strip (w.10 ~12mm) of white paper, insert a strip of paper into the hole in lower part of sensor hood, and confirm digital value goes up to 1023.
(Confirmation by smoke spray or other fake oil mist is possible.)



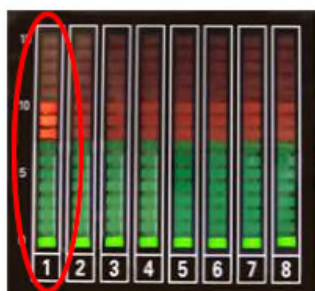
- ⑫ When digital value 1023 on the controller LCD is confirmed, it is possible for the sensor to operate on the engine.
If digital value does not go up to 1023 even after cleaning with cleaning liquid designated by Daihatsu Diesel, replace the sensor with new one.

JUDGMENT STANDARD FOR CLEANING OF MD-SX SENSOR

1. In case of the sensor with detector function for sensitivity deterioration



"SENSOR FAIL 17" is shown on controller LCD.

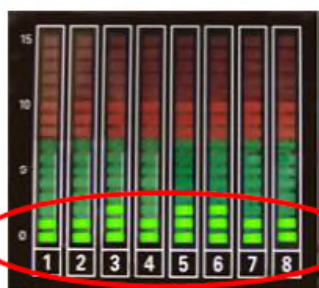


Mist indicator level when "SENSOR FAIL 17" is shown.

2. In case of the sensor without detector function



- ① In case change of mist density level between engine running and stopping has become extremely small.
- ② In case the indicator indicates only 0 or 1 even when engine is running.



Normal mist indication during engine running

3. Confirmation for digital value change of each sensor between engine running and stopping.

《Digital value reading procedure》

- ① Press MODE key on the controller.



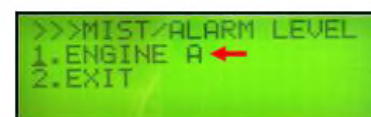
- ② At "1. STATUS", press ENTER key.



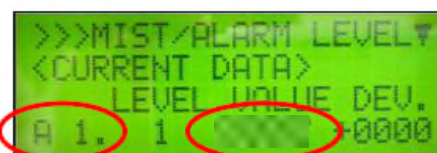
- ③ Choose "3. MIST/ALARM LEVEL" by ▼ key, press ENTER key.



- ④ At "1. MIST/ALARM LEVEL", press ENTER key.



- ⑤ At "1. ENGINE A", press ENTER key.



Sensor No.

Confirm digital value of each sensor using ▼ key.

Digital value

- 1) When the difference of digital value between engine running and engine stopping has become less than 10.
- 2) When the digital value has decreased more than 10 than the same load operation before.

洗浄して下さい Practice cleaning

16.4 Attention of using LOOP wiring for sensor cable routing

It recommends it as FAIL 20 generation measures when using it at the installation position where the vibration is big.

DAIHATSU recommend the cable routing method of MD-SX sensor unit is “*daisy chain*” topology.

Almost all MD-SX system is installed on engine with the daisy chain wiring. The troubleshooting in wiring defectiveness is easy, and cable cost and installation cost are reduced. Therefore DAIHATSU recommends the “*daisy chain*” topology.

In case of applying the “*loop*” topology, it is necessary to understand the difference between the *loop* and *daisy chain* topology. And please judge which is suitable.

The difference of MD-SX oil mist detecting system with the “*loop*” wiring.

- The addition of a cable for returns is necessary.
- All termination switch of MD-SX sensor unit must change [OFF] position.
- Using *loop* wiring, MD-SX system can improve reliability for the disconnection of cable. But in short circuit situation of the cable, the reliability is same as to use *daisy chain* wiring .
- MD-SX system can work as normal operation under one disconnection circuits point. However, MD-SX cannot detect a wiring defectiveness warning. (communicate through other connected line)
- In case of disconnection circuits point two or more , MD-SX can detect a wiring defectiveness and show warning as “Sensor Fail 20”. but to identify disconnection points might be slightly difficult.

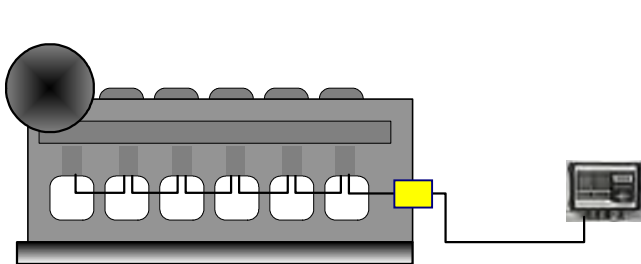


Fig.39 Daisy chain wiring

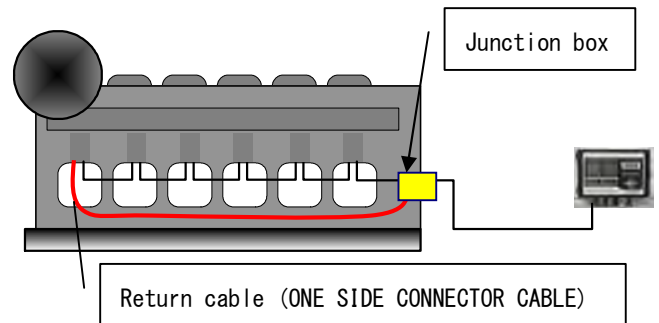


Fig.40 Loop wiring

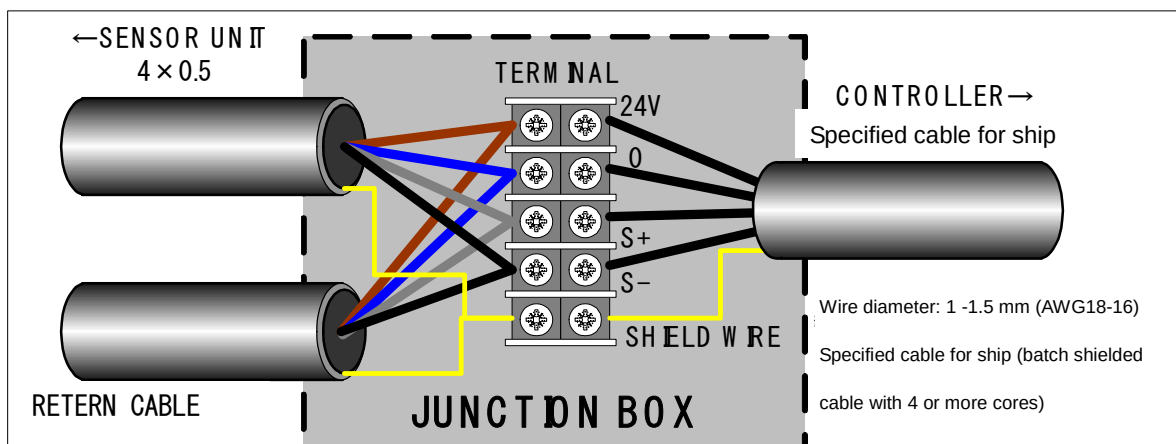


Fig. 41 Specification for connection in the junction box with loop wiring (Terminal box)

NOTE) The color specification of DAIHATSU supply cable is written the table of page 21.

DAIHATSU **DAIHATSU DIESEL MFG.CO.,LTD.**

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Daihatsu Diesel (Europe) Ltd.	5th Floor, Devon House, 58-60 St. Katharine's Way, London E1W 1LB, U.K. TEL: 44-20-7977-0280 FAX: 44-20-7702-4325
Daihatsu Diesel (AMERICA), Inc.	180 Adams Avenue, Hauppauge, NY 11788, U.S.A. TEL: 1-631-434-8787/8/9 FAX: 1-631-434-8759
Daihatsu Diesel (ASIA PACIFIC) Pte.Ltd.	128 Pioneer Road Singapore 639586 TEL: 65-6270-7235 FAX: 65-6270-6236
Daihatsu Diesel (SHANGHAI) Co.,Ltd.	Room A Floor 9, Huamin Empire Plaza, No.726 Yanan Rd(w), Shanghai, China TEL: 86-21-6225-7876/7 FAX: 86-21-6225-9299

●Please refer to the separate brochure for "DAIHATSU AFTER-SERVICE NETWORK".

- All information contained in this Manual is corrected at the time of printing, but will be subject to change without notice.

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TG60 型 5-6G60ME-C
曲轴盘车机使用说明书
OPERATION INSTRUCTION OF
MODEL TG60 TURNING GEAR FOR
5-6G60ME-C DIESEL ENGINE



上海乐春重工机电设备有限公司
SHANGHAI LECHUN HEAVY MACHINERY &
ELECTRONIC EQUIPMENT CO., LTD.

TG60 型 5-6G60ME-C 曲轴盘车机使用说明书

盘车机是在柴油机停止运行后，为转动曲轴而附设的一种装置，该型盘车机主要用于 5-6G60ME-C 柴油机的装配过程，启动前的准备工作，调整配气以及维修保养。

一、盘车机的主要技术数据：

1.减速齿轮机构：

额定输出扭矩：	42969N·m
最大输出扭矩：	58525N·m
传 动 比：	1730: 1
输 出 转 速：	0.94 r·p·m

2.国产船用制动电机：

带加热器，单相电源，其电压为 AC220V/60HZ 30W

型 号：	Y112M-4-H B3
额定功率：	4Kw-4P
电 制：	3×AC440V/60HZ/7.7A
启动电流：	48A
转 速：	1730r·p·m
制动电压：	DC170V(自整流)
制动力矩：	≥60N·m
防护级别：	IP55
绝缘等级：	F

二、盘车机结构：（见图 1）

该盘车机主要由船用制动电机、减速器、联锁装置、盘车齿轮、离合装置、手轮手柄和定位插销机构等组成的。

减速器由链传动，圆柱齿轮传动和三级行星齿轮传动组成的，总速比为 1730:1。

减速器的轴承座基座上有六个腰型孔，用于固定盘车机，调整盘车机轴线和柴油机轴线的平行度，调整盘车齿轮与飞轮齿轮之间的间隙。另外基座上还有两个Φ16H7 的销孔，用来安装 2 只定位销 A16m6×75。

船用制动电机安装在减速器主壳体和后壳体上的电机座板组件上，轴承座、主壳体、中间支座和后壳体用螺栓固牢联成一体。链传动安装在后壳体上。

离合装置由梯形螺杆 Tr40×7-7e，螺杆套 Tr40×7-7H，螺杆撑体、螺杆撑座、定位插销机构和手轮手柄组成的，安装在驱动轴上，通过转动手轮手柄带动盘车

齿轮作轴向移动，使盘车齿轮与飞轮齿轮处于啮合（盘车）或脱开（柴油机启动）的状态。

联锁装置安装在轴承座上方，由二位三通阀、限位开关、支架、拨块、控制杆及环首螺钉 M8 等组成的，二位三通阀与启动空气管路相通，限位开关与盘车机控制电路联接。

定位插销机构安装在离合装置里的梯形螺杆 Tr40×7-7e 上，当盘车机与飞轮齿轮啮合或脱开时，都得将定位插销插到螺杆撑体的端盖上的销孔里，以确保盘车齿轮不做轴向移动。

启动船用制动电机直接转动减速器，带动装在驱动轴上可移动的盘车齿轮与飞轮齿轮位于啮合，从而进入盘转柴油机曲轴。

驱动轴与盘车齿轮为双键 2-45H9/h9 联接。

三、盘车机安装（见图 1）

吊装前将联锁装置取下，拧上专用吊环螺钉 M30，然后将盘车机吊装到柴油机侧面盘车机撑座上。注意：此时盘车齿轮应处于与飞轮齿轮脱开时的位置上。待减速器基座上的六个腰形孔与柴油机上盘车机撑座上的孔相对应后，通过左右移动和调整垫在轴承座基座下的调整垫片 110×477×7 的厚度，使盘车机轴线与曲轴盘车机相平行；同时也使盘车机齿轮和飞轮齿轮啮合时的齿侧间隙符合要求。一般齿侧间隙为 $7\pm 1\text{mm}$ ，径向间隙为 16。另外还要使齿面接触均匀，然后在减速器轴承座基座上对称方向上装上 6 个 M30 双头螺栓及液压螺母。牢固盘车机的拧紧扭矩为 1000N.m。最后在对称位置上的 2-Φ16H7 的销孔里打上 2-Φ16m6×75 的定距销，再度检查齿侧间隙和径向间隙，若有变动应及时重新调整，直到符合要求为止。

固牢盘车机后，应将盘车齿轮移到脱开位置，取下吊环螺钉 M30，再把联锁装置装在接好的电路和气路，限位开关电路联接应按专业船用电机及控制箱电路系统说明书上要求进行，气路按图 2 装配。

将联锁机构上的控制杆先后放在水平和垂直位置上，检查盘车机开关电路联接是否正确。二位三通阀与启动空气管联接是否正确。上述安装及联接正确无误后，才能启动船用电机试运转盘车机，通过试运转来检查盘车机的振动、噪音、滑油温升和有无渗漏油及异常响声等情况，确认盘车机运行平稳、无异常现象，船用制动电机无论在通电和断电时都要发出“噼啪”的响声，且刹车敏捷，安全可靠后才能投入使用。

四、盘车机联锁机构动作原理：

顺时针（面向手轮）转动离合机构上的手轮手柄，直至盘车齿轮位于脱开

位置，此时与减速器端盖距离为 210~215mm，两齿面间距为 10~25mm，插上定位插销，再把控制杆放到水平位置，拧上环首螺钉 M8×70。由于拨块（一）的作用，限位开关处于切断电源状态，同时由于拨块（二）的作用，使二位三通阀开启空气管路，这时柴油机处于启动状态。

将控制杆抬起放在垂直位置，并拧上环首螺钉 M8×70。反时针（面向手轮）转动离合器机构上的手轮手柄，直至盘车齿轮位于啮合位置，此时与减速器端盖距离为 8mm，与第一个安装空中心线距离为 50mm，插上定位插销。由于拨块（一）的作用，使限位开关闭合电路接通，这时集控室里指示灯亮了；由于拨块（二）的作用，二位三通阀切断启动空气管路，柴油机处于不能启动状态。这时才能启动船用制动电机使盘车机盘转柴油机曲轴。

无论控制杆位于水平位置或者垂直位置，都要拧上环首螺钉 M8×70 和插上定位插销，以防控制杆倒下或脱开，以防盘车齿轮作轴向移动。

五、盘车机的使用及注意事项：

- 1.船用制动电机里的制动器，无论在断电制动还是通电打开（电机运转）都必须发出清脆的“噼啪”响声，才可以投入使用。
- 2.不盘转曲轴时，盘车齿轮位于脱开位置（移动间距为 210-215mm）插上定位销轴，将控制杆放到水平位置，拧上环首螺钉 M8×70。盘转曲轴前，控制杆位于垂直位置，拧上环首螺钉 M8×70，然后将盘车齿轮旋转到与飞轮齿轮啮合位置上，（距第一个安装孔为 50.5mm）插上定位销轴，这才可启动船用制动电机使盘车机盘转柴油机曲轴。
- 3.盘转柴油机曲轴前，两轮齿啮合面要涂上适量的润滑脂。
- 4.拆检盘车机时必须将盘车齿轮移动到脱开位置，关闭电源，放净润滑油后进行，严禁在运行中拆检。
- 5.盘车机要在专用吊环螺钉 M30 上起吊，严禁在船用制动电机、盘车齿轮和手轮处起吊，严防碰撞电机。

六、润滑油型号及油位调整：

减速器使用上海炼油厂“海”牌重负荷 N320 工业齿轮油。主要指标：密度 0.9，闪点 $\geq 220^{\circ}\text{C}$ ，凝度 0°C ，粘度指数 0.95，运动粘度 288~352 厘斯。

减速器和链罩内的油量必须加到窥视镜片二刻线中间，油位不得低于窥视镜的下刻线，也不要超过窥视镜片上刻线。

盘车机运转一段时间后若发现油位低于窥视镜片下刻线，则要加油到符合要求的油位。一般润滑油第一次用 50 小时更换，以后每 150 小时更换一次。

七、常见故障及解决办法

项目	常见故障	故障原因	解决方法
1	电机不能起动	1 接电线路断路 2 定子三相中有一相断路 3 定子接线错误 4 减速器可能故障 5 制动器未动作 6 控制箱可能故障 7 过载	1 检查接电线间的电压 2 检查保险丝和各相电源 3 按规定的接法和接线图,查出定子绕组的接线,纠正错误联接 4 检查链传动和减速器各级传动,更换磨损零件 5 检查制动器断电或通电时有无“噼啪”声及其电源 6 检查控制箱电子元件是否击穿和烧坏,做到及时更换 7 检查电机负载电流
2	电机温升过高	1 电机接法错误 2 定子绕组接地或匝间短路 3 电机过载 4 起动次数过多 5 通风不畅 6 制动器动作迟缓	1 Δ 接法电机误接成Y接工作或相反,必须立即断电改接 2 找出短路和接地的部分,进行修复 3 检查电机负载电流 4 改进操作方式 5 检查风叶是否损坏,做到及时更换 6 检查制动器气隙和直流励磁电压
3	电机有异常噪音或振动过大	1 定子和转子相擦 2 缺相运行 3 轴承缺油或损坏 4 电机接线有误 5 风叶损坏	1 检查轴承装配有无松动,定子和转子装配有无不良情况 2 检查电源或电机,及时加以修复 3 清洗轴承,加新油,或更换轴承 4 查找接线正确与否,及时加以更正 5 更换风叶
4	制动电机制动失灵	1 刹车片磨损较大 2 制动弹簧失效 3 动作迟缓 4 整流器损坏 5 制动器和配套的整流器接线有误	1 调整气隙或更换制动盘 2 调换弹簧 3 调整气隙,检查直流励磁电压 4 调换整流器 5 按电机接线盒内线路图接线
5	电机转动盘车齿轮不转动	1 链轮链条损坏 2 减速器里的太阳轮和齿轮轴磨损 3 链轮传扭键被剪切 4 内齿圈上没放传扭键	1 更换链条链轮 2 更换太阳轮或齿轮轴 3 拉出链轮,重新按上平键 4 打开减速器,检查哪一级内齿圈没放平键,然后重新打平键

八、直流电磁制动器：（见图 3）简称制动器

1. 制动器工作原理

当制动线圈（6）接通直流电源后，由于电磁力作用，电磁铁（7）吸引衔铁（5），并压缩弹簧（24），使制动盘（2）与衔铁（5）和电机端盖（26）的摩擦面脱开，电机即可正常运转。

当制动线圈（6）的直流电源切断后，电磁铁（7）失去电磁吸引，压缩弹簧（24）把衔铁（5）推出压紧制动盘（2），制动盘（2）受到衔铁（5）和电动机端盖的二个摩擦力矩作用，迅速刹住电动机转轴，使电机停止转动。

2. 制动器调节

制动器调节，主要对制动器的衔铁行程（气隙 Δ ）和摩擦力矩的调节，这二条对制动时间和制动力矩影响较大。船用制动电机出厂时已经调整好。

气隙（ Δ ）分为工作气隙和最大气隙二种，工作气隙制动电机出厂时已经调整好，制动器使用一段时间后，摩擦片磨损，使衔铁和电磁铁之间气隙增大，当气隙超过规定数值时，制动力矩就明显下降，制动时间就延长了。为使制动器能继续正常工作，必须重新调节气隙，工作气隙和最大气隙。一般气隙为 0.35~0.45mm，最大摩擦气隙为 1.00~1.10mm。

2.1 气隙（ Δ ）调节

电动机出厂时，气隙已经调节好，如用户使用一段时间或维修，气隙应该重新调整，其方法如下：

- (1) 将制动器装上电机后端盖后，均匀地旋紧固定螺钉（4），用塞尺测量实际的气隙，并记录三个（或六个）等分位置的实测值。
- (2) 先旋松拼紧螺母（21），再旋松固定螺钉（4），退出支撑螺钉（22），按表 1 规定选用工作气隙的塞尺，塞进第一个支撑点，旋紧螺钉（4），再旋紧螺钉（22），然后少许旋松螺钉（4），拔出塞尺，再少许旋进螺钉（22）约 1/4 圈，然后旋紧螺钉（4），用同样方法再调其他几点，要分别轮流给予调正，直至气隙符合要求后，才将螺母（21）拼紧，调整气隙工作要细心微调，切莫过急，否则反而费时。

2.2 制动力矩调节

用内六角扳手旋进调节螺钉（23），使弹簧（24）压缩，力矩增大，反之旋出，力矩减少，电动机出厂时，制动力矩均已调好。

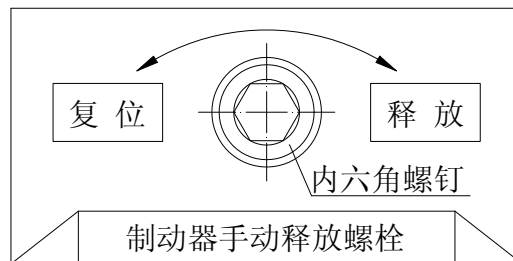
3. 制动器的维修

制动器的摩擦盘（2）是易损件，摩擦片经较长时间使用后，当摩擦片磨损到

约剩 1mm 时(出厂时 3.5mm)应给予更换,由于摩擦片贴到制动盘上需一定的工装和工艺,用户自行贴有一定难度,故可将制动盘一起更换。

九、带手动释放装置制动电动机(制动器手动释放和复位)

带手动释放装置制动电动机结构(见图 3)



制动器手动释放和复位小铭牌钉在风扇防护罩上。

1. 当往释放方向旋进调节内六角螺钉(11)时,摩擦盘处于脱开制动状态,此时电机轴亦能转动,可以启动电机,能盘转柴油机曲轴而不能制动曲轴,因为制动器不起制动作用。
2. 当往复位方向旋出调节内六角螺钉(11)时,摩擦盘处于复位制动状态,若接线盒内没装整流器或者整流器烧坏,不能闭合电路启动电机,否则会使制动器和电机烧坏。
3. 在制动器处于复位状态,在整流器完好无损的情况下,启动电机,制动器都会发出清脆的“噼啪”响声,此时盘车机可以盘转和制动柴油机曲轴。
4. 手动释放装置调节

手动(制动)释放装置是为解决制动电机与主机组装后能作主机的手动调整和维修方便之用。它是利用凸轮原理,能使制动状态暂时脱开的一种装置。调节方法是,旋进调节螺钉(11)推移释放环(10),顶出释放盘(13),通过牵引(8)把衔铁(5)拉过来压缩弹簧(24),使摩擦盘脱离制动状态,要求恢复制动状态,只要旋出调节螺钉(11)即可,释放盘利用弹簧(18)会自动复位的,要特别注意的是调节螺钉(11)不能旋得太进(深)只要制动摩擦盘脱离即可,就是说电机转轴能转动就行了,否则将内部凸轮挤压得变形,造成释放不能复位。如果发生了上述情况,制动电机采取应急措施后仍能临时投入运行。具体方法是,将螺钉(11)旋出,将释放盘(13)向内敲进,使制动能恢复正常(或将释放环(10)拆去,牵引杆螺母(17)旋松)即可临时应急使用,并不影响运转与制动,但手动释放已损坏,不能使用了,要及时更换损坏的零件,确保电机使用功能完整。

Operation instruction of model TG60 turning gear for 5-6G60ME-C diesel engine

Turning gear is an additional mechanism for turning crankshaft after the diesel engine stop running. The turning gear of this model is used for fitting of 5-6G60ME-C diesel engine, a special mechanism for preparation before running, adjusting distribution and maintenance.

1. Principal technical parameters

1.1 speed reducing gear mechanism:

Rated output torque:	42969N·m
Max. output torque:	58525N·m
Total output ratio:	1730: 1
Output speed:	0.94 r·p· m

1.2 domestic marine brake motor

With heater, voltage of single-phase power is AC220V/60HZ			30W
type:	Y112M-4-H	B ₃	
rated power:	4Kw-4P		
electric braking:	3×AC440V/60HZ/7.7A		
start current:	48A		
speed:	1730r·p· m		
brake voltage:	DC170V (self-rectification)		
braking torque:	≥60N·m		
protection class:	IP55		
insulation:	F		

2. Construction (see drawing1)

The turning gear is composed of marine brake motor, speed reducer, interlocking mechanism, movable gear, disengagement and engagement mechanism, hand wheel handle and locating inserted pin mechanism.

Speed reducer is composed of chain driving, cylinder gear driving and level 3 planetary gear driving. The total speed ratio is 1730:1.

There are six waist-holes in the bearing block of the reducer, for fixing the turning gear and adjusting the parallelism between the axis of turning gear and the axis of diesel engine, adjusting the clearance between the movable gear and crankshaft gear. Additionally, there are 2 ϕ 16H7 pin holes in the block for mounting 2 straight pin A16m6 $\times$ 75.

The marine brake motor is mounted on its bed-plate of the main housing and back housing of speed reducer. The bearing block, main housing, middle support and back housing are fastened together by bolts. Chain driving is mounted on the back housing.

The engagement and disengagement mechanism, mounted on the driving shaft, is composed of trapezoid screw stem Tr40 $\times$ 7-7e, screw stem bushing Tr40 $\times$ 7-7H, screw stem support, support block, locating inserted pin mechanism and hand wheel handle. By turning the handle it drives the movable gear axial moved, making the movable gear and the fly wheel gear engaged (turning) and disengaged (the diesel engine is under starting stage).

The interlocking mechanism, mounted on the upper part of the bearing block, is composed of two-position three-way valve, limit switch, bracket, block, control lever and eye bolt M8 $\times$ 70. The two-position three-way valve is communicated with the starting air pipe and the limit switch is connected with the control circuit of the turning gear.

Locating inserted pin mechanism is mounted on the trapezoid screw stem Tr40 $\times$ 7-7e of the disengagement and engagement mechanism. Whether the movable gear is engaged or disengaged with the fly wheel gear, the locating inserted pin should be inserted in the pin holes of the end cover of screw stem support to avoid movable gear moving axially.

The marine brake motor drives the axially moved movable gear which mounted on the output shaft of the speed reducer and the engaged fly wheel gear.

Driving shaft and movable gear are double-key 2-45H9/h9 connected.

3. Installation (see drawing1)

Before lifting the turning gear, remove the interlocking mechanism from it and fit a special lifting ring M30, then lift and mount the turning gear onto the side plate of the diesel engine. Please note the movable gear should be disengaged with the fly wheel gear. The 6 waist holes in the block of speed reducer should be corresponded with the holes in the side plate of the turning gear. By adjusting the left and right position of the turning gear and the thickness of the gasket 125 $\times$ 365 $\times$ 8 on the block of the speed reducer make

the turning gear axis be parallel with the crankshaft axis, engagement clearance between the movable gear and fly wheel gear should be within the requirement, generally, the flank clearance should be $7 \pm 1\text{mm}$, the diameter clearance should be 16mm, and even contact of the gear surface should be ensured. Then mount six M30 studs and hydraulic nuts on the reducer bearing base of symmetry direction. Tighten the turning gear with a tightening moment of $1000\text{N}\cdot\text{m}$. Finally spike 2- $\phi 16\text{mm} \times 75$ locating pins into 2- $\phi 16\text{H7}$ pin holes of symmetrical position.

Recheck the flank clearance of the gears and diameter clearance. If any abnormal, readjust it till meets the requirement.

After fixing the turning gear, move the movable gear to the disengagement side, dismantle the lifting eye bolt M30 and mount the interlocking mechanism. Then connect it with power supply and air line.

The circuit of the limit switch should be connected according to the instruction of special marine motor and control box circuit system. The air line should be connected according to drawing 2.

Put the control lever of the interlocking mechanism at its level and vertical positions successively. Then check the limit switch circuit of the turning gear, the two-position three-way valve and starting air pipe for correct connection. Finally, conduct a test-run on the turning gear to see whether all are normal, such as stability, noise, temperature rising of lubrication oil for the speed reducer. Put it into application after all are proved normal.

4. Operating principle of interlocking mechanism

Turn the hand wheel handle clockwise (facing the hand wheel) until the movable gear at the position of disengagement. The clearance between movable gear and the end cover of speed reducer is 210-215mm, the clearance between 2 gears is 10-25mm. Spike the locating inserted pin and put control lever at the horizontal position, then tighten the eye bolt $\text{M8} \times 70$. Owing to the action of shifting block (1), the switch is under cut-out condition. In the mean time, due to the action of shifting block (2), the two-position three-way valve is under such a condition that the starting air is ready to start the diesel engine.

Put control lever at the vertical position and screw the eye bolt $\text{M8} \times 70$. Turn the hand wheel clockwise (facing the hand wheel) until the movable gear engaged with the crankshaft gear, The clearance between movable gear and the end cover of speed reducer is 8mm and the space between the gear and the center of the first fixing hole should be 50mm. At this time, the

indicating light in the center control room goes on. Due to the action of shifting block (2), the two-position three-way valve for starting air is under cut-off condition and diesel engine cannot be started up. At that time, start the marine brake motor and the turning gear starts for cranking.

Caution: Whether the control lever is at the horizontal position or vertical position, the eye bolt $M8 \times 70$ must be tightened and the locating inserted pin must be inserted to protect the control lever from falling down or disengaging to avoid the movable gear moving axially.

5. Attentions

5.1 The brake of the marine brake motor, whether its power off or power on, must be crack, then put it into operation.

5.2 When the crankshaft is not turning, turn the movable gear to the disengagement position (moving distance should be 210-215mm). Spike the locating inserted pin, put the control lever to the horizontal position and screw the eye bolt $M8 \times 70$. Before turning the crankshaft, put the control lever to the vertical position and screw the eye bolt $M8 \times 70$. Then the movable gear should be engaged with fly wheel gear, (the distance between the first fixing hole should be 50.5mm), then spike the locating axis pin.

5.3 Before turning the crankshaft, the engaging surfaces of the movable gear should be slightly coated with grease.

5.4 Before the turning gear dismantled for check, it must be under static condition and the movable gear under disengaged condition, turn off the power and drain off the lubricating oil. It is not allowed to dismantle it for check during operation.

5.5 Lift the turning gear at the position of special lift ring M30. Do not carry out lifting operation at such position as marine brake motor, movable gear and hand wheel. During lifting and installing, the electric motor is not allowed to be collided.

6. Lubricating oil type and oil level adjustment

Fill the speed reducer with heavy loading industrial gear oil of “Hai” brand made from Shanghai refinery factory. Main performance: density 0.9, flash-point $\geq 220^{\circ}\text{C}$, solidifying point 0°C , viscosity index 0.95, dynamic viscosity 288-352cst.

The quantity of gear oil filled should be within sight through oil level dipstick glass. That is to say, the oil level cannot be lower than the visible level range through the oil level dipstick glass. It also cannot be higher than the

visible level range through the oil level dipstick glass.

After operating for some time, if the oil level is lower than the specified lower limit, add oil promptly to the visible level range. Renew the lubricating oil for the first time after 50 operating hours, then renew it after every 150 operating hours.

7. troubleshooting chart

item	trouble	Possible cause	What to do
1	Motor fails to start	1 circuit power cut 2 one phase may be turnoff 3 voltage too low 4 overload 5 brake failure	1 check voltage 2 check fuse and power supply of each phase 3 check voltage 4 check current of driven motor 5 check the brake and motor
2	Motor temperature rise too high	1 winding interturn short-circuit 2 improper line connections 3 motor overload 4 starting for too much times 5 brake delay	1 check winding 2 power off and reverse connection at motor 3 check current of driven motor 4 improve operation method 5 check the air gap of brake and DC excitation voltage
3	Noisy operation and stronger vibration	1 Friction between stator and rotor 2 Polyphase motor running single phase 3 Insufficient grease or defective bearing 4 Improper line connection 5 Detective blade	1 Check bearing for loose, or check stator and rotor for improper assembly and repair 2 Check power or motor and repair 3 Clean the bearing and refill the lubricants. Or replace bearing 4 Check connection and repair 5 Replace blade

4	Brake failure of motor with motor	1 friction disc wear too much 2 spring failure 3 brake delay 4 rectifier damaged 5 brake circuit failure	1 adjust air gap or replace brake disc 2 replace spring 3 adjust air gap and check DC excitation voltage 4 replace rectifier 5 properly check brake circuit failure
5	Movable gear isn't turning while the motor runs	1 chain damaged 2 sun gear shaft of speed reducer wear too much 3 flat key of chain is cut 4 no flat key be put on the ring gear	1 replace chain 2 replace sun gear or gear shaft 3 drug out the chain, refix flat key 4 open speed reducer, check the ring gear, then fix the flat key

8 .direct-current electromagnetic brake: (see drawing 3), brake for short

8.1 operational principle of brake

When the brake coil (6) connected to the direct-current power supply, due to the action of electromagnetic force, the electromagnet (7) attracting the armature (5) and compress the spring (24) make the brake disc (2) disengaged with friction surface of the armature (5) and motor end cover (26). Then the motor runs normally.

When the DC power supply of the brake coil (6) cut off, the electromagnet (7) lose the electromagnetic attraction. The compression spring (24) push out the armature (5) and compress the brake disc (2), so the disc (2) promptly brake the shaft of motor by the action of two friction torque of armature (5) and motor end cover., which make the motor stop turning.

8.2 adjustment of brake

The adjustment of brake is the adjustment t of armature stroke (air gap Δ) and friction torque of brake. These two have great effect on the brake time and brake torque. The marine brake motor will be adjusted before delivery.

Air gap (Δ) is divided into two kinds of working air gap and max. gap. Brake motor of operating air gap has been adjusted before delivery. After operate for some time, the friction wears and the air gap between the armature and the electromagnet increased. When the air gap exceeds the specified value, the brake torque will go down sharply, then the brake time will be prolong. The air gap (operating air gap and max. air gap) must be re-adjusted in order to make the brake operating normally. Generally, the air gap is 0.35-0.45mm, the max. friction gap is 1.00-1.10mm.

8.2.1 adjustment of air gap (Δ)

Brake motor of operating air gap has been adjusted before delivery. After it is used for some time or repaired, the air gap should be re-adjust, the method is as follows:

- (1) Mount the brake onto the back end cover of motor, tighten the set screw (4) evenly, measure the actual air gap with feeler gauge and record 3 (or 6) measured value of isotonic point.
- (2) Unscrew the tightening nut (21), then unscrew the set screw (4) and drop out the support screw (22). Choose feeler gauge of operating gap according to table1, then tuck it into the first support point, tighten the screw (4) then the screw (22), and then unscrew the nut (4) a little, draw out the feeler gauge and then tighten the screw (22) a little about 1/4 rounds, then tighten the nut (4). Adjust the other points by the same way. Adjust it in turn respectively and tighten the nut (21) until the air gap meets the requirement. Be more careful when adjusting the air gap. Too hasty will waste time.

8.2.2 Adjustment of brake torque

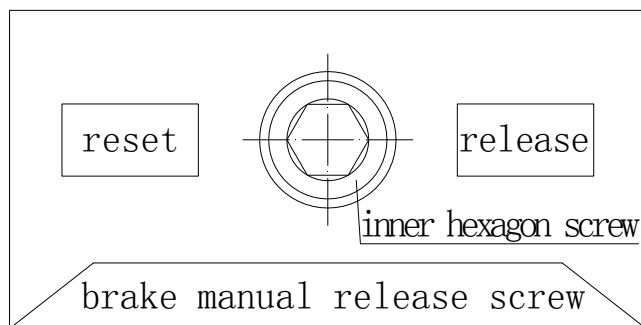
Tight the adjusting screw (23) with inner hexagon spanner make the spring (24) compressed and torque increased. Whereas unscrew make the torque decreased. The brake torque has been adjusted before delivery.

8.3 maintenance of brake

The friction disc of brake (2) is easily damaged parts. When the friction disc. is used for some time and wore to 1mm (3.5mm before delivery), it should be replaced. It is difficult for users to affix the friction disc onto the brake disc themselves, since it needs some tooling and certain processes. Users can replace it with brake disc together.

9 .manual release and reset of the brake

brake motor structure with manual release device (see drawing 3)



The nameplate of manual release and reset of the brake is tacked on the shield cover of the fan.

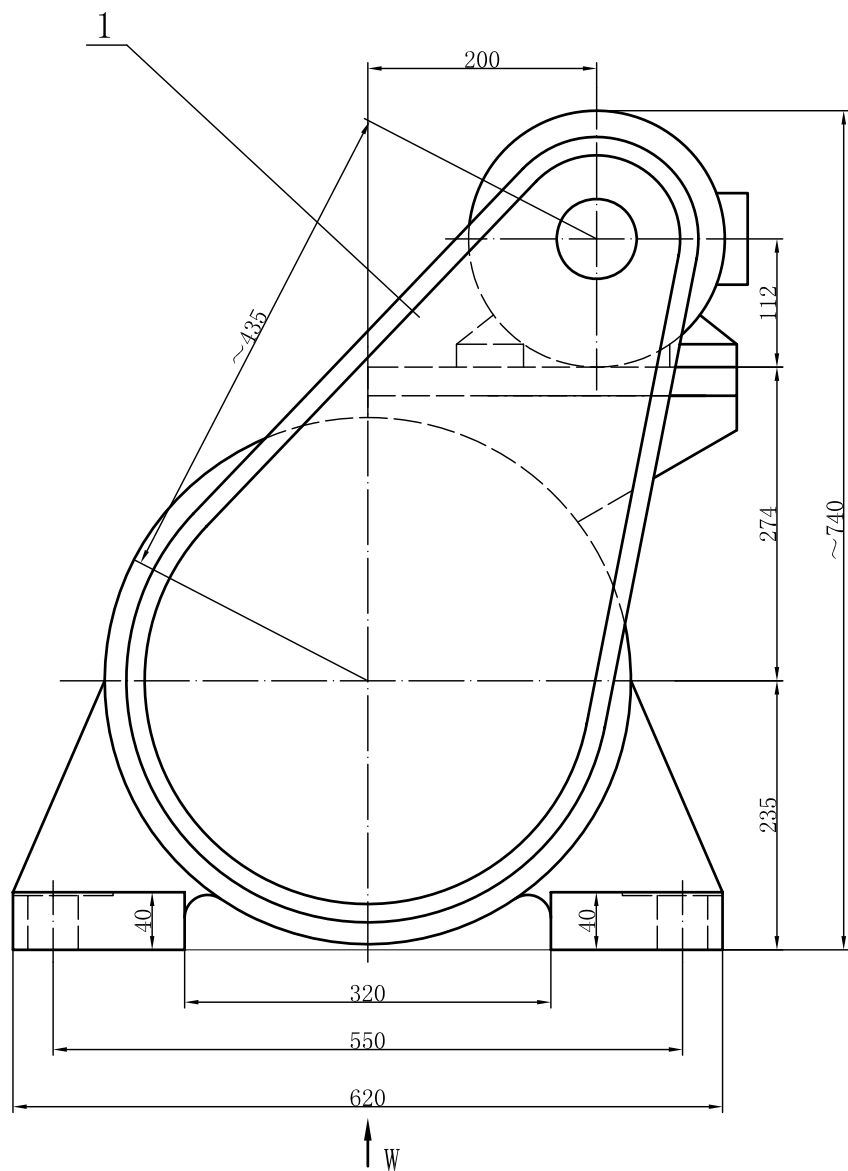
9.1 When screw in the inner hexagon screw (11) in the releasing direction, the friction disc is under disengagement condition. At that time, the motor can also turn. You can start the motor, but the crankshaft of the diesel engine cannot be turning, because the brake fails to take the braking action.

9.2 When screw out the inner hexagon screw (11) in the resetting direction, the friction disc is under engagement condition, the motor shaft cannot be turning. Do not close circuit and start the motor if there is no rectifier fixed in the connection box or the rectifier is burned out, or the brake or motor will be burned out.

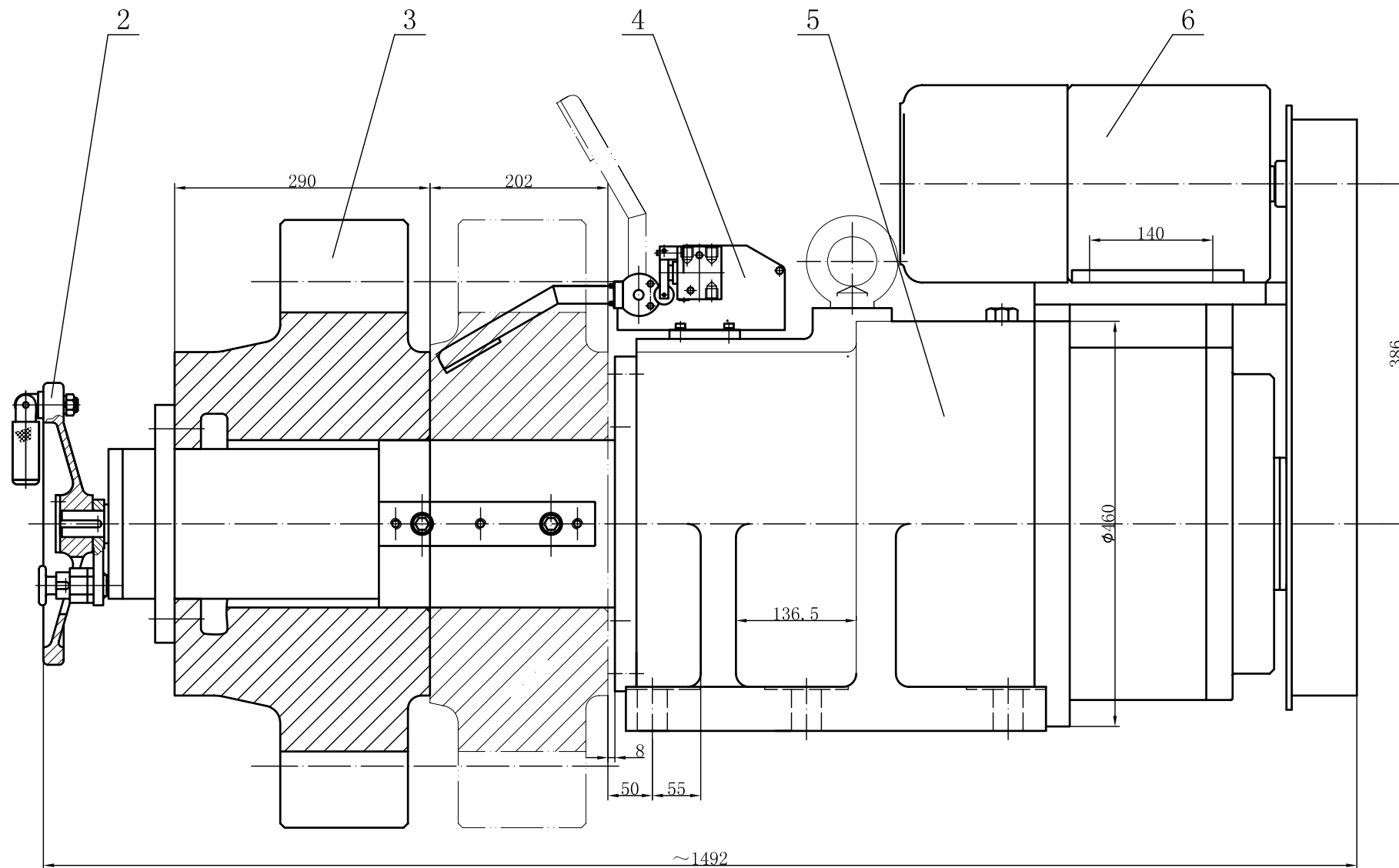
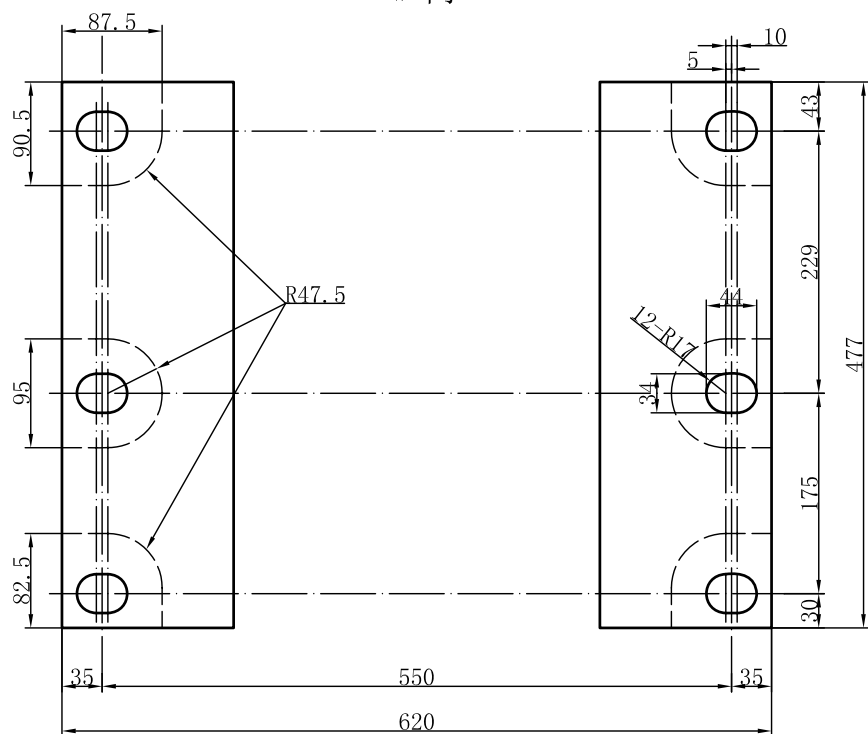
9.3 When the brake under the resetting state and the rectifier in good condition, starts the motor and the brake will be crack (make a sound of “pi pa”), then the turning gear turns and brakes the crankshaft of the diesel engine.

9.4 Adjustment of manual releasing mechanism

Manual (brake) releasing mechanism is to make it adjusting the main engine manually and repairing conveniently after the assembly of brake motor with the main engine. It uses cam principle, a mechanism which makes the brake disengaged temporarily. The adjusting method is, tightening the adjusting screw (11), shifting releasing ring (10), pushing out release disc (13), pulling the armature (5) to compress the compression spring (24) by drawbar (8), make the friction disc disengaged from braking. If it needs recovering braking, just unscrew the adjusting screw (11), the release disc. will be reset automatically by make use on spring (18). Pay the great attention that the adjusting screw (11) cannot be tighten too deep as long as the braking friction disc disengaged, that is to say, the motor shaft could be turning. Or it will push the inner cam distorted and cause it unable to reset. If the above situation happens, the brake motor will takes the emergency measures and still can operate temporarily. The method in detail is: unscrewing the screw (11), knocking into the release disc. (13), make the brake back to normal (or remove the release ring (10), unscrew the drawbar nut (17) , then it can be use temporarily. It won’ t affect operation and braking, but the manual releasing has been damaged. It should be replaced to ensure the full use of function of the motor.



W 向



5-6G60ME-C 曲轴盘车 Turning Gear

1. 链传动chain drive tp=15.875
2. 离合装置disengagement & engagement mechanism
3. 盘车齿轮movable gear
 $Z=11$ $m=50$ $x \cdot m=25$
4. 联锁装置interlocking mechanism
5. 减速器speed reducer
6. 船用制动电机marine brake motor Y112M-4-H 4Kw-4P B₃

						5-6G60ME-C	Motor 4Kw-4P B ₃		
						盘车机	TG60E-00-00		
标记处数	分区	更改文件号		签名	年月日		图样阶段标记	重量Kg	比例
设计	徐源达	14. 08. 28	绘图	徐源达	14. 08. 28				典
校对									
审核									
标检							共 11 页	第 7 页	
审定	胡文忠	14. 08. 28	批准				上海乐春重工机电设备有限公司		

面积 m²

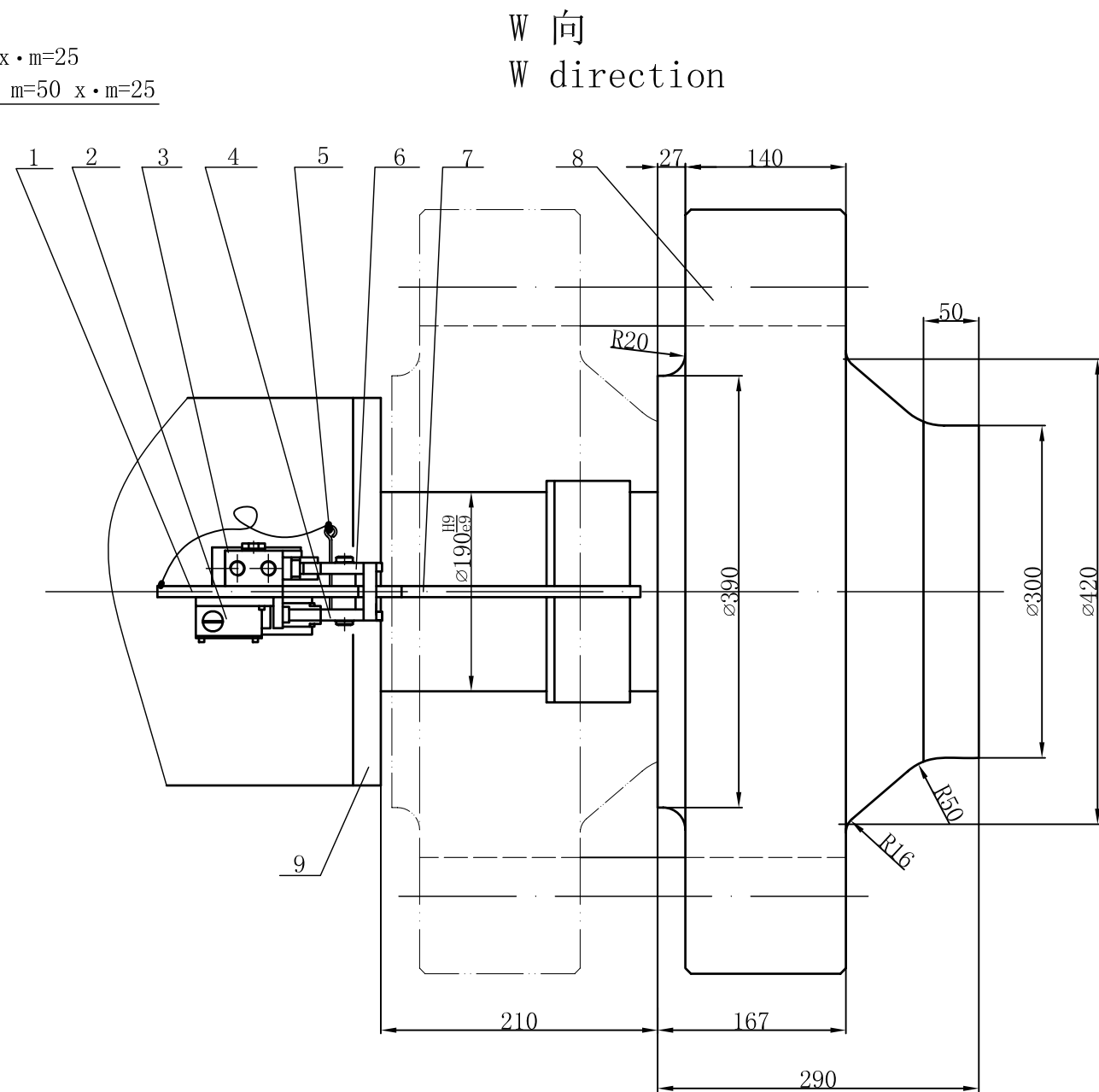
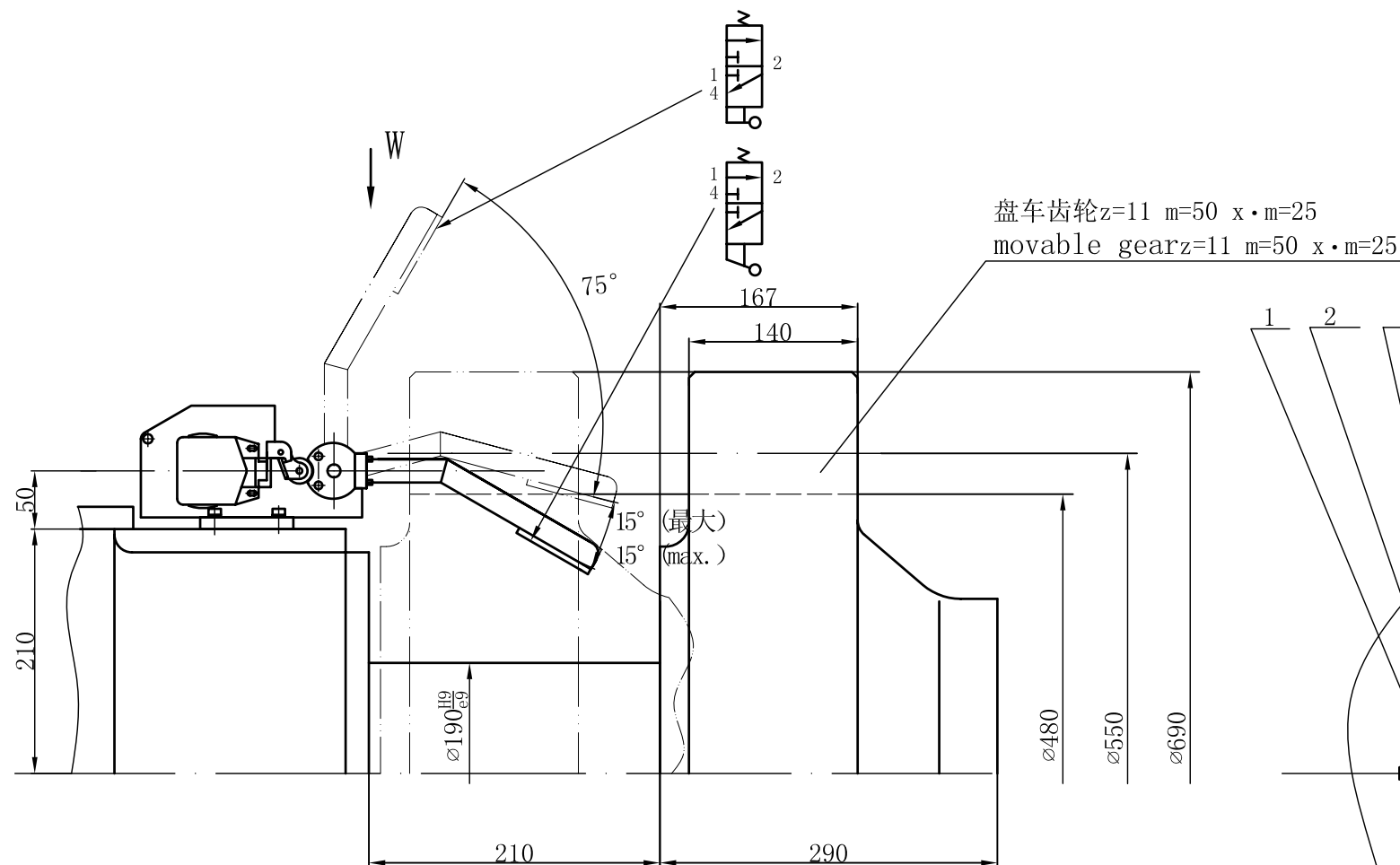


图2 5-6G60ME-C盘车机联锁装置
drawing2 Turning Gear interlocking mechanism

- | | |
|--|------|
| 1. 支架 Support | 1件pc |
| 2. 限位开关 Swich 3SE2 (404-0E) | 1件pc |
| 3. 二位三通阀 3/2-way valve | 1件pc |
| 4. 拨块 Disc with incision(1) | 1件pc |
| 5. 环首螺钉 Ring head bolt M8×70 | 1件pc |
| 6. 拨块 Disc with incision (2) | 1件pc |
| 7. 控制杆 Control level | 1件pc |
| 8. 盘车齿轮 Movable gear z=11, m=50, x·m=25 | 1件pc |
| 9. 减速器端盖 The head cover of speed reducer | 1件pc |

						5-6G60ME-C	Motor 4Kw-4P B ₃		
						联锁装置	TG60E-18-00		
标记	处数	分区	更改文件号	签名	年月日		图样阶段标记	重量Kg	比例
设计	徐源达	14.03.28	CAD	徐源达	14.03.28				典
校对									
审核							共 11 页	第 8 页	
标检							上海乐春重机电设备有限公司		
审定	胡文忠	14.03.28	批准						

面积 m²

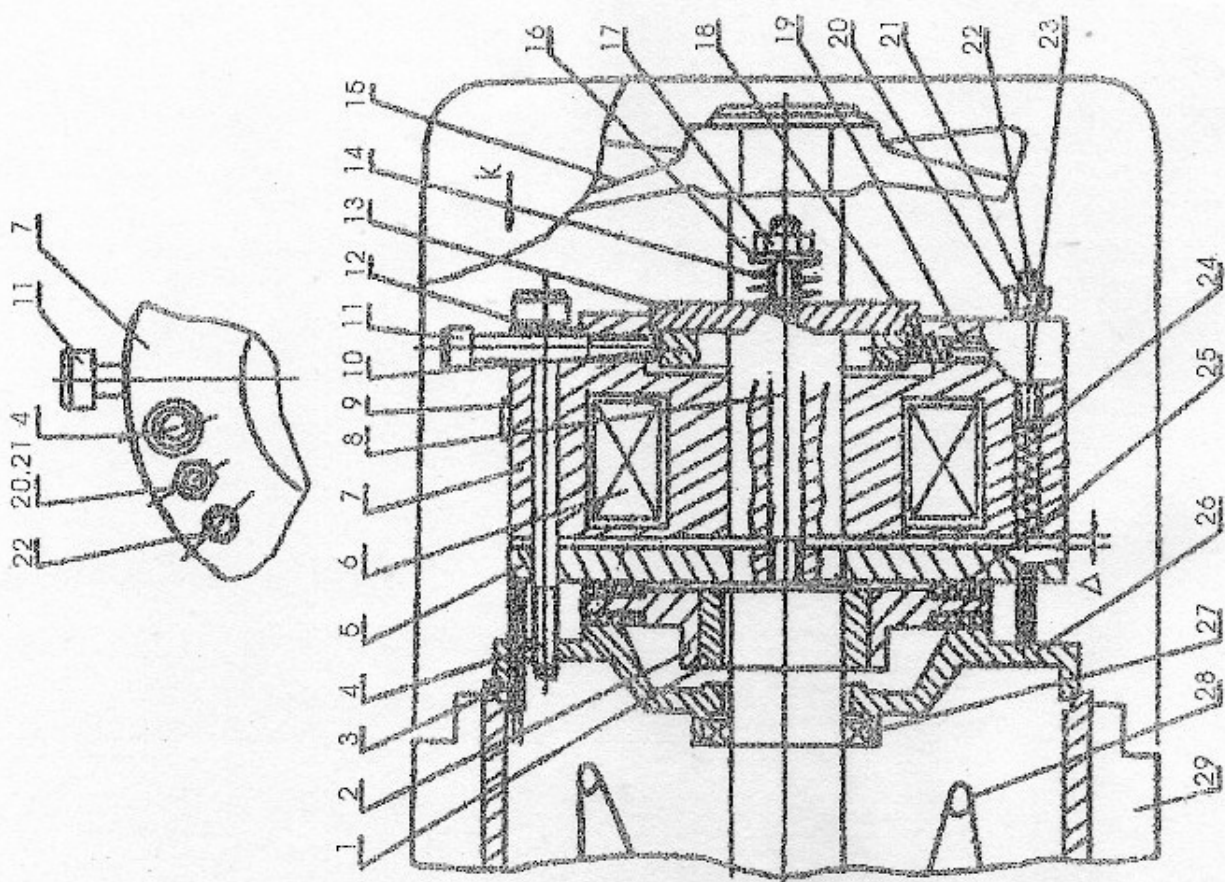
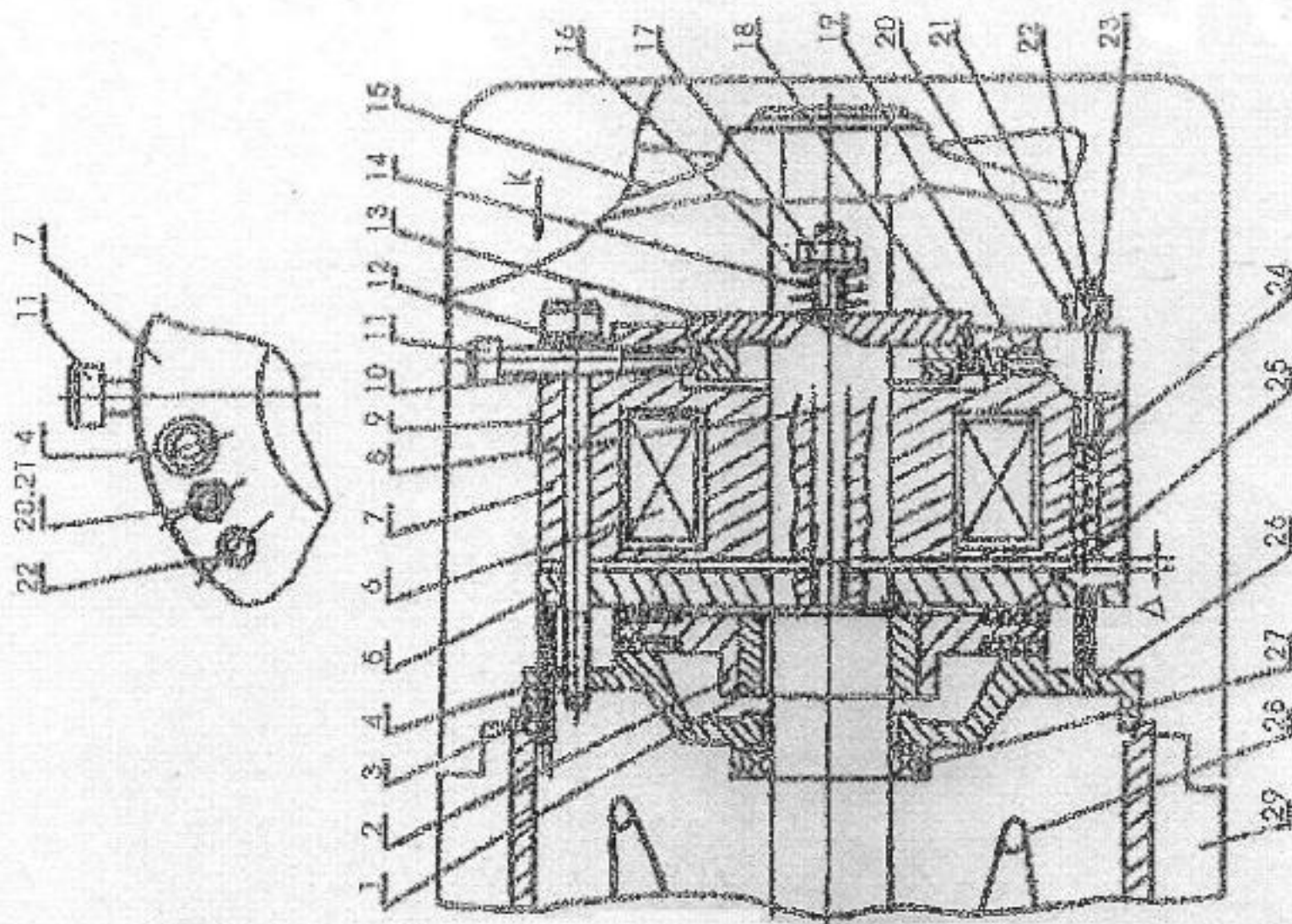


图3带手动释放装置制电动机结构

- 1.花键衬套
 - 2.制动盘
 - 3.引出线
 - 4.固定螺钉
 - 5.衔铁
 - 6.线圈
 - 7.电磁铁 (磁轭)
 - 8.牵引杆 (螺钉)
 - 9.铭牌
 - 10.释放环 (推力环)
 - 11.释放 — 复位 内六角螺钉
 - 12.弹簧垫圈
 - 13.释放盘
 - 14.锥形释放复位弹簧
 - 15.风扇
 - 16.垫圈
 - 17.牵引杆螺母
 - 18.释放复位弹簧
 - 19.固定复位弹簧螺钉
 - 20.弹簧垫圈
 - 21.支撑螺钉并紧螺母
 - 22.支撑螺钉
 - 23.力矩调节螺钉
 - 24.制动弹簧
 - 25.摩擦片
 - 26.端盖
 - 27.轴承
 - 28.定子绕组
 - 29.机座
- △: 气隙 (衔铁行程) 一般为0.50~0.70mm

1. Spline bush
2. Brake disc
3. Outgoing wire
4. Set screw
5. armature
6. coil
7. electromagnet (magnetic yoke)
8. Drawbar (bolt)
9. Nameplate
10. releasing ring (thrusting ring)
11. release —reset inner hexagon screw
12. spring gasket
13. release disc
14. cone release and reset spring
15. fan
16. gasket
17. drawbar nut
18. release and reset spring
19. fixed reset spring screw
20. spring gasket
21. tightening nut
22. support screw
23. torque adjusting screw
24. brake spring
25. friction disc
26. end cover
27. bearing
28. winding
29. block

△: air gag (armature stroke) generally 0.50~0.70mm

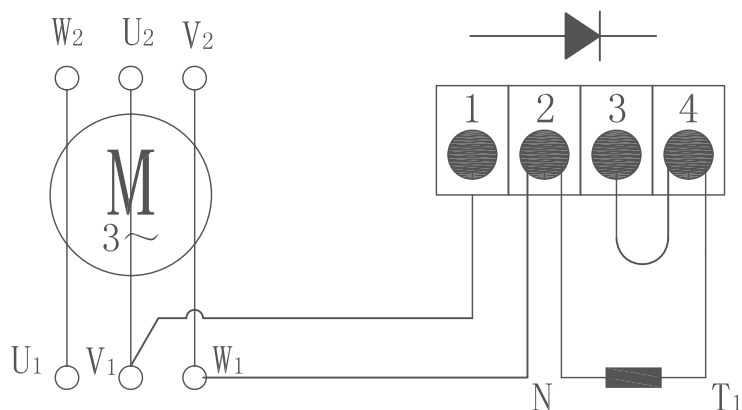


drawing3 brake motor structure with manual release device

Y-H Series Motor



泰力防爆整流器

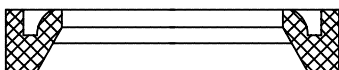
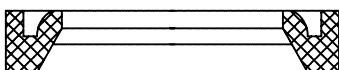
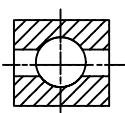


电源
Power Supply
3×AC440V/60HZ

制动器
Brake
DC170V

加热器
Heating
AC220V
30w

电机接线图
Circuit Diagram of E-motor

LIST OF SPARE PARTS FOR ACCESSORIES FOR MAIN DIESEL ENGINE 主机附件备件清单				DRWG.NO.:	
				PAGE:	TOTALPAGE:
LECHUN		LIST OF SPARE PARTS FOR TURNING GEAR 盘车机备件清单		MAIN ENGINE TYPE 5-6G60ME-C 主机型号	
SPARE PARTS					
No. 序号	Name 名称	Sketch 简图和尺寸	Supply 供应数量		Remarks 备注
			Working 工作数量	Spare 备件数量	
1	HG4-692-67 Oil Seal 骨架油封	 PD190x240x15	1pcs	2pcs	减速器输出端用 For output end of speed reducer use
2	HG4-692-67 Oil Seal 骨架油封	 PD45x75x10	1pcs	2pcs	减速器输入端用 For input end of speed reducer use
3	GB279-64 Rolling Bearing 轴承	 6207	2pcs	2pcs	电机用 For electric motor use
MFR'S NAME 制造商		SHANGHAI LECHUN HEAVY MACHINERY & ELECTRONIC EQUIPMENT CO.,LTD. 上海乐春重机电设备有限公司 TEL:86 21 51961688 51961699 FAX:86 21 51961688-8007			

SHANGHAI LECHUN HEAVY MACHINERY & ELECTRONIC EQUIPMENT CO., LTD.

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Table of contents

1	Preliminary remarks	5
1.1	Purpose of the manual	5
1.2	Symbols, definitions, contact address	6
2	Safety.....	7
2.1	Introduction	7
2.2	Definition of safety instructions.....	8
2.3	Warning plates on the turbocharger	9
2.4	Safe operation and maintenance	9
2.5	Hazards during operation and maintenance	13
2.6	Lifting of loads.....	18
2.7	Periodic check of the pressure vessels	19
3	Introduction	21
3.1	Essential information.....	21
3.2	Layout and function of the turbocharger	22
3.3	Storage of new turbochargers and cartridge groups.....	24
3.4	Intended use	26
3.5	Prerequisites for operation	27
3.6	Turbocharger rating plate	29
3.7	CE conformity	30
4	Removal and installation	31
4.1	Turbocharger weight	31
4.2	Removing the turbocharger.....	32
4.3	Installing the turbocharger.....	33
5	Commissioning	37
5.1	Oil supply	37
5.2	Inspection procedures.....	39
5.3	Commissioning after taking out of operation	41
6	Monitoring during operation	43
6.1	Oil pressure, oil temperature.....	43
6.2	Turbocharger speed.....	45
6.3	Low pressure measurement at the filter silencer	48

7	Operation and service	51
7.1	Noise emission.....	51
7.2	Service work	53
7.3	Expected replacement intervals	56
7.4	Stopping the engine	57
7.5	Flexible cut-out.....	58
8	Periodic maintenance	59
8.1	Foreword to maintenance.....	59
8.2	Cleaning the filter silencer	60
8.3	Changing the filter strip on the filter silencer casing.....	62
8.4	Cleaning the compressor during operation.....	64
8.5	Cleaning the turbine during operation.....	68
8.6	Suppliers of dry cleaning materials.....	72
8.7	Draining the gas outlet casing	73
9	Troubleshooting.....	75
9.1	Malfunctions when starting	75
9.2	Malfunctions during operation	76
9.3	Surging of the turbocharger.....	78
9.4	Malfunctions when stopping	79
9.5	Speed measurement system.....	80
10	Disassembly and assembly	81
10.1	Introduction	81
10.2	Weights of assemblies	83
10.3	Disassembly and assembly of the filter silencer casing	85
10.4	Dismantling and fitting the filter silencer	90
10.5	Dismantling wall insert and diffuser	91
10.6	Axial clearance A prior to disassembly	95
10.7	Dismantling the gas inlet casing, cover ring, nozzle ring.....	96
10.8	Fitting the nozzle ring, cover ring, gas inlet casing	101
10.9	Axial clearance A after assembly	105
10.10	Fitting diffuser, wall insert.....	106
10.11	Table of tightening torques.....	110
11	Taking out of operation at short notice	113
11.1	Possible emergency repairs	113
11.2	Locking the rotor	114
11.3	Blanking off the inlets and outlets.....	118

11.4	Bypassing the turbocharger	118
12	Mothballing the turbocharger	119
12.1	Taking the engine out of operation for up to 12 months.....	119
12.2	Taking the engine out of operation for more than 12 months	120
13	Disposing of turbocharger components.....	121
14	Spare parts.....	123
14.1	Ordering spare parts	123
14.2	View of turbocharger with part numbers.....	124
14.3	View of cartridge group with part numbers	126

1 Preliminary remarks

1.1 Purpose of the manual

Figure 1 shows a form from ABB Turbo Systems Ltd, CH 5401 Baden. The form is divided into several sections. At the top left is the ABB logo. To its right is the company name and address. Below this is a table with two columns. The first column is labeled 'Type' and contains fields for 'n Mmax' and 'n Bmax'. The second column is labeled 'HT' and contains fields for 't Mmax' and 't Bmax'. Below these fields are fields for 'kg' and 'Year'. At the bottom right is a section labeled 'Application according to the Operation Manual'. A dot next to the 'HT' label is circled and labeled with a '1'.

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.

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.

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.

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.**

2.3 Warning plates on the turbocharger

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

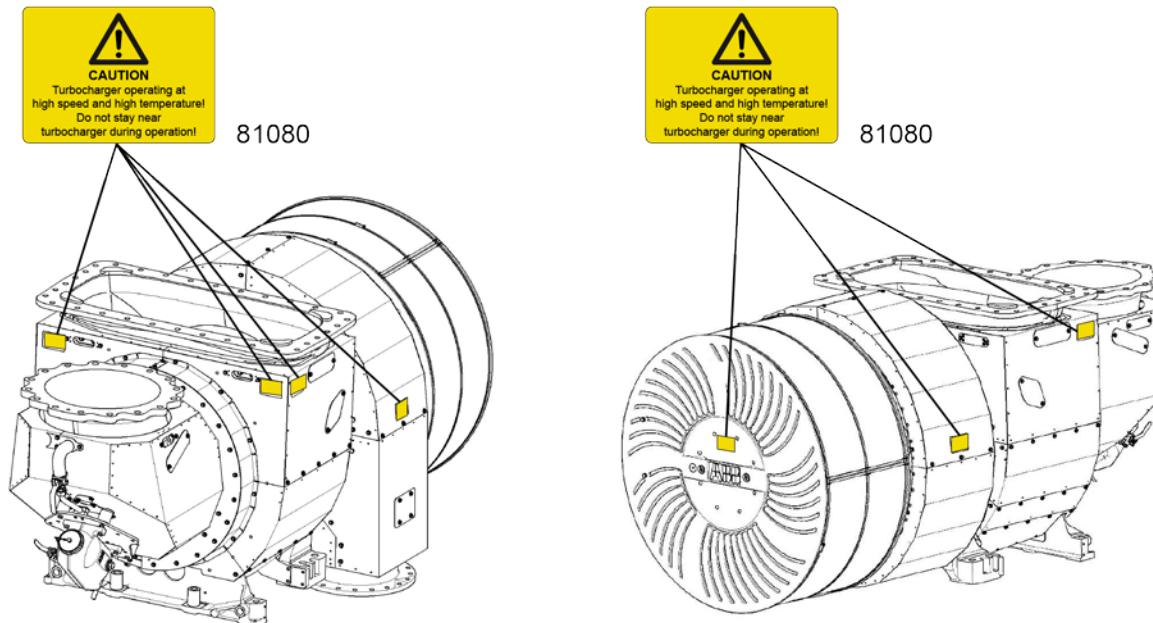


Figure 2: A...-L

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.

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.

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.

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.

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.

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]):

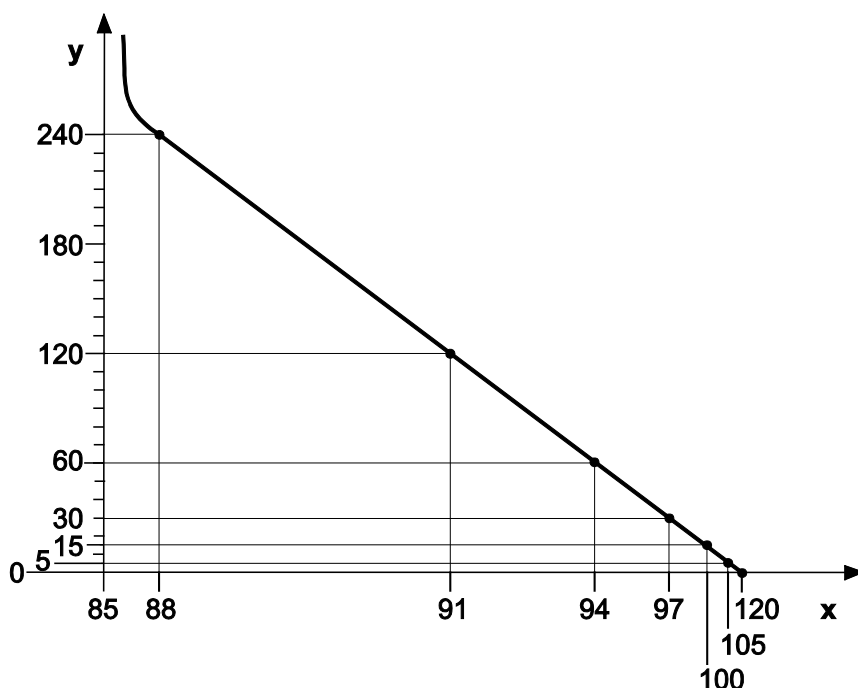


Figure 3

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

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.

**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.

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.

2.6 Lifting of loads

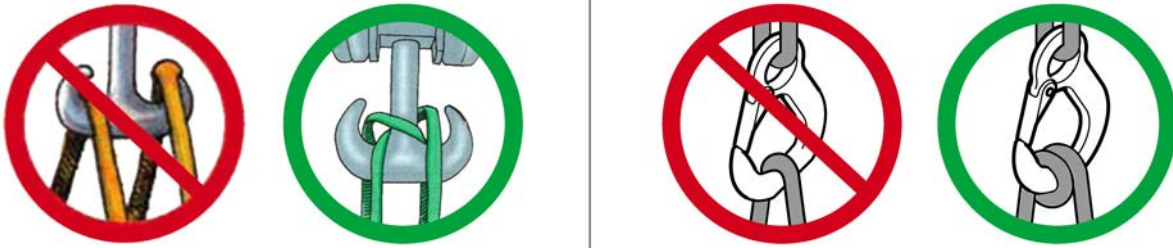


Figure 4

**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.

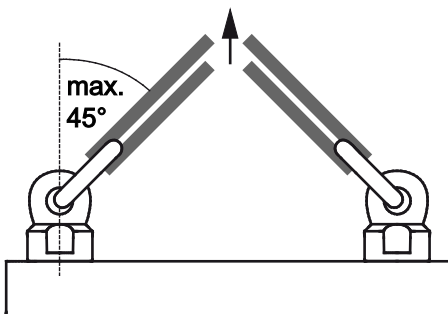


Figure 5

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.

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.

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.



3.2 Layout and function of the turbocharger

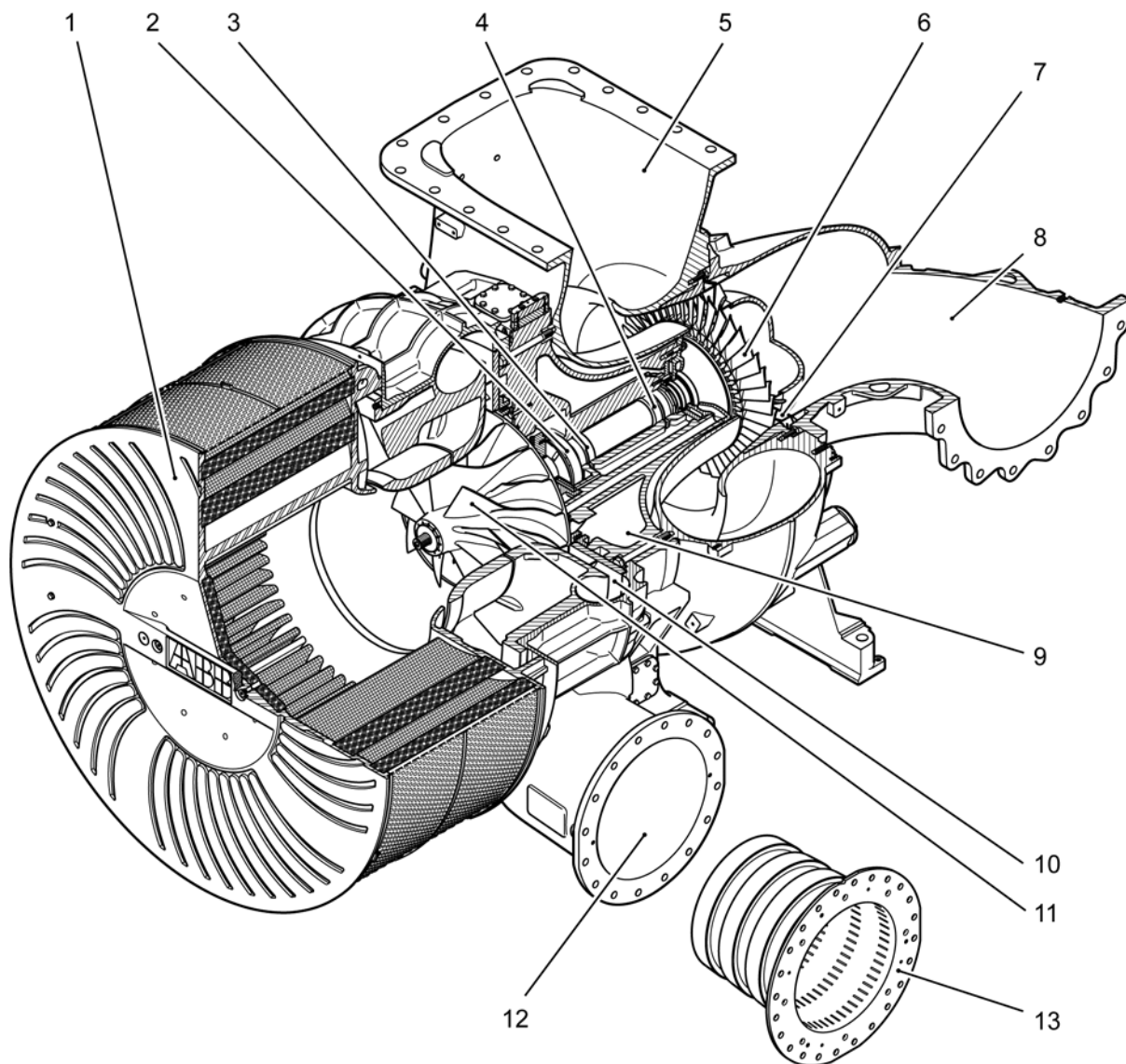


Figure 6

- | | |
|------------------------|---------------------------------|
| 1 Filter silencer | 8 Gas inlet casing |
| 2 Thrust bearing | 9 Bearing casing |
| 3 Radial plain bearing | 10 Diffuser |
| 4 Radial plain bearing | 11 Compressor wheel |
| 5 Gas outlet casing | 12 Compressor casing |
| 6 Turbine wheel | 13 Air-outlet silencer (option) |
| 7 Nozzle ring | |

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.

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: Volatile Corrosion Inhibitor (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.

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).

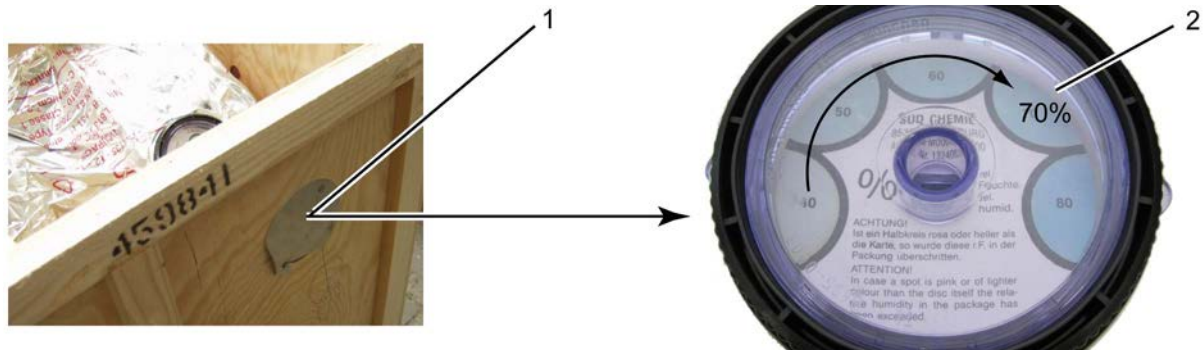


Figure 8

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.

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.

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.

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.

3.6 Turbocharger rating plate

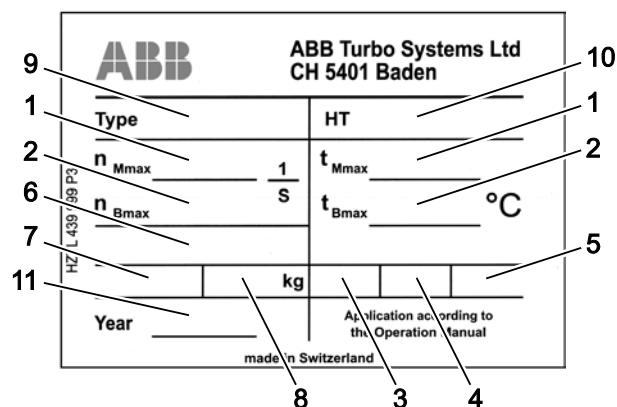


Figure 9

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

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

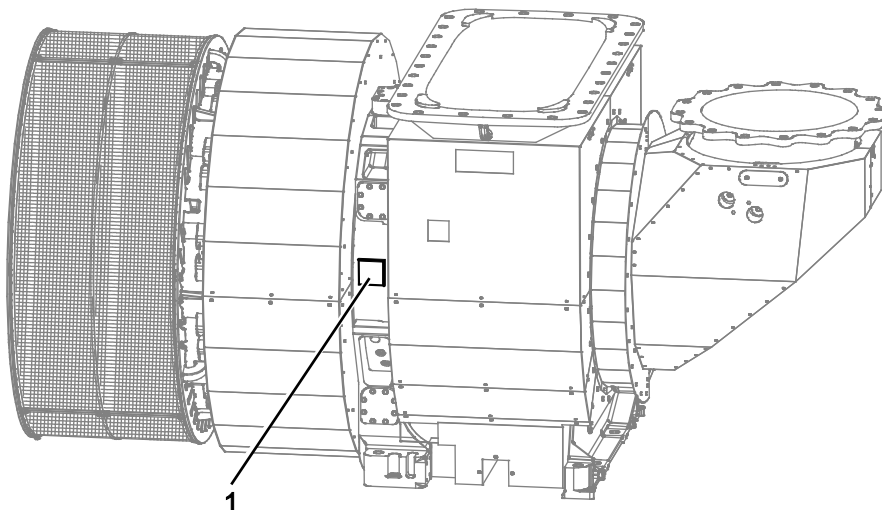


Figure 10

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.

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]

A270-L	A275-L
3800	6300

Table 1



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.

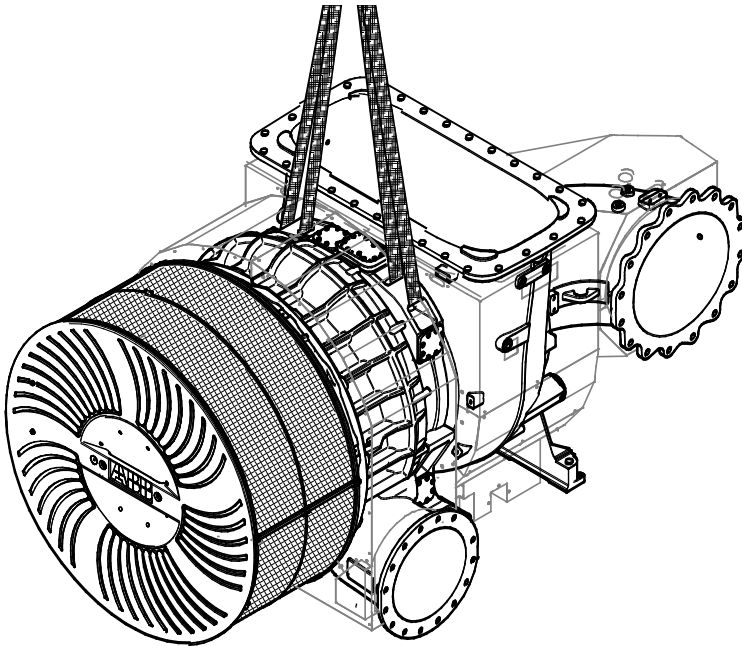


Figure 11

- ▶ 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.

4.3 Installing the turbocharger

4.3.1 Placing the turbocharger on the bracket

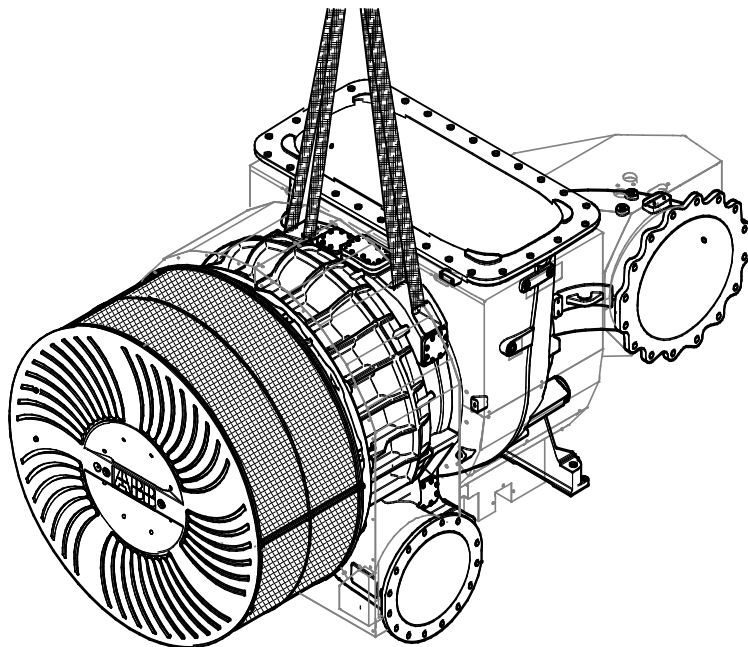


Figure 12

- ▶ 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.

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 $\geq 15\%$ of the nominal thread diameter
Dimension a	Height of the turbocharger foot
Dimension b	Thread set deeper in bracket
Depth of thread c	$\geq 1.5 \times$ 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

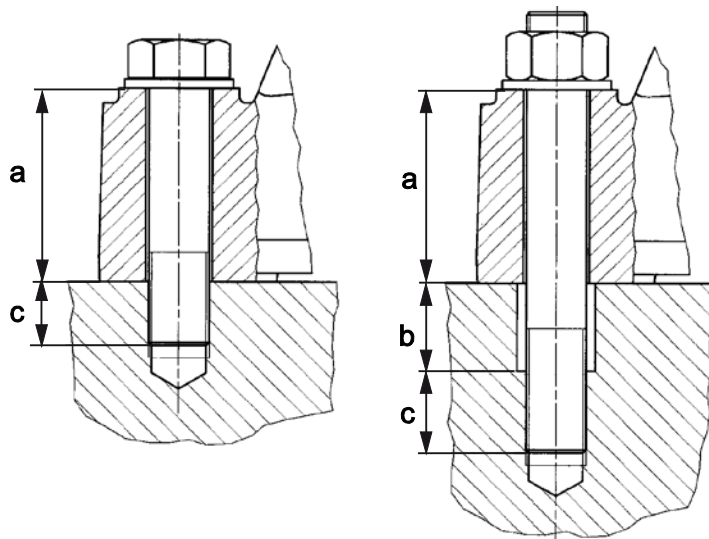


Figure 13

- Tighten the foot fixing screws or nuts diagonally according to the selected tightening method.

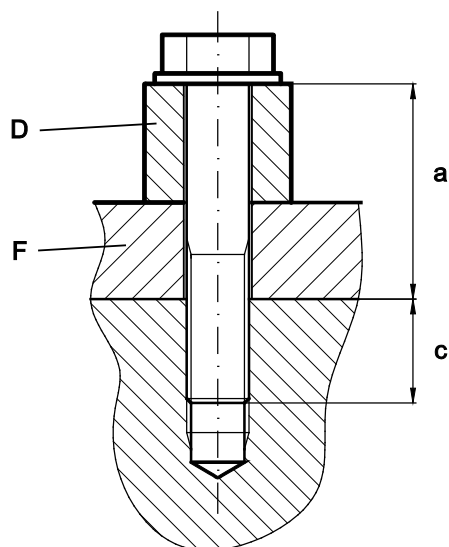
Turbine-end foot

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]
A270-L	M27	100	1000
A275-L	M30	120	1400

Table 3

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]
A270-L	M27	100	220	30	3.1
A275-L	M30	120	300	30	2.6

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.

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.

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

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.

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.

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.

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

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.

6.2 Turbocharger speed

6.2.1 Introduction

The speed of the turbocharger must be permanently monitored.

6.2.2 Layout and overview

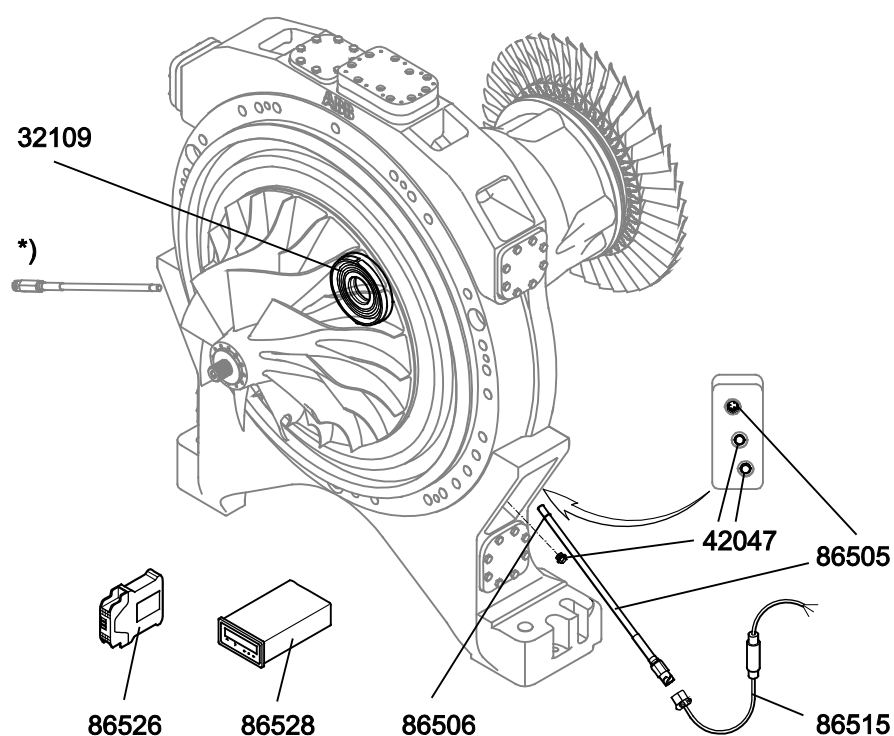


Figure 15

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

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.

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.

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

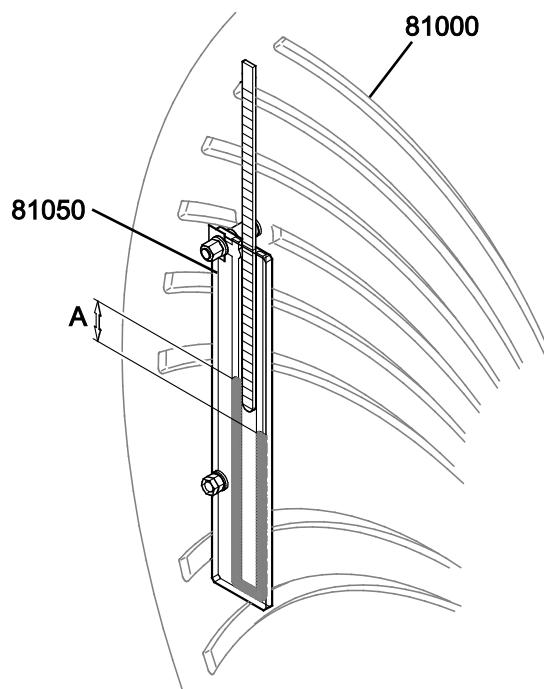


Figure 16

81000	Filter silencer
81050	U-tube manometer
A [mm H ₂ O]	Pressure loss / pressure difference

With a clean filter silencer (and optional clean filter mat), the pressure loss (A) is 120 mm H₂O maximum at full load.

If the pressure loss (A) has reached the value of 200 mm H₂O:

► 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.

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 level¹⁾ 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 measures²⁾ 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

Suggestion for noise insulation, bellows

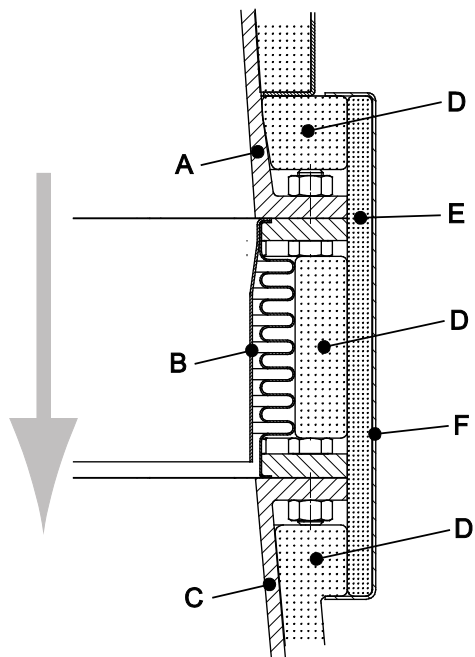


Figure 17

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

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.

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.

**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

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.

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.

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.

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.



8.2 Cleaning the filter silencer

Filter silencer with tension band

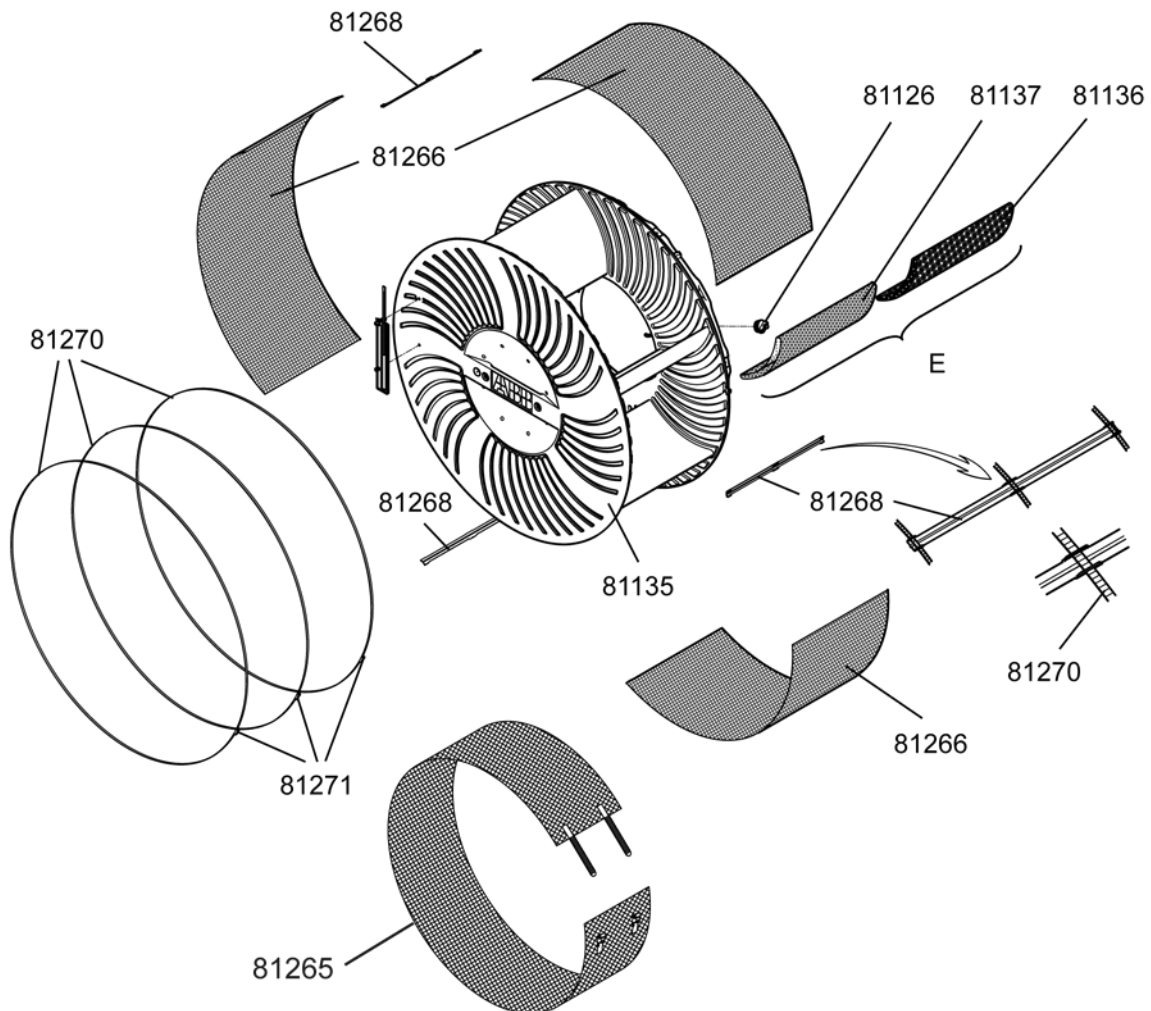


Figure 18

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)		

**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.

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.

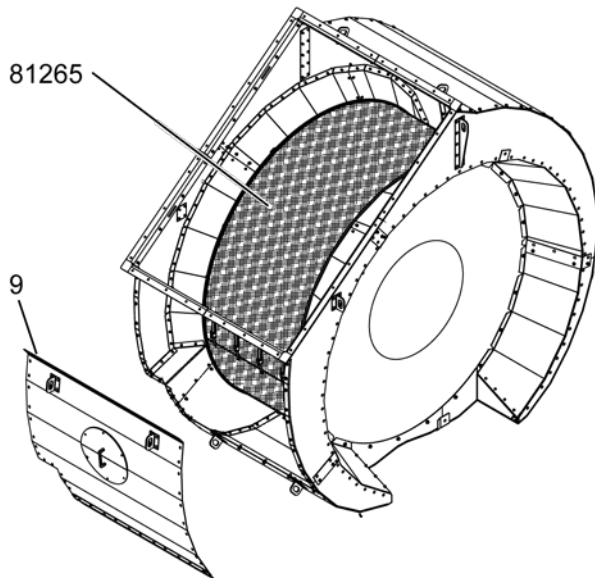


Figure 19

- Dismantle the circumferential part (9).

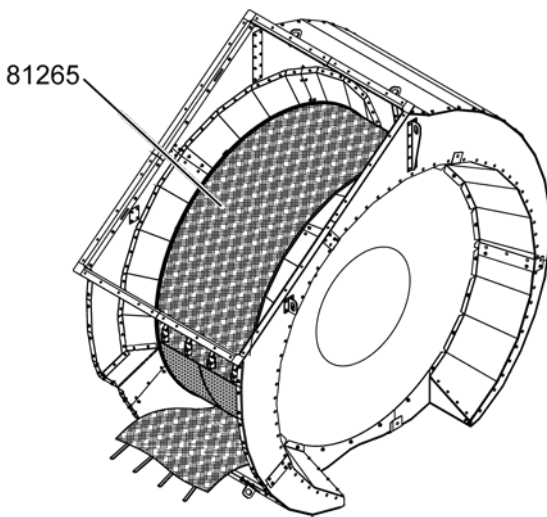


Figure 20

- Open the lock of the filter ring (81265).

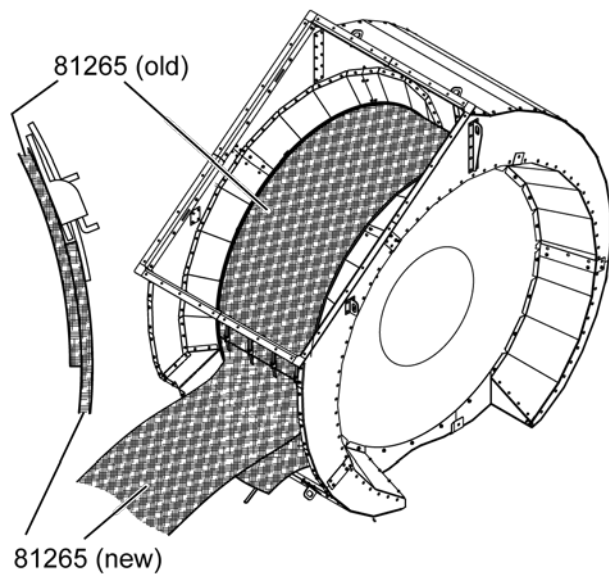


Figure 21

- Attach the new filter ring (81265) on the filter ring to be replaced so they overlap.

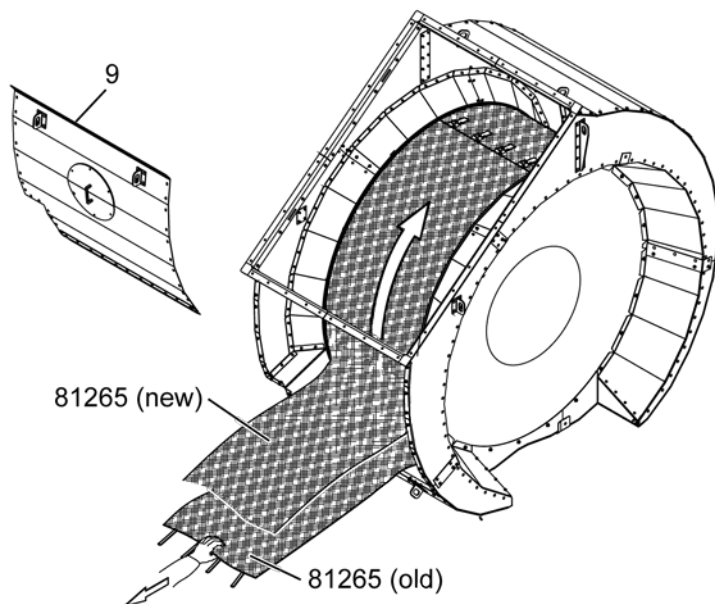


Figure 22

- 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).

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 pre-condition 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.

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.

8.4.2 Wet cleaning of compressor

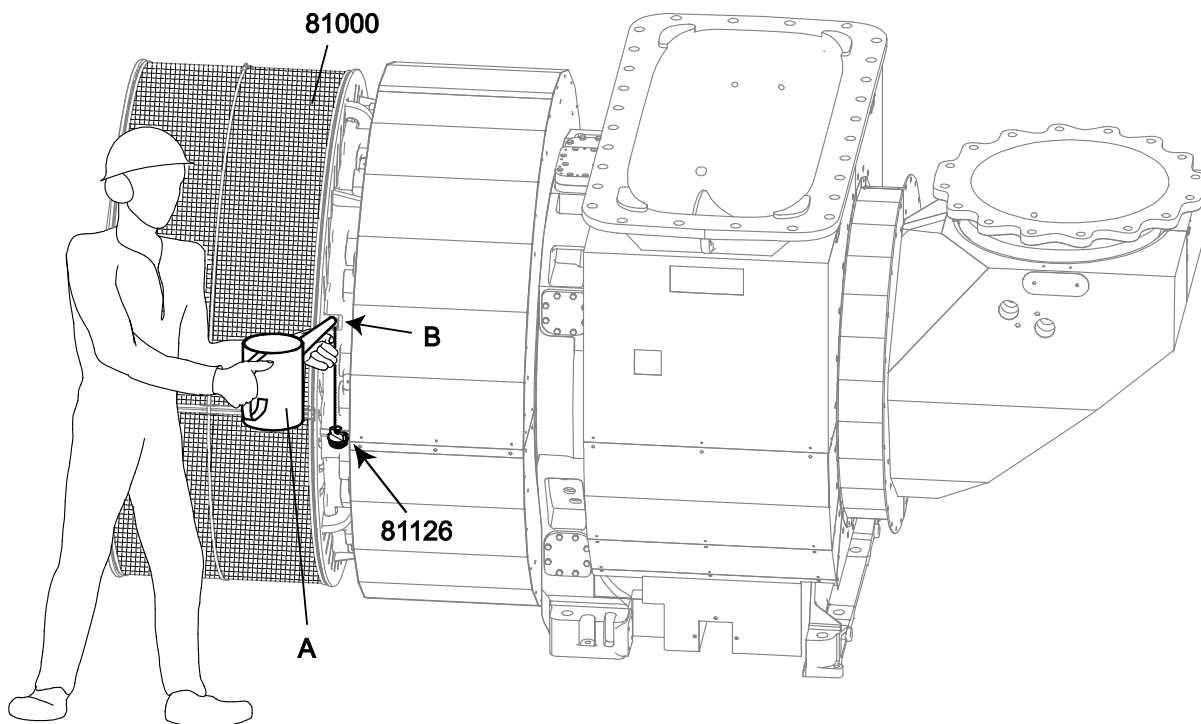


Figure 23

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.

Repeating the cleaning

If the cleaning is still unsuccessful after three processes, it is recommended to have the turbo-charger checked and cleaned by an ABB Turbocharging Service Station if the engine values are unsatisfactory.

Volume of water per cleaning process

Product	A270-L	A275-L
Quantity [dm ³]	2.0	3.0

Table 12

The filling time is 4 ... 15 seconds.

Checking the filter plug

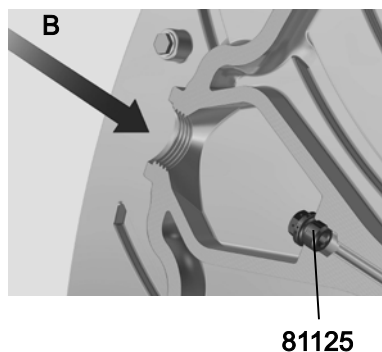


Figure 24

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]).

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 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 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.

8.5.2 Procedure for dry cleaning the turbine

Dry cleaning device

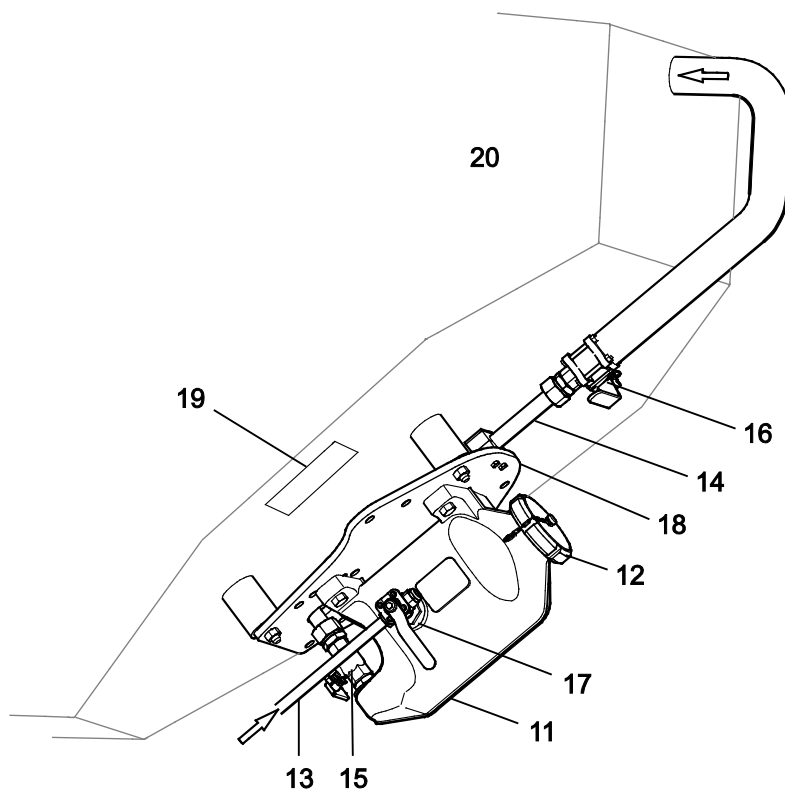


Figure 25

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).

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 turbo-charger 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.

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	A270-L	A275-L
Quantity [dm ³]	1.5	2.0

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.

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 HENGELO B.V.	Netherlands	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 Kungälv Sweden	Tel.: +46 303 630 75 Fax: +46 303 630 77 Email: lars@carlander.com
BOSUNG Engineering 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

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.

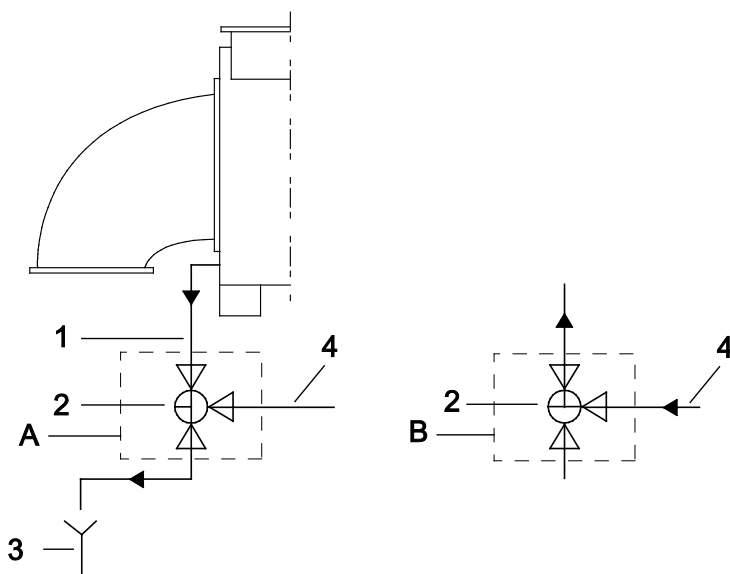


Figure 26

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.

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

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

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

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.

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

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

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]).

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.

10.2 Weights of assemblies

The specified weights of the individual parts or assemblies are rounded-up standard values.

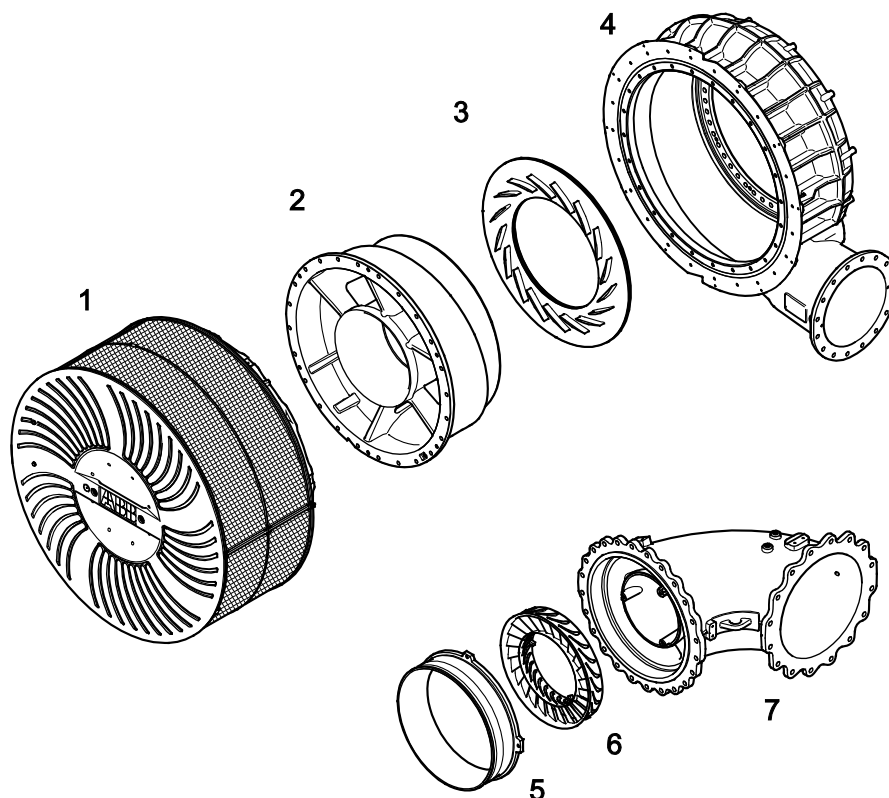


Figure 27

Weights of assemblies [kg]

Item	Assembly	A270-L	A275-L
1	Filter silencer	420	710
2	Wall insert	450	760
3	Diffuser	60	110
4	Compressor casing	620	1030
5	Cover ring	50	75
6	Nozzle ring	20	25
7	Gas inlet casing	240	380

Table 27

Weight of complete wall insert [kg]

The total weight of the complete wall insert is made up of the wall insert and diffuser assemblies.

A270-L	A275-L
510	870

Table 28

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.

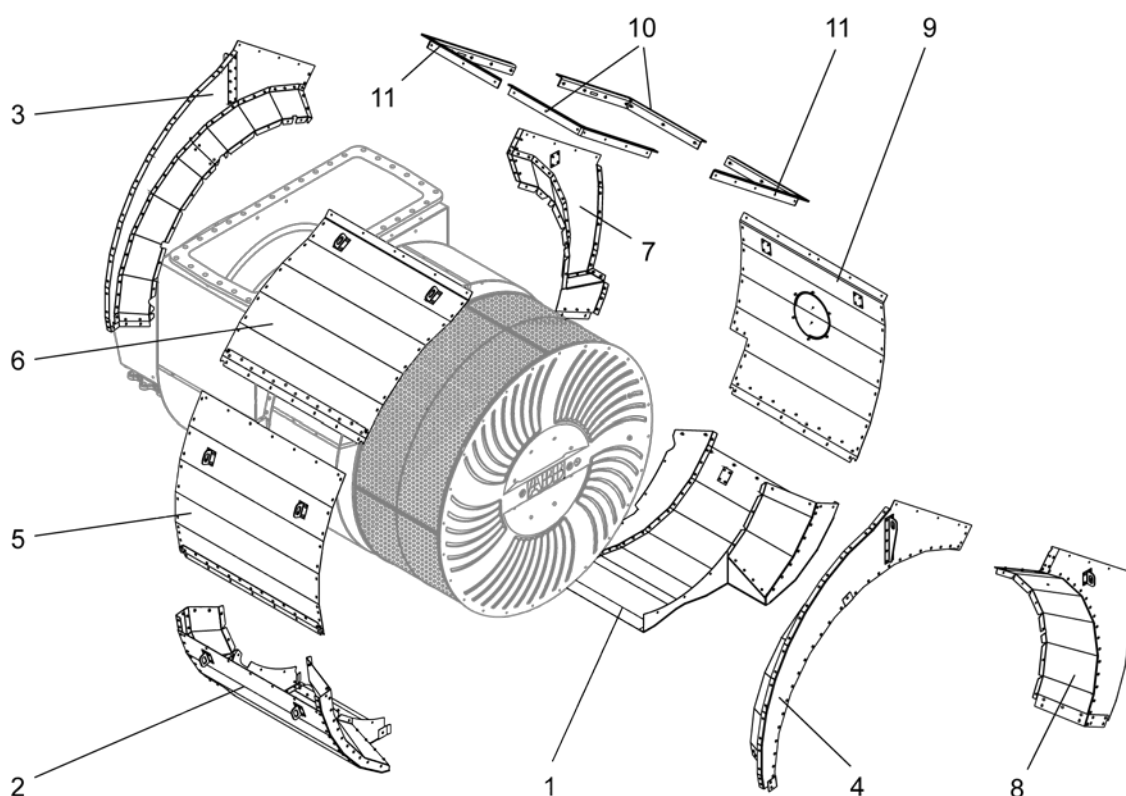


Figure 28

- | | |
|------------|----------------------|
| 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.

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.

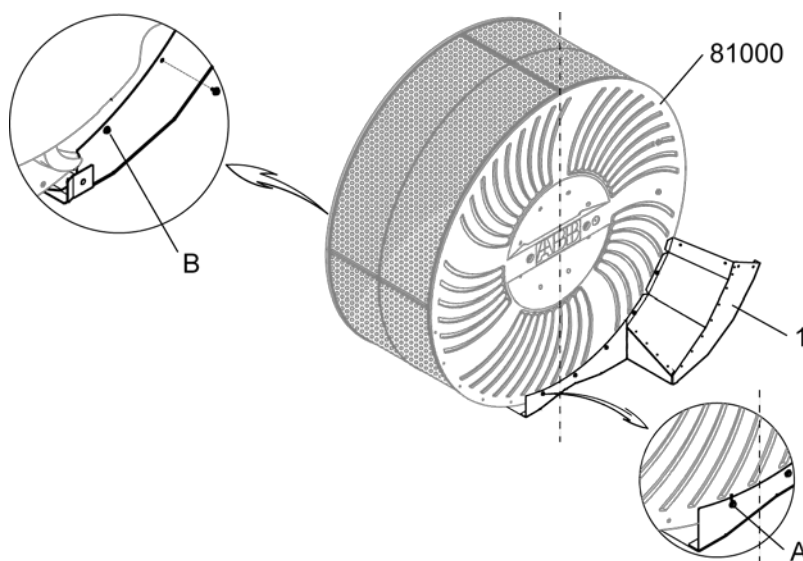


Figure 29

- 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).

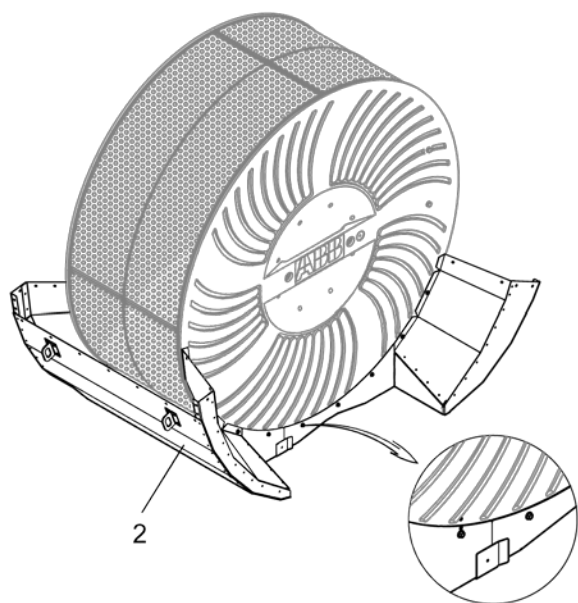


Figure 30

- Fit the bottom part (2) with the screws on the filter silencer.

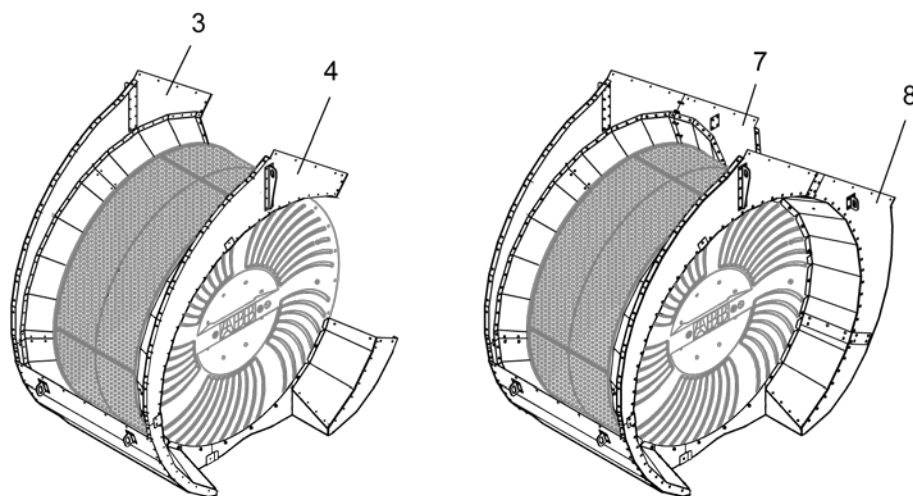


Figure 31

- 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).

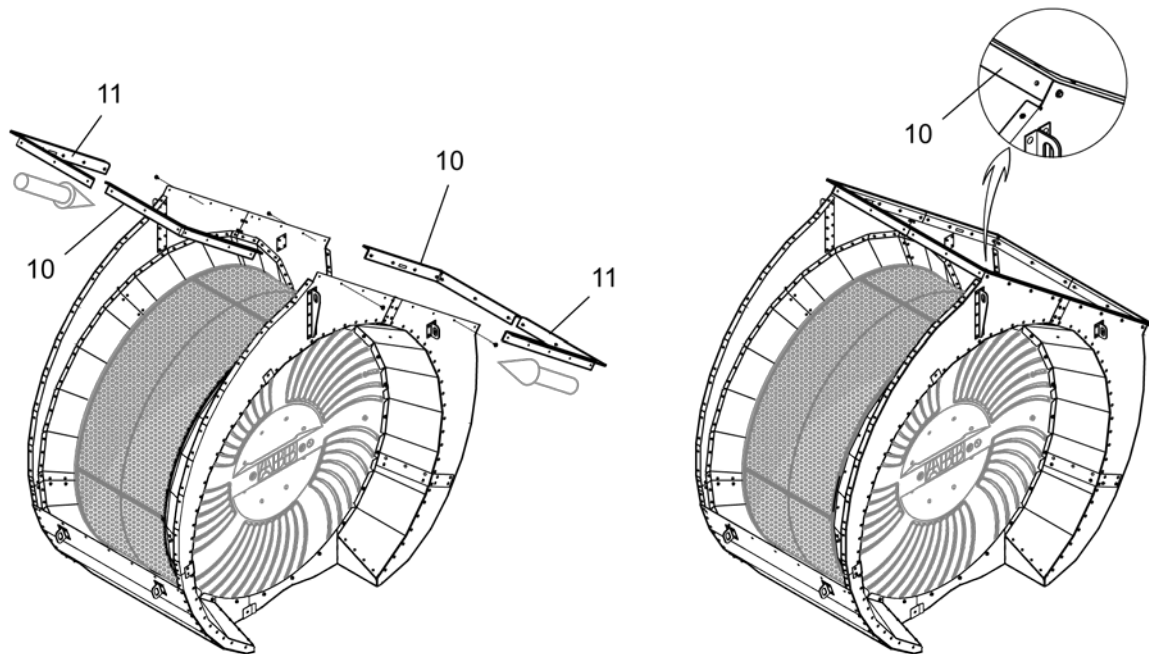


Figure 32

- Insert the flanges (10) and (11) laterally **between** the side parts and fit the screws.

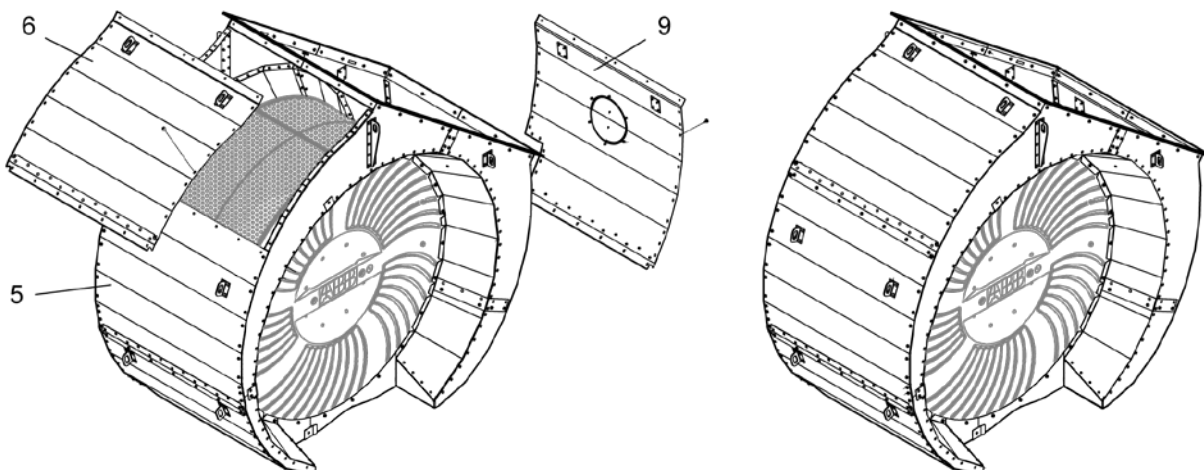


Figure 33

- Fit the circumferential part (5) with the screws.
- Fit the circumferential part (6) with the screws.
- Fit the circumferential part (9) with the screws.

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).

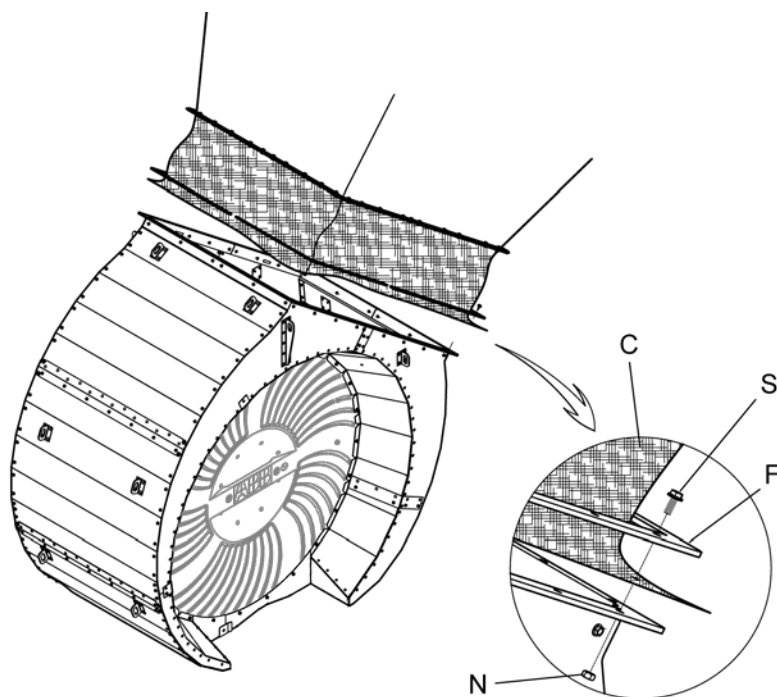
Bellows

Figure 34

- Fit bellows (C) with frame (F), screws (S) and nuts (N) on the filter silencer casing.

10.4 Dismantling and fitting the filter silencer

- Dismantle the insulation if necessary.

Dismantling the filter silencer

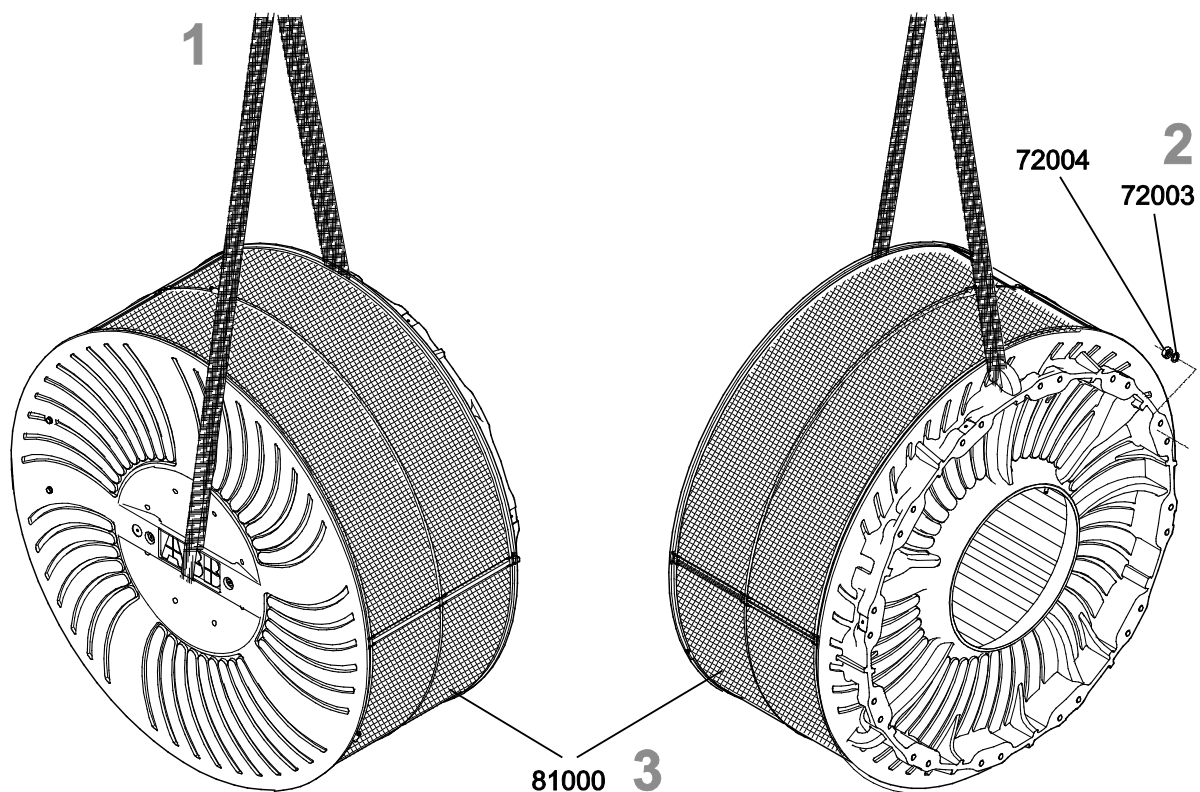


Figure 35

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]).

10.5 Dismantling wall insert and diffuser

Dismantling the wall insert

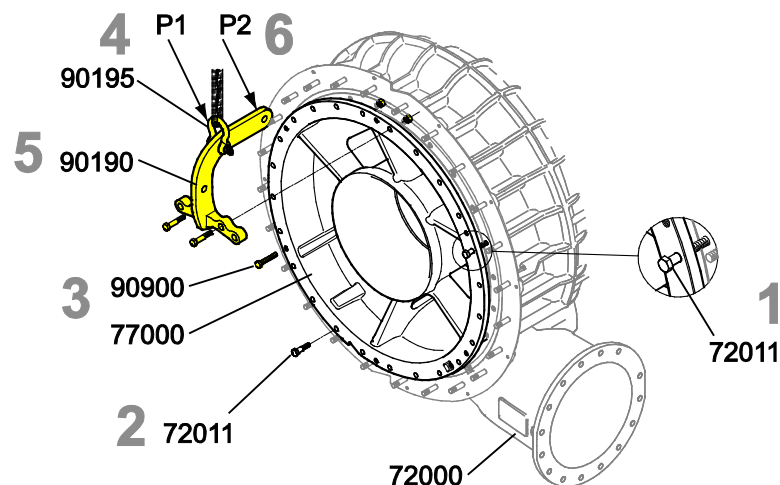


Figure 36

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).

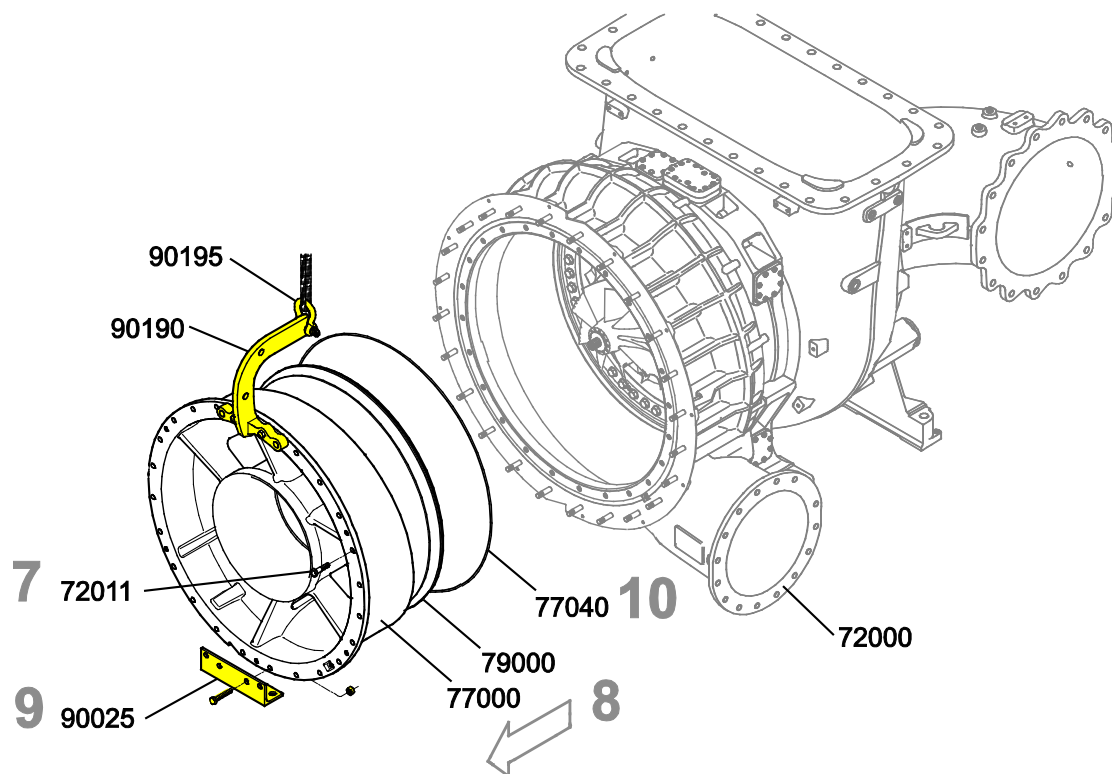


Figure 37

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).

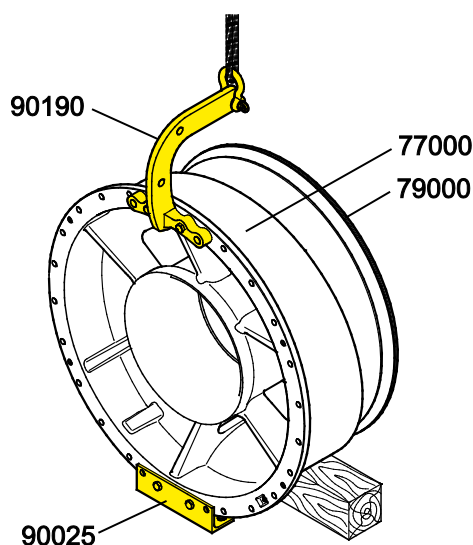


Figure 38

- Put the wall insert (77000) with diffuser (79000) down in a horizontal position and support it with the underlay.

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.

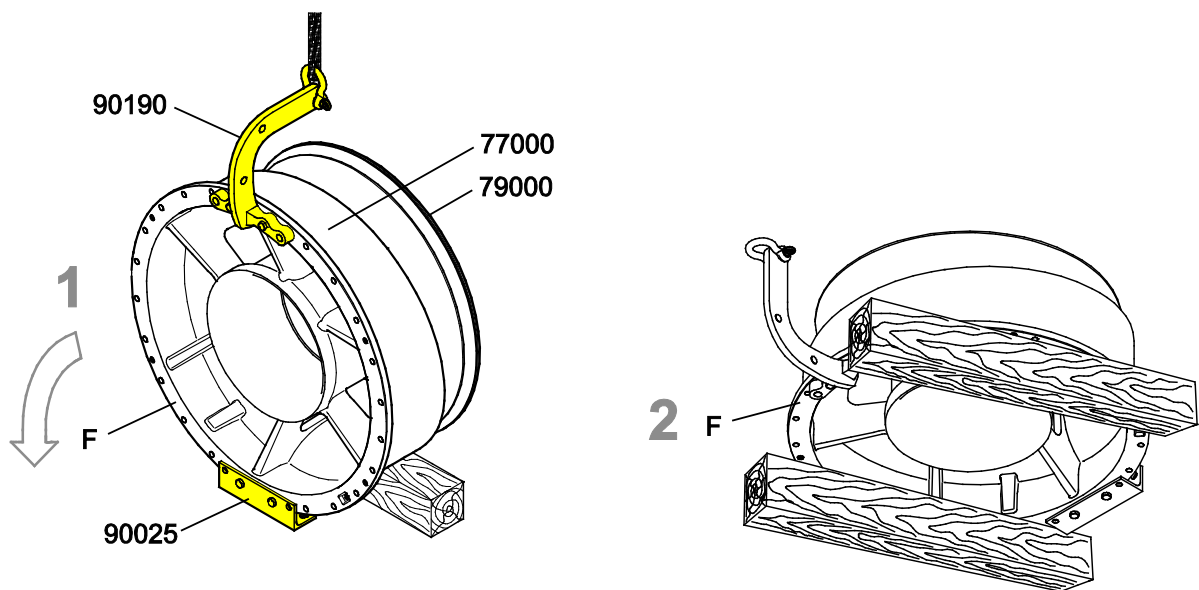


Figure 39

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.

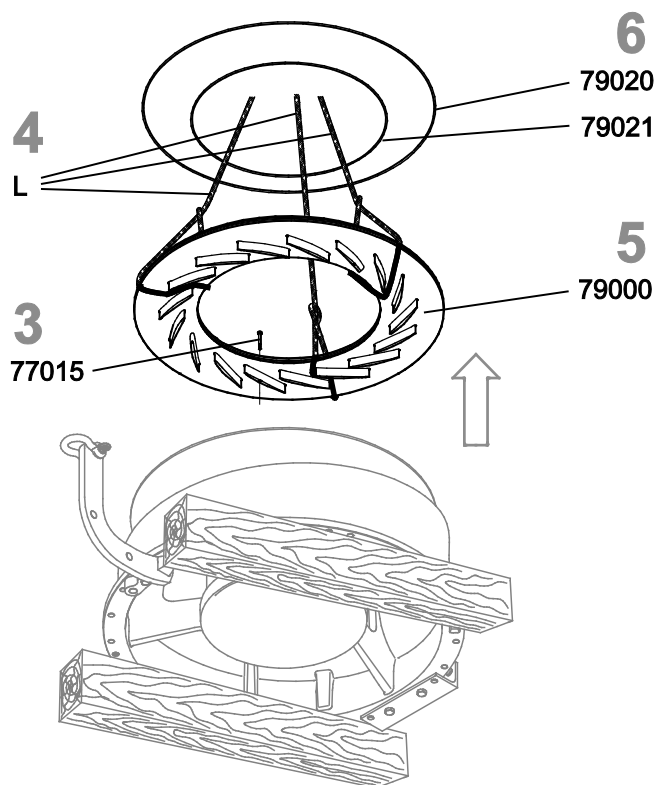


Figure 40

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).

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.

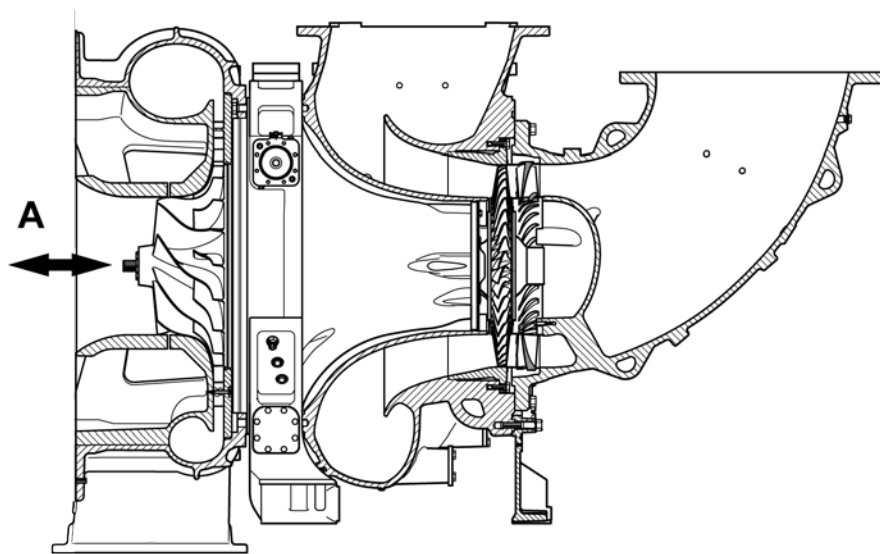


Figure 41

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]
A270-L	0.33 ... 0.63
A275-L	0.38 ... 0.68

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.

10.7 Dismantling the gas inlet casing, cover ring, nozzle ring

Dismantling the gas inlet casing

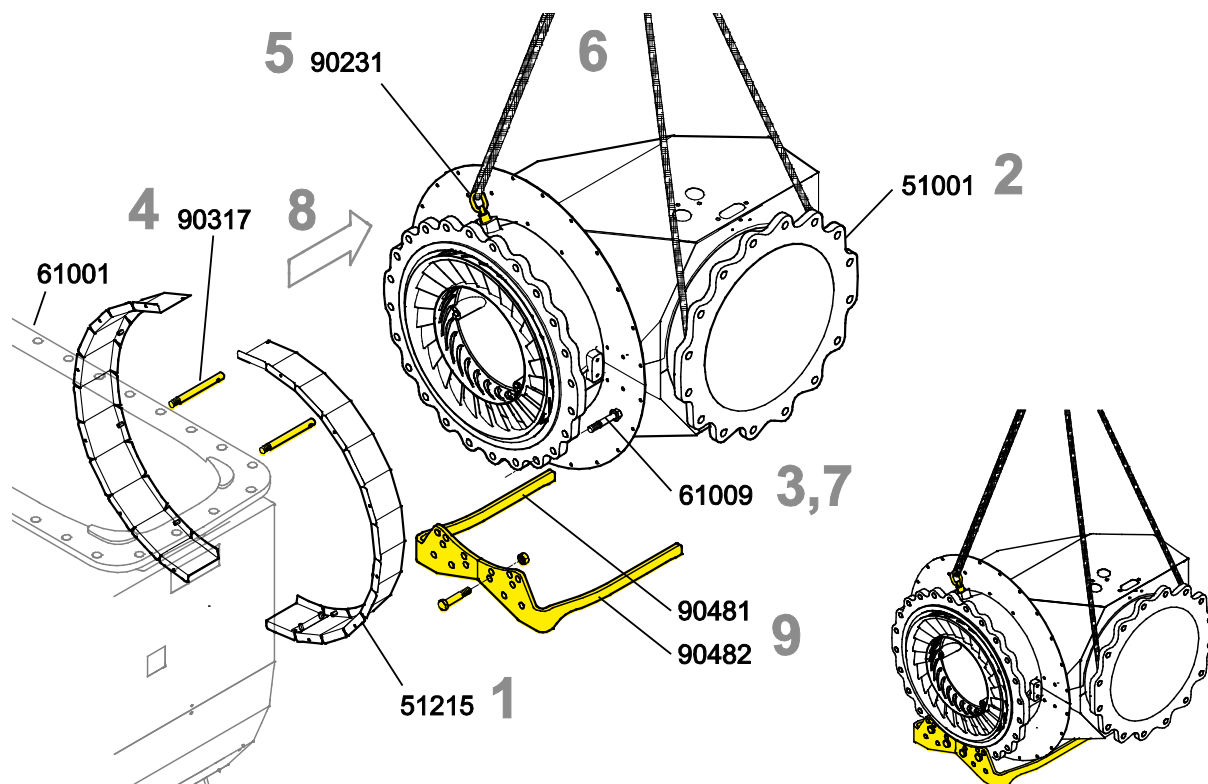


Figure 42

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 supports (90481, 90482) on the gas inlet casing (51001), then put down the casing.

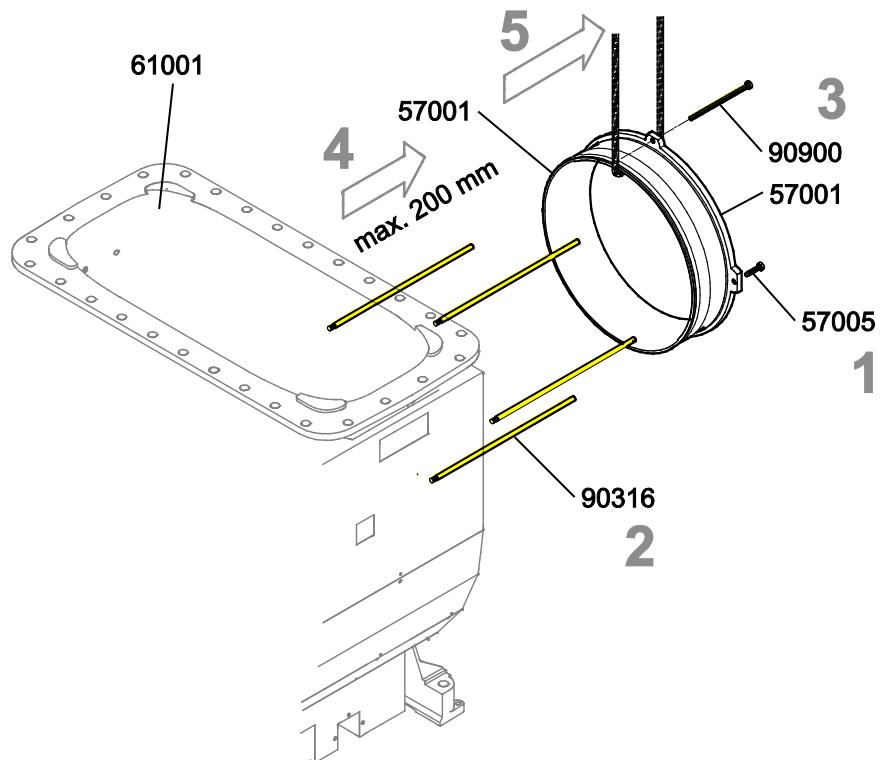
Dismantling the cover ring

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.

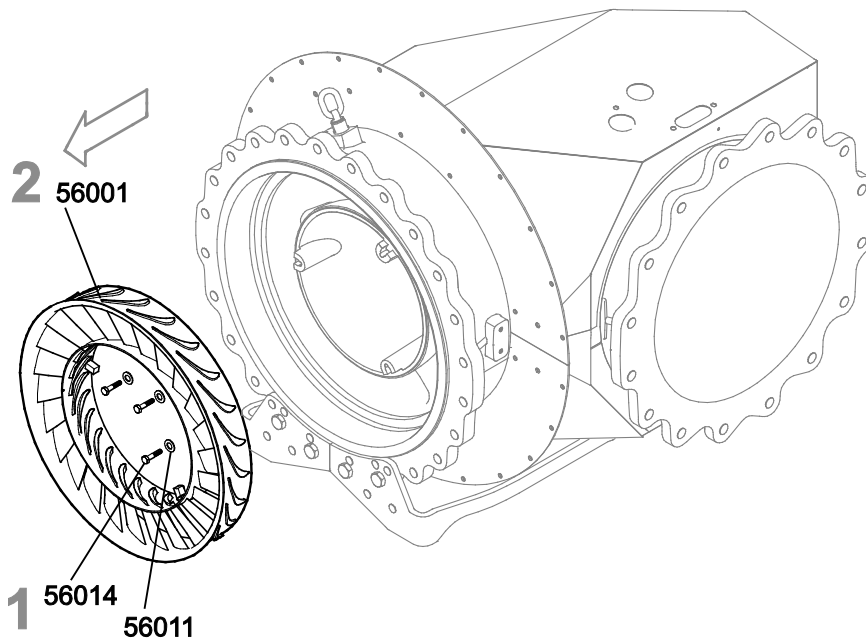
Dismantling the nozzle ring (A275-L and smaller)

Figure 44

1. Loosen screws (56014) and remove with washers (56011).
2. Remove and put down nozzle ring (56001).

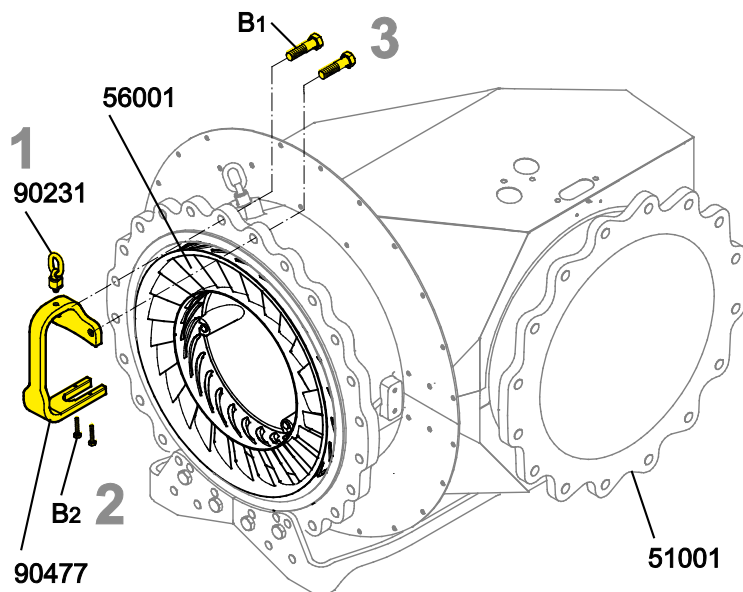
Dismantling the nozzle ring (A280-L and larger)

Figure 45

1. Fit the swivel lifting eye (90231) on the nozzle ring holder (90477).
2. Remove screws (B₂).
3. Fit the nozzle ring holder (90477) with screws (B₁) at the top of the flange of the gas inlet casing (51001).

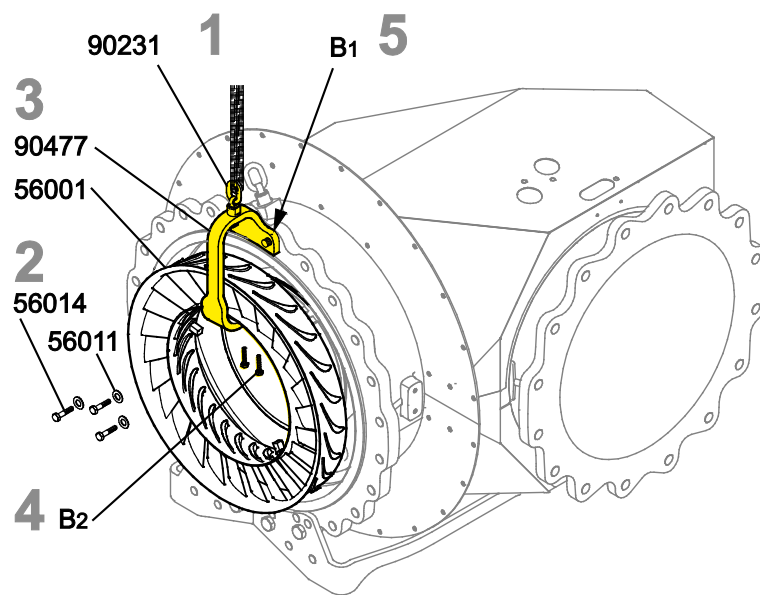


Figure 46

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 (B₂) into the nozzle ring holder.
5. Remove screws (B₁).

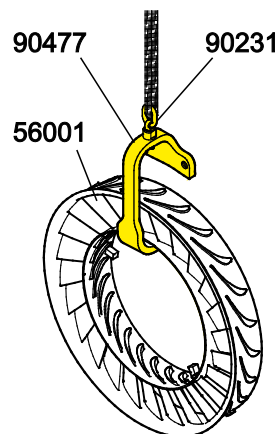


Figure 47

- Use the crane to remove and put down the nozzle ring (56001).

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 (A275-L and smaller)

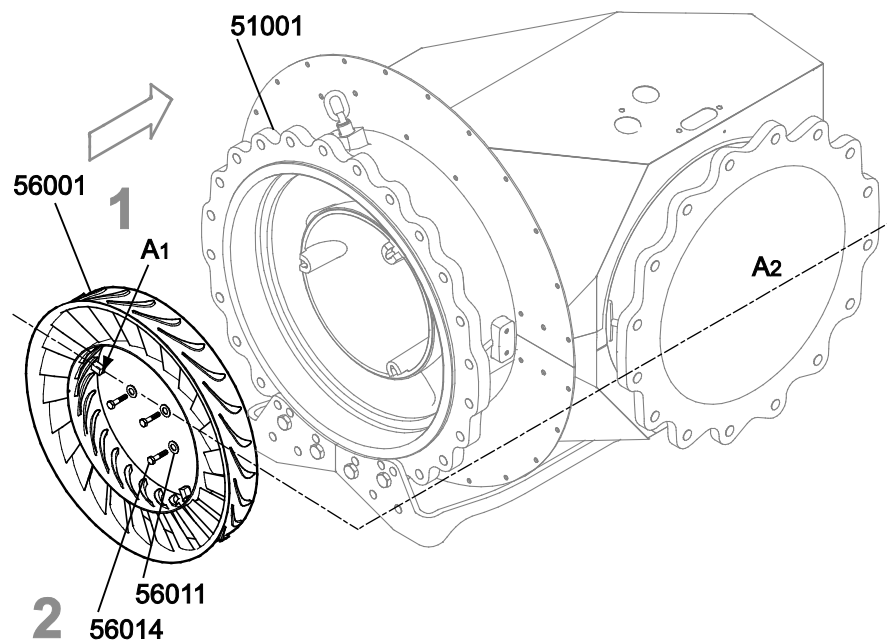


Figure 48

1. Align the notch (A₁) with the flange connection (A₂) and slide the nozzle ring (56001) into the gas inlet casing (51001).
2. Fit screws (56014) with washers (56011) (Table of tightening torques [→ 110]).

Fitting the nozzle ring (A280-L and larger)

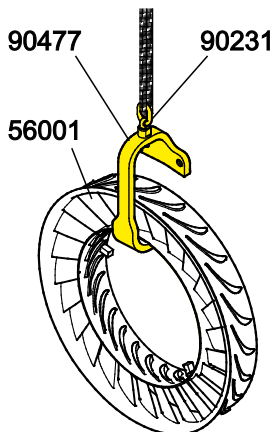


Figure 49

- Use lifting gear to secure the nozzle ring (56001) on the nozzle ring holder (90477) and transport it.

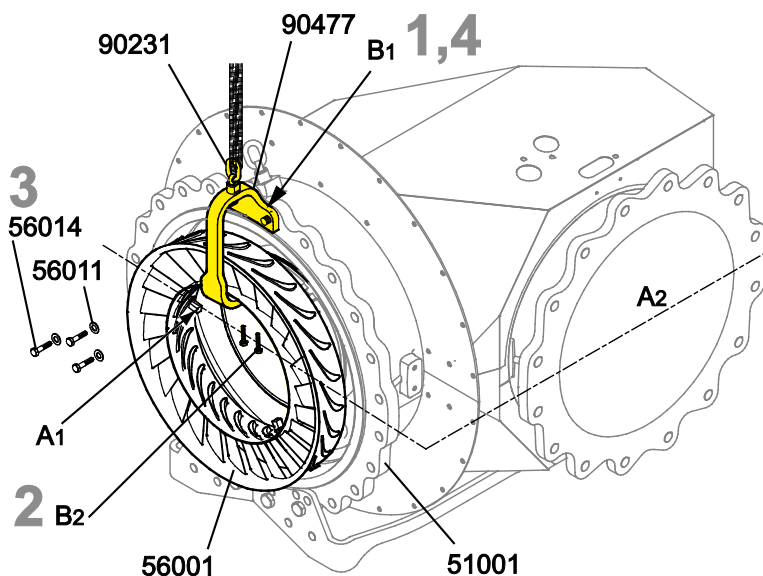


Figure 50

1. Fit the nozzle ring holder (90477) on the flange of the gas inlet casing (51001) with screws (B₁).
2. Remove screws (B₂), align the notch (A₁) on the cam of the nozzle ring (56001) with the flange connection (A₂) 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 (B₁) along with the nozzle ring holder (90477).

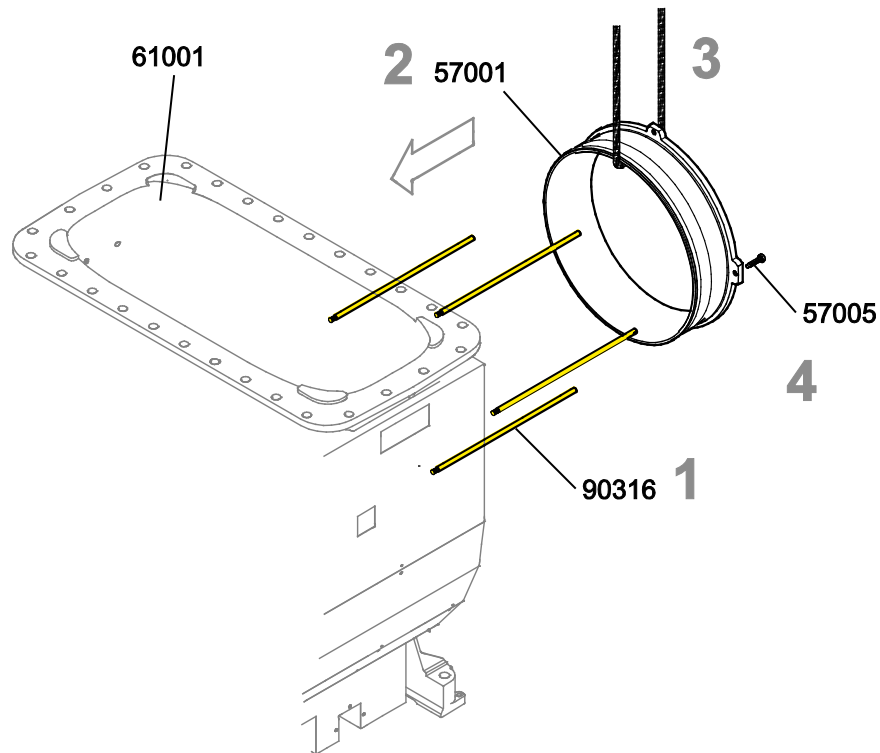
Fitting the cover ring

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]).

Fitting the gas inlet casing

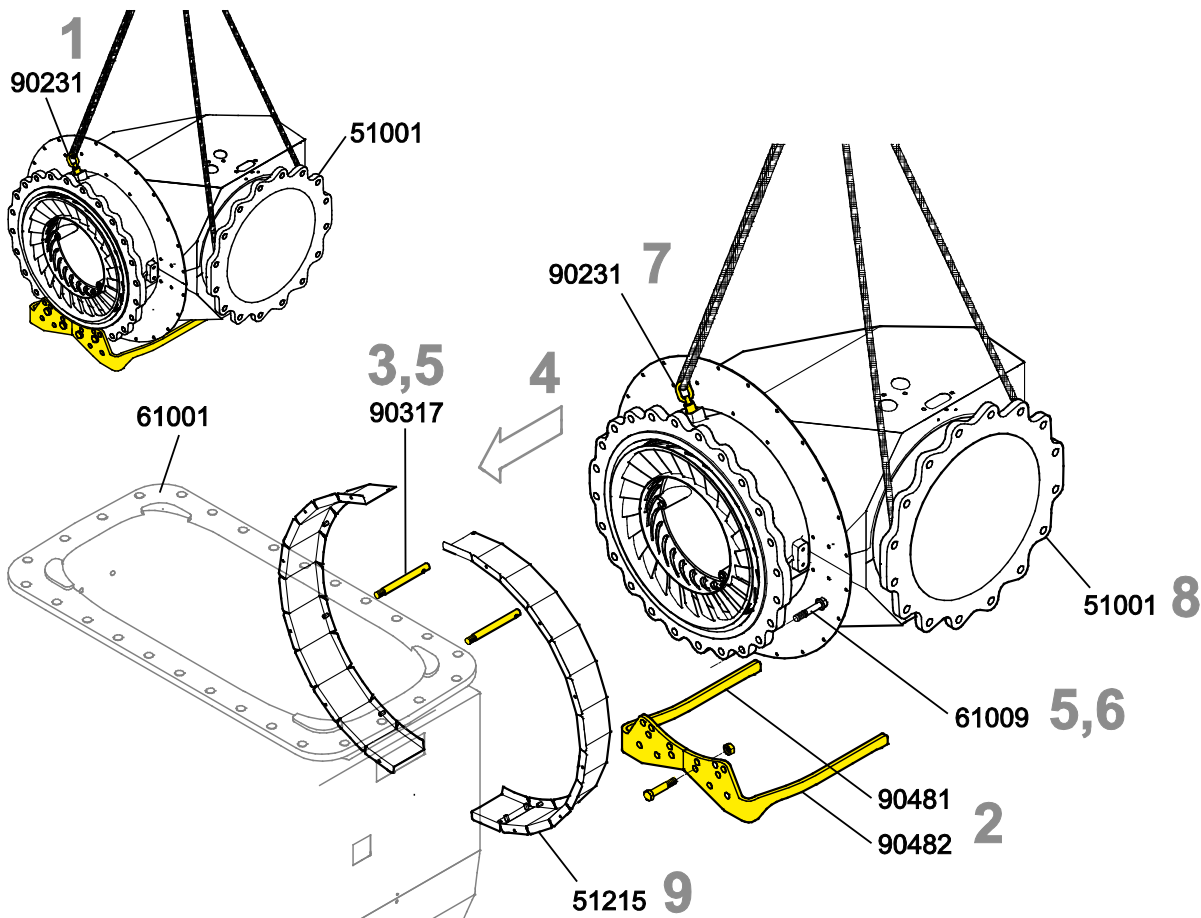


Figure 52

1. Attach lifting gear to swivel lifting eye (90231) and gas inlet casing (51001) and secure to the crane.
2. Dismantle and remove supports (90481, 90482) 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]).

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.

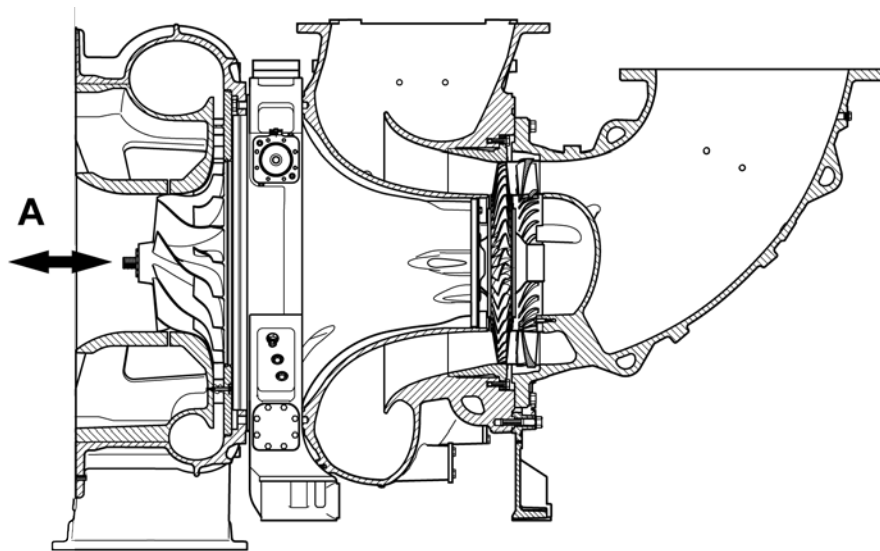


Figure 53

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]
A270-L	0.33 ... 0.63
A275-L	0.38 ... 0.68

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.

10.10 Fitting diffuser, wall insert

Fitting the diffuser

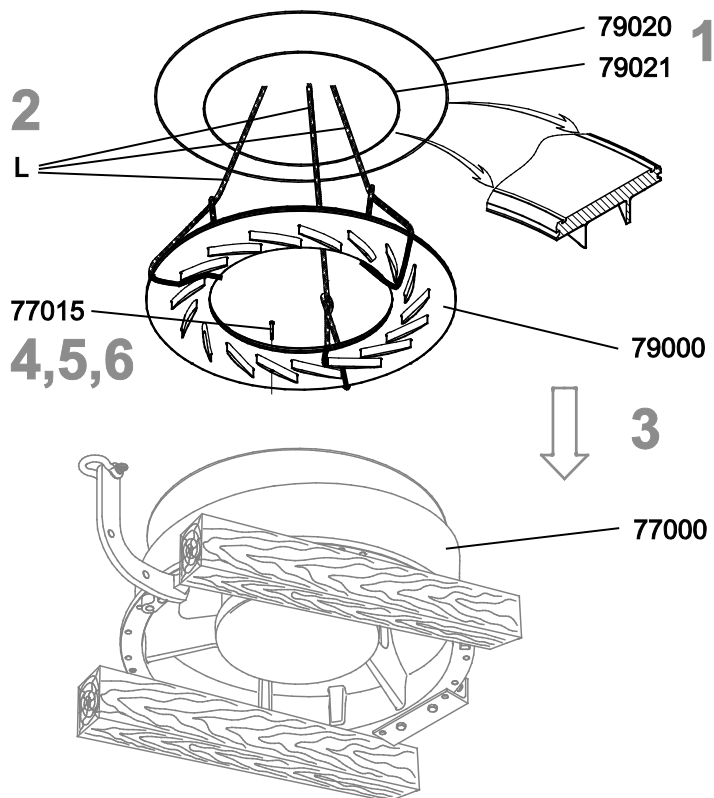


Figure 54

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]).

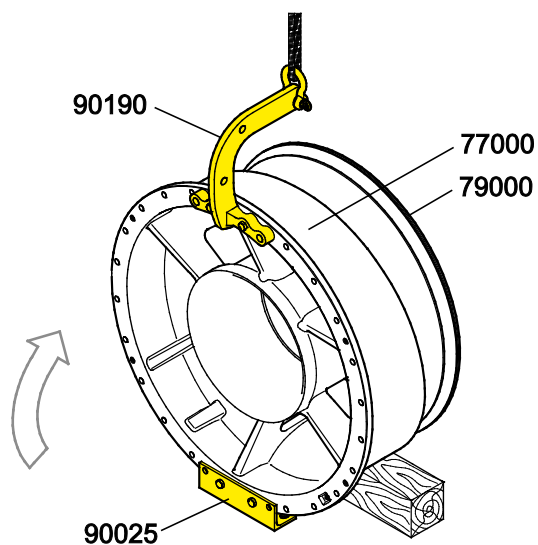
Fitting the wall insert

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.

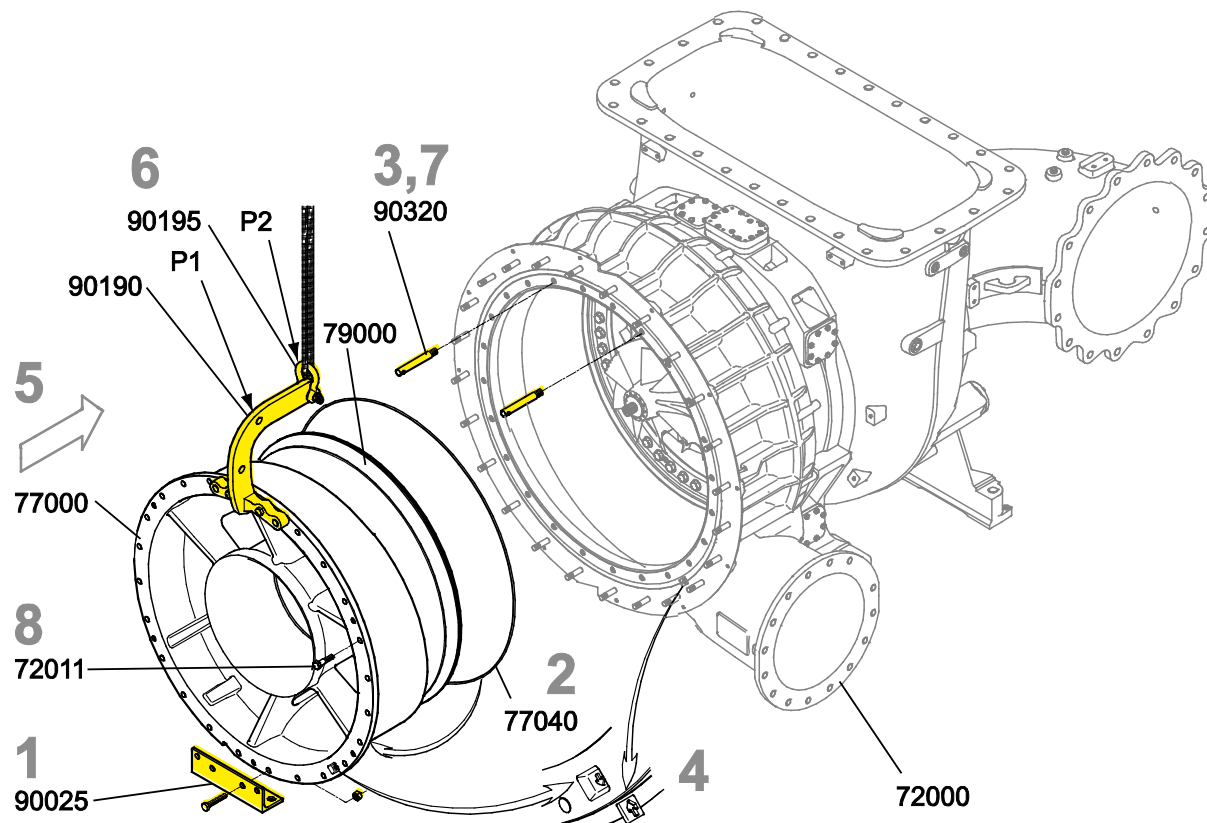


Figure 56

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]).



Blank area for drawing or diagram, consisting of multiple horizontal lines.

10.11 Table of tightening torques

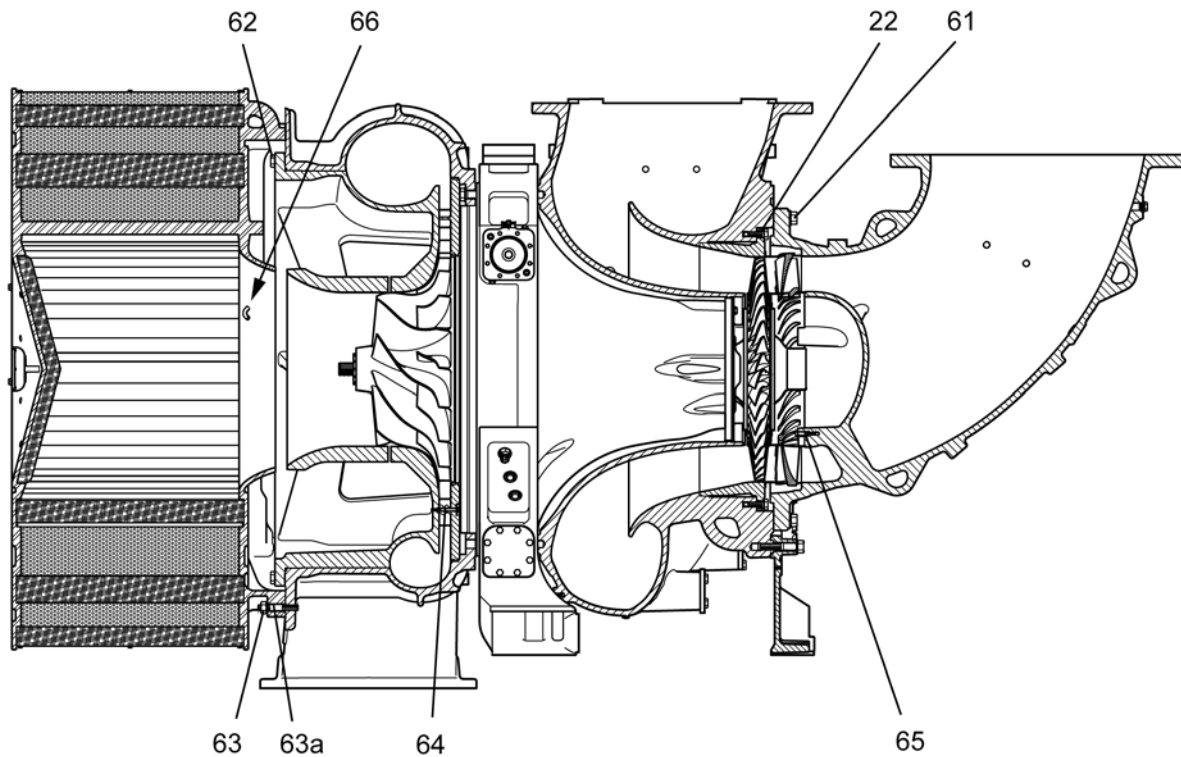


Figure 57

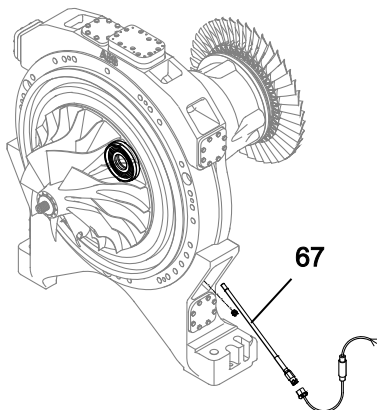


Figure 58

Tightening torques [Nm]

Item	Part number	A270-L	A275-L
22	57005	M12 50	M16 80
61 ¹⁾	61009	M18 40 ²⁾ 260	M22 50 ²⁾ 500
62 ¹⁾	72011	M20 500	M24 950
63 ¹⁾	72004	M16 200	M18 300
63a	72002	M16 60	M18 80
64	77015	M6 10	M8 25
65	56014	M10 35	M10 35
66	81125	G1/2" 45	G1/2" 45
67	86505	M18x1.5 150	M18x1.5 150

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

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.

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.

11.2.2 Fitting the locking device

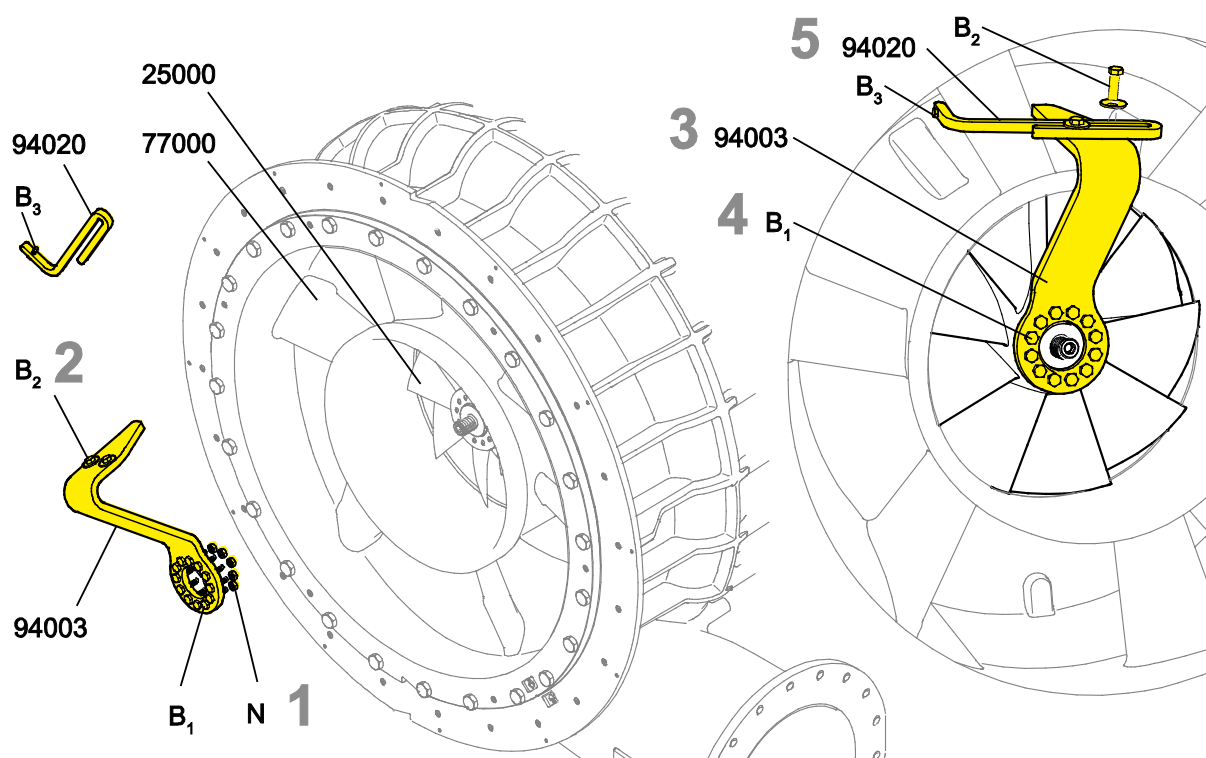


Figure 59

- Dismantle the filter silencer
(Dismantling and fitting the filter silencer [→ 90]).
- 1. Loosen retaining nuts (N) on locking device (94003) and remove with screws (B₁).
- 2. Loosen screws (B₂) and remove with washers.
- 3. Align locking device to a rib of the wall insert (77000) and the hole circle to the drill holes in the compressor wheel (25000).
- 4. Fit at least 9 screws (B₁) (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.
- 5. Align angle (94020) to rib of wall insert and fit screws (B₂) with washers as well as screw (B₃) (for tightening torques, see following table).

Product	Screw tightening torques [Nm]		
	B ₁	B ₂	B ₃
A270-L	M10 45	M12 75	M8 25
A275-L	M10 45	M12 75	M8 25

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.

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 %.

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.

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.

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.

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.

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.

14.2 View of turbocharger with part numbers

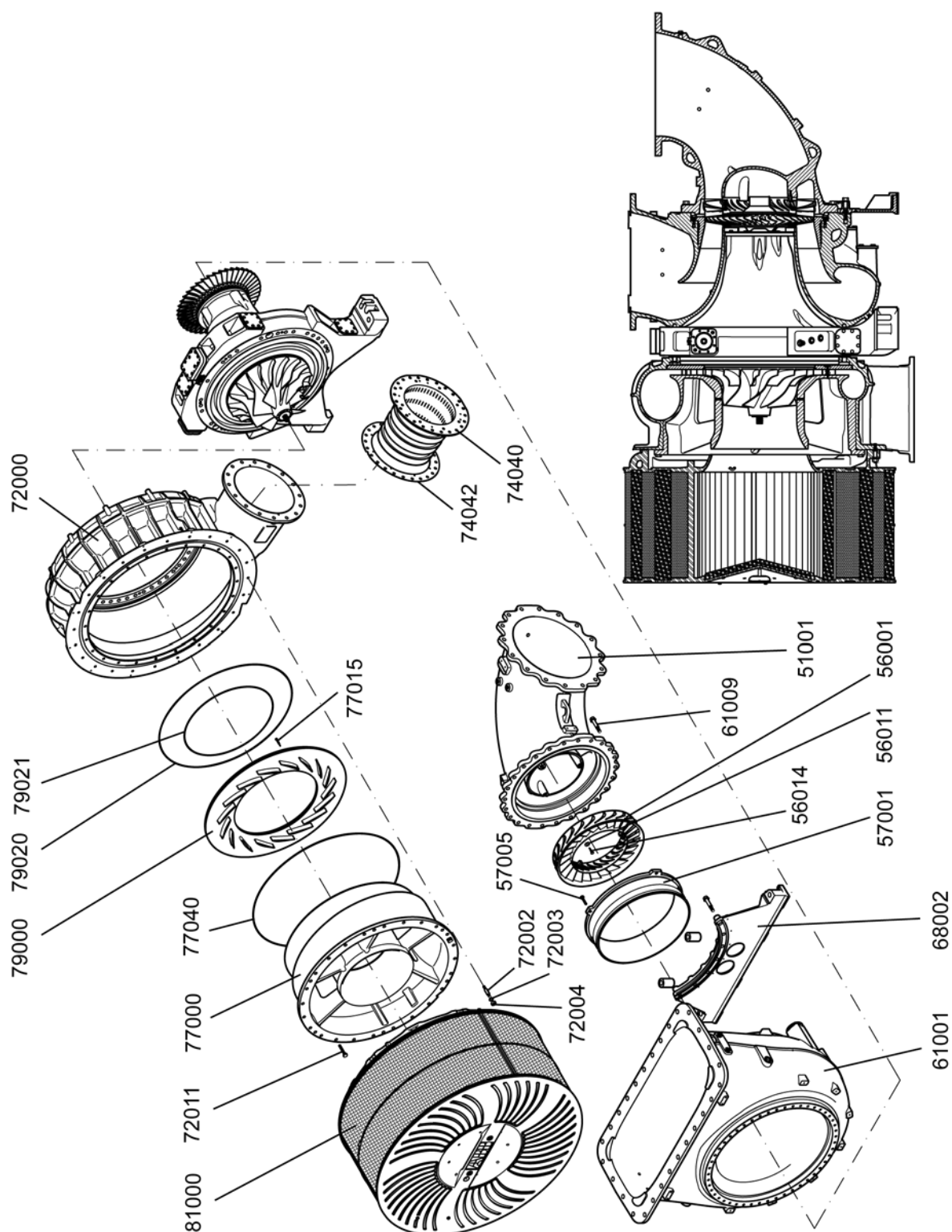


Figure 60

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

14.3 View of cartridge group with part numbers

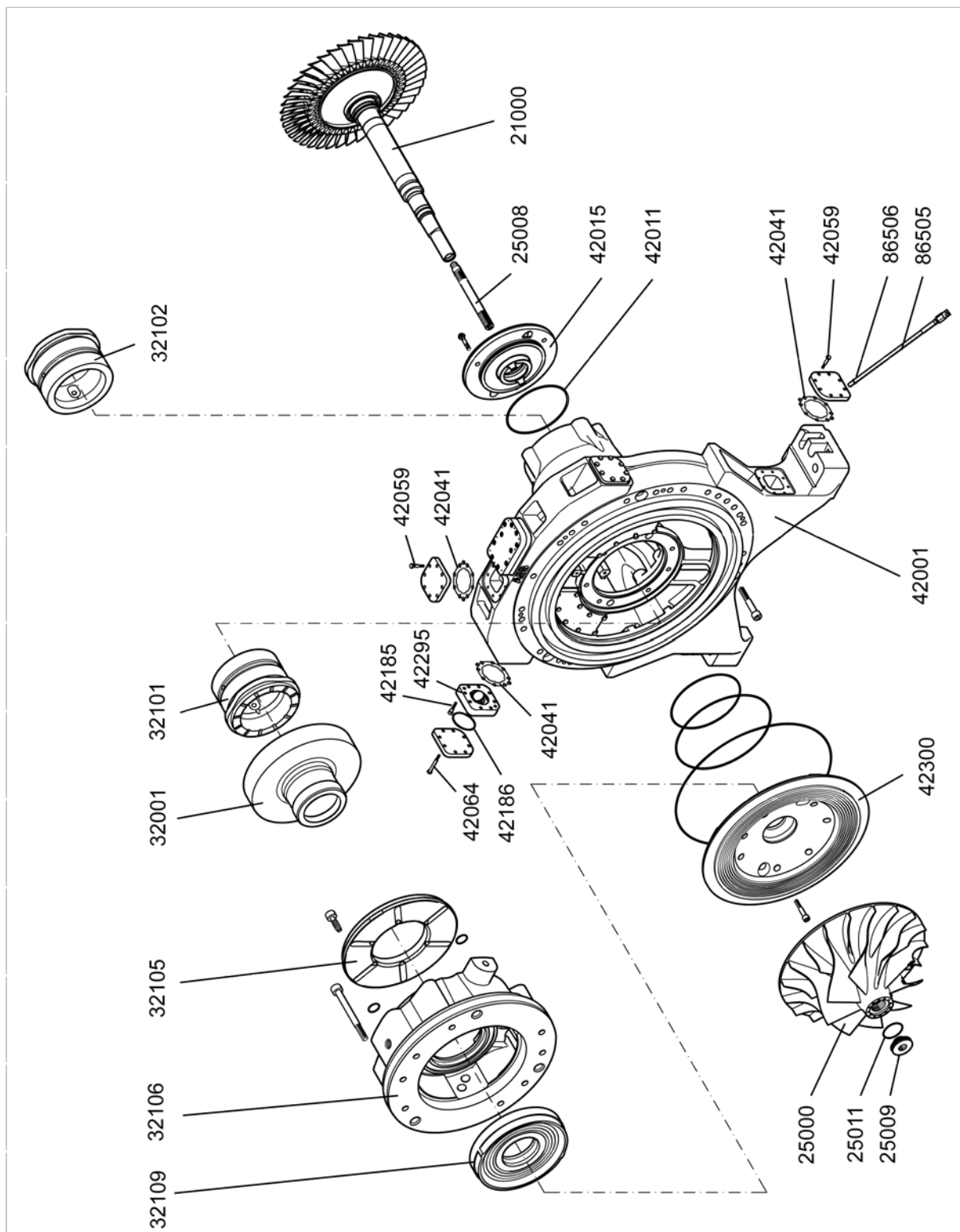


Figure 61

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

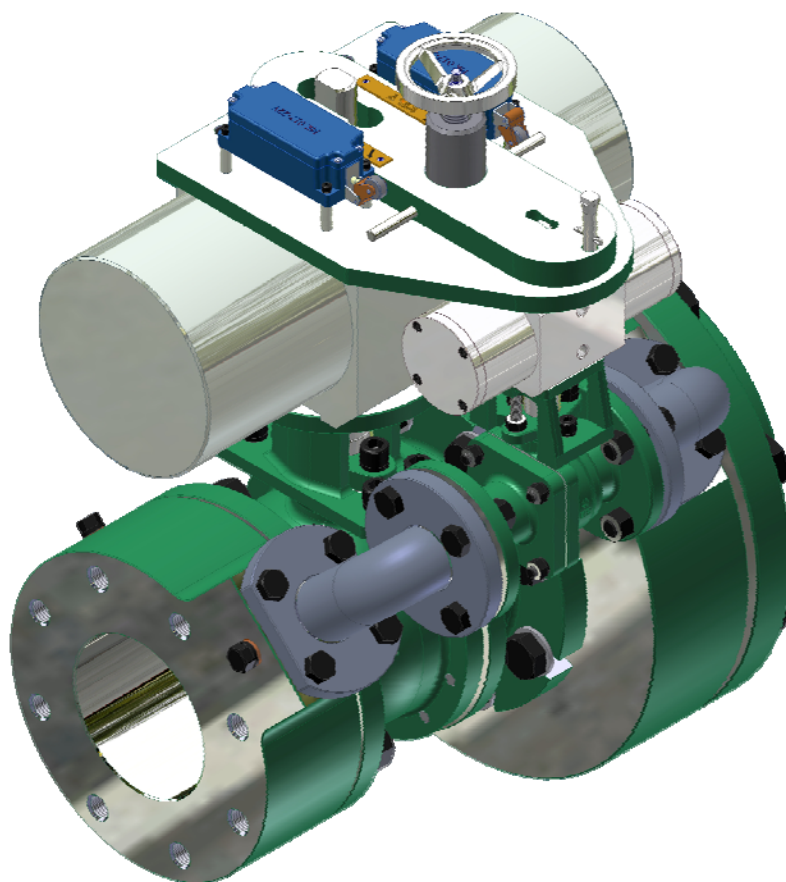
Table 37

ZQ 系列主起动阀用户手册

(适用于 ZQ65、ZQ65/25、ZQ100、ZQ100/25、ZQ150、ZQ150/40、ZQ200)

Handing Manual of the ZQ Series Main Starting Valve

(for ZQ65、ZQ65/25、ZQ100、ZQ100/25、ZQ150、ZQ150/40、ZQ200)



上海齐耀系统工程有限公司

QIYAO POWER SYSTEMS CO., LTD

目 录

1. 适用范围.....	2
2. 产品结构及分类.....	2
3. 外形及连接尺寸.....	2
4. 工作原理.....	3
5. 储存、保养、安装和使用.....	4
6. 常见故障及解决方法.....	4

Catalogue

1. SCOPE.....	6
2. PRODUCT STRUCTURE AND TYPE.....	6
3. STRUCTURE SIZE.....	7
4. OPERATIONAL PRINCIPLE.....	7
5. PRESERVATION, INSTALLATION AND OPERATING MAINTENANCE.....	8
6. FAMILIAR MALFUNCTION AND RESOLVENT.....	8

Spare part Instruction

1. SPARE PART INSTRUCTION OF TYPE ZQ65、ZQ100、ZQ150、ZQ200 MAIN STARTING VALVE.....	12
2. SPARE PART INSTRUCTION OF TYPE ZQ65/25、ZQ100/25、ZQ150/40 MAIN STARTING VALVE.....	17

1. 适用范围

本说明书适用于 ZQ 系列（主要包括 ZQ65、ZQ65/25、ZQ100、ZQ100/25、ZQ150、ZQ150/40、ZQ200）主起动阀产品的安装、使用和维修保养。

2. 产品结构及分类

ZQ 系列主起动阀根据是否带有慢转阀分为单球阀（见图 1）和双球阀（见图 2）两大类，每类主起动阀根据主球阀通径大小划分产品型号如下（见表 1）：

表 1 ZQ 系列主起动阀产品型谱

球 阀 产品型号	主球阀通 径 (DN)	副球阀通径 (DN)	适 用 机 型	备 注
ZQ65	Φ 65	/	26~35MC/ME-B	
ZQ65/25	Φ 65	Φ 25	26~35MC/ME-B	带慢转
ZQ100	Φ 100	/	42~50MC/MC-C/ME-C/ME-B	
ZQ100/25	Φ 100	Φ 25	42~50MC/MC-C/ME-C/ME-B	带慢转
ZQ150	Φ 150	/	60~90MC-C/ME/ME-C/ME-B	
ZQ150/40	Φ 150	Φ 40	60~90MC-C/ME/ME-C/ME-B	带慢转
ZQ200	Φ 200		98MC/MC-C/ME/ME-C	

ZQ 系列主起动阀主要由气动球阀及执行机构、止回阀部件和锁紧装置三部分组成。主起动阀中的关键部件——气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，足以保证主起动阀启闭所需要的力矩；止回阀的主要作用是保护主起动阀，防止气缸里的高温燃气倒流入主起动阀或起动空气管道内；锁紧装置通过锁紧驱动轴，避免对主起动阀的误操作。

3. 外形及连接尺寸

ZQ 系列各型号主起动阀的外形及连接尺寸如下（见表 2）：

表 2 ZQ 系列主起动阀外形及连接尺寸

单位: mm

产品型号	L	B	H	D	D1	D2	D3	z-d	n-M
ZQ65	364	250	589~619	Φ 185	Φ 145	Φ 145	Φ 185	8×Φ 18	8×M16
ZQ100	395	337	659~689	Φ 230	Φ 190	Φ 190	Φ 235	8×Φ 23	8×M20
ZQ150	491	467	861~891	Φ 300	Φ 250	Φ 250	Φ 300	8×Φ 26	8×M24
ZQ200	696	595	1010~1040	Φ 375	Φ 320	Φ 320	Φ 405	12×Φ 29	12×M24
ZQ65/25	482	390	589~619	Φ 185	Φ 145	Φ 145	Φ 185	8×M16	8×M16
ZQ100/25	484	427	659~689	Φ 235	Φ 190	Φ 190	Φ 235	8×M20	8×M20
ZQ150/40	601	553	861~891	Φ 300	Φ 250	Φ 250	Φ 300	8×M24	8×M24

4. 工作原理

主起动阀是二冲程低速柴油机操纵系统的重要组成设备之一,是压缩空气系统的总开关,用以开启或关闭由空气瓶至空气分配器和气缸起动阀的压缩空气通路。当它开启时,来自空气瓶的压缩空气穿过它迅速进入起动空气总管,通过空气分配器与气缸起动阀的配合动作,使柴油机起动。主起动阀的启闭直接控制起动过程的开始和结束,在起动操作时,空气瓶处于开启状态下,要求主起动阀能迅速启闭并能重复进行,启阀后能满足起动时所需要的压缩空气量,并使节流损失很小。起动完毕后能迅速切断压缩空气,并使残留在起动系统中的高压空气泄放大气。

ZQ 系列主起动阀通过气动执行机构驱动球阀转动,来实现主起动阀的开启或关闭。气动执行机构气缸为双活塞式结构,由活塞带动转轴作回转运动,转动角度为 90° (调整范围 $\pm 4^\circ$),通过转轴和阀杆带动球体,作同步转动实现开启、关闭动作。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。主起动阀球阀为浮动型结构,对球阀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道两端的压差达到密封。主起动阀主要性能参数如下:

工作介质: 压缩空气;

通道压缩空气压力: 4.0MPa;

开启/关闭速度: ZQ65、ZQ65/25、ZQ100、ZQ100/25: ≤ 2 sec/per,

ZQ150、ZQ150/40: ≤ 5 sec/per,

ZQ200: ≤ 15 sec/per;

气动执行机构控制气源压力: 0.7~0.8Mpa。

5. 储存、保养、安装和使用

5.1 储存及保养

5.1.1 主起动阀两端接口需用保护罩封死, 防止尘埃、污物等侵入。

5.1.2 主起动阀处于开启状态并存放在干燥、通风的室内。

5.1.3 长期存放的主起动阀应每月作定期检查, 清除尘埃及污垢, 在加工面上重新涂防锈油, 并确保将阀用手动或气源的形式启闭 3 次/月。

5.2 安装

5.2.1 安装前应对主起动阀进行仔细检查, 将主起动阀密封面、内腔及端面清洗干净, 方能转动气动球阀的球体, 以防损坏球面和密封圈, 并清除在保管或运输过程中沾染的污物。

5.2.2 安装时应仔细核对主起动阀标志是否与使用要求相一致。

5.2.3 主起动阀应按照装配图纸上的要求进行连接、安装, 连接螺栓应均匀拧紧。

5.3 使用

使用时主起动阀应全开或全关, 不允许部分开启作调节流量用。

5.4 应急措施

当主起动阀气动执行机构控制气源发生故障或控制系统失效的情况下, 可使用普通扳手手动扭转扁榫(见图 3, 件 1 上的扁榫)旋转 90 度, 对主起动阀进行应急的开启或关闭操作。

6. 常见故障及解决方法

使用中的主起动阀应定期进行检查、维修, 常见故障及排除方法见表 3。

表 3 主起动阀常见故障及排除方法

故障现象	原 因	排 除 方 法
气动球阀的传递杆转动不灵活或不能转动	(1) 压缩空气气源压力达不到要求 (2) 气缸密封部分发生泄漏或 O 型圈损坏 (3) 阀杆与转轴不同心度过大	(1) 调整球阀启闭控制气源压力到 0.7MPa 以上 (2) 检查气缸密封部位, 更换 O 型密封圈 (3) 旋松连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结部分
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、右阀体连接处泄漏	(1) 连接螺柱、螺母拧得不紧或松紧不均 (2) 连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
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 (4) 球体未转到完全关闭的位置	(1) 研磨球面或更换密封圈、清除污物 (2) 清除污物 (3) 更换密封圈 (4) 调整气缸后侧两端的螺母与螺钉到所需要的位置 (即调整气缸所启闭的角度 (有 $\pm 4^\circ$ 的微调余量))

1. Scope

This handling manual include installation, operating maintenance and spare part instruction, it can be applied to the ZQ Series main starting valve (including ZQ65、ZQ65/25、ZQ100、ZQ100/25、ZQ150、ZQ150/40、ZQ200).

2. Product structure and type

The ZQ series main starting valve according to whether has slow turning is divided into single ball valve(see the Fig.1) and double ball valve(see the Fig.2). Each kind of main starting valve to divide the product type according to the diameter of main ball valve as follows(see the table 1).

table 1 the product type of ZQ series main starting valve

Ball Valve Product type	Diameter of main ball valve	Diameter of slave ball valve	Engine Type	Remarks
ZQ65	Φ 65	/	26~35MC/ME-B	
ZQ65/25	Φ 65	Φ 25	26~35MC/ME-B	With slow turning
ZQ100	Φ 100	/	42~50MC/MC-C/ME-C/ME-B	
ZQ100/25	Φ 100	Φ 25	42~50MC/MC-C/ME-C/ME-B	With slow turning
ZQ150	Φ 150	/	60~90MC-C/ME/ME-C/ME-B	
ZQ150/40	Φ 150	Φ 40	60~90MC-C/ME/ME-C/ME-B	With slow turning
ZQ200	Φ 200		98MC/MC-C/ME/ME-C	

The ZQ series main starting valve is made up of ball valve with actuator, non-return valve and locking device. The pneumatic actuator which is the key part of main starting valve have double pistons. It can control the main starting valve to open or close by compression air. The main function of the non-return valve is to protect the main starting valve, it can keep the heat combustion gas from flow back into the main starting valve or air tank. The locking device is used to prevent from the main starting valve's mistake operation.

3. Structure size

The structure size of main starting valve as follows:(see the table 2)

table 2: the structure size

Unit:mm

type	L	B	H	D	D1	D2	D3	z-d	n-M
ZQ65	364	250	589~619	Φ 185	Φ 145	Φ 145	Φ 185	8× Φ 18	8×M16
ZQ100	395	337	659~689	Φ 230	Φ 190	Φ 190	Φ 235	8× Φ 23	8×M20
ZQ150	491	467	861~891	Φ 300	Φ 250	Φ 250	Φ 300	8× Φ 26	8×M24
ZQ200	696	595	1010~1040	Φ 375	Φ 320	Φ 320	Φ 405	12× Φ 29	12×M24
ZQ65/25	482	390	589~619	Φ 185	Φ 145	Φ 145	Φ 185	8×M16	8×M16
ZQ100/25	484	427	659~689	Φ 235	Φ 190	Φ 190	Φ 235	8×M20	8×M20
ZQ150/40	601	553	861~891	Φ 300	Φ 250	Φ 250	Φ 300	8×M24	8×M24

4. Operational principle

The main starting valve is one of the important equipment in the low speed diesel engine's operating system. It is the total switch of the compressed air system. It is used to open or close the compressed air thoroughfare that from air tank to air distributor and cylinder starting valve. When it open, the compressed air that comes from the air tank through it enter into starting air manifold quickly, under the match action of air distributor and cylinder starting valve, make diesel engine starting. The beginning and end of starting process are controlled by the main starting valve's open and close. While starting operation, the air tank is placed in opening state, main starting valve is open. It can cut off the compressed air quickly after starting finished, and make the high pressure air remain at starting system to release into atmosphere.

The main starting valve is driven by pneumatic actuator. The pneumatic actuator with double pistons drives the shaft to rotate with a rotary angle of 90°(adjusting range $\pm 4^\circ$). When the flat rabbet at the top of pneumatic actuator is parallel to the groove, it indicates the opening state of the valve. When it is perpendicular to the groove, it shows that the valve close. The main function parameter of main starting valve is as follows.

Working medium: compressed air

Working pressure: 4MPa

Opening/closing time: ZQ65、ZQ65/25、ZQ100、ZQ100/25:≤2 sec/per,

ZQ150、ZQ150/40: ≤5 sec/per,
ZQ200: ≤15 sec/per ;
Control pressure of pneumatic actuator: 0.7 ~ 0.8Mpa.

5. Preservation, Installation and Operating maintenance

5.1 Preservation

5.1.1 The connection in the both ends of main starting valve should be protected with protective hood, to prevent dust invading.

5.1.2 Keep the main starting valve in open station and place it in a dry room.

5.1.3 The main starting valve storing over a long period of time should be checked periodically, cleaned, and spread with rust preventive oil. The main starting valve to be activated for three cycles each month during continued out-of-use.

5.2 Installation

5.2.1 Do not turn the ball valve before cleaning up the main starting valve, so as to protect the ball surface and the seal ring from damaging and also to eliminate the defects caused in transportation.

5.2.2 Check the mark of main starting valve whether in accordance with required.

5.2.3 The installation of main starting valve should accord to the drawing. Coupling bolts should be tightened equably.

5.3 Operating maintenance

The main starting valve should be used in all open or whole close. Using it as a throttle valve is strictly forbidden.

5.4 Emergency measure

When the control system of pneumatic actuator is invalidation, turn the flat rabbet(see the Fig.3, flat rabbet on the top of pneumatic actuator(Pos.1)) 90° by spanner to make the main starting valve open or close.

6. Familiar malfunction and resolvent

The main starting valve in the usage should be checked periodically. If have any problem should fix in time. Familiar malfunction and resolvent as follows:(see the table 3)

table 3 Familiar malfunction and resolvent

malfunction	causes	resolvent
The valve stem of the pneumatic ball valve partly or totally loses its flexibility of rotation.	(1) The compressed air pressure is not up to the standard. (2) Leakage of the sealed cylinder parts or damage of the O- ring. (3) Non-coaxality of the valve stem and the shaft is too large.	(1) Adjust the opening pressure up to 7.0 Mpa or more. (2) Check the sealed parts of the cylinder or replace the O – ring. (3) Unscrew the connecting nut between the right valve body and the cylinder mounting stand. Readjust their joint parts.
Leakage of the filler of the pneumatic ball valve.	(1) the filler is not tight enough. (2) The filler is not effective after long usage.	(1) Uniformly tighten the screw on the gland cover. (2) Replace the filler.
Leakage at the joint of the left and right bodies of the pneumatic ball valve.	(1) The joint bolts and nuts are loose or the tightening force on each one is not equal. (2) Damage or dirt of the flange sealed surface. (3) Damage of the seal washers.	(1) Uniformly tighten the nuts. (2) Repair the sealed surface or clean off the dirt. (3) Replace the seal washers.
Leakage at the sealed part of the passageway of the pneumatic ball valve.	(1) Damage or dirt on the ball surface and the sealed surface. (2) Dirt between the bottom surface of the sealed ring and the valve stand. (3) Loss of effectiveness of the sealed ring for distortion or severe wear. (4) The ball body isn't thoroughly turned to the "close" position.	(1) Grind the ball surface or replace the sealed ring , clean off the dirt. (2) Clean off the dirt. (3) Replace the seal ring. (4) Adjust the screws and nuts at both sides behind the cylinder until they are in proper position. (adjust the open and close angle of the cylinder, fine adjustment $\pm 4^{\circ}$)

图 1 ZQ65、ZQ100、ZQ150、ZQ200 主起动阀结构图

Fig.1 Structural drawing of Type ZQ65、ZQ100、ZQ150、ZQ200 Main starting valve

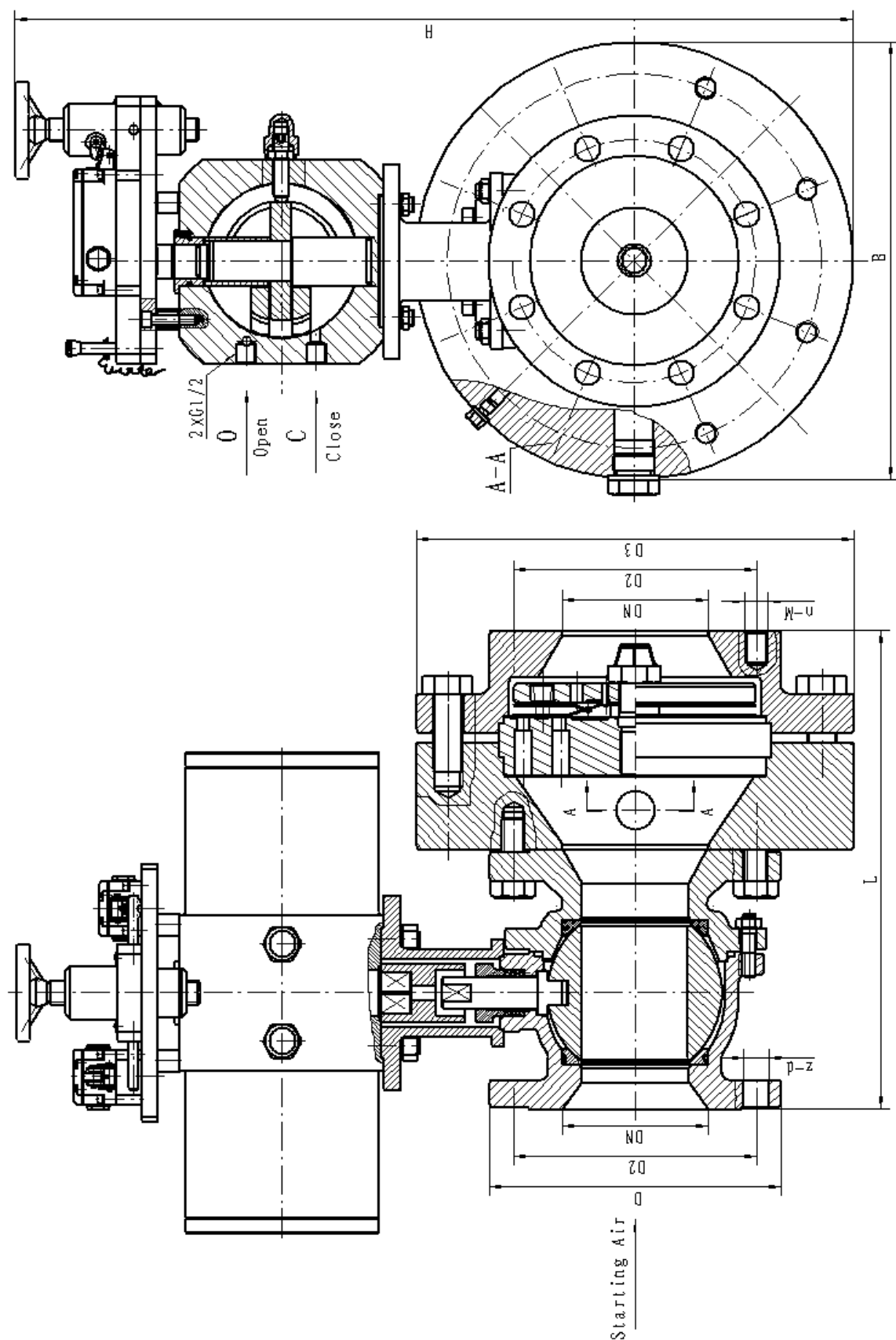
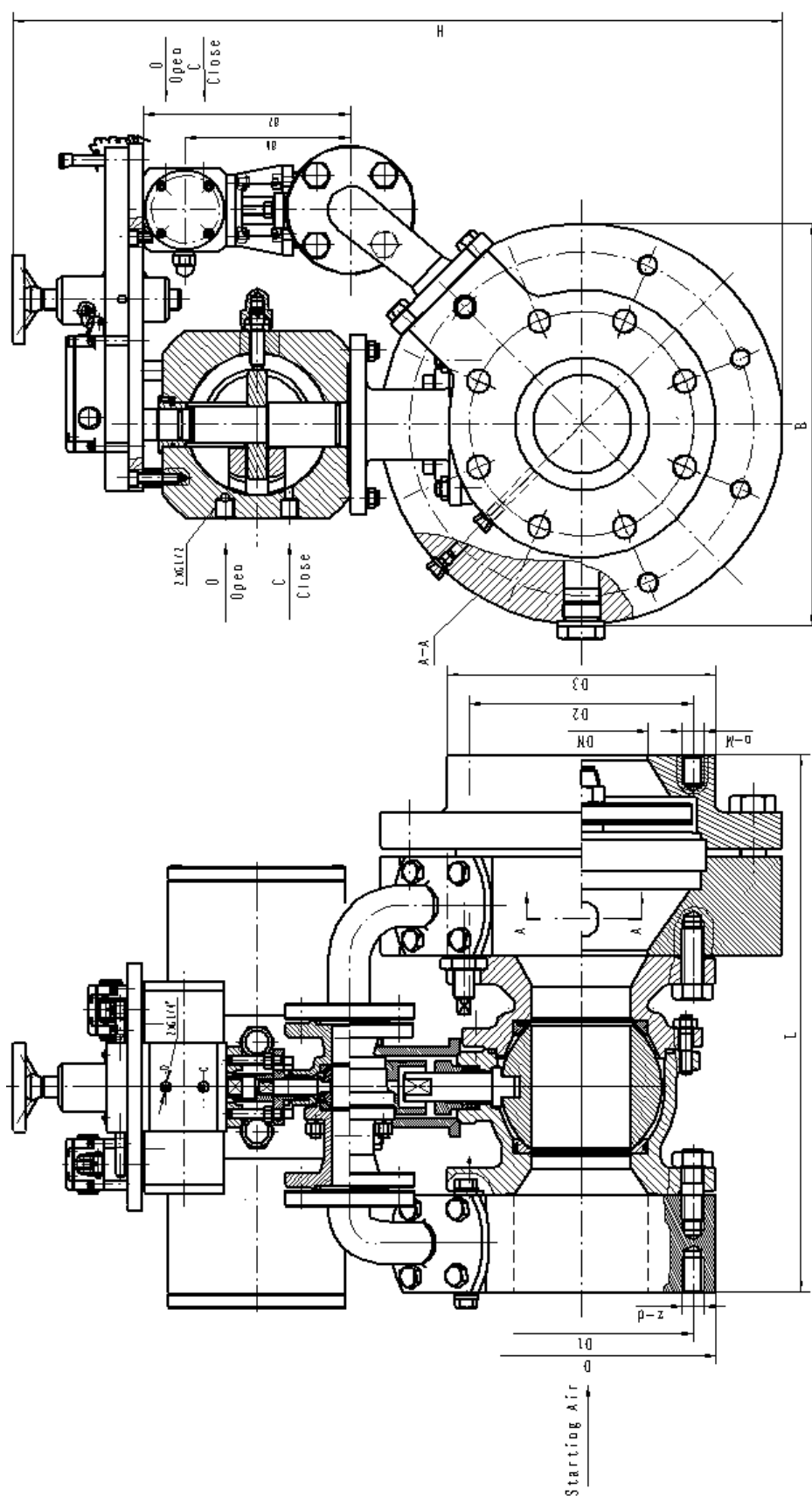


图 2 ZQ65/25、ZQ100/25、ZQ150/40 主起动阀结构图

Fig.2 Structural drawing of Type ZQ65/25、ZQ100/25、ZQ150/40 Main starting valve

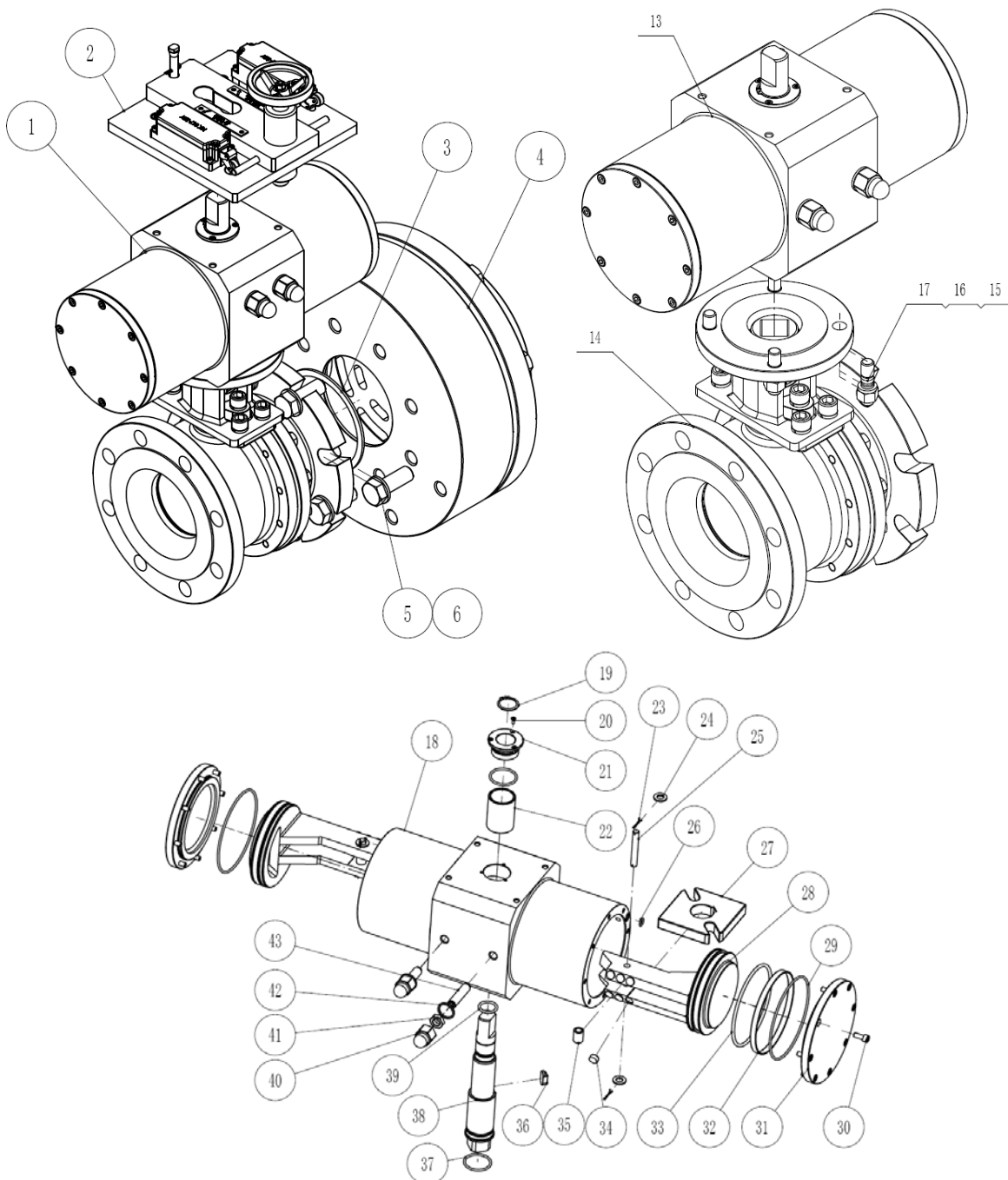


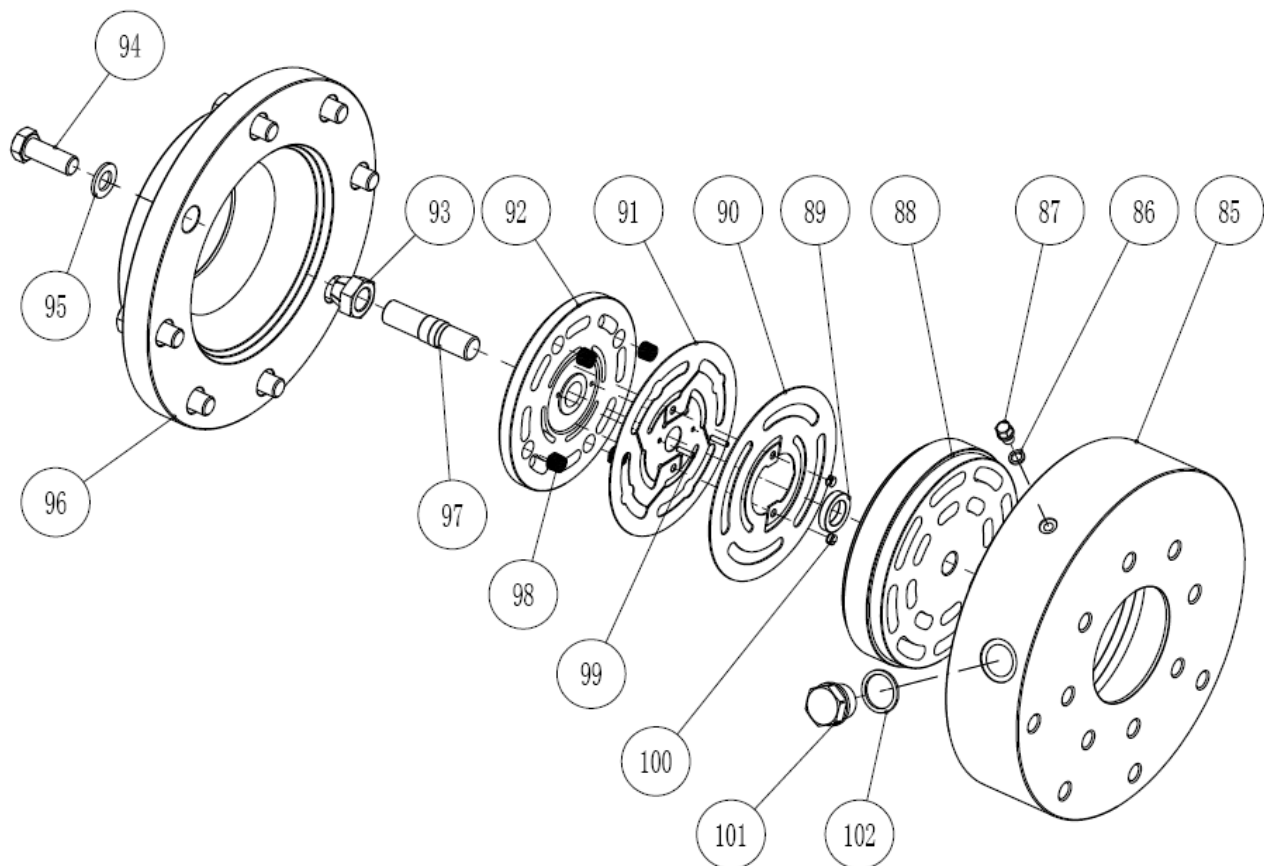
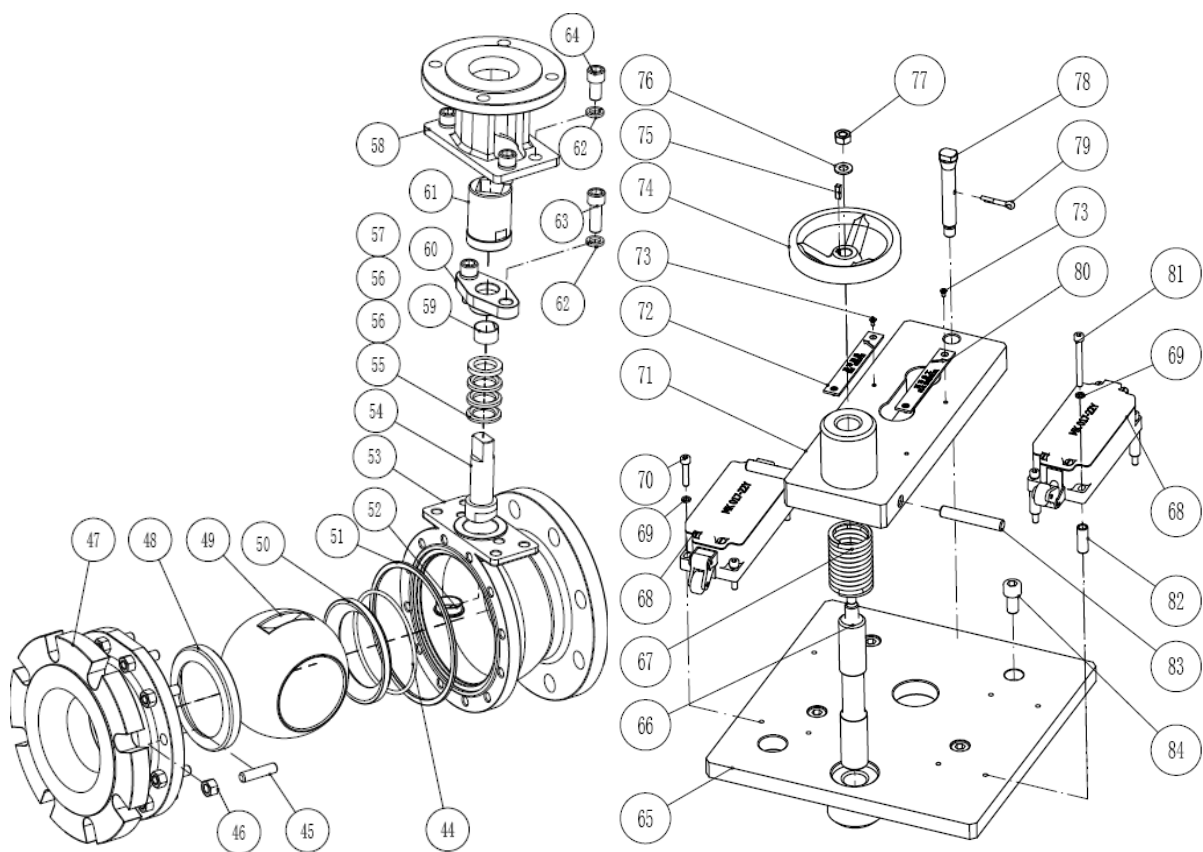
Spare part Instruction

1. Spare part Instruction of Type ZQ65、ZQ100、ZQ150、ZQ200

Main Starting Valve

1.1 Spare part figured diagram





1. 2 Spare part manual for Type ZQ65、ZQ100、ZQ150、ZQ200 Main Starting Valve

Item No.	Item Description	Spare part serial number			
		For Type ZQ65	For Type ZQ100	For Type ZQ150	For Type ZQ200
1	Ball valve with actuator	ZQ65-001	ZQ100-001	ZQ150-001	ZQ200-001
2	Locking device	ZQ65-002	ZQ100-002	ZQ150-002	ZQ200-002
3	Gasket	ZQ65-003	ZQ100-003	ZQ150-003	ZQ200-003
4	Non-return valve with housing	ZQ65-004	ZQ100-004	ZQ150-004	ZQ200-004
5	Screw	ZQ65-005	ZQ100-005	ZQ150-005	ZQ200-005
13	Actuator assembly	ZQ65-013	ZQ100-013	ZQ150-013	ZQ200-013
14	Ball valve	ZQ65-014	ZQ100-014	ZQ150-014	ZQ200-014
15	Nut	ZQ65-015	ZQ100-015	ZQ150-015	ZQ200-015
16	Washer	ZQ65-016	ZQ100-016	ZQ150-016	ZQ200-016
17	Screw	ZQ65-017	ZQ100-017	ZQ150-017	ZQ200-017
18	Cylinder body	ZQ65-018	ZQ100-018	ZQ150-018	ZQ200-018
19	Retaining ring	ZQ65-019	ZQ100-019	ZQ150-019	ZQ200-019
20	Screw	ZQ65-020	ZQ100-020	ZQ150-020	ZQ200-020
21	Bush	ZQ65-021	ZQ100-021	ZQ150-021	ZQ200-021
22	Distance ring	ZQ65-022	ZQ100-022	ZQ150-022	ZQ200-022
23	Split pin	ZQ65-023	ZQ100-023	ZQ150-023	ZQ200-023
24	Gasket	ZQ65-024	ZQ100-024	ZQ150-024	ZQ200-024
25	Pintle	ZQ65-025	ZQ100-025	ZQ150-025	ZQ200-025
26	O-ring	ZQ65-026	ZQ100-026	ZQ150-026	ZQ200-026
27	Shifter	ZQ65-027	ZQ100-027	ZQ150-027	ZQ200-027
28	Piston module	ZQ65-028	ZQ100-028	ZQ150-028	ZQ200-028
29	O-ring	ZQ65-029	ZQ100-029	ZQ150-029	ZQ200-029
30	Screw	ZQ65-030	ZQ100-030	ZQ150-030	ZQ200-030
31	Cap	ZQ65-031	ZQ100-031	ZQ150-031	ZQ200-031
32	Guide ring	ZQ65-032	ZQ100-032	ZQ150-032	ZQ200-032
33	O-ring	ZQ65-033	ZQ100-033	ZQ150-033	ZQ200-033
34	Antifriction gasket	ZQ65-034	ZQ100-034	ZQ150-034	ZQ200-034
35	Bush	ZQ65-035	ZQ100-035	ZQ150-035	ZQ200-035
36	Key	ZQ65-036	ZQ100-036	ZQ150-036	ZQ200-036
37	O-ring	ZQ65-037	ZQ100-037	ZQ150-037	ZQ200-037

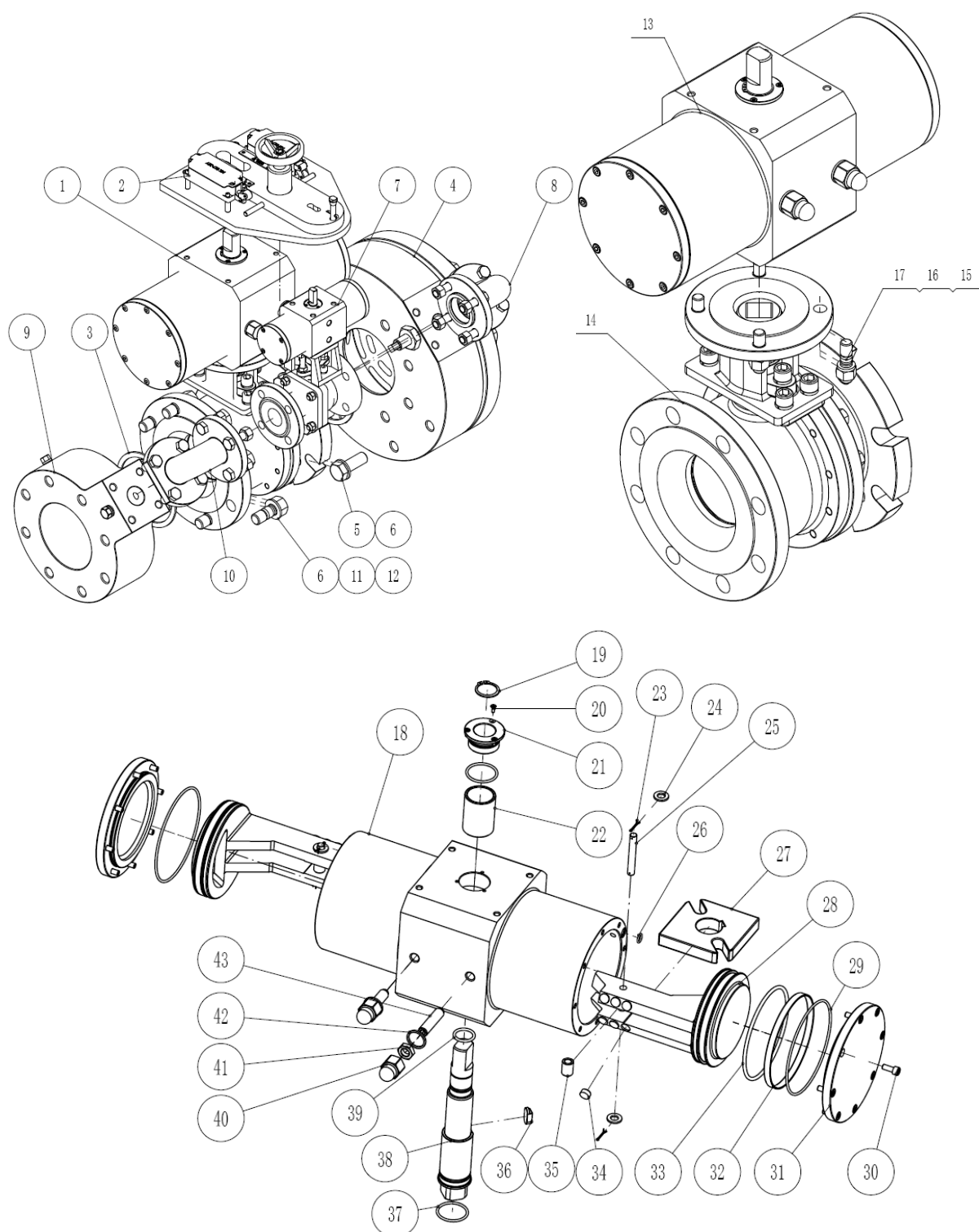
Item No.	Item Description	Spare part serial number			
		For Type ZQ65	For Type ZQ100	For Type ZQ150	For Type ZQ200
38	Shaft	ZQ65-038	ZQ100-038	ZQ150-038	ZQ200-038
39	O-ring	ZQ65-039	ZQ100-039	ZQ150-039	ZQ200-039
40	Cap nut	ZQ65-040	ZQ100-040	ZQ150-040	ZQ200-040
41	Nut	ZQ65-041	ZQ100-041	ZQ150-041	ZQ200-041
42	Seal washer	ZQ65-042	ZQ100-042	ZQ150-042	ZQ200-042
43	Adjusting screw	ZQ65-043	ZQ100-043	ZQ150-043	ZQ200-043
44	O-ring	ZQ65-044	ZQ100-044	ZQ150-044	ZQ200-044
45	Tapped stud	ZQ65-045	ZQ100-045	ZQ150-045	ZQ200-045
46	Nut	ZQ65-046	ZQ100-046	ZQ150-046	ZQ200-046
47	Cover	ZQ65-047	ZQ100-047	ZQ150-047	ZQ200-047
48	Seal ring	ZQ65-048	ZQ100-048	ZQ150-048	ZQ200-048
49	Ball	ZQ65-049	ZQ100-049	ZQ150-049	ZQ200-049
50	Inlet seal ring	ZQ65-050	ZQ100-050	ZQ150-050	ZQ200-050
51	Packing gland	ZQ65-051	ZQ100-051	ZQ150-051	ZQ200-051
52	Bush	ZQ65-052	ZQ100-052	ZQ150-052	ZQ200-052
53	Valve body	ZQ65-053	ZQ100-053	ZQ150-053	ZQ200-053
54	Valve spindle	ZQ65-054	ZQ100-054	ZQ150-054	ZQ200-054
55	Under pad ring	ZQ65-055	ZQ100-055	ZQ150-055	ZQ200-055
56	Middle pad ring	ZQ65-056	ZQ100-056	ZQ150-056	ZQ200-056
57	Top pad ring	ZQ65-057	ZQ100-057	ZQ150-057	ZQ200-057
58	Braket	ZQ65-058	ZQ100-058	ZQ150-058	ZQ200-058
59	Spacer ring	ZQ65-059	ZQ100-059	ZQ150-059	ZQ200-059
60	Cap	ZQ65-060	ZQ100-060	ZQ150-060	ZQ200-060
61	Connector	ZQ65-061	ZQ100-061	ZQ150-061	ZQ200-061
62	Spring washer	ZQ65-062	ZQ100-062	ZQ150-062	ZQ200-062
63	Bolt	ZQ65-063	ZQ100-063	ZQ150-063	ZQ200-063
64	Screw	ZQ65-064	ZQ100-064	ZQ150-064	ZQ200-064
65	Plate part	ZQ65-065	ZQ100-065	ZQ150-065	ZQ200-065
66	Screw stem	ZQ65-066	ZQ100-066	ZQ150-066	ZQ200-066
67	Spring	ZQ65-067	ZQ100-067	ZQ150-067	ZQ200-067
68	Position switch	ZQ65-068	ZQ100-068	ZQ150-068	ZQ200-068
69	Gasket	ZQ65-069	ZQ100-069	ZQ150-069	ZQ200-069
70	Screw	ZQ65-070	ZQ100-070	ZQ150-070	ZQ200-070

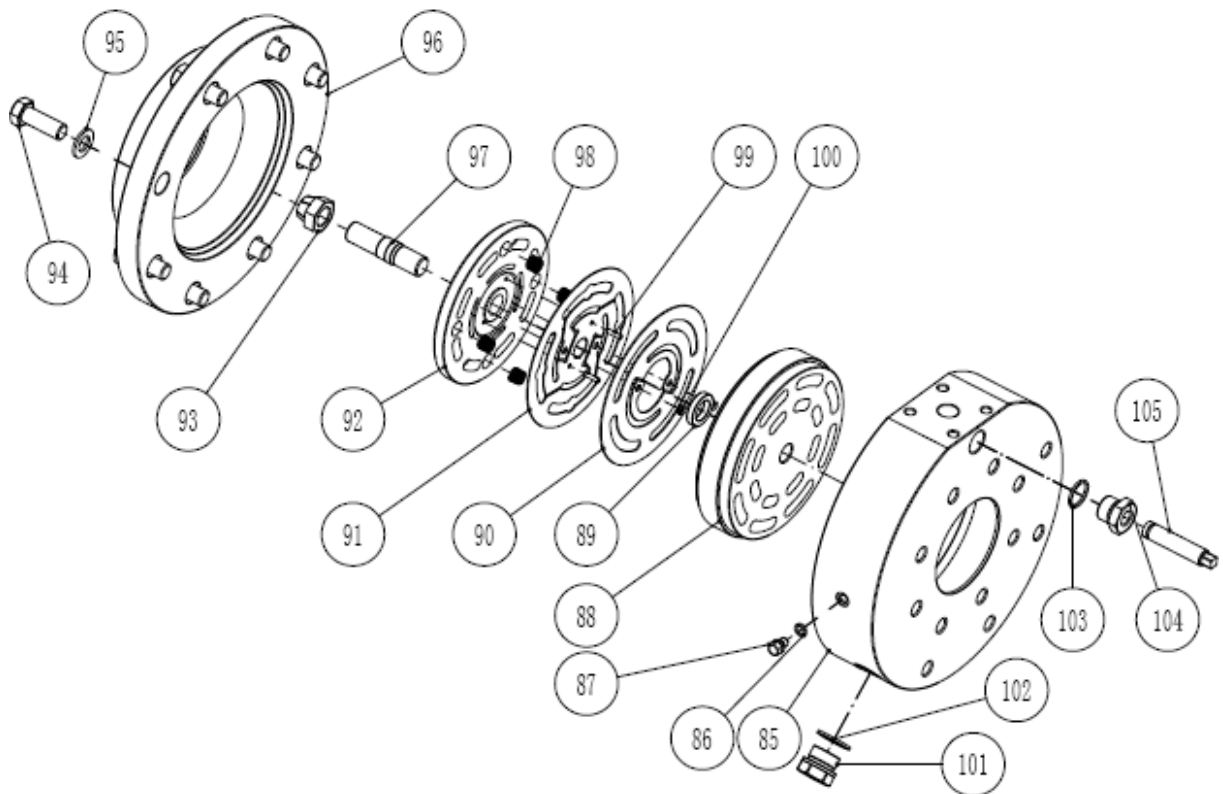
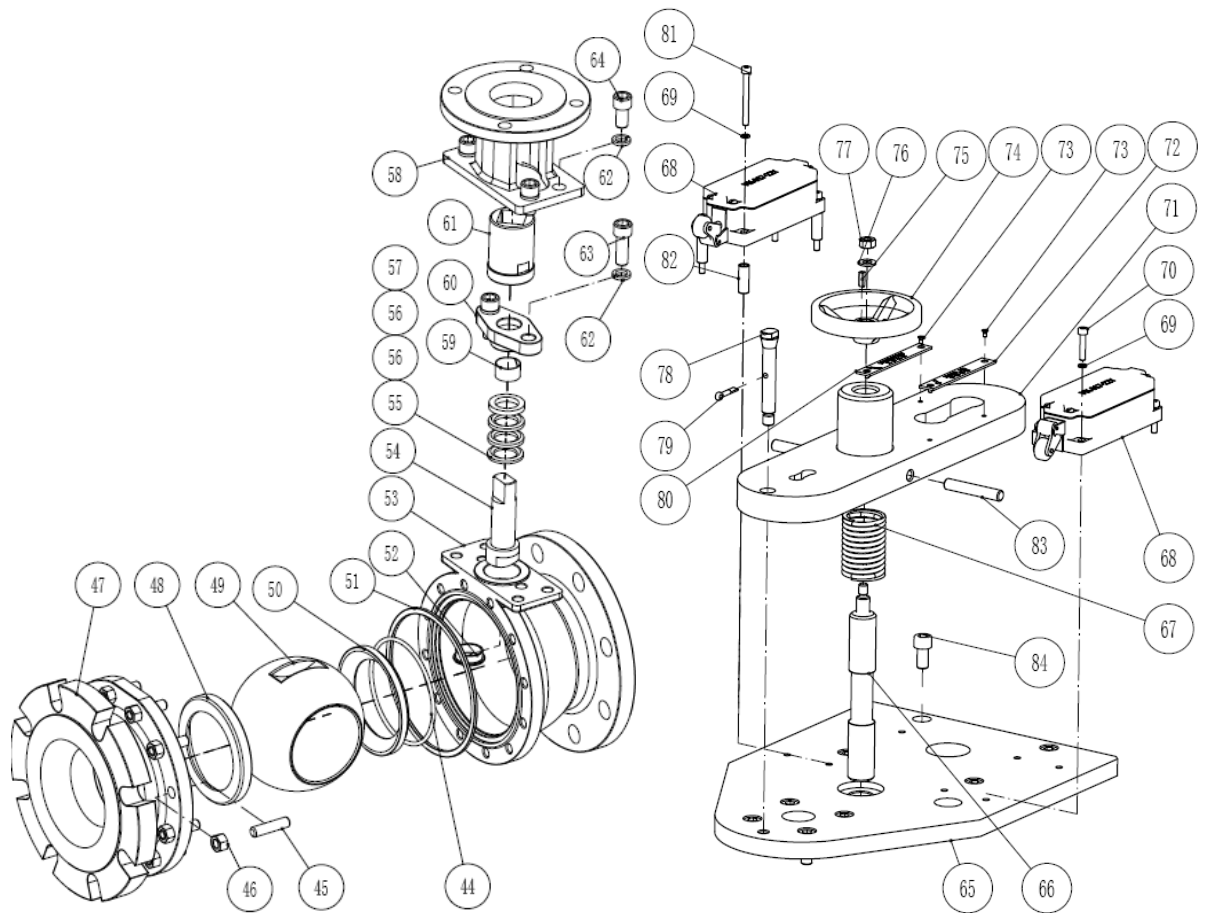
Item No.	Item Description	Spare part serial number			
		For Type ZQ65	For Type ZQ100	For Type ZQ150	For Type ZQ200
71	Locking plate part	ZQ65-071	ZQ100-071	ZQ150-071	ZQ200-071
72	Name plate(I)	ZQ65-072	ZQ100-072	ZQ150-072	ZQ200-072
73	Screw	ZQ65-073	ZQ100-073	ZQ150-073	ZQ200-073
74	Handle wheel	ZQ65-074	ZQ100-074	ZQ150-074	ZQ200-074
75	Key	ZQ65-075	ZQ100-075	ZQ150-075	ZQ200-075
76	Gasket	ZQ65-076	ZQ100-076	ZQ150-076	ZQ200-076
77	Nut	ZQ65-077	ZQ100-077	ZQ150-077	ZQ200-077
78	Guide post	ZQ65-078	ZQ100-078	ZQ150-078	ZQ200-078
79	Pin	ZQ65-079	ZQ100-079	ZQ150-079	ZQ200-079
80	Name plate(II)	ZQ65-080	ZQ100-080	ZQ150-080	ZQ200-080
81	Screw	ZQ65-081	ZQ100-081	ZQ150-081	ZQ200-081
82	Distance ring	ZQ65-082	ZQ100-082	ZQ150-082	ZQ200-082
83	Pin	ZQ65-083	ZQ100-083	ZQ150-083	ZQ200-083
84	Bolt	ZQ65-084	ZQ100-084	ZQ150-084	ZQ200-084
85	Inlet housing	ZQ65-085	ZQ100-085	ZQ150-085	ZQ200-085
86	Gasket	ZQ65-086	ZQ100-086	ZQ150-086	ZQ200-086
87	Plug	ZQ65-087	ZQ100-087	ZQ150-087	ZQ200-087
88	Valve seat	ZQ65-088	ZQ100-088	ZQ150-088	ZQ200-088
89	Space block	ZQ65-089	ZQ100-089	ZQ150-089	ZQ200-089
90	Valve plate	ZQ65-090	ZQ100-090	ZQ150-090	ZQ200-090
91	Buffer plate	ZQ65-091	ZQ100-091	ZQ150-091	ZQ200-091
92	Position plate	ZQ65-092	ZQ100-092	ZQ150-092	ZQ200-092
93	Locking nut	ZQ65-093	ZQ100-093	ZQ150-093	ZQ200-093
94	Bolt	ZQ65-094	ZQ100-094	ZQ150-094	ZQ200-094
96	Outlet housing	ZQ65-096	ZQ100-096	ZQ150-096	ZQ200-096
97	Fitting bolt	ZQ65-097	ZQ100-097	ZQ150-097	ZQ200-097
98	Spring	ZQ65-098	ZQ100-098	ZQ150-098	ZQ200-098
99	Adjusting pin	ZQ65-099	ZQ100-099	ZQ150-099	ZQ200-099
100	Rivet	ZQ65-100	ZQ100-100	ZQ150-100	ZQ200-100
101	Plug	ZQ65-101	ZQ100-101	ZQ150-101	ZQ200-101
102	Gasket	ZQ65-102	ZQ100-102	ZQ150-102	ZQ200-102

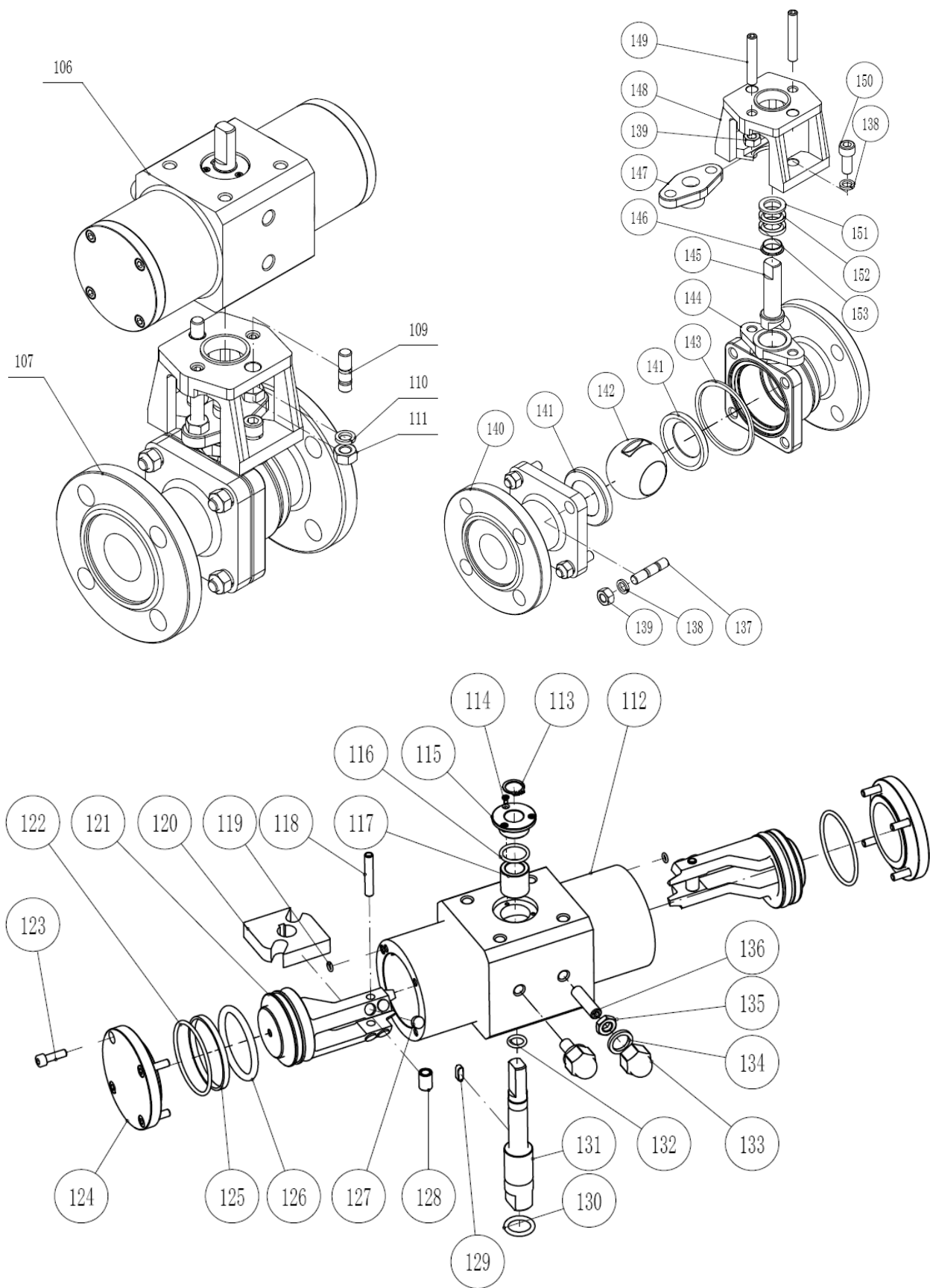
2. Spare part Instruction of Type ZQ65/25、ZQ100/25、ZQ150/40

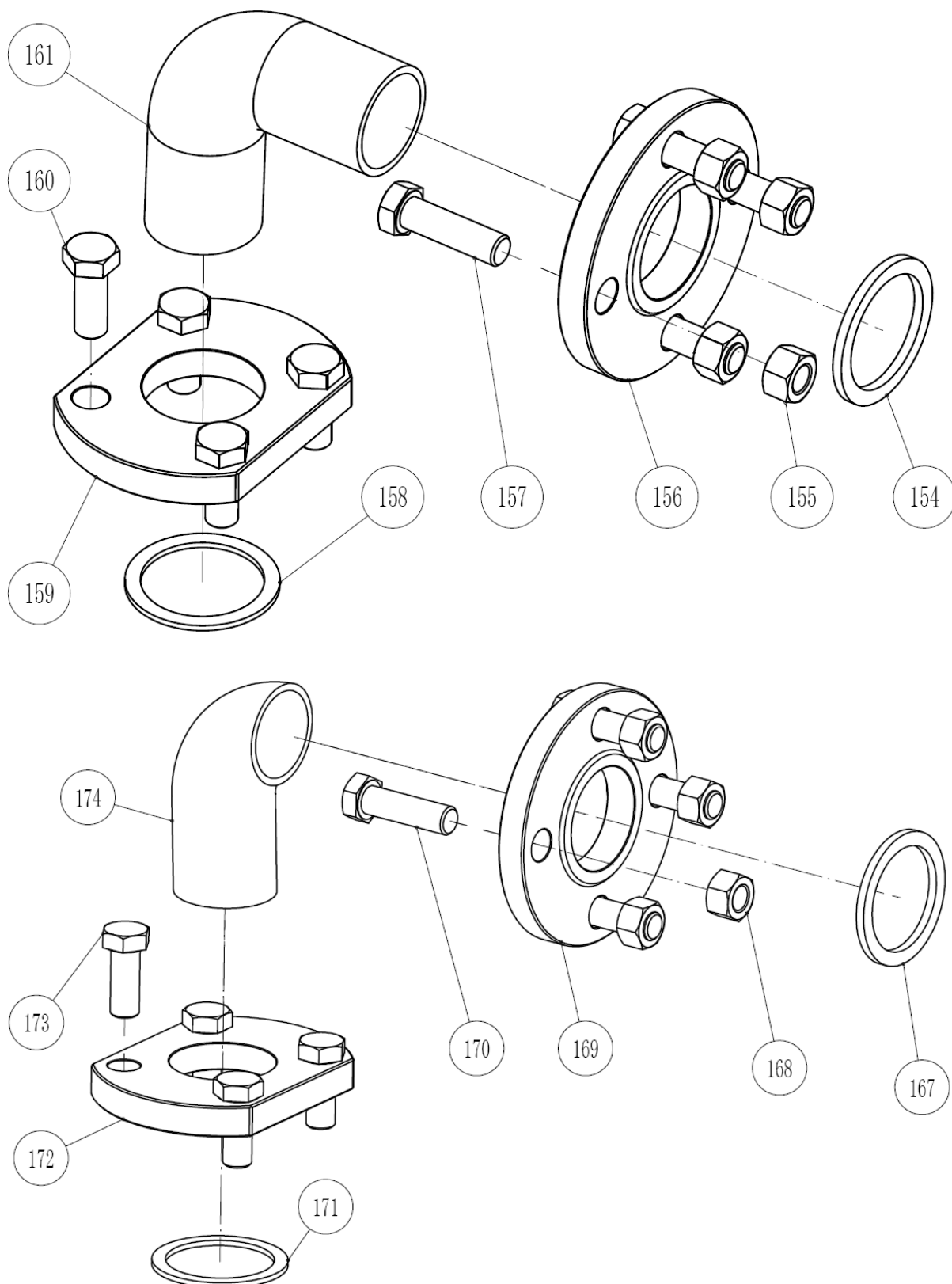
Main Starting Valve

2.1 Spare part figured diagram









2.2 Spare part manual for Type ZQ65/25、ZQ100/25、ZQ150/40 Main Starting Valve

Item No.	Item Description	Spare part serial number		
		For Type ZQ65/25	For Type ZQ100/25	For Type ZQ150/40
1	Main ball valve with actuator	ZQ65/25-001	ZQ100/25-001	ZQ150/40-001
2	Locking device (with slow turning)	ZQ65/25-002	ZQ100/25-002	ZQ150/40-002
3	Gasket	ZQ65/25-003	ZQ100/25-003	ZQ150/40-003
4	Non-return valve with housing	ZQ65/25-004	ZQ100/25-004	ZQ150/40-004
5	Bolt	ZQ65/25-005	ZQ100/25-005	ZQ150/40-005
7	Slave ball valve with actuator	ZQ65/25-007	ZQ100/25-007	ZQ150/40-007
8	Escape pipe module	ZQ65/25-008	ZQ100/25-008	ZQ150/40-008
9	Intermediate piece part	ZQ65/25-009	ZQ100/25-009	ZQ150/40-009
10	Air inlet pipe module	ZQ65/25-010	ZQ100/25-010	ZQ150/40-010
11	Nut	ZQ65/25-011	ZQ100/25-011	ZQ150/40-011
12	Bolt	ZQ65/25-012	ZQ100/25-012	ZQ150/40-012
13	Main actuator assembly	ZQ65/25-013	ZQ100/25-013	ZQ150/40-013
14	Main ball valve	ZQ65/25-014	ZQ100/25-014	ZQ150/40-014
15	Nut	ZQ65/25-015	ZQ100/25-015	ZQ150/40-015
16	Washer	ZQ65/25-016	ZQ100/25-016	ZQ150/40-016
17	Screw	ZQ65/25-017	ZQ100/25-017	ZQ150/40-017
18	Cylinder body	ZQ65/25-018	ZQ100/25-018	ZQ150/40-018
19	Retaining ring	ZQ65/25-019	ZQ100/25-019	ZQ150/40-019
20	Screw	ZQ65/25-020	ZQ100/25-020	ZQ150/40-020
21	Bush	ZQ65/25-021	ZQ100/25-021	ZQ150/40-021
22	Distance ring	ZQ65/25-022	ZQ100/25-022	ZQ150/40-022
23	Split pin	ZQ65/25-023	ZQ100/25-023	ZQ150/40-023
24	Gasket	ZQ65/25-024	ZQ100/25-024	ZQ150/40-024
25	Pintle	ZQ65/25-025	ZQ100/25-025	ZQ150/40-025
26	O-ring	ZQ65/25-026	ZQ100/25-026	ZQ150/40-026
27	Shifter	ZQ65/25-027	ZQ100/25-027	ZQ150/40-027
28	Piston module	ZQ65/25-028	ZQ100/25-028	ZQ150/40-028
29	O-ring	ZQ65/25-029	ZQ100/25-029	ZQ150/40-029
30	Screw	ZQ65/25-030	ZQ100/25-030	ZQ150/40-030
31	Cap	ZQ65/25-031	ZQ100/25-031	ZQ150/40-031

Item No.	Item Description	Spare part serial number		
		For Type ZQ65/25	For Type ZQ100/25	For Type ZQ150/40
32	Guide ring	ZQ65/25-032	ZQ100/25-032	ZQ150/40-032
33	O-ring	ZQ65/25-033	ZQ100/25-033	ZQ150/40-033
34	Antifriction gasket	ZQ65/25-034	ZQ100/25-034	ZQ150/40-034
35	Bush	ZQ65/25-035	ZQ100/25-035	ZQ150/40-035
36	Key	ZQ65/25-036	ZQ100/25-036	ZQ150/40-036
37	O-ring	ZQ65/25-037	ZQ100/25-037	ZQ150/40-037
38	Shaft	ZQ65/25-038	ZQ100/25-038	ZQ150/40-038
39	O-ring	ZQ65/25-039	ZQ100/25-039	ZQ150/40-039
40	Cap nut	ZQ65/25-040	ZQ100/25-040	ZQ150/40-040
41	Nut	ZQ65/25-041	ZQ100/25-041	ZQ150/40-041
42	Seal washer	ZQ65/25-042	ZQ100/25-042	ZQ150/40-042
43	Adjusting screw	ZQ65/25-043	ZQ100/25-043	ZQ150/40-043
44	O-ring	ZQ65/25-044	ZQ100/25-044	ZQ150/40-044
45	Tapped stud	ZQ65/25-045	ZQ100/25-045	ZQ150/40-045
46	Nut	ZQ65/25-046	ZQ100/25-046	ZQ150/40-046
47	Cover	ZQ65/25-047	ZQ100/25-047	ZQ150/40-047
48	Seal ring	ZQ65/25-048	ZQ100/25-048	ZQ150/40-048
49	Ball	ZQ65/25-049	ZQ100/25-049	ZQ150/40-049
50	Inlet seal ring	ZQ65/25-050	ZQ100/25-050	ZQ150/40-050
51	Packing gland	ZQ65/25-051	ZQ100/25-051	ZQ150/40-051
52	Bush	ZQ65/25-052	ZQ100/25-052	ZQ150/40-052
53	Valve body	ZQ65/25-053	ZQ100/25-053	ZQ150/40-053
54	Valve spindle	ZQ65/25-054	ZQ100/25-054	ZQ150/40-054
55	Under pad ring	ZQ65/25-055	ZQ100/25-055	ZQ150/40-055
56	Middle pad ring	ZQ65/25-056	ZQ100/25-056	ZQ150/40-056
57	Top pad ring	ZQ65/25-057	ZQ100/25-057	ZQ150/40-057
58	Braket	ZQ65/25-058	ZQ100/25-058	ZQ150/40-058
59	Spacer ring	ZQ65/25-059	ZQ100/25-059	ZQ150/40-059
60	Cap	ZQ65/25-060	ZQ100/25-060	ZQ150/40-060
61	Connector	ZQ65/25-061	ZQ100/25-061	ZQ150/40-061

Item No.	Item Description	Spare part serial number		
		For Type ZQ65/25	For Type ZQ100/25	For Type ZQ150/40
62	Spring washer	ZQ65/25-062	ZQ100/25-062	ZQ150/40-062
63	Bolt	ZQ65/25-063	ZQ100/25-063	ZQ150/40-063
64	Screw	ZQ65/25-064	ZQ100/25-064	ZQ150/40-064
65	Plate part	ZQ65/25-065	ZQ100/25-065	ZQ150/40-065
66	Screw stem	ZQ65/25-066	ZQ100/25-066	ZQ150/40-066
67	Spring	ZQ65/25-067	ZQ100/25-067	ZQ150/40-067
68	Position switch	ZQ65/25-068	ZQ100/25-068	ZQ150/40-068
69	Gasket	ZQ65/25-069	ZQ100/25-069	ZQ150/40-069
70	Screw	ZQ65/25-070	ZQ100/25-070	ZQ150/40-070
71	Locking plate part	ZQ65/25-071	ZQ100/25-071	ZQ150/40-071
72	Name plate(I)	ZQ65/25-072	ZQ100/25-072	ZQ150/40-072
73	Screw	ZQ65/25-073	ZQ100/25-073	ZQ150/40-073
74	Handle wheel	ZQ65/25-074	ZQ100/25-074	ZQ150/40-074
75	key	ZQ65/25-075	ZQ100/25-075	ZQ150/40-075
76	Gasket	ZQ65/25-076	ZQ100/25-076	ZQ150/40-076
77	Nut	ZQ65/25-077	ZQ100/25-077	ZQ150/40-077
78	Guide post	ZQ65/25-078	ZQ100/25-078	ZQ150/40-078
79	Pin	ZQ65/25-079	ZQ100/25-079	ZQ150/40-079
80	Name plate(II)	ZQ65/25-080	ZQ100/25-080	ZQ150/40-080
81	Screw	ZQ65/25-081	ZQ100/25-081	ZQ150/40-081
82	Distance ring	ZQ65/25-082	ZQ100/25-082	ZQ150/40-082
83	Pin	ZQ65/25-083	ZQ100/25-083	ZQ150/40-083
84	Bolt	ZQ65/25-084	ZQ100/25-084	ZQ150/40-084
85	Inlet housing	ZQ65/25-085	ZQ100/25-085	ZQ150/40-085
86	ZQ150-300-006	ZQ65/25-086	ZQ100/25-086	ZQ150/40-086
87	ZQ150-300-005	ZQ65/25-087	ZQ100/25-087	ZQ150/40-087
88	Valve seat	ZQ65/25-088	ZQ100/25-088	ZQ150/40-088
89	Space block	ZQ65/25-089	ZQ100/25-089	ZQ150/40-089
90	Valve plate	ZQ65/25-090	ZQ100/25-090	ZQ150/40-090
91	Buffer plate	ZQ65/25-091	ZQ100/25-091	ZQ150/40-091

Item No.	Item Description	Spare part serial number		
		For Type ZQ65/25	For Type ZQ100/25	For Type ZQ150/40
92	Position plate	ZQ65/25-092	ZQ100/25-092	ZQ150/40-092
93	Locking nut	ZQ65/25-093	ZQ100/25-093	ZQ150/40-093
94	Bolt	ZQ65/25-094	ZQ100/25-094	ZQ150/40-094
96	Outlet housing	ZQ65/25-096	ZQ100/25-096	ZQ150/40-096
97	Fitting bolt	ZQ65/25-097	ZQ100/25-097	ZQ150/40-097
98	Spring	ZQ65/25-098	ZQ100/25-098	ZQ150/40-098
99	Adjusting pin	ZQ65/25-099	ZQ100/25-099	ZQ150/40-099
100	Rivet	ZQ65/25-100	ZQ100/25-100	ZQ150/40-100
101	Plug	ZQ65/25-101	ZQ100/25-101	ZQ150/40-101
102	Gasket	ZQ65/25-102	ZQ100/25-102	ZQ150/40-102
103	Gasket	ZQ65/25-103	ZQ100/25-103	ZQ150/40-103
104	Adjusting nut	ZQ65/25-104	ZQ100/25-104	ZQ150/40-104
105	Valve spindle	ZQ65/25-105	ZQ100/25-105	ZQ150/40-105
106	Slave actuator assembly	ZQ65/25-106	ZQ100/25-106	ZQ150/40-106
107	Slave ball valve	ZQ65/25-107	ZQ100/25-107	ZQ150/40-107
108	Connector	ZQ65/25-108	ZQ100/25-108	ZQ150/40-108
109	Screw	ZQ65/25-109	ZQ100/25-109	ZQ150/40-109
110	Gasket	ZQ65/25-110	ZQ100/25-110	ZQ150/40-110
111	Nut	ZQ65/25-111	ZQ100/25-111	ZQ150/40-111
112	Cylinder body	ZQ65/25-112	ZQ100/25-112	ZQ150/40-112
113	Retaining ring	ZQ65/25-113	ZQ100/25-113	ZQ150/40-113
114	Screw	ZQ65/25-114	ZQ100/25-114	ZQ150/40-114
115	Bush	ZQ65/25-115	ZQ100/25-115	ZQ150/40-115
116	O-ring	ZQ65/25-116	ZQ100/25-116	ZQ150/40-116
117	Distance ring	ZQ65/25-117	ZQ100/25-117	ZQ150/40-117
118	Pintle	ZQ65/25-118	ZQ100/25-118	ZQ150/40-118
119	O-ring	ZQ65/25-119	ZQ100/25-119	ZQ150/40-119
120	Shifter	ZQ65/25-120	ZQ100/25-120	ZQ150/40-120
121	Piston	ZQ65/25-121	ZQ100/25-121	ZQ150/40-121
122	O-ring	ZQ65/25-122	ZQ100/25-122	ZQ150/40-122

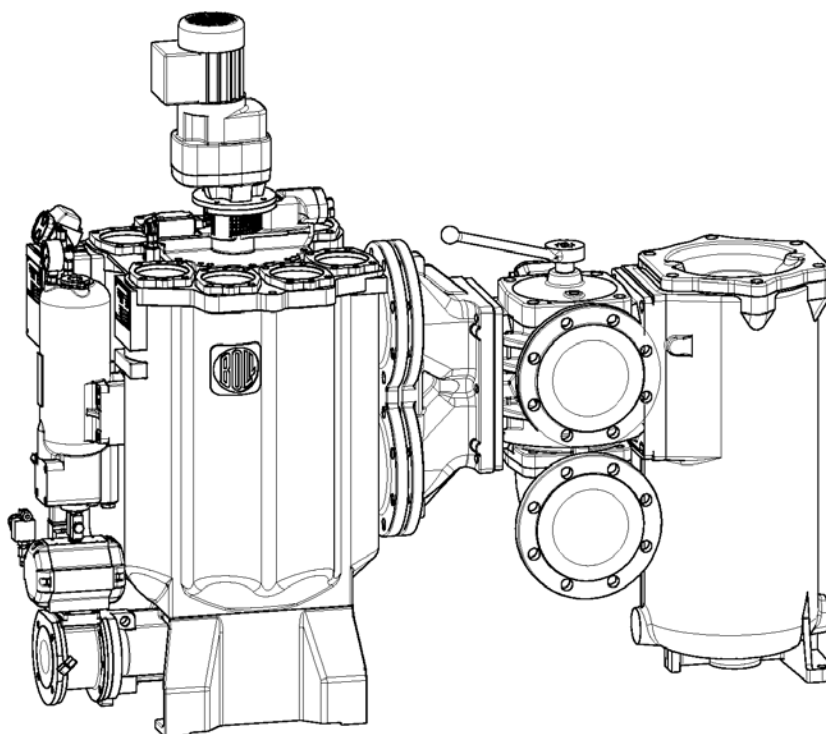
Item No.	Item Description	Spare part serial number		
		For Type ZQ65/25	For Type ZQ100/25	For Type ZQ150/40
123	Screw	ZQ65/25-123	ZQ100/25-123	ZQ150/40-123
124	Cap	ZQ65/25-124	ZQ100/25-124	ZQ150/40-124
125	Guide ring	ZQ65/25-125	ZQ100/25-125	ZQ150/40-125
126	O-ring	ZQ65/25-126	ZQ100/25-126	ZQ150/40-126
127	Antifriction gasket	ZQ65/25-127	ZQ100/25-127	ZQ150/40-127
128	Bush	ZQ65/25-128	ZQ100/25-128	ZQ150/40-128
129	Key	ZQ65/25-129	ZQ100/25-129	ZQ150/40-129
130	O-ring	ZQ65/25-130	ZQ100/25-130	ZQ150/40-130
131	Shaft	ZQ65/25-131	ZQ100/25-131	ZQ150/40-131
132	O-ring	ZQ65/25-132	ZQ100/25-132	ZQ150/40-132
133	Cap nut	ZQ65/25-133	ZQ100/25-133	ZQ150/40-133
134	Seal washer	ZQ65/25-134	ZQ100/25-134	ZQ150/40-134
135	Nut	ZQ65/25-135	ZQ100/25-135	ZQ150/40-135
136	Screw	ZQ65/25-136	ZQ100/25-136	ZQ150/40-136
137	Bolt	ZQ65/25-137	ZQ100/25-137	ZQ150/40-137
138	Gasket	ZQ65/25-138	ZQ100/25-138	ZQ150/40-138
139	Nut	ZQ65/25-139	ZQ100/25-139	ZQ150/40-139
140	Cover	ZQ65/25-140	ZQ100/25-140	ZQ150/40-140
141	Seal ring	ZQ65/25-141	ZQ100/25-141	ZQ150/40-141
142	Ball	ZQ65/25-142	ZQ100/25-142	ZQ150/40-142
143	Packing gland	ZQ65/25-143	ZQ100/25-143	ZQ150/40-143
144	Valve body	ZQ65/25-144	ZQ100/25-144	ZQ150/40-144
145	Valve spindle	ZQ65/25-145	ZQ100/25-145	ZQ150/40-145
146	Bush	ZQ65/25-146	ZQ100/25-146	ZQ150/40-146
147	Cap	ZQ65/25-147	ZQ100/25-147	ZQ150/40-147
148	Braket	ZQ65/25-148	ZQ100/25-148	ZQ150/40-148
149	Hexagon socket head cap screw	ZQ65/25-149	ZQ100/25-149	ZQ150/40-149
150	Bolt	ZQ65/25-150	ZQ100/25-150	ZQ150/40-150
151	Under pad ring	ZQ65/25-151	ZQ100/25-151	ZQ150/40-151
152	Middle pad ring	ZQ65/25-152	ZQ100/25-152	ZQ150/40-152

Item No.	Item Description	Spare part serial number		
		For Type ZQ65/25	For Type ZQ100/25	For Type ZQ150/40
153	Top pad ring	ZQ65/25-153	ZQ100/25-153	ZQ150/40-153
154	Gasket	ZQ65/25-154	ZQ100/25-154	ZQ150/40-154
155	Nut	ZQ65/25-155	ZQ100/25-155	ZQ150/40-155
156	Flange	ZQ65/25-156	ZQ100/25-156	ZQ150/40-156
157	Screw	ZQ65/25-157	ZQ100/25-157	ZQ150/40-157
158	Gasket	ZQ65/25-158	ZQ100/25-158	ZQ150/40-158
159	Flange	ZQ65/25-159	ZQ100/25-159	ZQ150/40-159
160	Screw	ZQ65/25-160	ZQ100/25-160	ZQ150/40-160
161	Escape pipe	ZQ65/25-161	ZQ100/25-161	ZQ150/40-161
162	Intermediate piece	ZQ65/25-162	ZQ100/25-162	ZQ150/40-162
163	ZQ150-300-005	ZQ65/25-163	ZQ100/25-163	ZQ150/40-163
164	ZQ150-300-006	ZQ65/25-164	ZQ100/25-164	ZQ150/40-164
165	Plug	ZQ65/25-165	ZQ100/25-165	ZQ150/40-165
166	Gasket	ZQ65/25-166	ZQ100/25-166	ZQ150/40-166
167	Gasket	ZQ65/25-167	ZQ100/25-167	ZQ150/40-167
168	Nut	ZQ65/25-168	ZQ100/25-168	ZQ150/40-168
169	Flange	ZQ65/25-169	ZQ100/25-169	ZQ150/40-169
170	Screw	ZQ65/25-170	ZQ100/25-170	ZQ150/40-170
171	Gasket	ZQ65/25-171	ZQ100/25-171	ZQ150/40-171
172	Flange	ZQ65/25-172	ZQ100/25-172	ZQ150/40-172
173	Screw	ZQ65/25-173	ZQ100/25-173	ZQ150/40-173
174	Air inlet pipe	ZQ65/25-174	ZQ100/25-174	ZQ150/40-174



Operating instructions for automatic filter

Type	6.64.1
Nominal diameter	DN 100 - DN 150
Filter element	Filter candle



BOLL & KIRCH
Filterbau GmbH

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50170 Kerpen
Germany
www.bollfilter.de

Date	Version	Language	Order no.	Item no.
04.2015	001	en	4049876	01





Table of Contents

1	Preamble	7
1.1	General	7
1.2	Warranty and liability	7
1.3	Copyright	8
2	General safety instructions	9
2.1	Basic safety instructions	9
2.1.1	Proper use	9
2.1.2	Warning signs and symbols	9
2.1.3	Target group	10
2.1.4	Obligations of the user/operator	10
2.1.5	Selection and qualifications of staff	10
2.1.6	Organisational measures	11
2.1.6.1	General	11
2.1.6.2	Maintenance and servicing	11
2.1.7	Consumables	11
2.1.7.1	Filtered media	11
2.1.7.2	Cleaning agent	11
3	Transportation and storage	13
3.1	Transportation	13
3.2	Storage	13
3.3	Packaging material	13
4	Scope of delivery	15
5	Technical data	17
5.1	Type plate	17
5.2	Overview of automatic filter assembly group	17
5.3	Overview of assembly groups, segmented plug valve	21
5.4	Overview of bypass filter assembly group	23
6	Installation	25
6.1	Special safety instructions	25
6.2	Preparation for transportation	26
6.3	Filter installation	26
6.3.1	Floor fastening	27
6.3.2	Installation diagram	28
6.3.3	Identifying the flow direction	29
6.3.4	Filter inlet/outlet pipe connections	29
6.3.5	Flushing oil outlet pipe connection	29
6.3.6	Filter heater (optional)	30
6.3.7	Connection of compressed air supply	31
6.3.7.1	Pneumatic diagram	32
6.3.8	Electrical connections	33
6.3.9	Potential equalisation	33
7	Operation	35
7.1	Functional description of the automatic filter	35
7.1.1	Filter housing	35
7.1.2	Controller	35
7.1.3	Differential pressure monitoring system	35



7.1.4	Air tank	36
7.1.5	Gear motor with limit switch	36
7.1.6	Flushing oil line	36
7.1.7	Filtration stage	37
7.1.8	Backflushing stage	39
7.2	Functional description of the segmented plug valve	41
7.2.1	Plug valve circuit	41
7.2.2	Pressure compensation	42
7.3	Functional description of the bypass filter	43
7.3.1	Differential pressure monitoring system	43
7.3.2	Housing cover safety device (optional)	44
7.4	Automatic filter filter insert	45
7.4.1	Filter insert with filter candles	45
7.4.2	Functional description of the filter insert with filter candles	45
7.5	Bypass filter filter insert	46
7.5.1	Star-pleated filter element	47
7.5.2	Functional description of the star-pleated filter element	48
7.6	Commissioning	49
7.6.1	Determination of time interval for time-controlled backflushing	50
7.7	Removal from service	51
7.7.1	Short-term removal from service	51
7.7.2	Longer term removal from service / removal	51
7.7.3	Disposal	51
8	Maintenance and servicing	53
8.1	Special safety instructions	53
8.2	Cleaning agent	54
8.3	Special tool	54
8.4	Maintenance intervals	55
8.5	Cleaning/replacing the filter element on the automatic filter	57
8.5.1	Preparatory work	57
8.5.2	Removing the filter insert with filter candles	59
8.5.3	Cleaning the filter insert with filter candles	60
8.5.3.1	Cleaning the filter candles in case of stubborn soiling	61
8.5.4	Installing the filter insert with filter candles	63
8.5.5	Concluding work	63
8.6	Cleaning/replacing the filter element on the bypass filter	64
8.6.1	Preparatory work	64
8.6.2	Removing the star-pleated filter element	65
8.6.2.1	Removing and attaching the filter element clamp	65
8.6.3	Cleaning the star-pleated filter element	66
8.6.4	Installing the star-pleated filter element	67
8.6.5	Concluding work	68
8.7	Manually backflushing the filter in the event of power failure	69
8.8	Remedying faults	71
8.8.1	Trouble shooting	71
9	Appendix	73
9.1	Filter	73
9.1.1	Technical data	73
9.1.2	Technical data sheet	74



9.1.3	Spare parts	75
9.1.3.1	Spare parts drawing	75
9.1.3.2	Spare parts list	78
9.2	Differential pressure indicator	83
9.2.1	Technical data sheet	83
9.2.2	Spare parts list	84
9.3	Supplier's documentation	85
9.4	Cleaning devices	85
9.5	BOLL CLEAN 2000 cleaning agent product information	86
9.6	Worldwide sales and service network, subsidiaries and representatives	87
9.7	Declaration of conformity	89





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 as well as to reduce down times, increase the reliability and even the serviceable life of the filter. Read the operating instructions carefully and attentively.

Supply 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 General safety instructions

2.1 Basic safety instructions

2.1.1 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", 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.

2.1.2 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.



2.1.3 Target group

The operating instructions apply for use by qualified specialist staff only.

2.1.4 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.

2.1.5 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 employ qualified or trained staff. Clearly define the staff responsibilities for assembly, operation, as well as maintenance and servicing.



2.1.6 Organisational measures

2.1.6.1 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.

2.1.6.2 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.

2.1.7 Consumables

- Observe the regulations for environmental protection. Make sure that consumables are disposed of properly and in an environmentally friendly manner.

2.1.7.1 Filtered media

- When handling media which are to be filtered, make sure you follow the respective safety regulations for the media.

2.1.7.2 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 switch-over 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 placed 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 indicate the information mentioned 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.

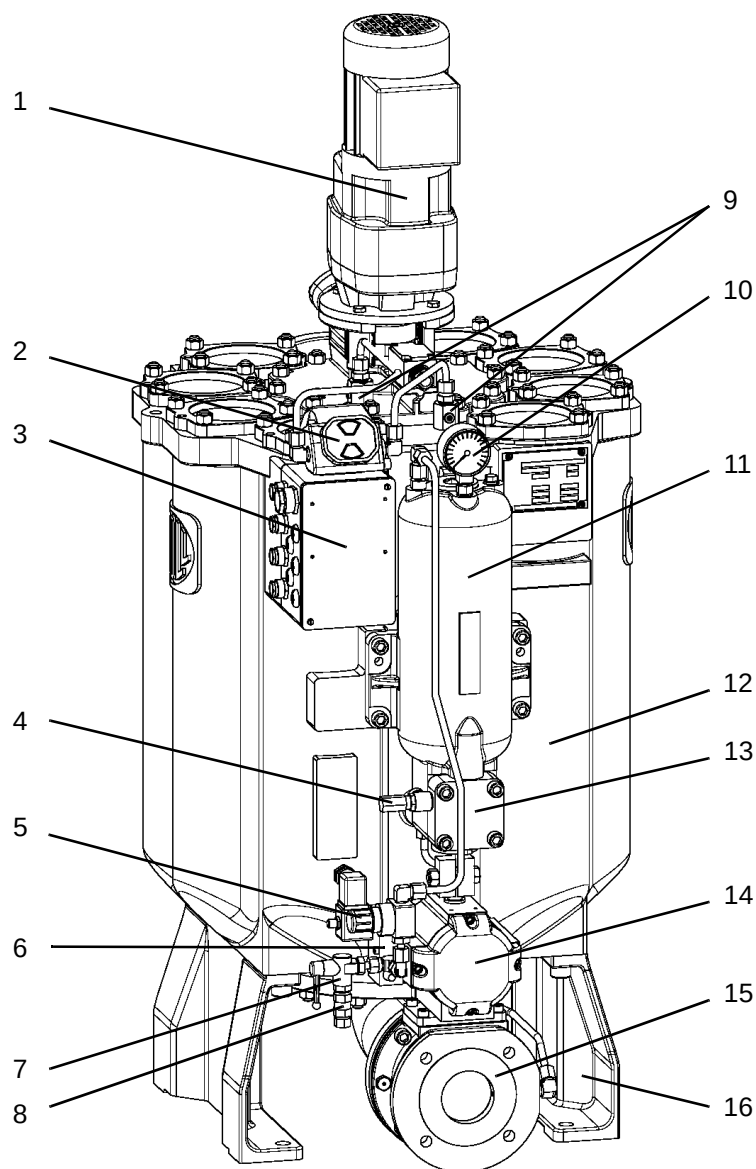


Fig. 5-1 Overview of assembly groups (view I)

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

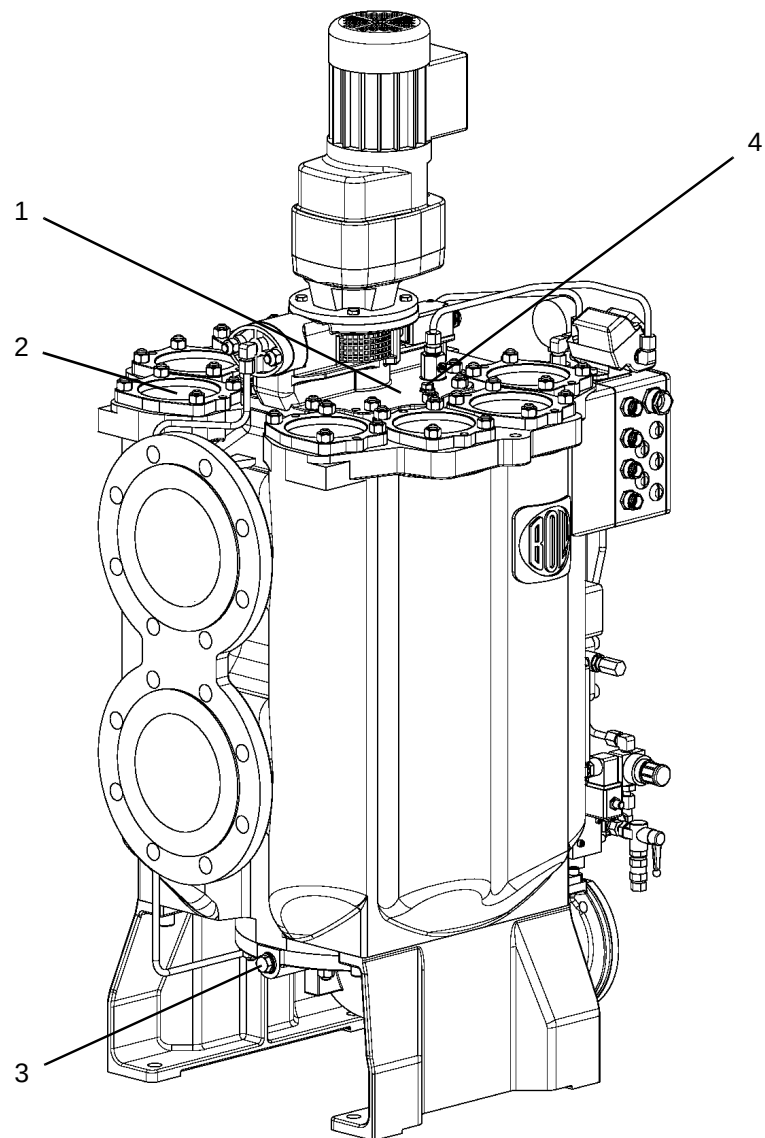


Fig. 5-2 Overview of assembly groups (view II)

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.

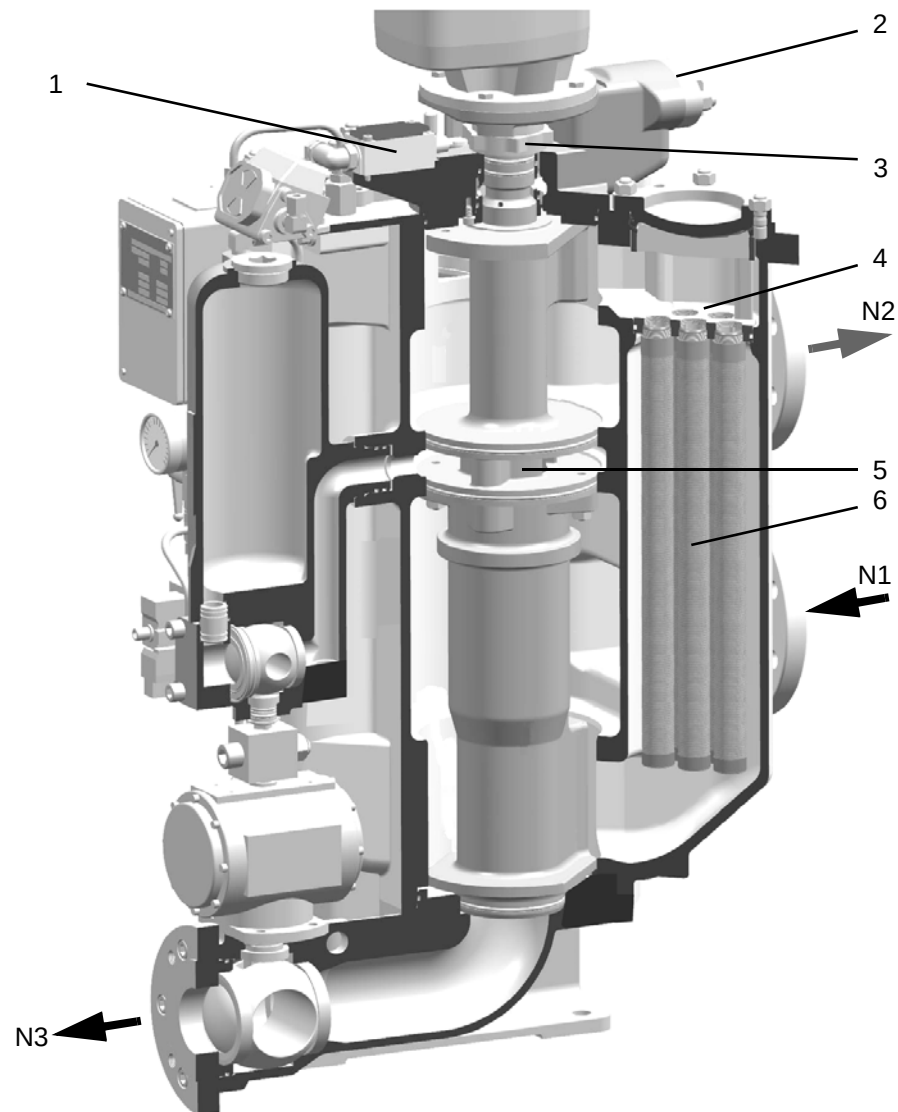


Fig. 5-3 Overview of assembly groups (cross sectional view)

- | | | | |
|---|------------------|----|---------------------|
| 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

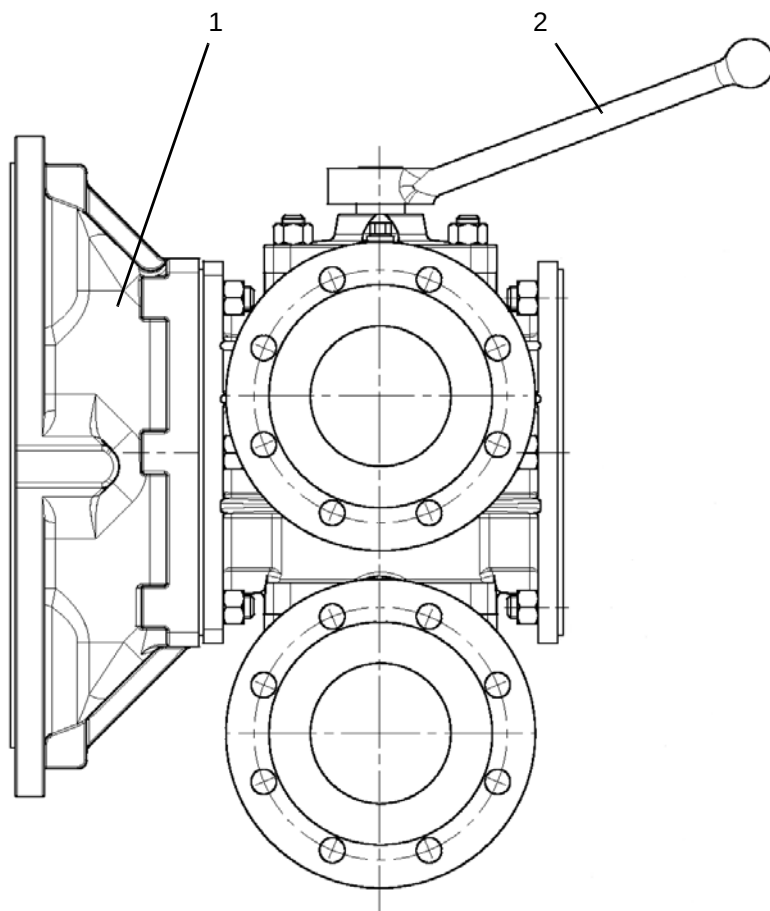


Fig. 5-4 Overview of assembly groups (view)

- 1 Intermediate piece
- 2 Key

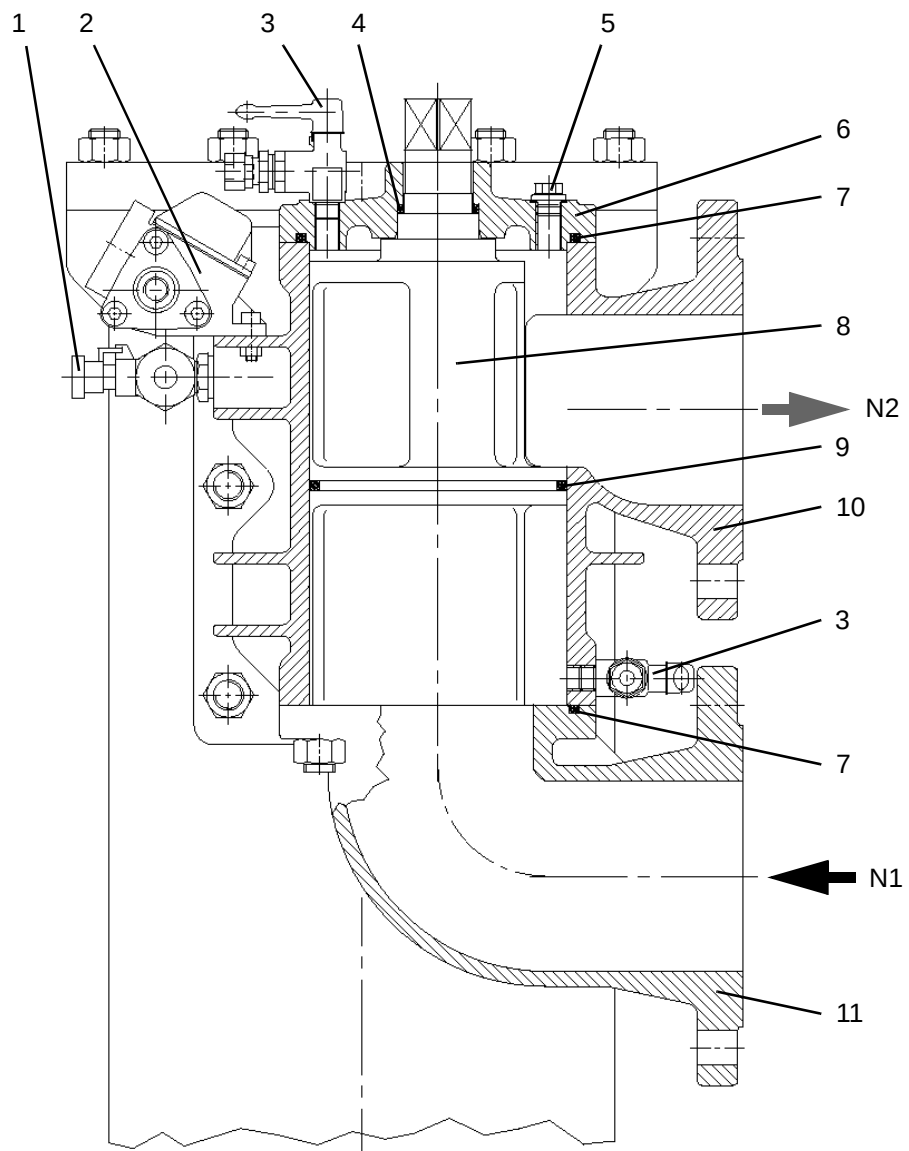


Fig. 5-5 Overview of assembly groups (cross sectional view)

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

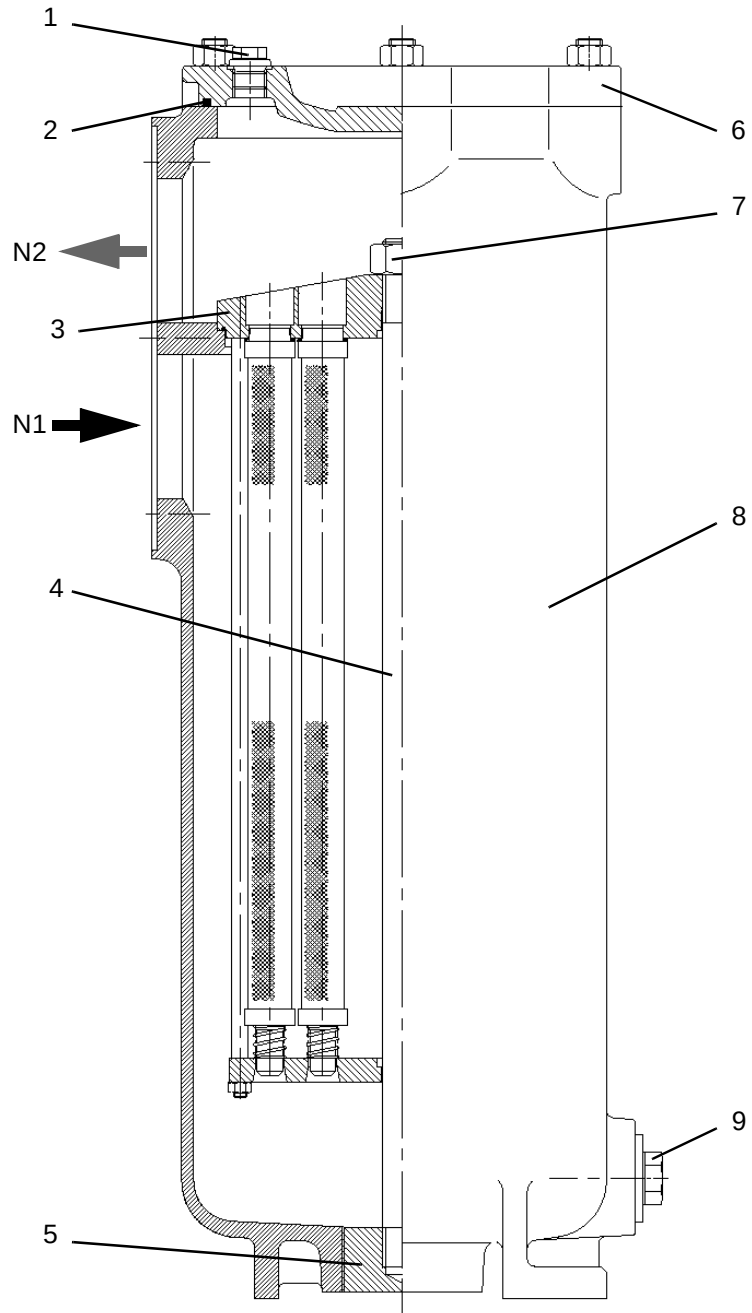


Fig. 5-6 Overview of assembly groups

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 follow 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 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 the installation. The contact data for the respective national subsidiaries can be found in the appendix of the operating instructions.

6.2 Preparation for transportation

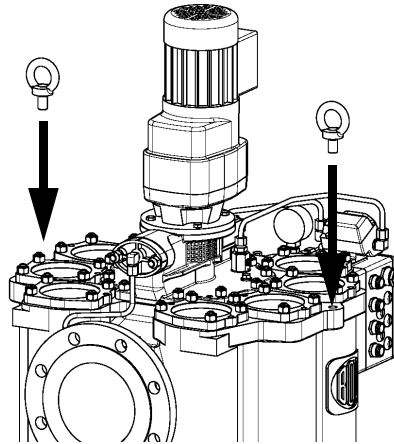


Fig. 6-1 Preparation for transportation

- 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 designed exclusively 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

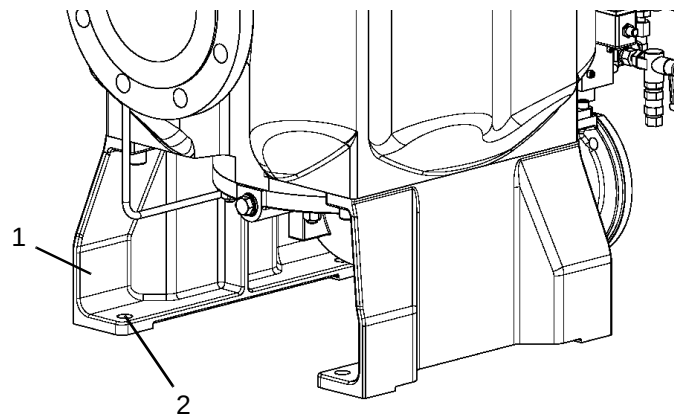


Fig. 6-2 Automatic filter with support leg for floor fastening

- 1 Floor fastening
- 2 Fastening point

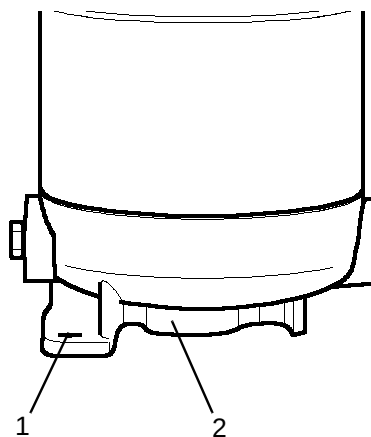


Fig. 6-3 Bypass filter with support leg for floor fastening

- 1 Fastening point
- 2 Support leg

- Make sure the foundation has sufficient load-bearing strength.
- 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

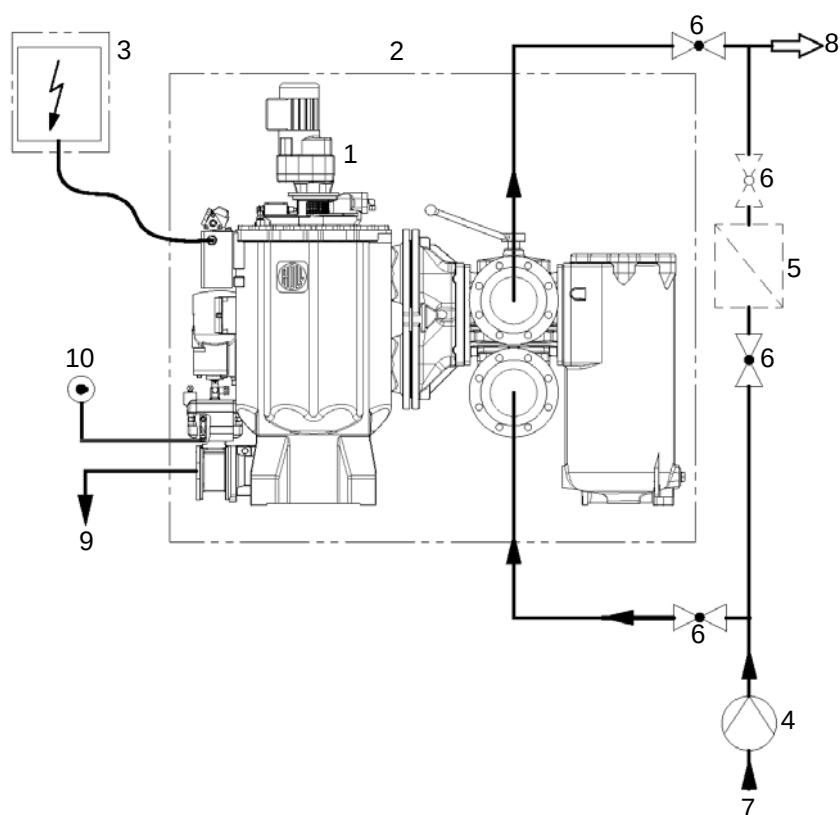


Fig. 6-4 Installation diagram

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

- ▶ Make sure that there is sufficient space in the vicinity of the filter for maintenance and servicing work.
- ▶ 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 counter pressure.

6.3.6 Filter heater (optional)

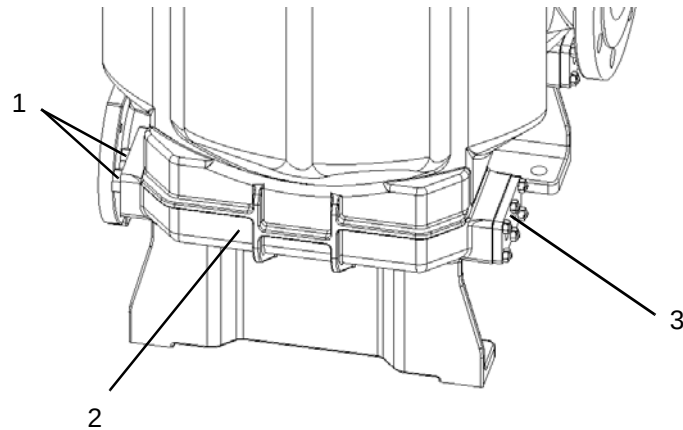


Fig. 6-5 Automatic filter heating (optional)

- 1 Piping connection
- 2 Filter heating (optional)
- 3 Drain plug

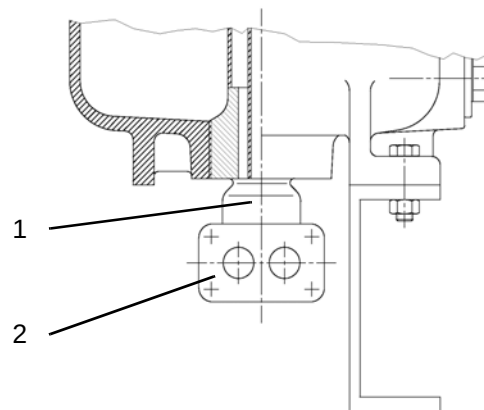


Fig. 6-6 Bypass filter heating (optional)

- 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

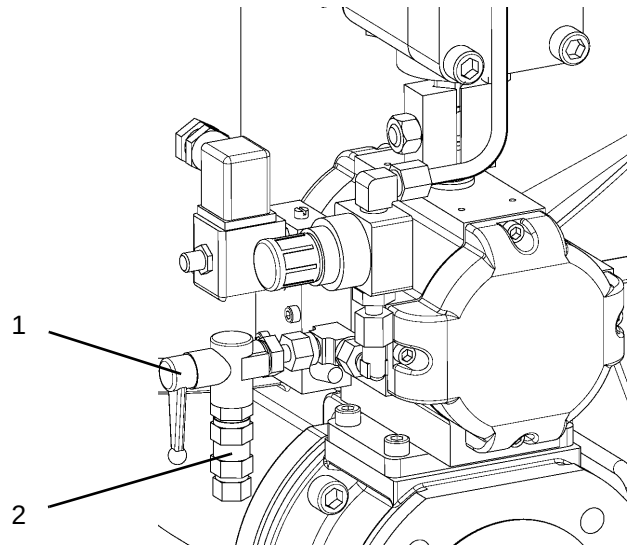


Fig. 6-7 Connection of compressed air supply

- 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

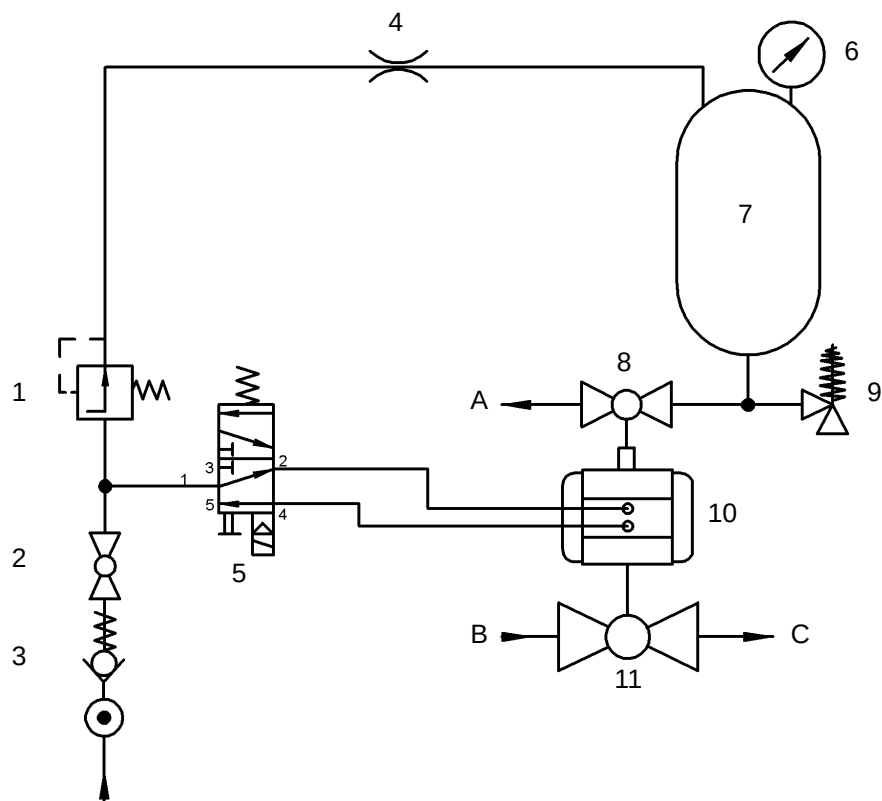


Fig. 6-8 Pneumatic diagram

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 pressure difference 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

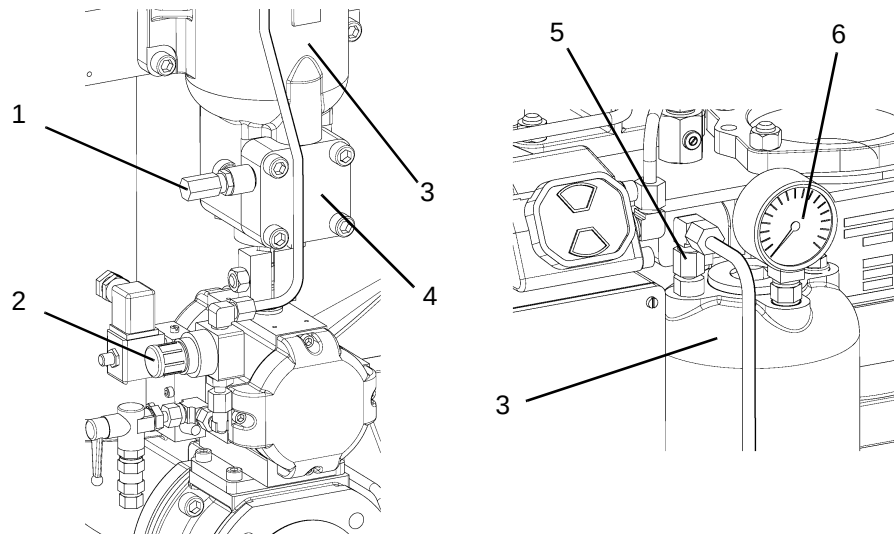


Fig. 7-1 Overview of the air tank

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

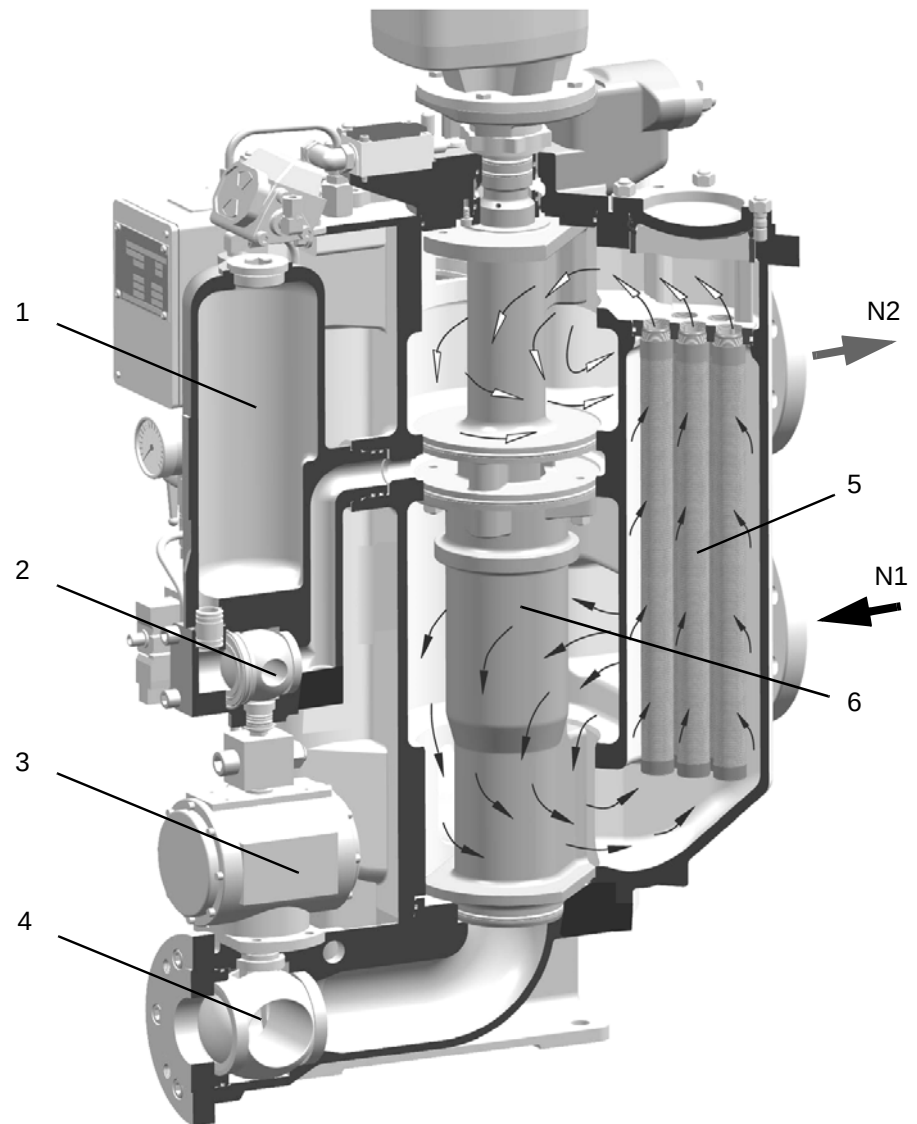


Fig. 7-2 Filtration stage

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

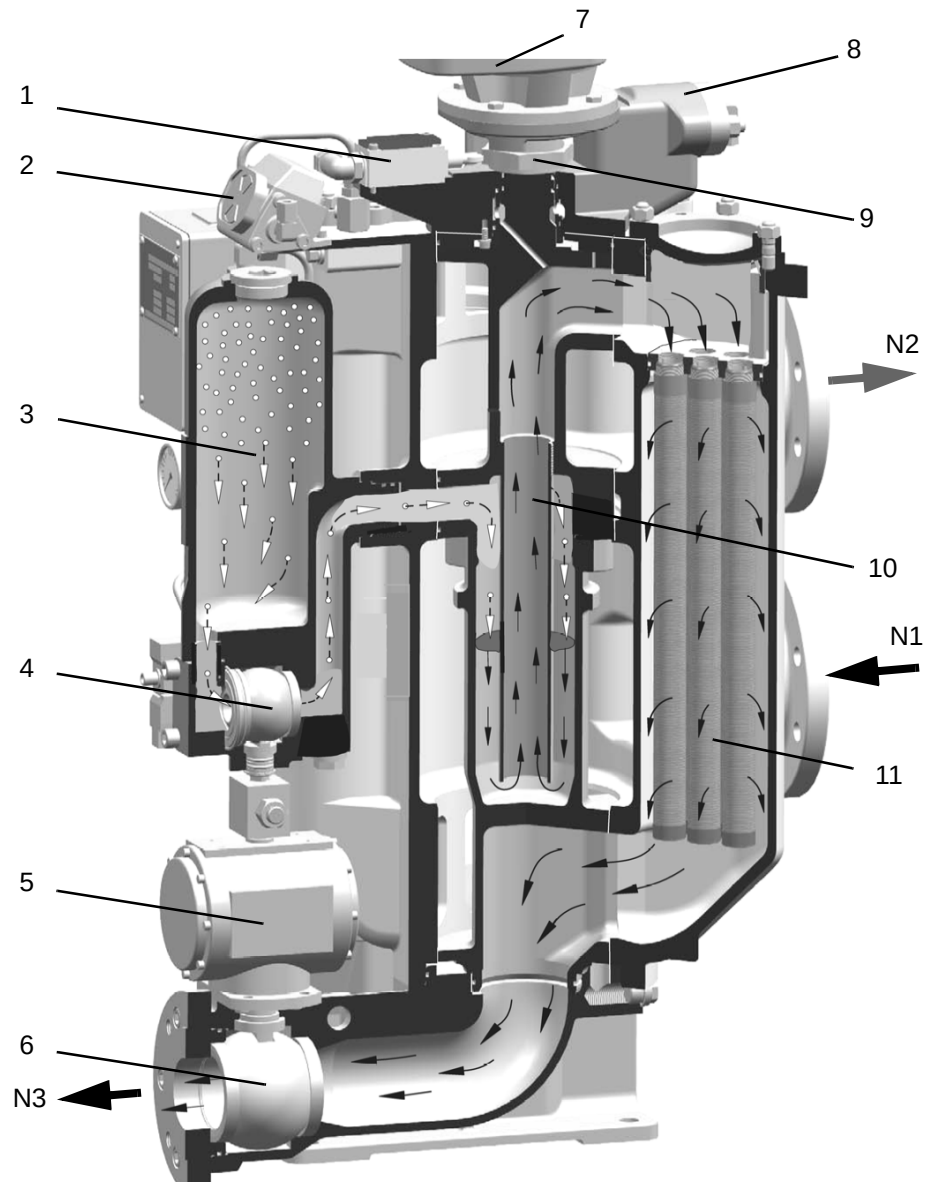


Fig. 7-3 Backflushing stage

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

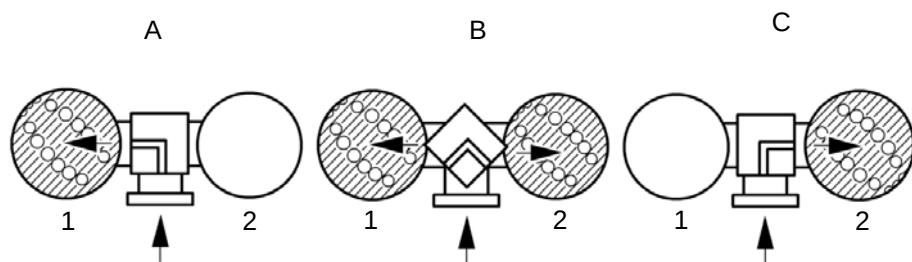


Fig. 7-4 Position of the segmented plug valve

- 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.

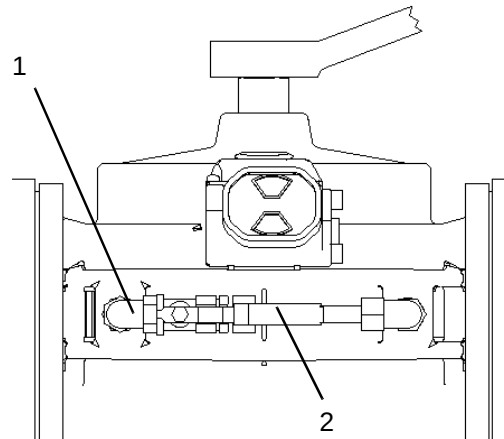


Fig. 7-5 Pressure compensation

- 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 pressure difference 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)

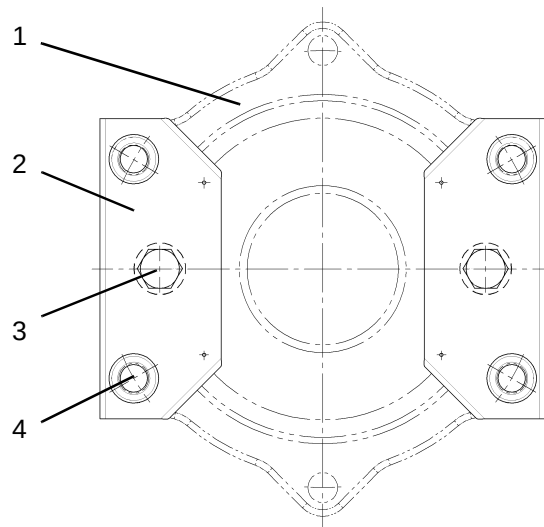


Fig. 7-6 Housing cover safety device (optional)

- | | |
|---|--|
| 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 uncontrolled 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

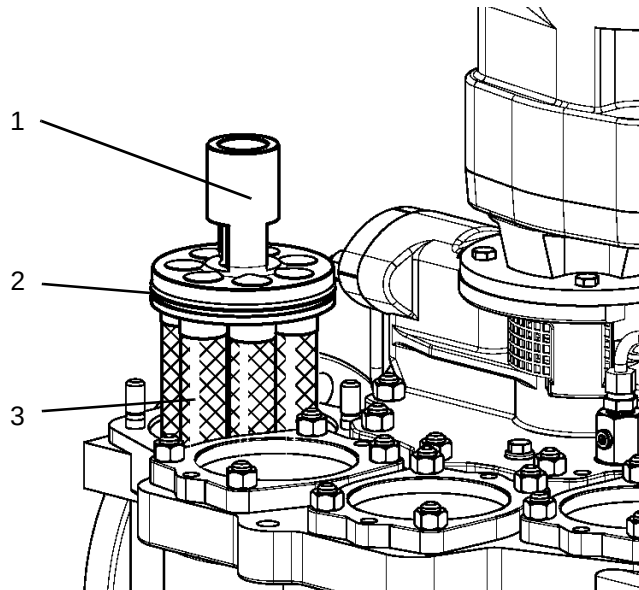


Fig. 7-7 Construction of the filter insert with filter candles

- 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, version 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

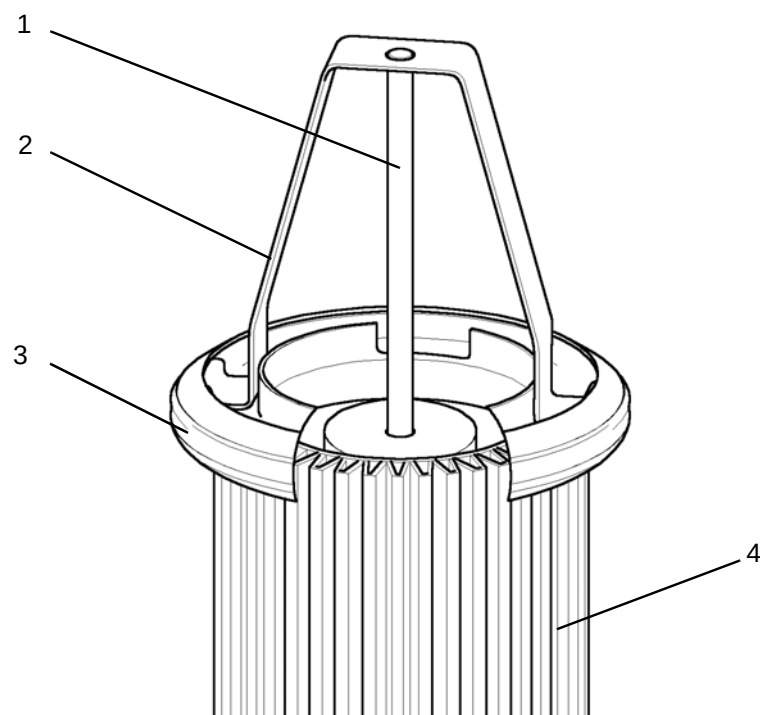


Fig. 7-8 Construction of star-pleated filter element

- 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 as well as 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 done by qualified specialist staff or persons who have received appropriate instruction.
 - When performing any work on the filter, always wear the appropriate safety clothing.
 - The use of 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 way that the filter or the components do not become get 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 if 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 if necessary.
-



8.2

Cleaning agent



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 soiling.

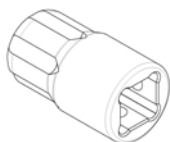
- BOLL & KIRCH Filterbau GmbH recommends BOLL CLEAN 2000 cleaning agent. For more detailed information, see the appendix of these operating instructions.
- With liquid cleaning agents, ensure that after cleaning, the filter components are only reinstalled when completely dry.

8.3

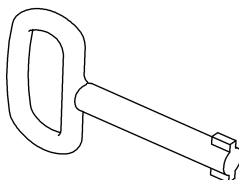
Special tool

The manufacturer provides the following special tool (example illustration) for the filter:

Candle box nut for removing the filter elements



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,
 - 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

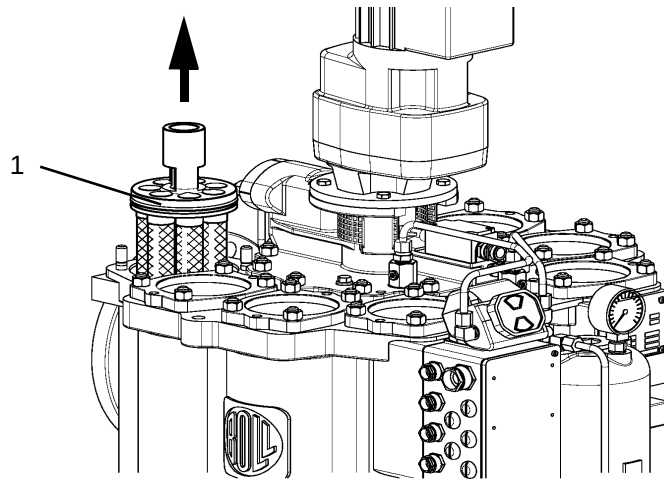


Fig. 8-1 Removing the filter insert with filter candles

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.



- ▶ Unscrew the filter elements from the sieve plate using the candle box nut 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:
35 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 threaded connector 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 threaded connector 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

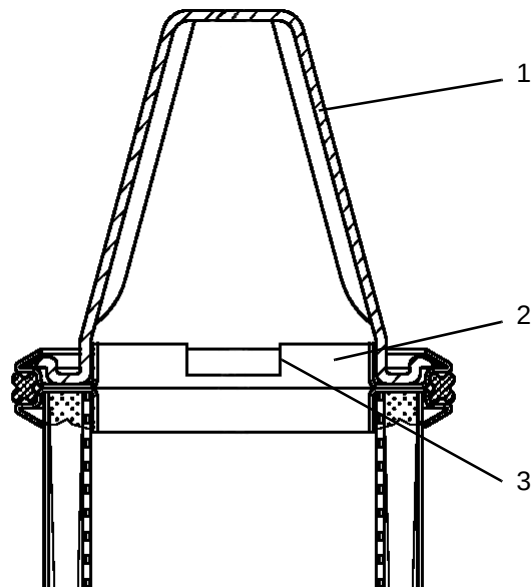


Fig. 8-2 Removing and attaching the filter element clamp

- 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 material 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.

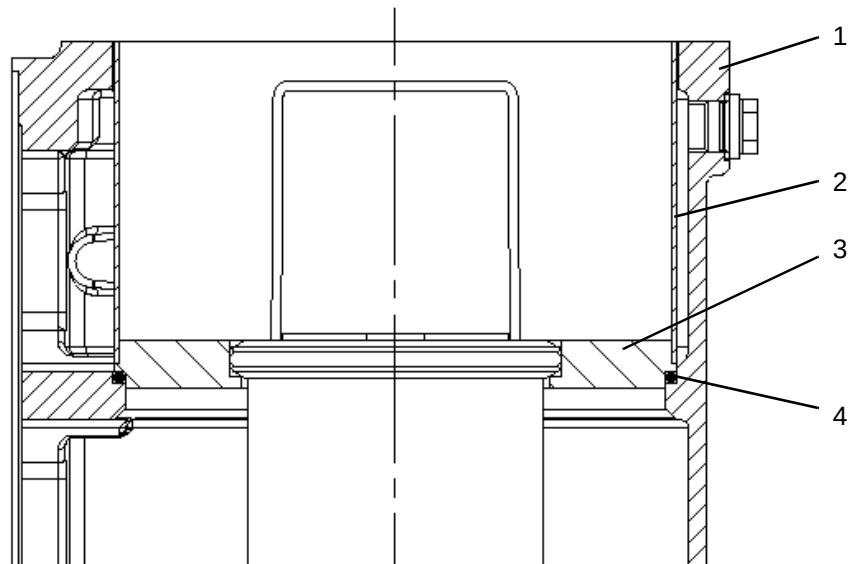


Fig. 8-3 Installing the filter element

- | | | | |
|---|-------------------------|---|-------------|
| 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 threaded connector 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).

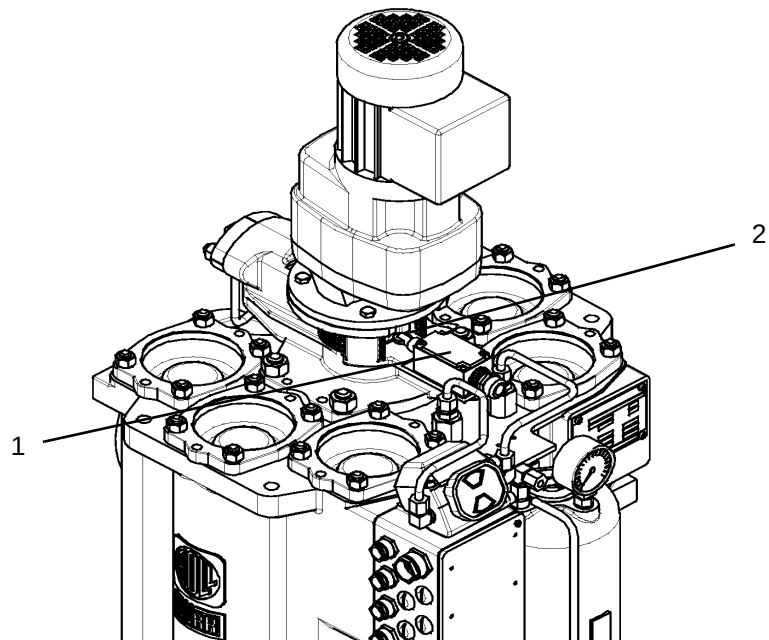


Fig. 8-4 Position of cam disc / limit switch

- 1 Limit switch
- 2 Cam disc

- Cams and limit switches must be aligned exactly opposite each other.

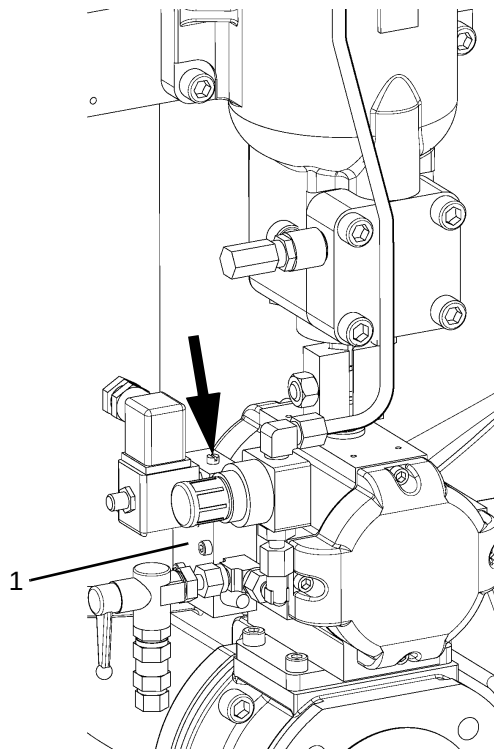


Fig. 8-5 Manual triggering of backflushing

1 Solenoid valve

- ▶ Trigger backflushing directly by manually actuating (arrow) the solenoid valve (using a screwdriver). Manual operation 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 Remediating 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	Clean/replace 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	Clean/replace 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	100
Fluid to be filtered	Hydraulic oil
Fine filter units	6 µm
Mesh number	ST15BL3
Permitted operating pressure	3.00 bar
permitted max. operating temperature	50.00 °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	0.040 Nm ³
Flushing quantity per chamber and flushing process	12.00 Liter
Flushing time	8 s
sound emission (DIN 45 635)	< 70 dB(A)

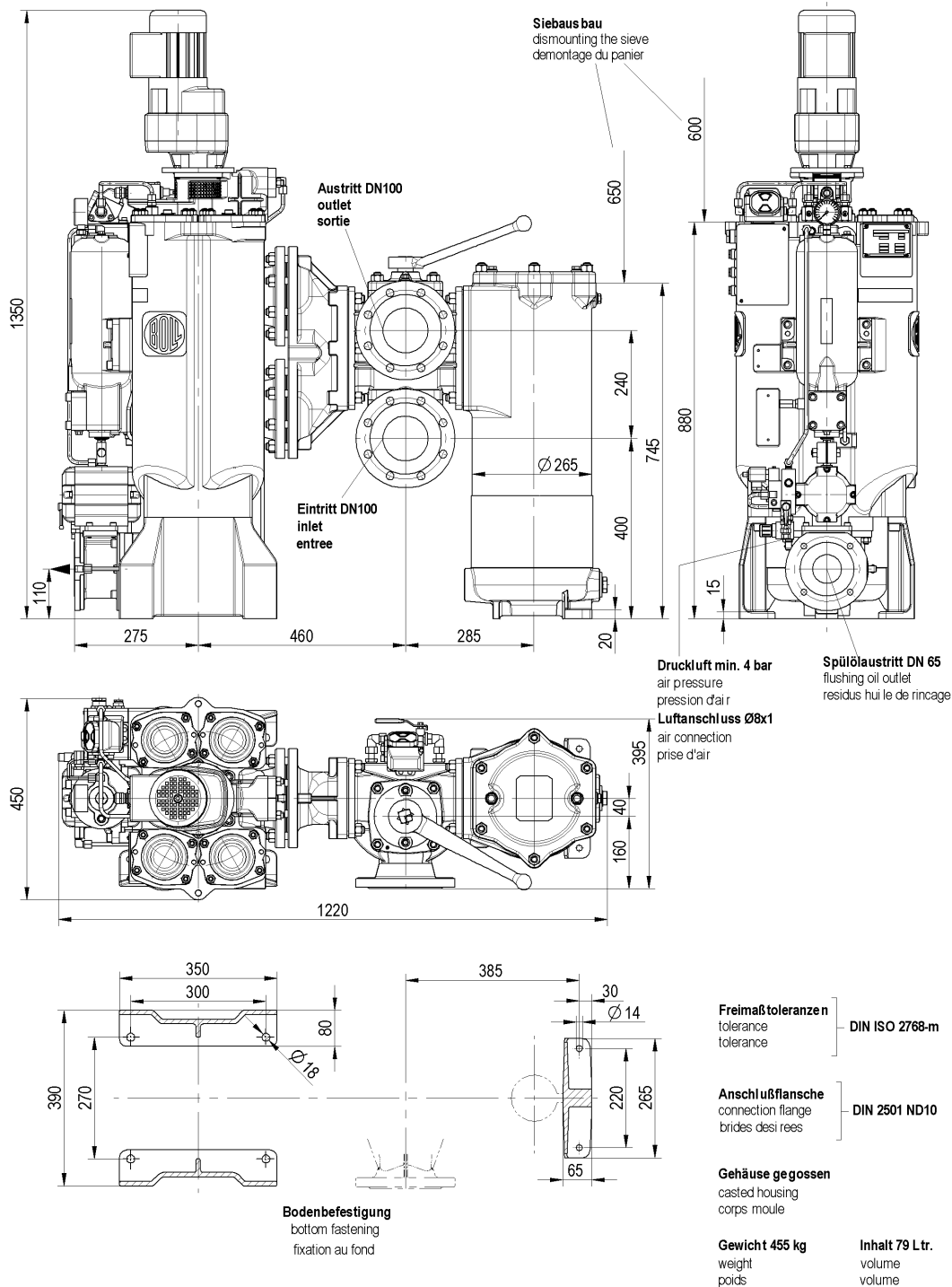
Filter element

Element type of filter	Mesh star candle
Number of filter elements	12
Element type of bypass filter	Star pleated sieve element



9.1.2 Technical data sheet

Z113947
TYP 6.64.1 DN100
10.12.07



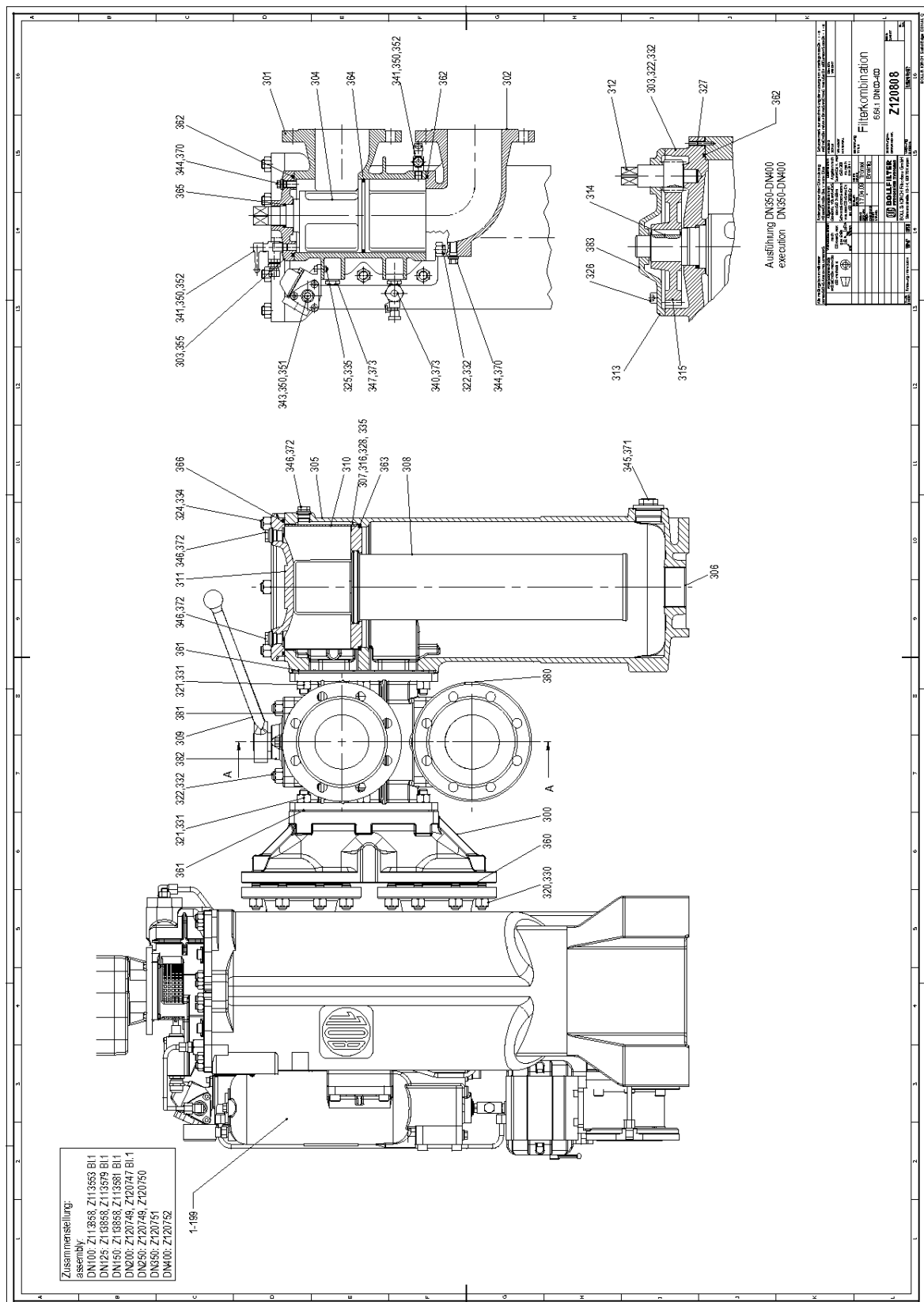
subject to alterations
filter combination

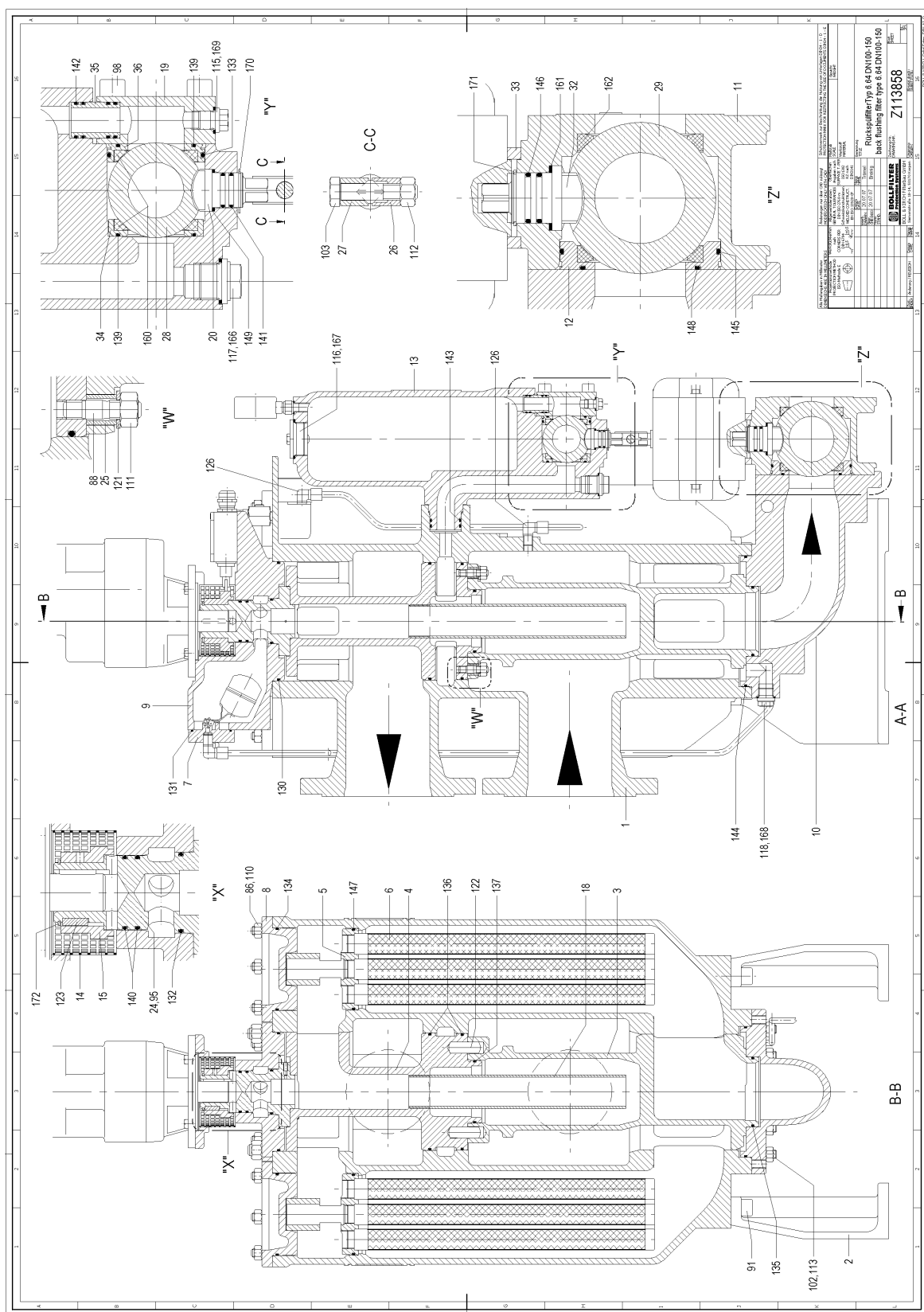
Änderungen vorbehalten!
Filterkombination
TYP 6.64.1 DN100

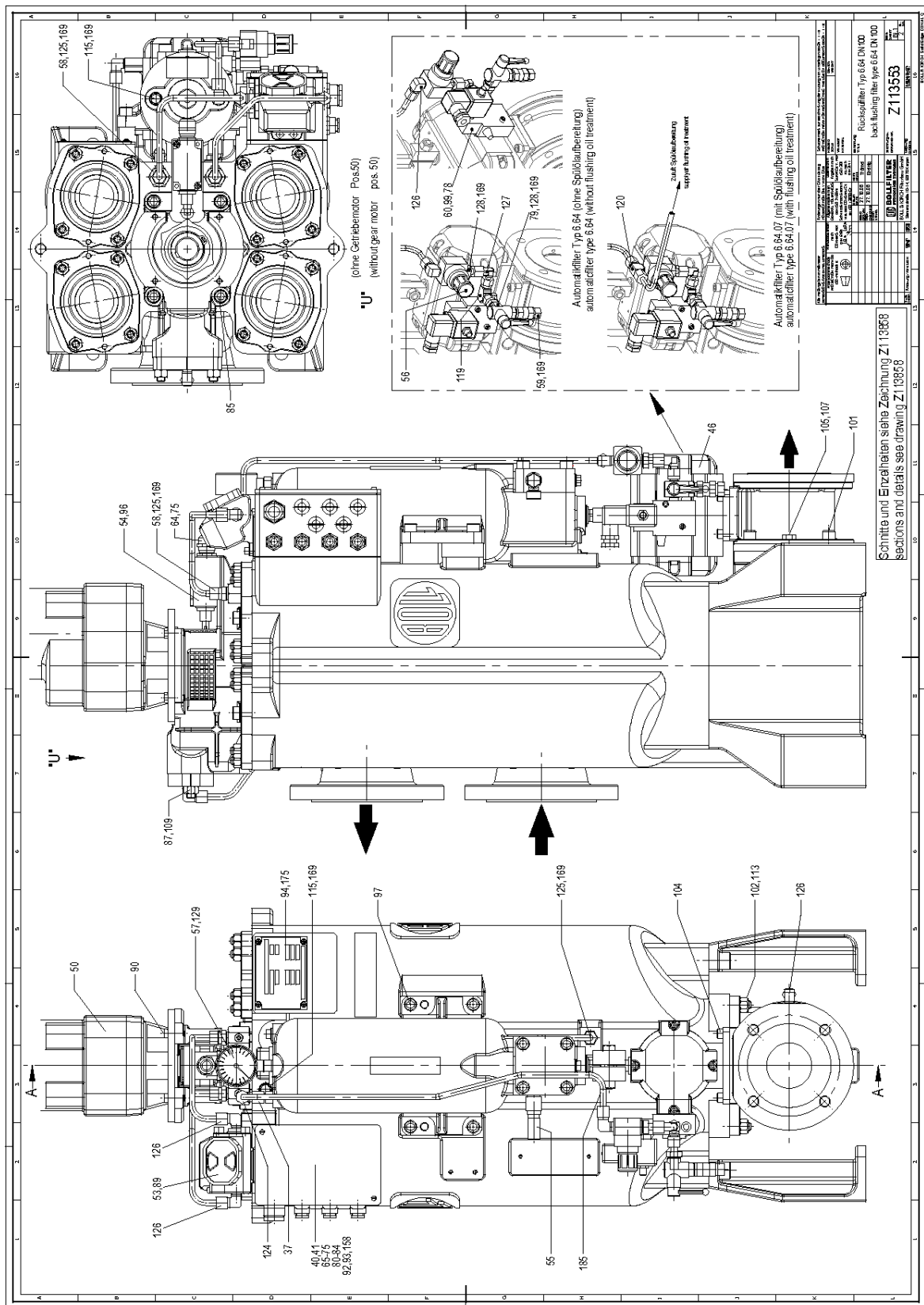
modifications réservées
combinaison de filtres

9.1.3 Spare parts

9.1.3.1 Spare parts drawing









9.1.3.2 Spare parts list

Document	Description	Date
290807	automatic filter	01.02.16
	Dimension drawing: Z113947	
	Assembly: Z120808,Z113858,Z113553 BL.1	

Item	ID no.	Description	Quantity	Unit
00001	6530094	housing	1	pcs.
00002	6820001	bottom fastening	2	pcs.
00003	5420030	Cock	1	pcs.
00004	5420031	Cock	1	pcs.
00005	5030028	sieve plate for 3 candles	4	pcs.
00006	1341446	star-pleated element	12	pcs.
00007	0600553	air escape aggregate	1	pcs.
00008	5230014	housing cover	4	pcs.
00009	5230012	cover change over housing	1	pcs.
00010	6830024	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	5130009	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	5630061	coupling piece	2	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.
00040	5950197	connection box	1	pcs.
00041	8350029	cover for connection box	1	pcs.
00046	4500058	Double Piston Part Turn Actuator	1	pcs.
00050	4500099	gear motor	1	pcs.
00053	0550001	differential pressure indicator	1	pcs.



Item	ID no.	Description	Quantity	Unit
00053	2560009	three way ball valve	2	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 gauge G1/4	2	pcs.
00059	2608775	non return valve	1	pcs.
00060	4105912	connector plug	1	pcs.
00060	2656655	solenoid valve	1	pcs.
00060	4203914	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	2010326	hexagon socket head cap screw	4	pcs.
00086	2000004	stud bolt	16	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.
00102	2000004	stud bolt	6	pcs.



Item	ID no.	Description	Quantity	Unit
00103	2000159	hexagon socket head cap 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.
00109	2100006	hexagon nut	2	pcs.
00110	2100006	hexagon nut	16	pcs.
00111	2115515	self-locking hexagon-head nut	2	pcs.
00112	2100006	hexagon nut	1	pcs.
00113	2100006	hexagon nut	6	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	3	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	3040317	o-ring	1	pcs.
00131	3130009	o-ring	1	pcs.
00132	3030164	o-ring	1	pcs.
00133	3046821	o-ring	1	pcs.
00134	3041058	o-ring	4	pcs.
00135	3042236	o-ring	1	pcs.
00136	3040083	o-ring	2	pcs.
00137	3040412	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	3040108	o-ring	1	pcs.
00145	3040105	o-ring	1	pcs.
00146	3040099	o-ring	2	pcs.
00147	3040661	o-ring	4	pcs.
00148	3040103	o-ring	1	pcs.



Item	ID no.	Description	Quantity	Unit
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	10	pcs.
00170	2205949	locking ring	1	pcs.
00171	2203318	locking ring	1	pcs.
00172	2203398	locking ring	1	pcs.
00175	9401690	nameplate	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 connection"	1	pcs.
00176	9404642	label: "Delta P differential pressure indicator"	1	pcs.
00176	9808492	label	1	pcs.
00180	4302200	Control Box	1	pcs.
00185	0600232	Pipe	1	pcs.
00197	6700750	candle box nut	1	pcs.
00197	2380014	crank handle	1	pcs.
00300	5130021	adapter	1	pcs.
00301	6230654	cock casing	1	pcs.
00302	5432364	angle inlet	1	pcs.
00303	6434388	cock casing cover	1	pcs.
00304	6320023	cock plug	1	pcs.
00305	6130636	housing	1	pcs.
00306	5300478	threaded plug	1	pcs.
00307	5500018	sieve plate	1	pcs.
00308	1948650	star-pleated element	1	pcs.
00309	8650481	key	1	pcs.
00310	7110495	tube	1	pcs.
00311	6430053	cover	1	pcs.
00316	5700129	covering plate	1	pcs.
00320	2009090	stud bolt	16	pcs.
00321	2000007	stud bolt	12	pcs.
00322	2000007	stud bolt	8	pcs.
00324	2009088	stud bolt	6	pcs.



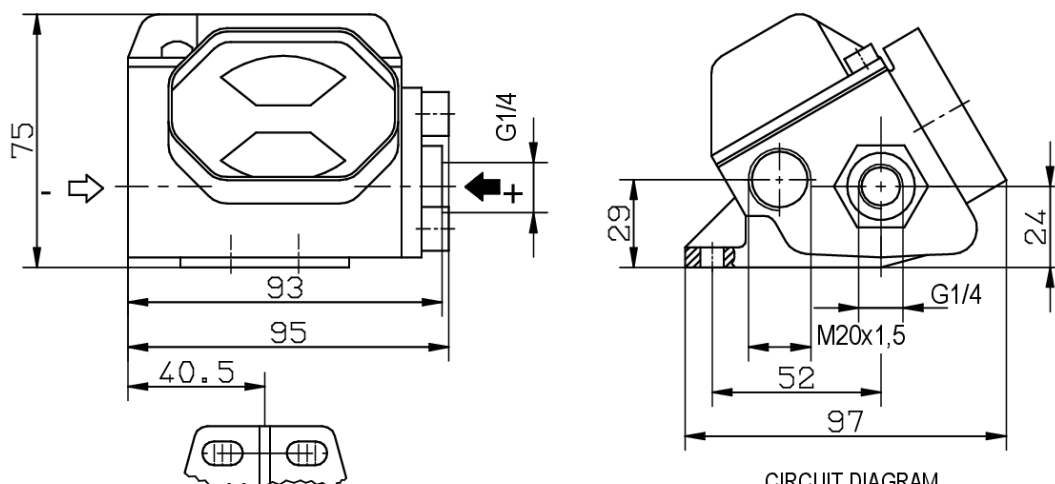
Item	ID no.	Description	Quantity	Unit
00325	2000123	hexagon socket head cap screw	2	pcs.
00328	2000130	hexagon socket head cap screw	4	pcs.
00330	2100007	hexagon nut	16	pcs.
00331	2100007	hexagon nut	12	pcs.
00332	2100007	hexagon nut	8	pcs.
00334	2100007	hexagon nut	6	pcs.
00335	2100003	hexagon nut	2	pcs.
00340	0200439	pressure compensation	1	pcs.
00341	2560356	angle ball valve	2	pcs.
00343	0550001	differential pressure indicator	1	pcs.
00343	2560009	three way ball valve	2	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	3380070	flat 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	3030520	o-ring	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.
1-199	297037	Back Flushing Filter	1	pcs.



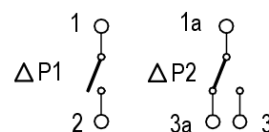
9.2 Differential pressure indicator

9.2.1 Technical data sheet

Z45550
TYP4.36.2
09.01.06



CIRCUIT DIAGRAM



SPECIFICATION:
PROTECTION CLASS: IP 65

ELECTR. DATA: SWITCHING VOLTAGE $V \approx \text{MAX.} =$
FREQUENCY HZ $\text{MAX.} =$
SWITCHING CURRENT A $\text{MAX.} =$
MAKING AND/OR BREAKING CAPACITY
WVA $\text{MAX.} =$

250	220
0-60	0-60
1	0.8
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 ΔP 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.

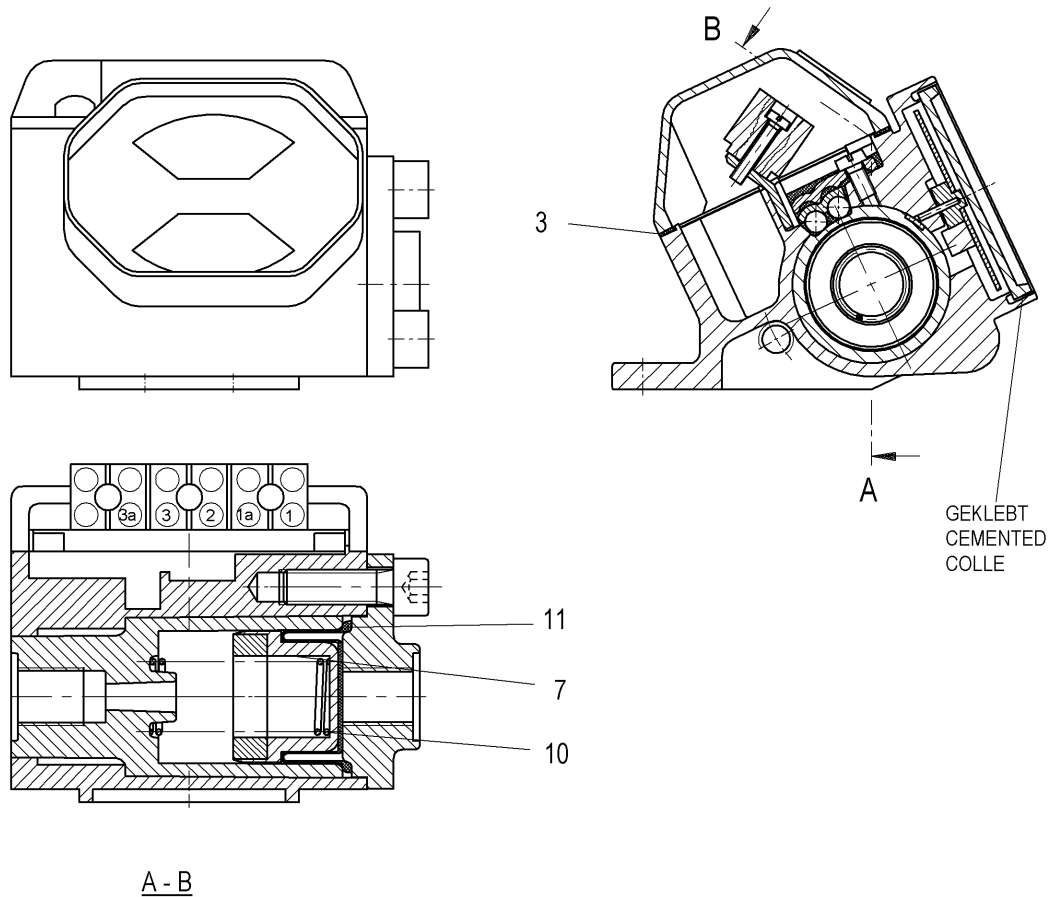
THE RED SEGMENT OF THE INDICATOR DISC IS VISIBLE OVER A PRESSURE RANGE EQUAL TO APPROX. 50-100% ΔP . THE FIRST REED CONTACT IS ACTUATED AT 75% ΔP_1 , AND THE SECOND AT 100% ΔP_2 .

DIFFERENTIAL PRESSURE CONTACT INDICATOR TYPE 4.36.2



9.2.2 Spare parts list

Z21434
TYP4.36.2+4.46.2
11.02.94



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.

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1	Verkaufsbüro	Agency
2	Lager	Stockist
3	Service	Service

Februar 2016



9.7 Declaration of conformity

BOLLFILTER Protection Systems	QUALITY – MANAGEMENT FORMBLATT / FORM SHEET			
	EG-KONFORMITÄTSERKLÄRUNG DECLARATION OF CONFORMITY	Document FB-8-93	Part 8	Revision 09

Ausgestellt in Übereinstimmung mit der Maschinenrichtlinie 2006/42 /EG
 Issued in accordance with the Machinery Directive 2006/42/EC

Hersteller / Manufacturer: **Boll & Kirch Filterbau GmbH**
 Siemensstrasse 10-14
 D- 50170 Kerpen

Wir erklären hiermit, dass das nachstehend beschriebene Produkt den folgenden Normen und Richtlinien entspricht.
 We herewith declare, that the undernoted items have been manufactured in compliance with the following standards and rules.

Bezeichnung: / designation:	Automatikfilter / Automatikfilter
Typ: / type:	6.03, 6.04, 6.10, 6.12, 6.17, 6.18*, 6.19, 6.21*, 6.22*, 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*

Titel und/oder Nr. sowie Ausgabedatum der angewandten Norm
 title and/or No. and date of issue of the applied standard

DIN EN ISO 12100: 2011-03

Angewandte Gemeinschaftsrichtlinien der EU / Applied rules of European Union

Bei elektrischen Anbauteilen entsprechen diese folgenden Richtlinien /
 Electrical assembly parts are in accordance to following standards

- ☒ **Niederspannungs-Richtlinie 2006/95/EG / Low Voltage Directive 2006/95/EC**
- ☒ **Elektromagnetische Verträglichkeit 2004/108/EG/ EMC Directive 2004/108/EC**

Bescheinigung erstellt durch / Certificate written by :	Qualitätsstelle
Zusammengestellt durch : file compiled by :	Boll & Kirch Filterbau GmbH Siemensstrasse 10-14 D- 50170 Kerpen 04.03.2015
Datum / Hersteller-Unterschrift: Date / Manufacturer's signature	 M. Kämper Produktionsleiter / Production Manager
Angaben zum Unterzeichner: Details of the undersigned	

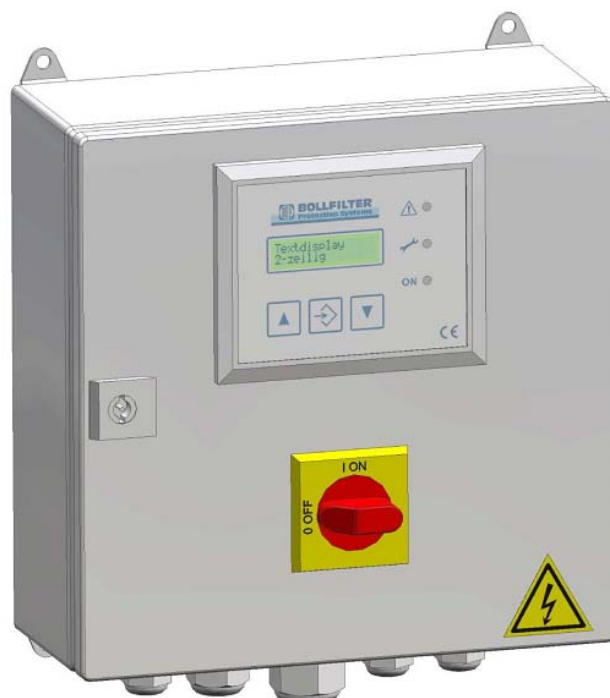
maschinelles Dokument / electronic document





Operating and installation instructions

Electronic controller Type: 2200



BOLL & KIRCH
Filterbau GmbH

Siemensstraße 10 - 14
50170 Kerpen
Germany
www.bollfilter.de

Date	Version	Language	Order no.	Item no.
05.2015	007	en	-	-





Table of Contents

1	Basic safety instructions for the electronic controller	5
2	Technical data of controller and control cabinet components . . .	7
2.1	Power components	7
2.1.1	Supply	7
2.1.2	Motor control	7
2.1.3	Power supply	7
2.1.4	Fuse protection	7
2.2	Control circuit board inputs / outputs	8
2.2.1	Optocoupler inputs (E1 - E5), terminals 31 - 40	8
2.2.2	Live relay outputs.	8
2.2.3	Potential-free relay outputs	8
2.3	Circuit diagrams.	8
3	Operation	9
3.1	Device functions and control sequence	9
3.1.1	Master switch operation feedback contact.	10
3.1.2	Control voltage monitoring.	10
3.1.3	Motor fault	10
3.1.4	Differential pressure too high, flushing oil treatment cartridge alarm	10
3.1.5	DP - too high, backflushing filter (100 %)	10
3.1.6	Key C (number of flushes).	10
3.1.7	Multiple flushing.	10
3.1.8	DP alarm (flushing frequency monitoring)	11
3.2	Display for "Operation" mode.	11
3.3	Text messages	11
3.3.1	Text display after switching on.	11
3.3.2	Text display in "Operation" mode.	12
3.3.3	Alarm messages	13
3.4	Setting and operation.	13
3.4.1	Setting level - Viewing and selecting parameters	13
3.4.2	Setting level - Changing and saving parameters.	13
3.4.3	Return to operation level	13
3.5	List and description of parameters.	14
3.5.1	P0 Filter type	14
3.5.2	P1 Multiple flushing	14
3.5.3	P2 Time-controlled backflushing	14
3.5.4	P3 Time-controlled backflushing	14
3.5.5	P4 Back-flushing time	15
3.5.6	P5 Filling time	15
3.5.7	P6 After-blowing time.	15
3.5.8	P7 Cartridge alarm delay time	16
3.5.9	P8 DP alarm (flushing frequency monitoring)	16
3.5.10	P9 Motor fault	16
3.5.11	P10 Back flushing time	17
3.5.12	P11 Language	17
3.5.13	P12 Testcode.	18
3.5.14	P14 Pressure compensation time	18
4	Description and function of controller	19
4.1	Controller type 6.18 / 6.19 / 6.44	19



4.2	Controllers of types 6.21/6.22/6.23 / 6.24	20
4.3	Controllers of type 6.60	21
4.4	Controllers of type 6.61	23
4.5	Controllers of type 6.62	25
4.6	Controllers of type 6.64	26
4.7	Controllers of type 6.72	28
5	Appendix.	31
5.1	Setting values	31
5.2	Circuit diagram	32
5.3	Worldwide sales and service network, subsidiaries and representatives	41



1

Basic safety instructions for the electronic controller



DANGER!

Risk of accidents from improper installation

Installing the controller or the connected equipment improperly may cause the device to fail and lead to serious or even fatal personal injuries. You must therefore follow the general safety regulations for equipment in industrial electrical systems and pay particular attention to the following points:

- The controller must be installed by qualified specialist staff only (as defined by the guidelines IEC 364, DIN VDE 0105 for electrical equipment).
 - The laws, guidelines, directives and regulations for the installation of electrical equipment which are valid at the location for installation must be adhered to.
 - Settings on devices with protection class IP00 without covers must only be made by authorised specialist staff when the devices are switched off. The local regulations for safety and the prevention of accidents must be observed.
 - The controller must only be operated within the permitted area of application.
-



2 Technical data of controller and control cabinet components

2.1 Power components

2.1.1 Supply

Supply L1-L2-L3 direct to 4-pole master switch – Q1 (T1-T2-T3)

2.1.2 Motor control

Motor connection U-V-W direct to motor contactor – K1 (2-4-6)

2.1.3 Power supply

Primary voltages	0 - 220 V, 380 V, 400 V, 440 V, 500 V, 550 V
------------------	--

Secondary voltages

0 V AC - 230 V AC

0 V AC - 115 V AC

0 V DC - 24 V DC

0 V AC - 20 V AC

Valve voltage 230 V AC

Valve voltage 115 V AC

Valve voltage 24 V DC

Control circuit board supply voltage

2.1.4 Fuse protection

Fuses in the control cabinet

F1 to F3

each 1 A

Fuses on the control circuit board

Fuse F1

0.8 A T (slow-blow)

Fuse F2

2.0 A T (slow-blow)



2.2 Control circuit board inputs / outputs

2.2.1 Optocoupler inputs (E1 - E5), terminals 31 - 40

2.2.2 Live relay outputs

Outputs VE1 - VN1 to VE3 - VN3

Terminals 8 - 13



NOTE

The connections and designations depend on the type of filter and can be found in the respective circuit diagrams.

2.2.3 Potential-free relay outputs

Outputs A1 - A15

Messages 1 - 5
(change-over contact)

Terminals 16 - 30



NOTE

The connections and designations depend on the type of filter and can be found in the respective circuit diagrams.

2.3 Circuit diagrams

The circuit diagrams for the controller are contained in the appendix of these operating and installation instructions.

3 Operation

3.1 Device functions and control sequence

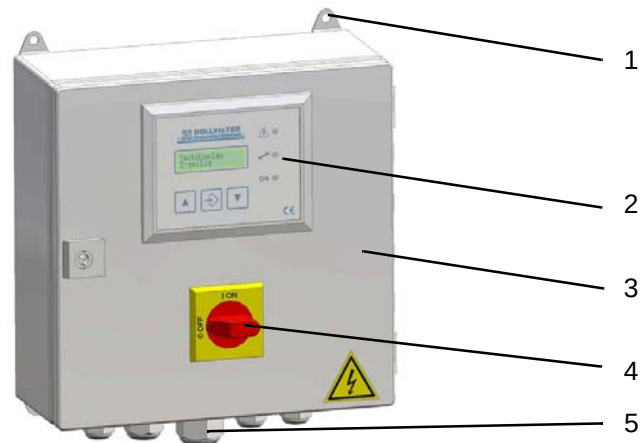


Fig. 3-1 Electronic controller type 2200

- 1 Fastening
- 2 Display and operating elements
- 3 Housing
- 4 Master switch
- 5 Connection

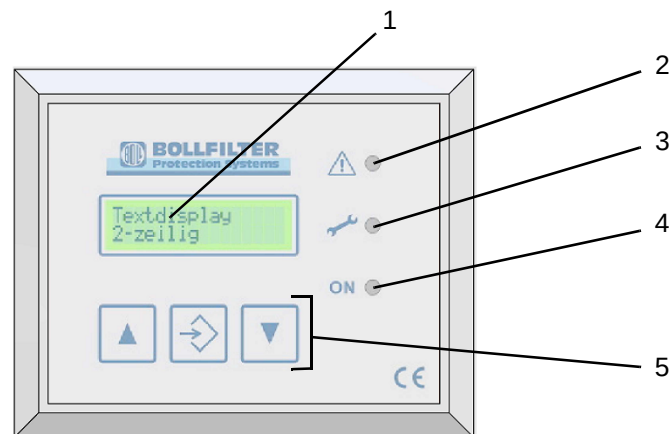


Fig. 3-2 Display and operating elements

- 1 Display screen for text display, 2 lines of 16 characters
- 2 "Alarm" LED (red)
- 3 "Service" LED (yellow)
- 4 "Operation" LED (green)
- 5 Keypad



NOTE

The three keys on the keypad are assigned to the key references displayed above them in the second line of the display as follows:

Key **C**: When pressed, shows the number of flushes

Key **F**: When pressed, triggers manual flushing

Key **Q**: When pressed, acknowledges the alarm messages

3.1.1 Master switch operation feedback contact

When the master switch is in the "On" position, a contact is made.

3.1.2 Control voltage monitoring

As soon as the master switch is actuated, the power supply is activated and the controller is working properly, the green "Operation" LED lights up and the "Control voltage monitoring" relay is activated. In the event of operating voltage failure or a fuse fault on the control circuit board, no LED lights up and the "Control voltage monitoring" relay is no longer activated.

3.1.3 Motor fault

If the measured motor current exceeds the set setpoint value for parameter P9, a message appears in the display and a potential-free signal is sent to the relay outputs. The motor and the backflushing function switch off immediately. Once the fault has been remedied, the user has to acknowledge the alarm message by pressing the Q key.

3.1.4 Differential pressure too high, flushing oil treatment cartridge alarm

The signal transmitter is a pressure switch contact which is connected to the "Differential pressure indicator DP too high flushing oil treatment" optocoupler input. If the message is active for a longer period than the time set in parameter P7, an alarm message appears in the display. Once the fault has been remedied, the user has to acknowledge the alarm message by pressing the Q key.

3.1.5 DP - too high, backflushing filter (100 %)

The signal transmitter is a pressure switch contact which is connected to the "Differential pressure indicator DP too high, backflushing filter" optocoupler input. If the message is active for longer than 2 seconds, an alarm message appears in the display screen and the red "Alarm" LED lights up. Once the fault has been remedied, the user has to acknowledge the alarm message by pressing the Q key.

3.1.6 Key C (number of flushes)

When key C (number of flushes) is pressed, the number of flushing cycles which have been performed is shown on the display screen for 3 seconds.

3.1.7 Multiple flushing

The number of parameterised chambers is worked off with each flushing command.



3.1.8 DP alarm (flushing frequency monitoring)

If "DP flushing" has been activated before the "Time-controlled backflushing" time elapses, the "DP alarm" message appears on the display screen and the yellow "Service" LED lights up.

3.2 Display for "Operation" mode

The green "Operation" LED lights up once the power supply has been switched on and the controller is at operation level ("Operation" mode).

3.3 Text messages

3.3.1 Text display after switching on

Boll & Kirch	Company name
xxxxxxxxxx	Programme number

After a short delay, the parameterised controller type is displayed in the second line of the display.

6.18/6.19/6.44	Controller type 0
6.21/6.22/6.23/6.24	Controller type 1
6.60	Controller type 2
6.60 Alarm DP	Controller type 3
6.60.07/6.72.07	Controller type 4
6.60.07/6.72.07 AL. DP	Controller type 5
6.61	Controller type 6
6.61 Alarm DP	Controller type 7
6.61.07	Controller type 8
6.61.07 AL. DP	Controller type 9
6.62	Controller type 10
6.62 Alarm DP	Controller type 11
6.64	Controller type 12
6.64 Alarm DP	Controller type 13
6.64.07	Controller type 14
6.64.07 AL. DP	Controller type 15
6.72	Controller type 16
6.72 Alarm DP	Controller type 17



3.3.2 Text display in "Operation" mode

forced fl. 00:01 Remaining time till forced flushing is triggered 00 h 01 min

C - F - Q Reference to keys

When flushing has been triggered, the following messages appear in the first line (depending on the source):

Mains flushing When flushing is triggered by "Power supply on"

Manual flushing When flushing is triggered by the F key

forced flushing When flushing is triggered by time-controlled backflushing

DP flushing When flushing is triggered by backflushing filter differential pressure

When flushing has been triggered, the following messages may in the second line (depending on the source):

Flush. time 3S Remaining flushing time

After bl. t. 3S Remaining after-blowing time



NOTE

3S indicates that the remaining flushing/after-blowing time is 3 seconds.

If the C key is pressed, the following message appears on the display screen:

No.of flushes

xxxxxx cycles Number of flushing cycles

The number of flushing cycles is saved and backed up in the event of a mains failure.



3.3.3 Alarm messages



NOTE

- The red "Alarm" LED lights up every time an alarm message is issued.
- All alarm messages are saved and backed up in the event of a mains failure.
- The alarm message and the operation messages are shown alternately in the second line of the display, switching every 2 seconds.
- When the Q key is pressed, all alarm messages are deleted, but only if the respective cause of the alarm has been remedied. If the cause of the alarm is not remedied, the alarm message appears again.

Alarm messages in the display:

Motor fault	In the event of a "Motor fault" alarm
DP too high	In the event of "Differential pressure too high Filter 100 %"
Cartridge alarm	In the event of "Differential pressure too high flushing oil conditioning 100 %"

If the flushing frequency monitoring is switched on:

DP alarm	DP alarm backflushing triggered by differential pressure 75 %
-----------------	---

3.4 Setting and operation

3.4.1 Setting level - Viewing and selecting parameters

In order to access the setting level "Selecting and viewing parameters" press keys $\triangle$ and ∇ together until the green "Operation" LED is extinguished (approximately 3 seconds). The first display line shows the parameter and the second line shows the parameter value. All parameters can now be displayed by repeatedly pressing the key $\triangle$ or ∇ .

3.4.2 Setting level - Changing and saving parameters

In order to access the setting level "Changing and saving parameters", press the middle key until the green "Operation" LED flashes (approximately 3 seconds). The parameter can now be changed by repeatedly pressing the key $\triangle$ or ∇ . In order to save the value and return to the setting level "Selecting and viewing parameters", press the middle key until the green "Operation" LED is extinguished (approximately 3 seconds).

3.4.3 Return to operation level

In order to access the operation level, press keys $\triangle$ and ∇ together until the green "Operation" LED lights up (approximately 3 seconds).



3.5 List and description of parameters

3.5.1 P0 Filter type

Adjustable in steps of one	Range 0 - 17
Factory setting	Initial value 0
Text display, line 1	P0 filter type
Text display, line 2	6.18/6.19/6.44

3.5.2 P1 Multiple flushing



NOTE

This parameter is **only** visible with filter type P0 = 6, 7, 8, 9, 10, 11, 12, 13, 14, 15.

Adjustable in steps of one	Range 1 - 99 x
Factory setting	Initial value 1
Text display, line 1	P1 multiple fl.
Text display, line 2	XXX chambers

3.5.3 P2 Time-controlled backflushing

Adjustable in steps of one hour	Range 0 - 59 h
Factory setting	Initial setting 2 h
Text display, line 1	P2 forced flush.
Text display, line 2	XXX hours

3.5.4 P3 Time-controlled backflushing

Adjustable in steps of one minute	Range 0 - 59 min
Factory setting	Initial value 0 min
Text display, line 1	P3 forced flush.
Text display, line 2	XXX minutes



3.5.5 P4 Back-flushing time



NOTE

This parameter is **not** visible with filter type P0 = 1.

Adjustable in steps of one second	Range 5 - 100 s
Factory setting	Initial value 20 s

Text display, line 1	P4 flushing time
Text display, line 2	XXX seconds

3.5.6 P5 Filling time



NOTE

This parameter is **not** visible with filter type P0 = 0 and P0 = 1.

Adjustable in steps of 10 seconds	Range 10 - 600 s
Factory setting	Initial value 180 s

Text display, line 1	P5 Filling time
Text display, line 2	XXX seconds

3.5.7 P6 After-blowing time



NOTE

This parameter is **only** visible with filter type P0 = 4, 5, 8, 9, 14, 15.

Adjustable in steps of one second	Range 5 - 100 s
Factory setting	Initial value 30 s

Text display, line 1	P6 After blow. t.
Text display, line 2	XXX seconds



3.5.8 P7 Cartridge alarm delay time



NOTE

This parameter is **only** visible with filter type P0 = 4, 5, 8, 9, 14, 15.

Adjustable in steps of 10 seconds	Range 10 - 600 s
Factory setting	Initial value 30 s

Text display, line 1	P7 Cartridge al.
Text display, line 2	XXX seconds

3.5.9 P8 DP alarm (flushing frequency monitoring)



NOTE

This parameter is **only** visible with filter type P0 = 3, 5, 7, 9, 11, 13, 15, 17.

Setting	Off / On
Factory setting	Initial setting "On"

Text display, line 1	P8 DP alarm
Text display, line 2	Off
or	
Text display, line 2	On

3.5.10 P9 Motor fault



NOTE

This parameter is **only** visible with filter type P0 = 0, 6, 7, 8, 9, 12, 13, 14, 15.

Adjustable in steps of 0.01 A	Range 0.10 to 0.99 A
Factory setting	Initial value 0.4 A

Text display, line 1	P9 Motor fault
Text display, line 2	0000 mA



3.5.11 P10 Back flushing time



NOTE

This parameter is **only** visible with filter type P0 = 1, type 6.21/6.22/6.23/6.24.
Setting: ND 32 = 1 / ND 40 = 2 / ND 50 = 3 (ND = nominal diameter)
A certain control time is selected from a table according to the nominal diameter.
The parameter is not required if the setting is P0 ... 1.



NOTE

For filter type 6.21/6.22, the backflushing time must generally be set to ND 50=3.

Adjustable in steps of one

Range 0 to 2

Factory setting

Initial setting ND 32 = 1 s

Text display, line 1

P10 flush.time

Text display, line 2

ND=XX =XX sec

3.5.12 P11 Language

You can select from German, English, French and Spanish.

Setting

D German

ES Spanish

F French

GB English

Factory setting

Initial setting D German

Text display, line 1

P11 Language

Text display, line 2

GB English



3.5.13

P12 Testcode



NOTE

This parameter is **only** visible with filter type P0 = 0.



NOTE

The test code switches the controller to a test mode which is provided **for authorised persons only**.

Adjustable in steps of one

Range 0 to 250

Factory setting

Initial value 0

Text display, line 1

P12 Testcode

Text display, line 2

XXX

3.5.14

P14 Pressure compensation time



NOTE

This parameter is **only** visible with filter type P0 = 12, 13, 14, 15.

Adjustable in steps of one second

Range 0 to 99 s

Factory setting

Initial value 10 s

Text display, line 1

P14 PET

Text display, line 2

XXX seconds



4 Description and function of controller

4.1 Controller type 6.18 / 6.19 / 6.44

Inputs

Pressure switch "DP reached, backflushing filter" → 75 %

Pressure switch "DP too high, backflushing filter" → 100 %

Outputs

Motor

Flushing valve

Potential-free contacts

- | | |
|---|----------------------|
| 1) "Control voltage monitoring" alarm | Output A1, A2, A3 |
| 2) Collective fault, comprising:
- "Maximum differential pressure reached" alarm
and
- "Motor fault" alarm | Output A4, A5, A6 |
| 3) "Motor fault" alarm | Output A7, A8, A9 |
| 4) "Flushing active" message | Output A10, A11, A12 |

Functional description 6.18, 6.19 and 6.44

See the operating instructions for the filter's function.

Flushing is triggered by:

- 1) Key F
- 2) The forced flushing time elapsing
- 3) Pressure switch "DP reached, backflushing filter"

Special attributes

- All alarms are displayed and signalled and saved via potential-free contacts.
- If the controller is in parameterisation mode, flushing cannot be triggered manually.
- If the "Controller type" parameter is changed, the functions are re-started.



4.2 Controllers of types 6.21/6.22/6.23 / 6.24

Inputs 6.21/6.22/6.23 and 6.24

Pressure switch "DP reached, backflushing filter" → 75 %

Pressure switch "DP too high, backflushing filter" → 100 %

Outputs 6.21/6.22/6.23 and 6.24

Flushing valve

Potential-free contacts and messages 6.21/6.22/6.23 and 6.24

- | | |
|---------------------------------------|-------------------|
| 1) "Control voltage monitoring" alarm | Output A1, A2, A3 |
| 2) "Maximum DP reached" alarm | Output A4, A5, A6 |

Functional description 6.21/6.22/6.23 and 6.24

See the operating instructions for the filter's function.

Flushing is triggered by:

- 1) Key F
- 2) The forced flushing time elapsing
- 3) Pressure switch "DP reached, backflushing filter"

Special attributes

- All alarms are displayed and signalled and saved via potential-free contacts.
- If the controller is in parameterisation mode, flushing cannot be triggered manually.
- If the "Controller type" parameter is changed, the functions are re-started.



4.3 Controllers of type 6.60

Inputs 6.60 and 6.60 Alarm DP (flushing frequency monitoring)

"Position reached" limit switch

Pressure switch "DP reached, backflushing filter" → 75 %

Pressure switch "DP too high, backflushing filter" → 100 %

Additional inputs for 6.60.07 (flushing oil treatment)

Pressure switch "DP too high, flushing oil treatment" → 100 %

Outputs 6.60 and 6.60 Alarm DP

Flushing valve

Chamber valve

Additional outputs for 6.60.07 and 6.60.07 Alarm DP

After-blowing valve

Potential-free contacts and messages 6.60

- | | |
|---|-------------------|
| 1) "Control voltage monitoring" alarm | Output A1, A2, A3 |
| 2) Group fault: | Output A4, A5, A6 |
| "Maximum differential pressure reached" alarm | |

Potential-free contacts and messages 6.60 Alarm DP

- | | |
|---|-------------------|
| 1) "Control voltage monitoring" alarm | Output A1, A2, A3 |
| 2) Group fault: | Output A4, A5, A6 |
| "Maximum differential pressure reached" alarm | |
| 3) "Backflushing triggered by DP" alarm | Output A7, A8, A9 |

Potential-free contacts and messages 6.60.07

- | | |
|---|-------------------|
| 1) "Control voltage monitoring" alarm | Output A1, A2, A3 |
| 2) Collective fault, comprising: | Output A4, A5, A6 |
| - "Maximum differential pressure reached" alarm | |
| and | |
| - "Cartridge" alarm | |
| (DP alarm flushing oil treatment) | |



Potential-free contacts and messages 6.60.07 Alarm DP

- | | |
|--|-------------------|
| 1) "Control voltage monitoring" alarm | Output A1, A2, A3 |
| 2) Collective fault, comprising: | Output A4, A5, A6 |
| - "Maximum differential pressure reached" alarm
and | |
| - "Cartridge" alarm
(DP alarm flushing oil treatment) | |
| 3) "Backflushing triggered by DP" alarm | Output A7, A8, A9 |

Functional description 6.60

See the operating instructions for the filter's function.

Flushing is triggered by:

- 1) Switching on the power supply
- 2) Key F
- 3) The forced flushing time elapsing
- 4) Pressure switch "DP reached, backflushing filter"

Additional functions for 6.60 Alarm DP (flushing frequency monitoring)

If flushing is triggered by the "DP reached, back flushing filter" pressure switch before the forced flushing time elapses, a DP alarm is signalled (Flushing frequency alarm).

Special attributes

- All alarms are displayed and signalled and saved via potential-free contacts.
- If the controller is in parameterisation mode, flushing cannot be triggered manually.
- If the "Controller type" parameter is changed, the functions are re-started.



4.4 Controllers of type 6.61

Inputs 6.61 and 6.61 Alarm DP (flushing frequency monitoring)

"Position reached" limit switch

Pressure switch "DP reached, backflushing filter" → 75 %

Pressure switch "DP too high, backflushing filter" → 100 %

Additional inputs 6.61.07 and 6.61.07 Alarm DP (flushing oil treatment)

Pressure switch "DP too high, flushing oil treatment" → 100 %

Outputs 6.61 and 6.61 Alarm DP

Flushing valve

Motor

Additional outputs for 6.61.07 and 6.61.07 Alarm DP

After-blowing valve

Potential-free contacts and messages 6.61

- | | |
|---|-------------------|
| 1) "Control voltage monitoring" alarm | Output A1, A2, A3 |
| 2) Collective fault, comprising: | Output A4, A5, A6 |
| - "Maximum differential pressure reached" alarm and | |
| - "Motor fault" alarm | |

Potential-free contacts and messages 6.61 Alarm DP

- | | |
|---|-------------------|
| 1) "Control voltage monitoring" alarm | Output A1, A2, A3 |
| 2) Collective fault, comprising: | Output A4, A5, A6 |
| - "Maximum differential pressure reached" alarm and | |
| - "Motor fault" alarm | |
| 3) "Backflushing triggered by DP" alarm | Output A7, A8, A9 |

Potential-free contacts and messages 6.61.07

- | | |
|---|-------------------|
| 1) "Control voltage monitoring" alarm | Output A1, A2, A3 |
| 2) Collective fault, comprising: | Output A4, A5, A6 |
| - "Maximum differential pressure reached" alarm | |
| - "Motor fault" alarm and | |
| - "Cartridge" alarm (DP alarm flushing oil treatment) | |



Potential-free contacts and messages 6.61.07 Alarm DP

- | | |
|---|-------------------|
| 1) "Control voltage monitoring" alarm | Output A1, A2, A3 |
| 2) Collective fault, comprising: | Output A4, A5, A6 |
| - "Maximum differential pressure reached" alarm | |
| - "Motor fault" alarm and | |
| - "Cartridge" alarm (DP alarm flushing oil treatment) | |
| 3) "Backflushing triggered by DP" alarm | Output A7, A8, A9 |

Functional description 6.61

See the operating instructions for the filter's function.

Flushing is triggered by:

- 1) Switching on the power supply
- 2) Key F
- 3) The forced flushing time elapsing
- 4) Pressure switch "DP reached, backflushing filter"

Special attributes

- When flushing is triggered by switching on the power and an open limit switch, a flushing cycle starts directly with the flushing valve.
- If the controller is in parameterisation mode, flushing cannot be triggered manually.
- If the "Controller type" parameter is changed, the functions are re-started.



4.5 Controllers of type 6.62

Inputs 6.62

"Position reached" limit switch

Pressure switch "DP reached, backflushing filter" → 75 %

Pressure switch "DP too high, backflushing filter" → 100 %

Outputs 6.62

Flushing valve

Chamber valve supplied with pulse

Potential-free contacts and messages 6.62

- | | |
|--|-------------------|
| 1) "Control voltage monitoring" alarm | Output A1, A2, A3 |
| 2) Group fault:
"Max differential pressure reached" alarm | Output A4, A5, A6 |

Potential-free contacts and messages 6.62 Alarm DP (flushing frequency monitoring)

- | | |
|--|-------------------|
| 1) "Control voltage monitoring" alarm | Output A1, A2, A3 |
| 2) Group fault:
"Maximum differential pressure reached" alarm | Output A4, A5, A6 |
| 3) "Backflushing triggered by DP" alarm | Output A7, A8, A9 |

Functional description 6.62

See the operating instructions for the filter's function.

Flushing is triggered by:

- 1) Switching on the power supply
- 2) Key F
- 3) The forced flushing time elapsing
- 4) Pressure switch "DP reached, backflushing filter"

Special attributes

- When flushing is triggered by switching on the power and an open limit switch, a flushing cycle starts directly with the flushing valve.
- If the controller is in parameterisation mode, flushing cannot be triggered manually.
- If the "Controller type" parameter is changed, the functions are re-started.



4.6 Controllers of type 6.64

Inputs 6.64 and 6.64 Alarm DP (flushing frequency monitoring)

"Position reached" limit switch

Pressure switch "DP reached, backflushing filter" → 75 %

Pressure switch "DP too high, backflushing filter" → 100 %

Additional inputs 6.64.07 and 6.64.07 Alarm DP (flushing oil treatment)

Pressure switch "DP too high, flushing oil treatment" → 100 %

Outputs 6.64 and 6.64 Alarm DP

Flushing valve

Motor

Relief valve

Additional outputs for 6.64.07 and 6.64.07 Alarm DP

After-blowing valve

Potential-free contacts and messages 6.64

- | | |
|---|-------------------|
| 1) "Control voltage monitoring" alarm | Output A1, A2, A3 |
| 2) Collective fault, comprising: | Output A4, A5, A6 |
| - "Maximum differential pressure reached" alarm | |
| and | |
| - "Motor fault" alarm | |

Potential-free contacts and messages 6.64 Alarm DP

- | | |
|---|-------------------|
| 1) "Control voltage monitoring" alarm | Output A1, A2, A3 |
| 2) Collective fault, comprising: | Output A4, A5, A6 |
| - "Maximum differential pressure reached" alarm | |
| and | |
| - "Motor fault" alarm | |
| 3) "Backflushing triggered by DP" alarm | Output A7, A8, A9 |

Potential-free contacts and messages 6.64.07

- | | |
|---|-------------------|
| 1) "Control voltage monitoring" alarm | Output A1, A2, A3 |
| 2) Collective fault, comprising: | Output A4, A5, A6 |
| - "Maximum differential pressure reached" alarm | |
| - "Motor fault" alarm and | |
| - "Cartridge" alarm (DP alarm flushing oil treatment) | |



Potential-free contacts and messages 6.64.07 Alarm DP

- | | |
|---|-------------------|
| 1) "Control voltage monitoring" alarm | Output A1, A2, A3 |
| 2) Collective fault, comprising: | Output A4, A5, A6 |
| - "Maximum differential pressure reached" alarm | |
| - "Motor fault" alarm and | |
| - "Cartridge" alarm (DP alarm flushing oil treatment) | |
| 3) "Backflushing triggered by DP" alarm | Output A7, A8, A9 |

Functional description 6.64

See the operating instructions for the filter's function.

Flushing is triggered by:

- 1) Switching on the power supply
- 2) Key F
- 3) The forced flushing time elapsing
- 4) Pressure switch "DP reached, backflushing filter"

Special attributes

- When flushing is triggered by switching on the power and an open limit switch, a flushing cycle with the flushing valve starts after expiry of the pressure compensation time.
- If the controller is in parameterisation mode, flushing cannot be triggered manually.
- If the "Controller type" parameter is changed, the functions are re-started.



4.7 Controllers of type 6.72

Inputs 6.72 and 6.72 Alarm DP (flushing frequency monitoring)

"Position reached" limit switch

Pressure switch "DP reached, backflushing filter" → 75 %

Pressure switch "DP too high, backflushing filter" → 100 %

Additional inputs for 6.72.07 (flushing oil treatment)

Pressure switch "DP too high, flushing oil treatment" → 100 %

Outputs 6.72 and 6.72 Alarm DP

Flushing valve

Chamber valve

Additional outputs for 6.72.07 and 6.72.07 Alarm DP

After-blowing valve

Potential-free contacts and messages 6.72

- | | |
|--|-------------------|
| 1) "Control voltage monitoring" alarm | Output A1, A2, A3 |
| 2) Group fault:
"Maximum differential pressure reached" alarm | Output A4, A5, A6 |

Potential-free contacts and messages 6.72 Alarm DP

- | | |
|--|-------------------|
| 1) "Control voltage monitoring" alarm | Output A1, A2, A3 |
| 2) Group fault:
"Maximum differential pressure reached" alarm | Output A4, A5, A6 |
| 3) "Backflushing triggered by DP" alarm | Output A7, A8, A9 |

Potential-free contacts and messages 6.72.07

- | | |
|--|-------------------|
| 1) "Control voltage monitoring" alarm | Output A1, A2, A3 |
| 2) Collective fault, comprising:
- "Maximum differential pressure reached" alarm
and
- "Cartridge" alarm
(DP alarm flushing oil treatment) | Output A4, A5, A6 |



Potential-free contacts and messages 6.72.07 Alarm DP

- | | |
|--|-------------------|
| 1) "Control voltage monitoring" alarm | Output A1, A2, A3 |
| 2) Collective fault, comprising: | Output A4, A5, A6 |
| - "Maximum differential pressure reached" alarm
and | |
| - "Cartridge" alarm
(DP alarm flushing oil treatment) | |
| 3) "Backflushing triggered by DP" alarm | Output A7, A8, A9 |

Functional description 6.72

See the operating instructions for the filter's function.

Flushing is triggered by:

- 1) Switching on the power supply
- 2) Key F
- 3) The forced flushing time elapsing
- 4) Pressure switch "DP reached, backflushing filter"

Additional functions for 6.72 Alarm DP (flushing frequency monitoring)

If flushing is triggered by the "DP reached, back flushing filter" pressure switch before the forced flushing time elapses, a DP alarm is signalled (Flushing frequency alarm).

Special attributes

- All alarms are displayed and signalled and saved via potential-free contacts.
- If the controller is in parameterisation mode, flushing cannot be triggered manually.
- If the "Controller type" parameter is changed, the functions are re-started.





5 Appendix

5.1 Setting values

Setting values control box type 2200

	wiring diagram (standard)	P0 Filter type	P1 Multiple flushing	P2 Forced flushing	P3 Forced flushing	P4 Flushing time	P5 Filling time	P6 After-blowing time	P7 Delay time cartridge alarm	P8 DP-Alarm	P9 Motor fault	P10 Back-flushing time	P11 Language	P12 Test- code	P14 Pressure compensation time
6.18/6.19/6.44	Z46140	0	/	2h	0min	20s	/	/	/	/	0.4A	/	D	/	/
6.21/6.22	Z46460	1	/	2h	0min	/	/	/	/	/	/	3	D	/	/
6.23/6.24	Z46141	1	/	2h	0min	/	/	/	/	/	/	1	D	/	/
6.60	Z46142	2	/	2h	0min	8s	120s	/	/	/	/	/	D	/	/
6.60 A1.DP	Z46142	3	/	2h	0min	8s	120s	/	/	on	/	/	D	/	/
6.60.07	Z46143	4	/	2h	0min	8s	120s	18s	180s	/	/	/	D	/	/
6.60.07 A1.DP	Z46143	5	/	2h	0min	8s	120s	18s	180s	on	/	/	D	/	/
6.61	Z46144	6	1	2h	0min	8s	up to DN150=120s as from DN200=150s	/	/	/	0.4A	/	D	/	/
6.61 A1.DP	Z46144	7	1	2h	0min	8s	up to DN150=120s as from DN200=150s	/	/	on	0.4A	/	D	/	/
6.61.07	Z46145	8	1	2h	0min	8s	up to DN150=120s as from DN200=150s	18s	180s	/	0.4A	/	D	/	/
6.61.07 A1.DP	Z46145	9	1	2h	0min	8s	up to DN150=120s as from DN200=150s	18s	180s	on	0.4A	/	D	/	/
6.62	Z46146	10	1	2h	0min	8s	120s	/	/	/	/	/	D	/	/
6.62 A1.DP	Z46146	11	1	2h	0min	8s	120s	/	/	on	/	/	D	/	/
6.64	Z46147	12	1	2h	0min	8s	up to DN150=180s as from DN200=360s	/	/	/	0.4A	/	D	/	up to DN150=1s as from DN200=10s
6.64 A1.DP	Z46147	13	1	2h	0min	8s	up to DN150=180s as from DN200=360s	/	/	on	0.4A	/	D	/	up to DN150=1s as from DN200=10s
6.64.07	Z46148	14	1	2h	0min	8s	up to DN150=180s as from DN200=360s	18s	180s	/	0.4A	/	D	/	up to DN150=1s as from DN200=10s
6.64.07 A1.DP	Z46148	15	1	2h	0min	8s	up to DN150=180s as from DN200=360s	18s	180s	on	0.4A	/	D	/	up to DN150=1s as from DN200=10s
6.72	Z46282	16	/	2h	0min	8s	DN40=120s DN65=200s DN80=240s	/	/	/	/	/	D	/	/
6.72 A1.DP	Z46282	17	/	2h	0min	8s	DN40=120s DN65=200s DN80=240s	/	/	on	/	/	D	/	/
6.72.07	Z46354	4	/	2h	0min	8s	DN40=120s DN65=200s DN80=240s	18s	180s	/	/	/	D	/	/
6.72.07 A1.DP	Z46354	5	/	2h	0min	8s	DN40=120s DN65=200s DN80=240s	18s	180s	on	/	/	D	/	/

Set-points can be adjusted according to the particular requirements.



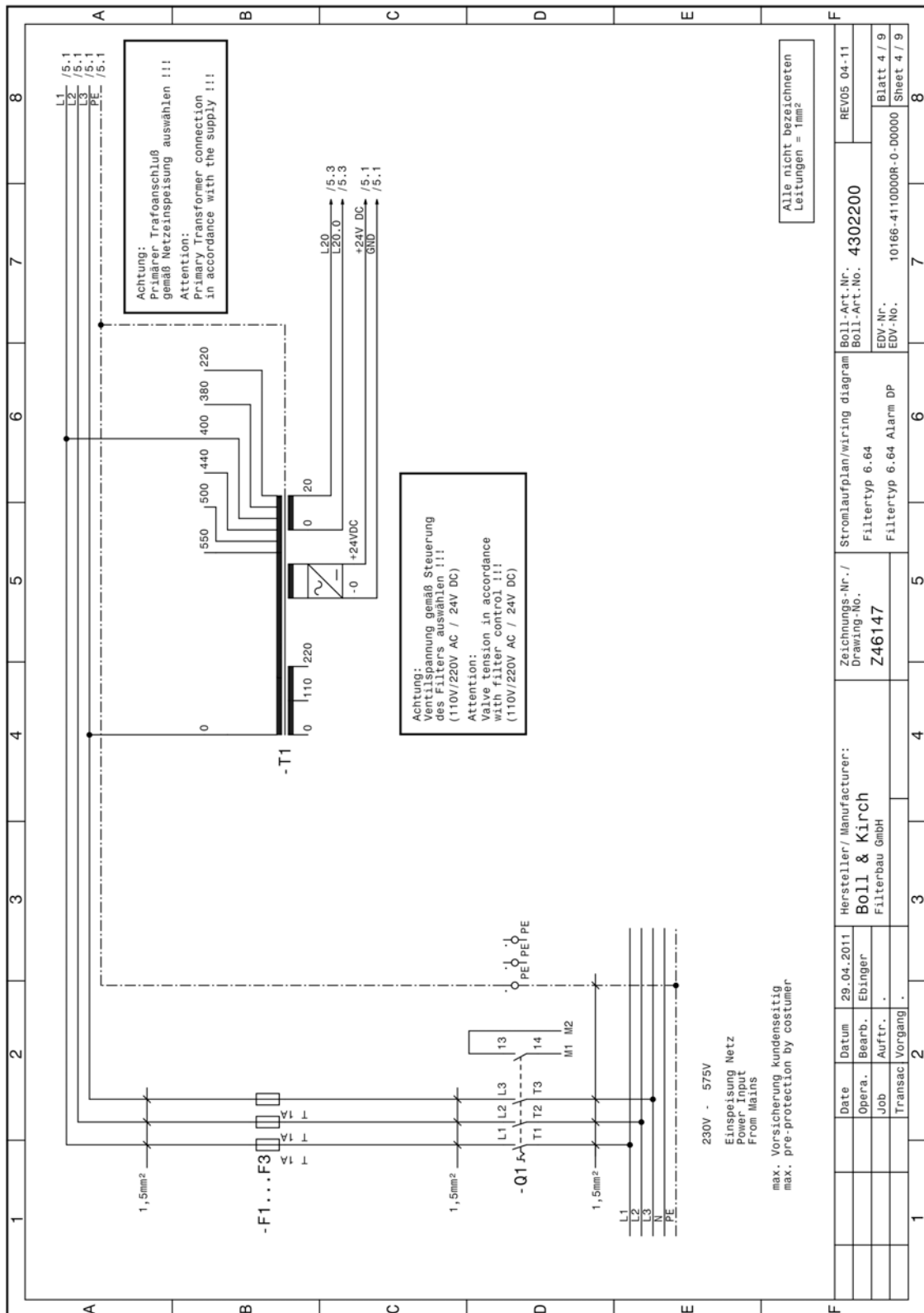
5.2 Circuit diagram

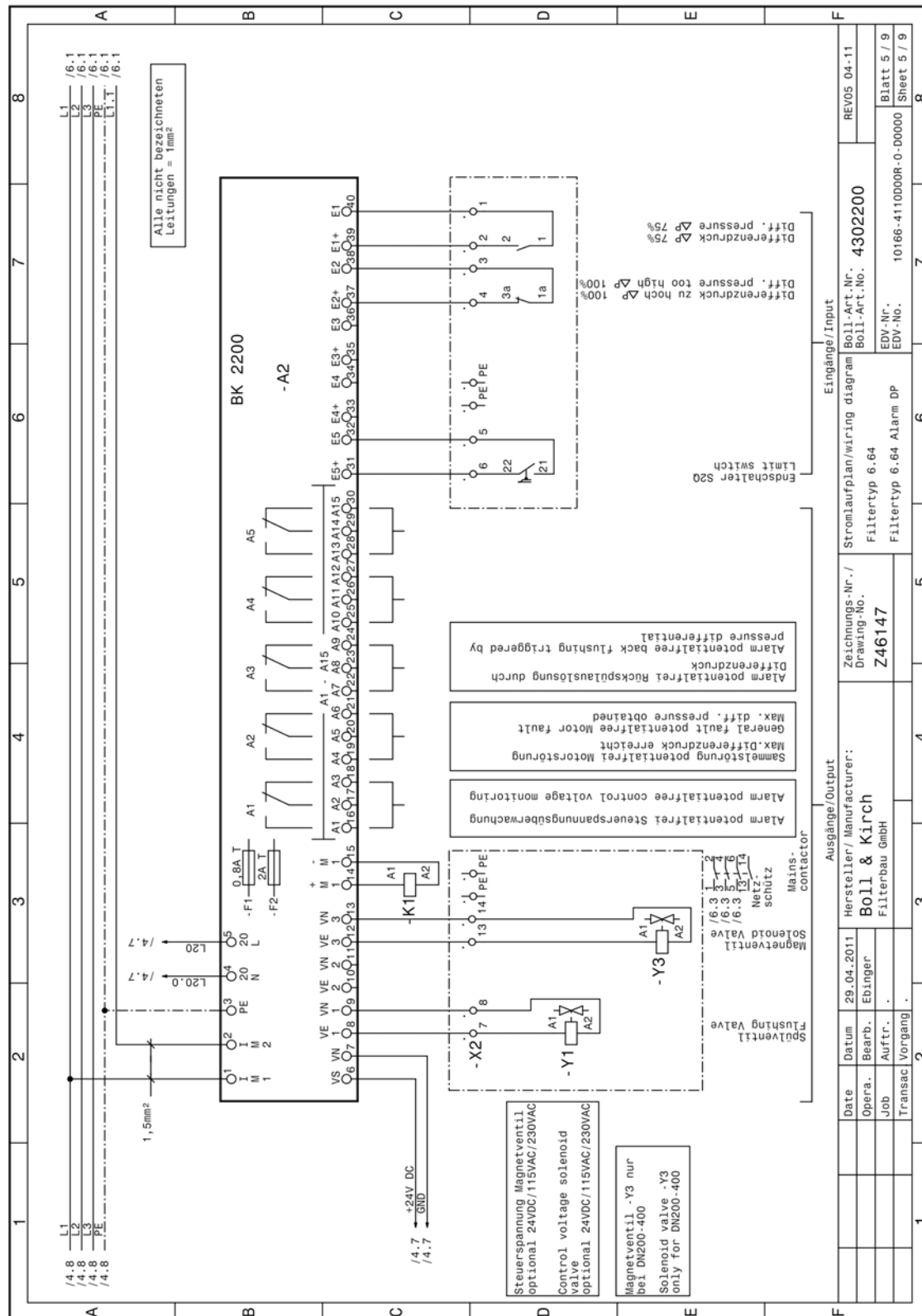
1	2	3	4	5	6	7	8
E P L A N - DECKBLATT E P L A N - COVER							
HERSTELLER: manufacturer:							
Boll & Kirch Filterbau GmbH Siemensstraße 10-14 50143 Kerpen							
Anlage: plant:							
Vollautomatischer Rückspülfilter Typ 6.64 Alarm DP fully automatic back flushing filter type 6.64 type 6.64 Alarm DP							
Verdrahtungsfarben: color of transmission:							
Hauptstromkreis/main power : schwarz/black Steuerstromkreis/control power : rot/red Fremdspeisung/extern voltage : orange/orange Schutzleiter/ground : grün-gelb/green-yellow							
Hersteller / Manufacturer: Boll & Kirch Filterbau GmbH				Zeichnungs-Nr. / Drawing-No. Z46147		Deckblatt/cover Filtertyp 6.64 Filtertyp 6.64 Alarm DP	
Date Opera. Job		29.04.2011 Bearb. Auftrr.		Boll-Art.Nr. Boll-Art.No. 4302200		REV05 04-11 Blatt 1 / 9 Sheet 1 / 9	

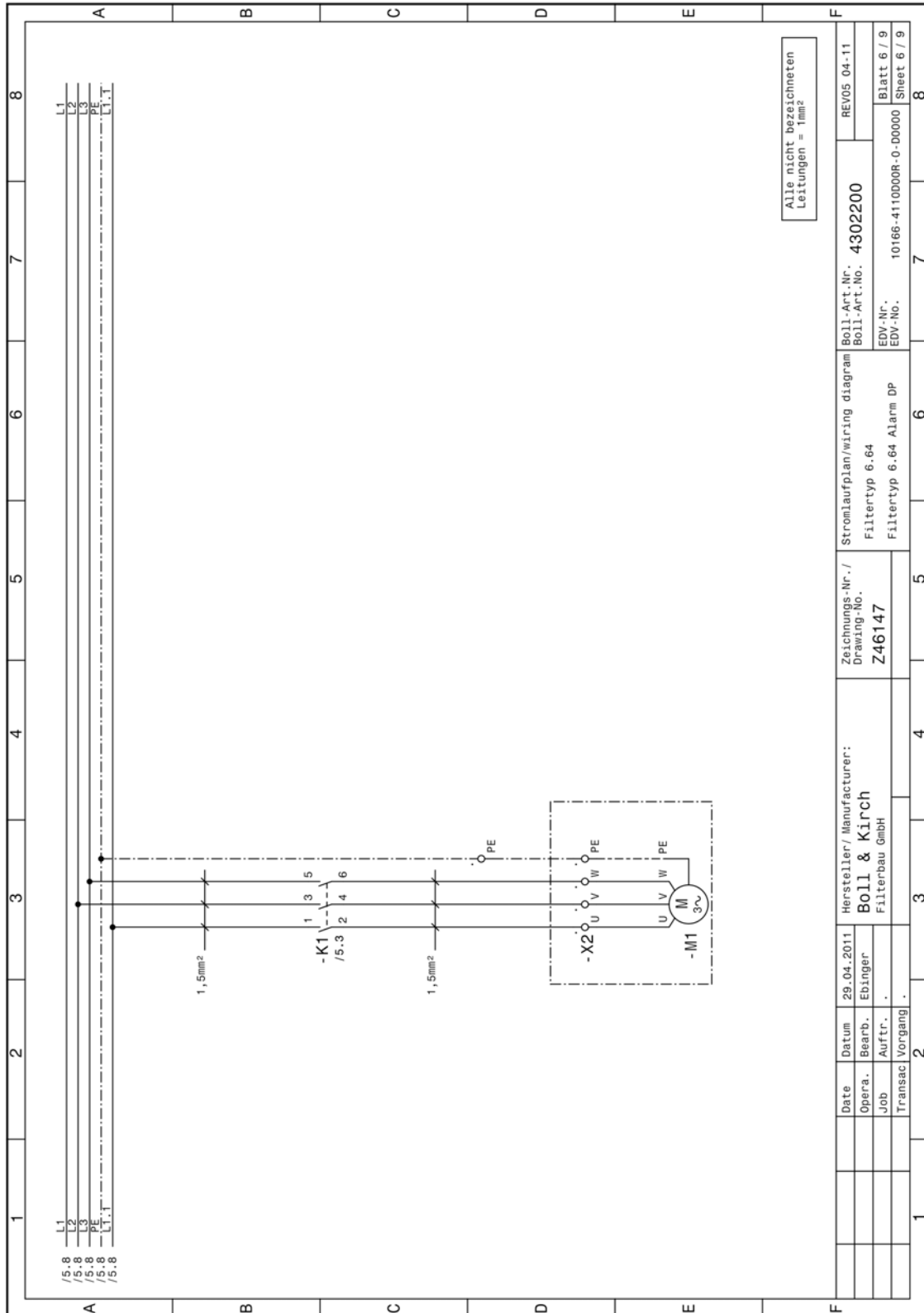


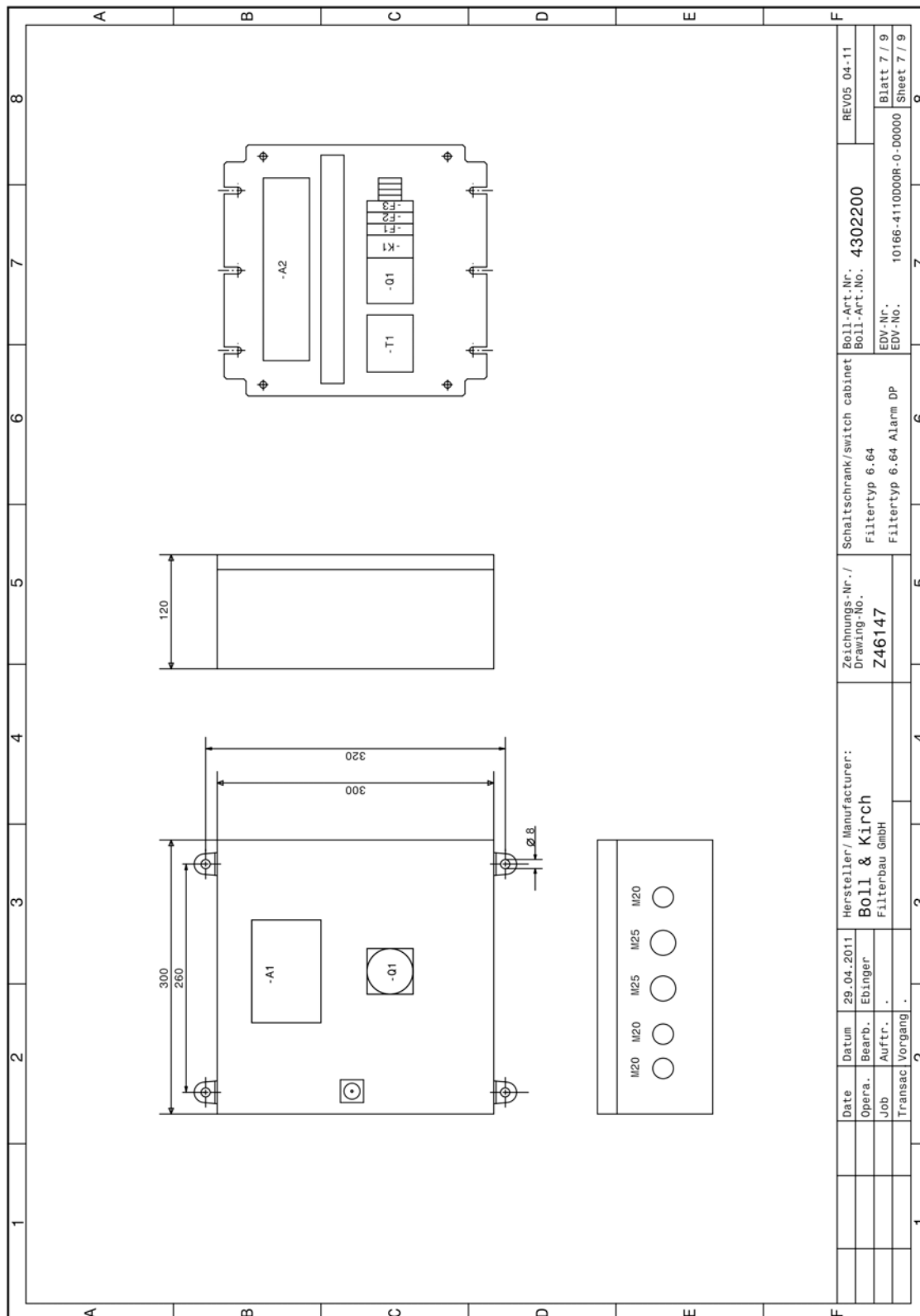
	1	2	3	4	5	6	7	8																																								
A																																																
B	Spannungen <u>voltages</u> Betriebsspannung : operating voltage 3/PE 50-60Hz, 230-575V +/- 5% Steuerspannung : control power Optional 230V AC 115V AC 24V DC Verdrahtung <u>wiring</u> Ausführung der Schaltanlage nach: VDE 0660 Teil 5, IEC 439 Bestimmungen für fabrikfertige Schalt- Gerätekombinationen mit Nennspannung bis 750V Nennspannung : 450/750V Nennisolationsspannung : 450/750V nach VDE 0110 . Schutzart IP 65 Umgebungstemperatur max. 55C Die Verdrahtung erfolgt flexibel. Alle elektrischen Verbindungen werden in H07V-K / bei Leistungsverdrahtung 1,5qmm, bei Steuerleitungen 1qmm verlegt. Die Verdrahtung erfolgt von oben nach unten bzw. von links nach rechts. gemäß den Stromlaufplänen. <u>wiring</u> cabinet built after : VDE 0660 part 5, IEC 439 spezification for factory cabinets with rated voltage unit 750V rated voltage : 450/750V rated isolation voltage : 450/750V according to VDE 0110, protection IP 65 are with H07V-K / by power wiring 1,5qmm. by control circuit 1qmm. The wiring is from above to down or from left to right. following the circuit diagram.																																															
C																																																
D	Klemmleisten Übersicht Terminal strip overview ----- X2=Klemmleisten X2 terminal strip X2 HINWEISE <u>advices</u> Schaltanlage switchboard plant RAL 7035 Kabeleinführung : transmission instruction ☐ oben above ☒ unten down Hauptschalter: main switch ☒ vorne/front ☐ links/left ☐ rechts/right Kundenvorschriften : client orders ☐ ja yes ☒ nein no Schranksockel : cabinet base ☐ ja yes ☒ nein no ☐ 100mm ☐ 200mm ☐ 300mm																																															
E																																																
F	<table border="1"><thead><tr><th>Date</th><th>29.04.2011</th><th colspan="2">Hersteller/ Manufacturer:</th><th colspan="2">Zeichnungs-Nr./ Drawing-No.</th><th colspan="2">Allgemein/general</th><th colspan="2">Boll-Art.Nr. / REV05 04-11</th></tr></thead><tbody><tr><td>Opera.</td><td>Bearb. Ebinger</td><td colspan="2">Boll & Kirch</td><td colspan="2">Z46147</td><td colspan="2">Filtertyp 6.64</td><td colspan="2">Boll-Art.No. 4302200</td></tr><tr><td>Job</td><td>Auftr. .</td><td colspan="2">Filterbau GmbH</td><td colspan="2"></td><td colspan="2">Filtertyp 6.64 Alarm DP</td><td colspan="2">EDV-Nr. 10166-4110D00R-0-D0000</td></tr><tr><td>Transac</td><td>Vorgang .</td><td colspan="2"></td><td colspan="2"></td><td colspan="2"></td><td colspan="2">Blatt 2 / 9 Sheet 2 / 9</td></tr></tbody></table>								Date	29.04.2011	Hersteller/ Manufacturer:		Zeichnungs-Nr./ Drawing-No.		Allgemein/general		Boll-Art.Nr. / REV05 04-11		Opera.	Bearb. Ebinger	Boll & Kirch		Z46147		Filtertyp 6.64		Boll-Art.No. 4302200		Job	Auftr. .	Filterbau GmbH				Filtertyp 6.64 Alarm DP		EDV-Nr. 10166-4110D00R-0-D0000		Transac	Vorgang .							Blatt 2 / 9 Sheet 2 / 9	
Date	29.04.2011	Hersteller/ Manufacturer:		Zeichnungs-Nr./ Drawing-No.		Allgemein/general		Boll-Art.Nr. / REV05 04-11																																								
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Job	Auftr. .	Filterbau GmbH				Filtertyp 6.64 Alarm DP		EDV-Nr. 10166-4110D00R-0-D0000																																								
Transac	Vorgang .							Blatt 2 / 9 Sheet 2 / 9																																								

[illegible]











Materialliste Materials list							Blatt : 1 Sheet : 1	
Nr. No.	Anz. Num.	Kennzeichnung Labelling	Benennung Description	Hersteller Manufacturer	Typ / Art.-Nr. Type / Art.-No.	Boll & Kirch Art.No.	Kenngröße Parameter	
1	1	-A1/-A2	Filtersteuerung (2 Platinen)	RECO	BK 2200	4300121		
1	1	-A1/-A2	Filter control (2 PCB's)	RECO	BK 2200	4300121		
	1		Verbindungskabel		Patchkabel RJ45 Cat5e	4100074	0,5m	
	1		Connection cable		Patchkabel RJ45 Cat5e	4100074	0,5m	
2	1	-F1...F3	Trennhebel-Sicherungs-Klemme	Phoenix Contact	UK 6,3-HESI 3004171	4200147	16 mm²	
2	1	-F1...F3	Lever-type fuse element	Phoenix Contact	UK 6,3-HESI 3004171	4200147	16 mm²	
	1		G-Sicherungseinsatz	ESKA	632.717	4200146	T 1A, 6,3x32	
	1		Unit fuse set	ESKA	632.717	4200146	T 1A, 6,3x32	
3	1	-F1...F3	Trennhebel-Sicherungs-Klemme	Phoenix Contact	UK 6,3-HESI 3004171	4200147	16 mm²	
3	1	-F1...F3	Lever-type fuse element	Phoenix Contact	UK 6,3-HESI 3004171	4200147	16 mm²	
	1		G-Sicherungseinsatz	ESKA	632.717	4200146	T 1A, 6,3x32	
	1		Unit fuse set	ESKA	632.717	4200146	T 1A, 6,3x32	
4	1	-F1...F3	Trennhebel-Sicherungs-Klemme	Phoenix Contact	UK 6,3-HESI 3004171	4200147	16 mm²	
4	1	-F1...F3	Lever-type fuse element	Phoenix Contact	UK 6,3-HESI 3004171	4200147	16 mm²	
	1		G-Sicherungseinsatz	ESKA	632.717	4200146	T 1A, 6,3x32	
	1		Unit fuse set	ESKA	632.717	4200146	T 1A, 6,3x32	
5	1	-K1	Leistungsschutz	ABB	BC6-30-10	4200148	4kV/690V, 24V DC	
5	1	-K1	Power contactor	ABB	BC6-30-10	4200148	4kV/690V, 24V DC	
6	1	-O1	Hauptschalter	ABB	OT16E3	4200149	25A	
6	1	-O1	Main switch	ABB	OT16E3	4200149	25A	
	1		Hilfsschalter 1S	ABB	OA1G10	4200149		
	1		Auxiliary switch block NO	ABB	OA1G10	4200149		
	1		Hauptschaltergriff	ABB	OHY2AJ	4200149		
	1		Selector handle	ABB	OHY2AJ	4200149		
	1		Verlängerungswelle	ABB	OXSSx105	4200149	105 mm	
	1		Extended shaft	ABB	OXSSx105	4200149	105 mm	
7	1	-T1	Transformator	Siemens	4AM3496-0EJ00-0FA0	4200150	220...550V/20,110,220V+24VDC	
7	1	-T1	Transformer	Siemens	4AM3496-0EJ00-0FA0	4200150	220...550V/20,110,220V+24VDC	
8	2	-X	PE-Klemme	Phoenix Contact	UT 2,5-Quattro-PE	4100073	2,5 mm²	
8	2	-X	Earth wire terminal	Phoenix Contact	UT 2,5-Quattro-PE	4100073	2,5 mm²	
9	1	-Z	Genäuse	Rittal	EB 1555.500	4306540	300 x 300 x 120 mm	
9	1	-Z	Switching cabinet	Rittal	EB 1555.500	4306540	300 x 300 x 120 mm	
10	1	-Z	Wandbefestigungshalter	Rittal	KL1590.000	4507593	8mm	
10	1	-Z	Wall range spacer	Rittal	KL1590.000	4507593	8mm	
				Zeichnungs-Nr. / Drawing-No.	Stückliste / part list	Boll-Art.Nr. Boll-Art.No.	REV05 04-11	
				Z46147	Filtertyp 6.64	EDV-Nr. EDV-No.	Blatt 8 / 9 Sheet 8 / 9	
							Filtertyp 6.64 Alarm DP	

[illegible]



5.3 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
Postfach 1420, D-50143 Kerpen
Siemensstr. 10-14, D-50170 Kerpen
Tel.: +49/(0)2273/562-0
Fax: +49/(0)2273/562-223
E-Mail: info@bollfilter.com
www.bollfilter.com
- 1 3** BOLL & KIRCH Filterbau GmbH
Geschäftsstelle Nord
An der Strusbek 34
D - 22926 Ahrensburg
Tel.: +49/(0)4102/4740-0
Fax: +49/(0)4102/4740-22
E-Mail: info@bollfilter.de
www.bollfilter.de
- 1** IVG Pumpen- und Filtrationstechnik Gera
Prehlis 13 A
D - 07552 Gera
Tel.: +49/(0)365/42 00 07 4
Fax: +49/(0)365/42 00 07 5
E-Mail: ivg-neubert@superkabel.de
www.ivg-neubert.de
- 1** BOLL & KIRCH Filterbau GmbH
Geschäftsstelle Süd
Rangaustraße 7a
D - 91639 Wolframs-Eschenbach
Tel.: +49/(0)9875/97899-0
Fax: +49/(0)9875/97899-29
E-Mail: norbert.henkeltmann@bollfilter.de
www.bollfilter.de



Europe

- Austria / Czech Republic / Slovakia / Slovenia**
- 1 2 3** Schmachtl GmbH
Pummererstrasse 36
A - 4020 Linz
Tel.: +43/(0)732/76 46 0
Fax: +43/(0)732/78 50 36
E-Mail: g.oehler@schmachtl.at
www.schmachtl.at
- Belgium / Luxembourg**
- 1 2 3** AUXIMECA N.V.
Wijtschotbaan 3/3
B - 2900 Schoten
Tel.: +32/(0)3 646 61 80
Fax: +32/(0)3 646 93 98
E-Mail: info@auximeca.be
www.auximeca.com

- Croatia**
- 1** Marine Trade d.o.o.
Vladimira Nazora 6
HR - 47000 Karlovac
Tel.: +385/(0)47/ 61 19 07
Fax: +385/(0)47/ 43 12 61
E-Mail: marine-trade@ka.t-com.hr

- Cyprus**
- 1** M.I.E. Services Ltd.
The Hawk Building
124 Gladstonos Street
CY - 3032 Limassol
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Fax: +357/(0)25 763 902
E-Mail: info@mieserv.cy.net
www.miegroup.com.cy

- Denmark / Sweden / Norway / Iceland / Finland / Lithuania / Latvia / Estonia**
- 1 2 3** BOLLFILTER Nordic ApS
Hammerbakken 21
DK - 3460 Birkerød
Tel.: +45/(0)45/42 12 00
Fax: +45/(0)45/42 12 99
E-Mail: info@bollfilter.dk
www.bollfilter.dk

- Greece / Bulgaria**
- 1 2 3** FILTERKON
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GR - 14561 Kifissia
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Fax: +30/(0)210/92 42 242
E-Mail: filterkon@filterkon.com
www.filterkon.com

- Great Britain / Ireland**
- 1 2 3** BOLLFILTER UK Limited
Unit 9 Station Road
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Fax: +44/(0)1621/86 92 57
E-Mail: sales@bollfilter.co.uk
www.bollfilteruk.co.uk

- Italy**
- 1 2** DE.CO.STA Spa
Via Bicetti de Buttinoni, 12
I - 20156 Mailand
Tel.: +39/(0)0238/00 52 83
Fax: +39/(0)0238/00 36 31
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- Switzerland / Liechtenstein**
- 1 2 3** EIG CRUSTAG
120 Route de Frontenex
CH - 1208 Genève
Tel.: +41/(0)22/73 59 50 0
Fax: +41/(0)22/78 66 17 1
E-Mail: info@eig-crustag.ch
www.eig-crustag.ch

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- 1 2 3** BOLLFILTER España S.L.
Zona Cami Ral
Paseo del Ferrocarril, 339 3ª - 2ª
E - 08860 Castelldefels
Tel.: +34/(0)93/634 26 80
Fax: +34/(0)93/665 22 79
E-Mail: info@bollfilter.es
www.bollfilter.com

- The Netherlands**
- 1 2 3** Lubrafil B.V.
Aalborg 2
NL - 2993 LP Barendrecht
Tel.: +31/(0)180/55 62 55
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E-Mail: lubrafil@lubrafil.nl
www.lubrafil.nl

- Turkey**
- 1** ARES PLAKALI ESANJOR SAN.
Ve TIC. LTD. STI
HSOSB ORDU CAD. NO:4
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www.aresphe.com



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22635 Venture Drive
Novi, MI 48375 - USA
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Fax: +1(0)248/773-8201
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www.bollfilterusa.com
- 2 3** Motor-Services Hugo Stamp, Inc.
USA - Ft. Lauderdale, Florida 33315
Tel.: +1(0)954/763 3660
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Asia

- India**
1 2 3 BOLLFILTER India Pvt. Ltd.
"Monarch Plaza", Office No. 106
Sector-11, CBD Belapur,
IN - Navi Mumbai 400614
Tel.: +91(0)22/27 56 01 47
Fax: +91(0)22/27 56 01 46
E-Mail: info@bollfilterindia.com
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- Japan**
1 2 3 BOLLFILTER Japan Ltd.
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95 Edo-machi, Chuo-ku
JP - Kobe 650-0033
Tel.: +81(0)78/331 8031
Fax: +81(0)78/331 8032
E-Mail: info@bollfilter.jp
www.bollfilter.jp

Middle East

- 1 2** Safe Technical Supply Co. L.L.C.
P.O. Box 4832
UAE - Dubai
Tel.: +971(0)4/32 43 24 0
Fax: +971(0)4/32 43 78 6
E-Mail: info@safetechnical.com
www.safetechnical.com

People's Republic of China incl. Hong Kong

- 1 2 3** BOLLFILTER CHINA Ltd.
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Fax: +86 21 5043 3329
E-Mail: grace.yip@bollfilterchina.com
www.bollfilterchina.com

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- 1 2 3** IMI Corporation Pte. Ltd.
13 Joo Koon Crescent
SGP - Singapur 629021
Tel.: +65-68 61 42 22
Fax: +65-68 62 42 22
E-Mail: imicorp@imicorp.com.sg
www.imicorp.com.sg

South Korea

- 1 2 3** Blohm + Voss (Korea) Ltd.
Room 1812, Ocean Tower
760-3, U-Dong, Haeundae-gu
612-020 Pusan, Korea
Tel.: +82-51-740 5700
Fax: +82-51-740 57 04/5/6
E-Mail: bvkorea@bvkorea.com



Africa

- South Africa**
1 2 Afrifil Manufacturing (PTY) LTD
8 Pressberg Road Modderfontein
ZA - Isando, 1600
Tel.: +27 11 452 5444
Fax: +27 11 609 9535
E-Mail: sales@afriphil.co.za
www.afriphil.co.za

- 1** Verkaufsbüro Agency
2 Lager Stockist
3 Service Service

Februar 2015



安庆船用电器有限责任公司

ANQING MARINE ELECTRIC DEVICE CO., LTD

POWER A/B SUPPLY ME-C ENGINE

ME-C 主机控制系统不间断电源A/B

5363491-4. 4

Type: AD-UPS2400-3

型号: AD-UPS2400-3



ADD: 3.9 Square Kilometer Industrial Park In AnQing
Economic and Technical Development Zone.

地址: 安徽省安庆市经济技术开发区3.9平方工业园三城寺路

Tel 电话: +86-556-5315485

Fax 传真: +86-556-5311583

Postal 邮编: 246005

E-mail: aq485jyb@163.com

D/E NO. (机型): 6G60ME-C9.5

Hull NO. (船号): 0311113/14/15/16/17/18/19/20

Shipyard: New Times Shipbuilding Co., Ltd

船 厂: 江苏新时代造船有限公司

D/E Maker: CSSC-MES Diesel Co., Ltd

柴油机制造商: 上海中船三井造船柴油机有限公司

Class 船级社:

Designed 设 计	陈文涛	2017/6/21					
Checked 校 对	徐文涛	2017/6/21					
Confirmed 审 核	陈文涛	2017/6/21	A	增加安装脚厚度尺寸、 进线口定位尺寸	4	徐文涛	2017-06-21
Approved 批 准	陈文涛	2017/6/21	ReV. 标记	Modif. 修改原因	PAGE 页码	Name 姓 名	Date 日期
Drg. No. 图 号		AD5363491-4. 4					
					Page: 1 第 1 页	Total: 19 共 19 页	

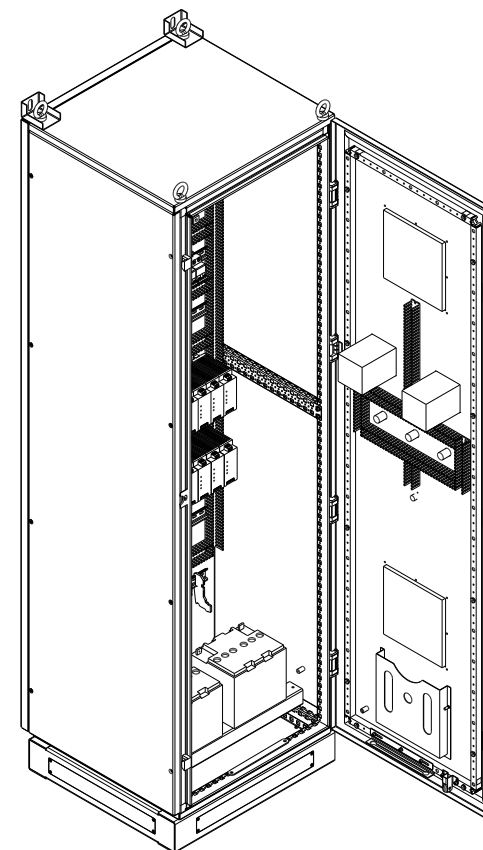
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A	1	AD5363491-4. 4				COVER 封面				1									
	2	AD5363491-4. 4-10				Contents 目录				2									
	3	AD5363491-4. 4-20				Configuration UPS配置				3									
B	4	AD5363491-4. 4-21				Power supply A/B outline diagram 电源A/B外形图				4									
	5	AD5363491-4. 4-30				UPS-A/B PRINCIPLE DIAGRAM UPS-A/B原理图				5									
	6	AD5363491-4. 4-31				UPS-A/B PRINCIPLE DIAGRAM UPS-A/B 原理图				6									
	7	AD5363491-4. 4-32				UPS-A/B PRINCIPLE DIAGRAM UPS-A/B 原理图				7									
C	8	AD5363491-4. 4-33				UPS-A/B PRINCIPLE DIAGRAM UPS-A/B 原理图				8									
	9	AD5363491-4. 4-34				UPS-A/B PRINCIPLE DIAGRAM UPS-A/B 原理图				9									
	10	AD5363491-4. 4-35				UPS-A/B PRINCIPLE DIAGRAM UPS-A/B 原理图				10									
	11	AD5363491-4. 4-36				UPS-A/B PRINCIPLE DIAGRAM UPS-A/B 原理图				11									
D	12	AD5363491-4. 4-37				External Interface Diagram 外部接线图				12									
	13	AD5363491-4. 4-38				External Interface Diagram 外部接线图				13									
	14	AD5363491-4. 4-40				Chinese Elements List 1 中文元件清单1				14									
	15	AD5363491-4. 4-41				Chinese Elements List 2 中文元件清单2				15									
E	16	AD5363491-4. 4-42				Chinese Elements List 3 中文元件清单3				16									
	17	AD5363491-4. 4-43				English Elements List 1 英文元件清单1				17									
	18	AD5363491-4. 4-44				English Elements List 2 英文元件清单2				18									
	19	AD5363491-4. 4-45				English Elements List 3 英文元件清单3				19									
					Power Supply For ME-C ECS MEC机型UPS电源		 安庆船用电器有限责任公司 ANQING MARINE ELECTRIC DEVICE CO., LTD		Contents 目录		Drg. No. 图 号 AD5363491-4. 4-10		= PAGE 2 + 第 2 页 TOTAL: 19 共 19 页						
Rev. 标记		Modif. 修改原因		Qty. 数量											Name 姓名		Date 日期		
DESIGNED 设计		陈义永		CONFIRMED 审核											江小虎		2016/10/27		
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Capacity of each supply dependent on the cylinder quantity of the engines

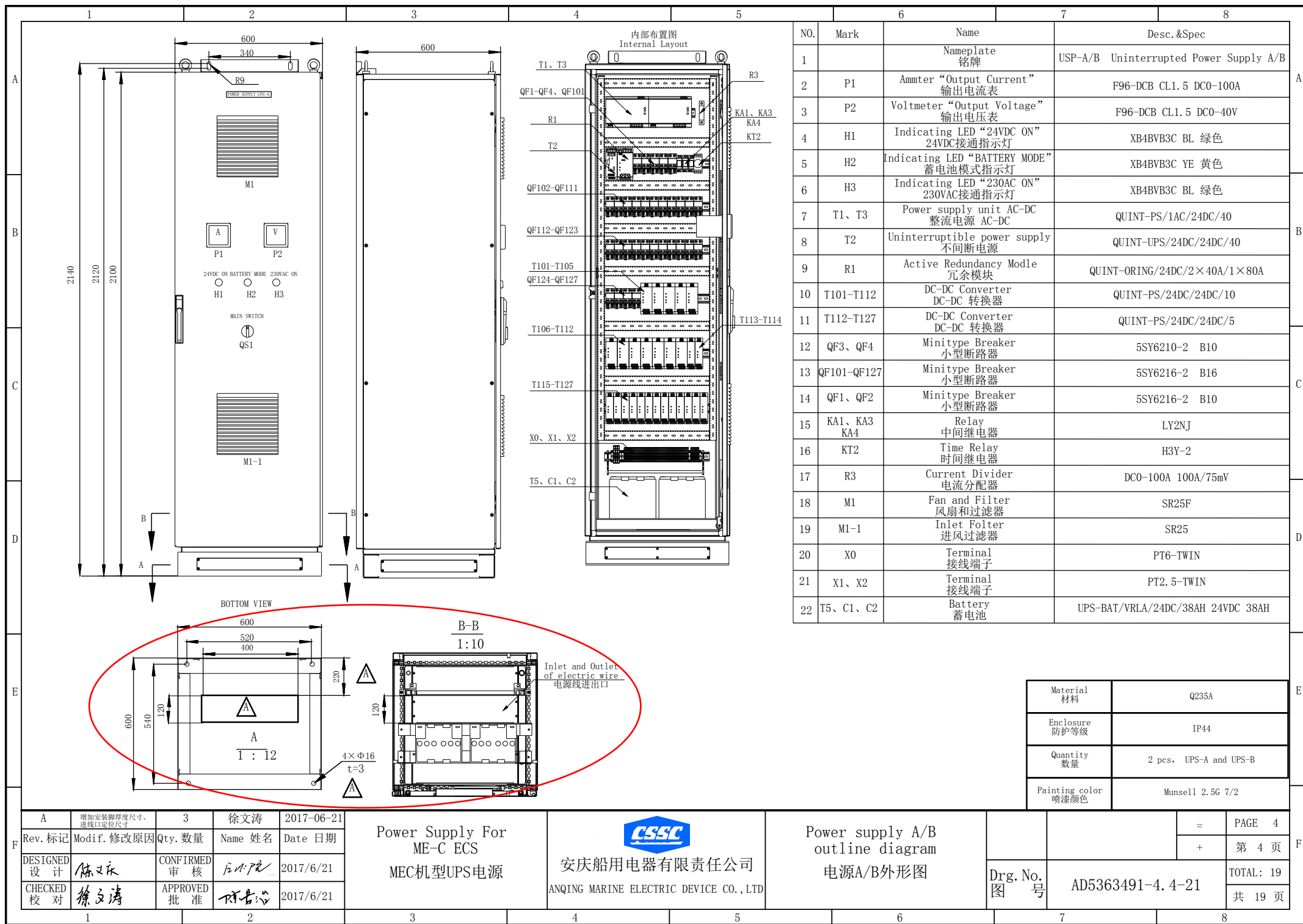
	4 Cyl.	5 Cyl.	6 Cyl.	7 Cyl.	8 Cyl.
Capacity	1200W	1200W	1200W	1300W	1300W
No of breakers	19	20	21	22	23
DC/DC Converter configuration	7 pcs 5A 12 pcs 10A	8 pcs 5A 12 pcs 10A	9 pcs 5A 12 pcs 10A	10 pcs 5A 12 pcs 10A	11 pcs 5A 12 pcs 10A

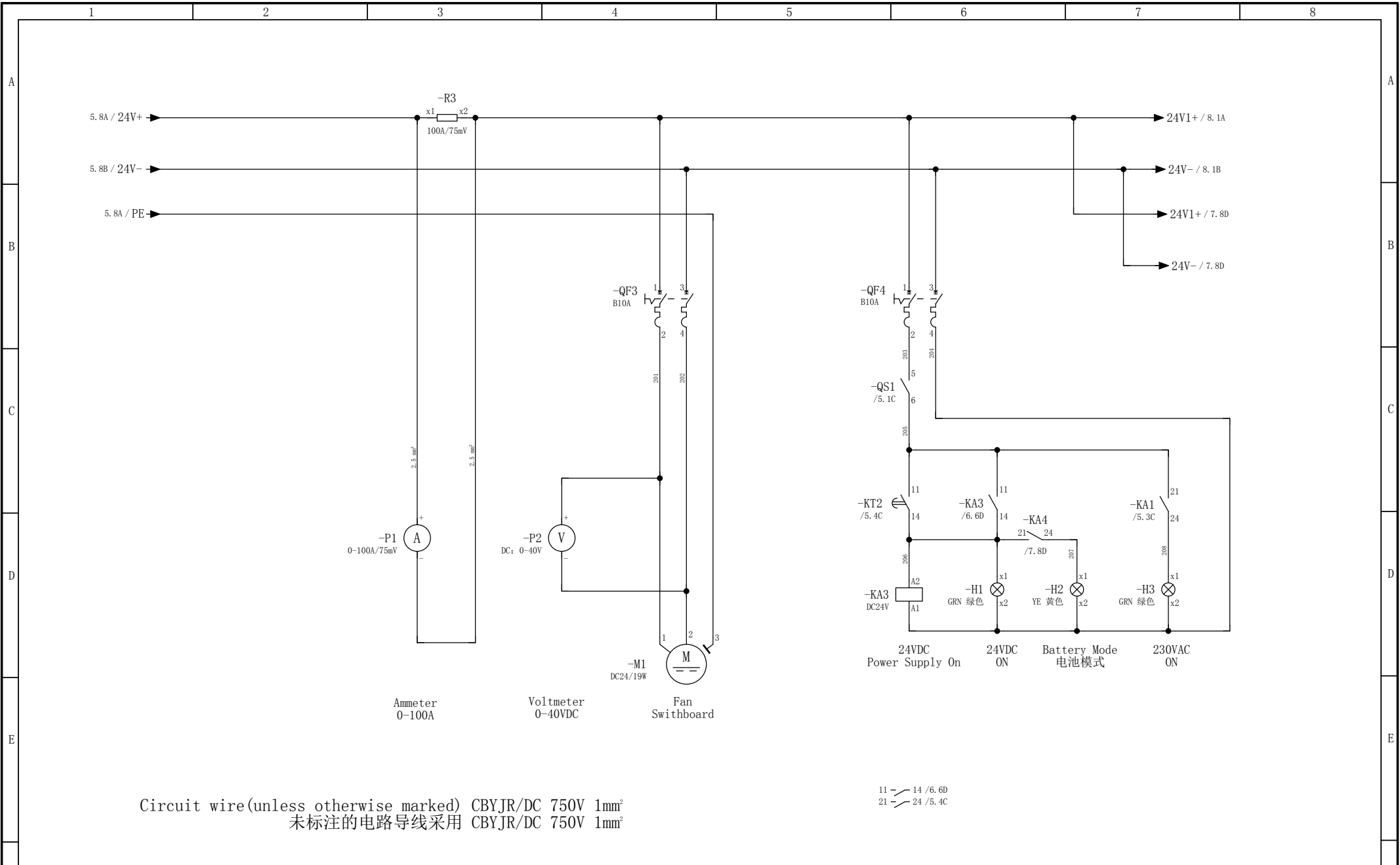
	9 Cyl.	10 Cyl.	11 Cyl.	12 Cyl.
Capacity	1300W	1400W	1400W	1400W
No of breakers	24	25	26	27
DC/DC Converter configuration	12 pcs 5A 12 pcs 10A	13 pcs 5A 12 pcs 10A	14 pcs 5A 12 pcs 10A	15 pcs 5A 12 pcs 10A

Note:Output Breakers, DC/DC converter and terminals according to Cylinder's number

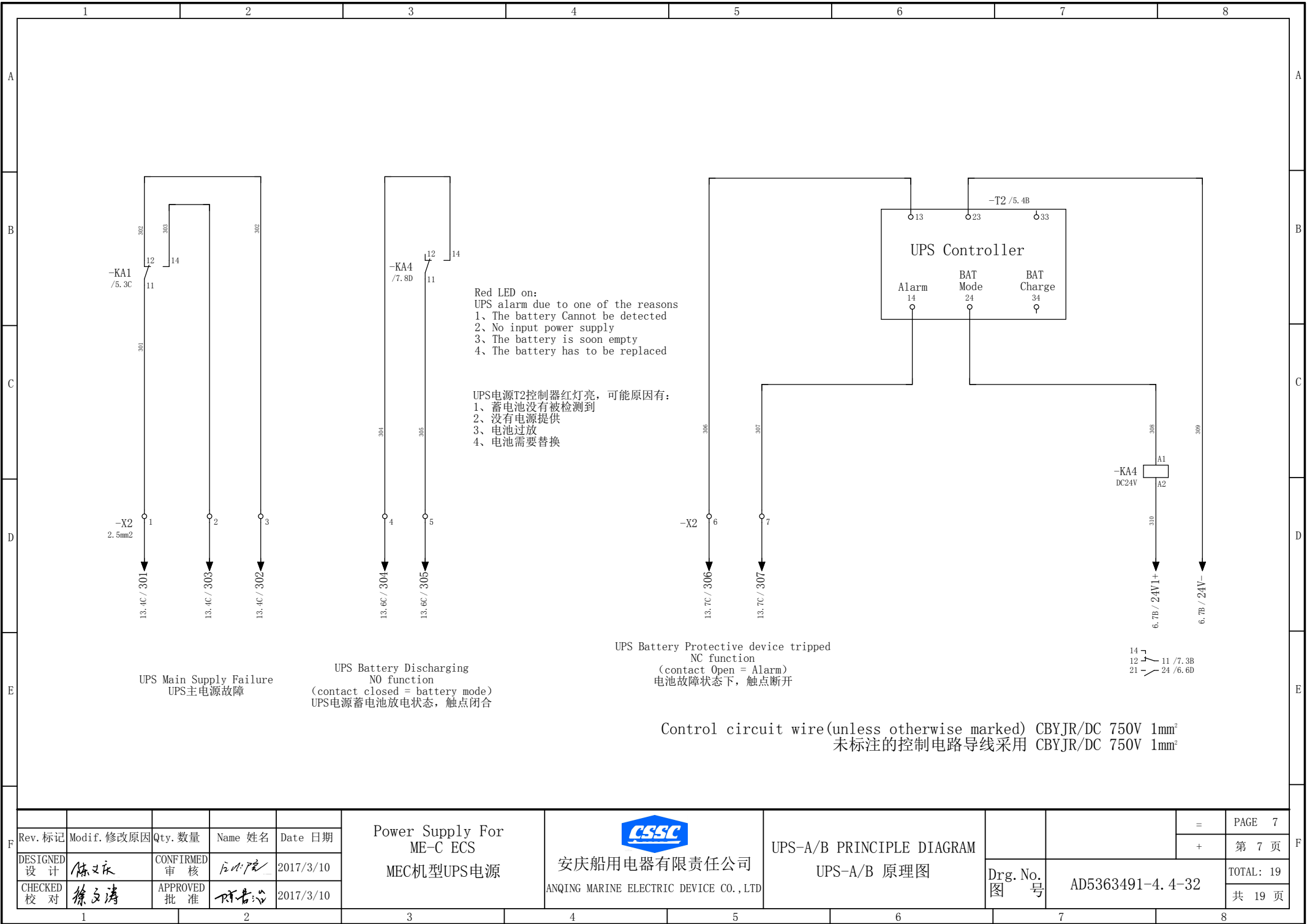


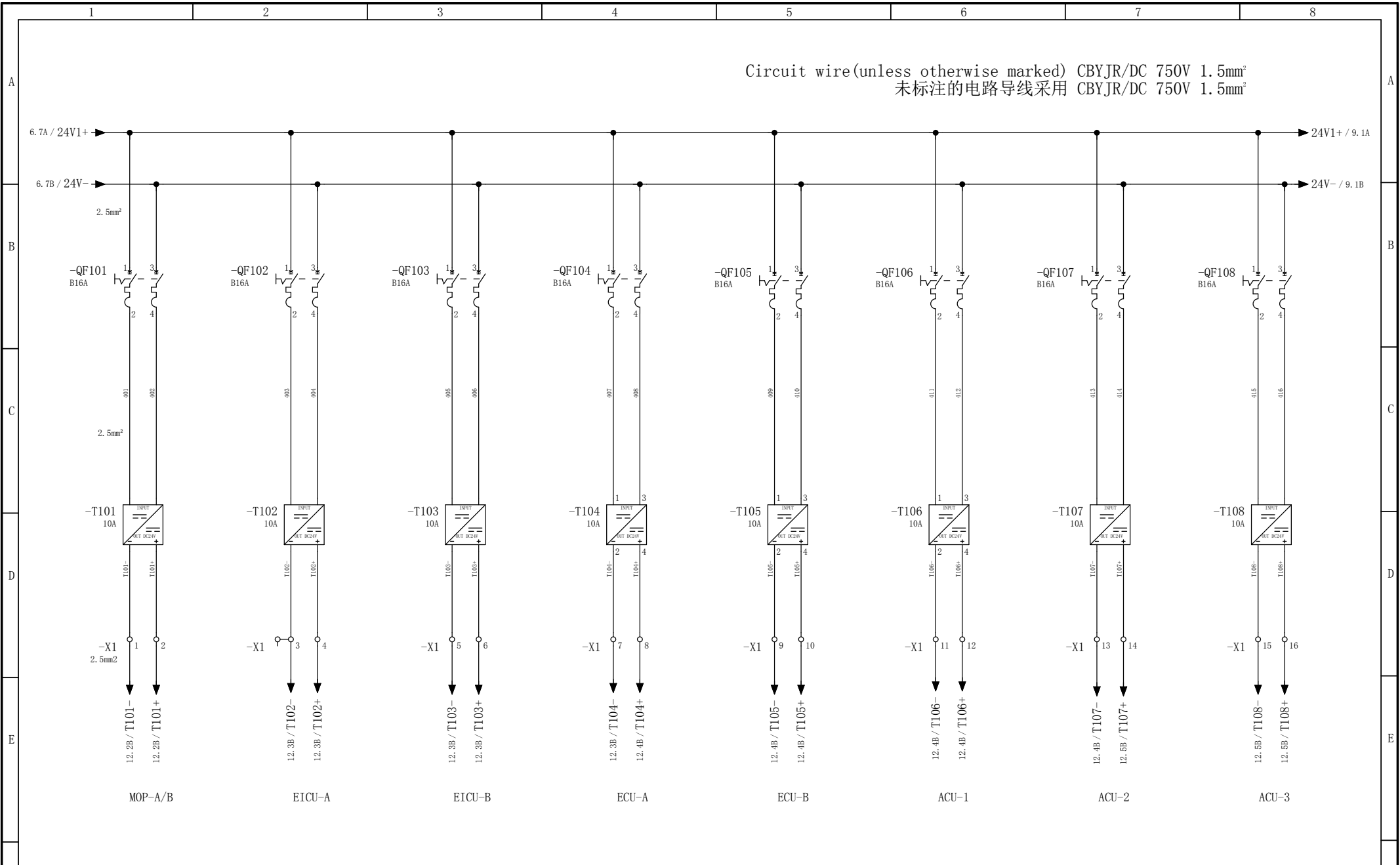
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Rev. 标记	Modif. 修改原因	Qty. 数量	Name 姓名	Date 日期						+	第 3 页
DESIGNED 设计	陈义永	CONFIRMED 审核	江小虎	2016/10/27							TOTAL: 19
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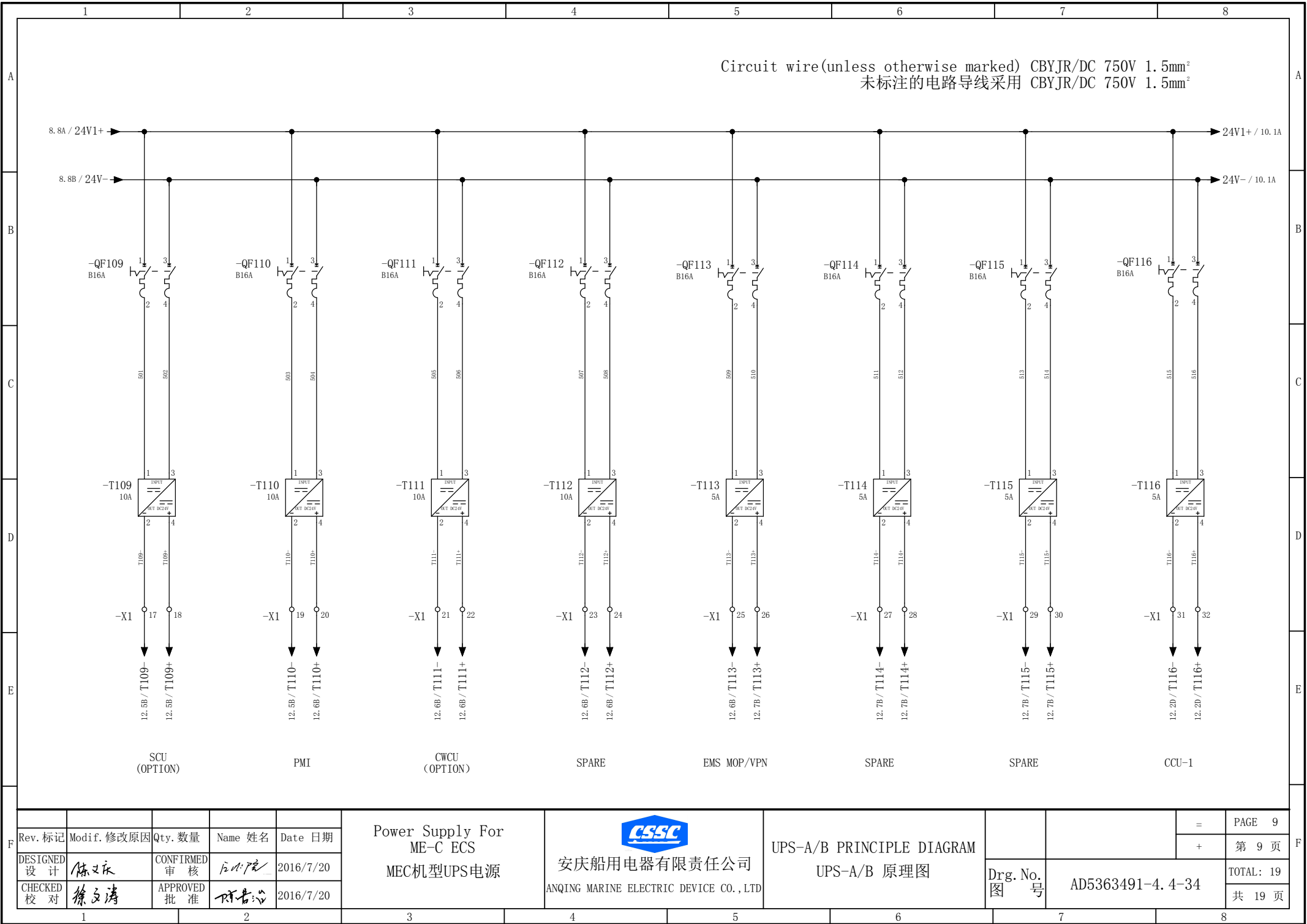


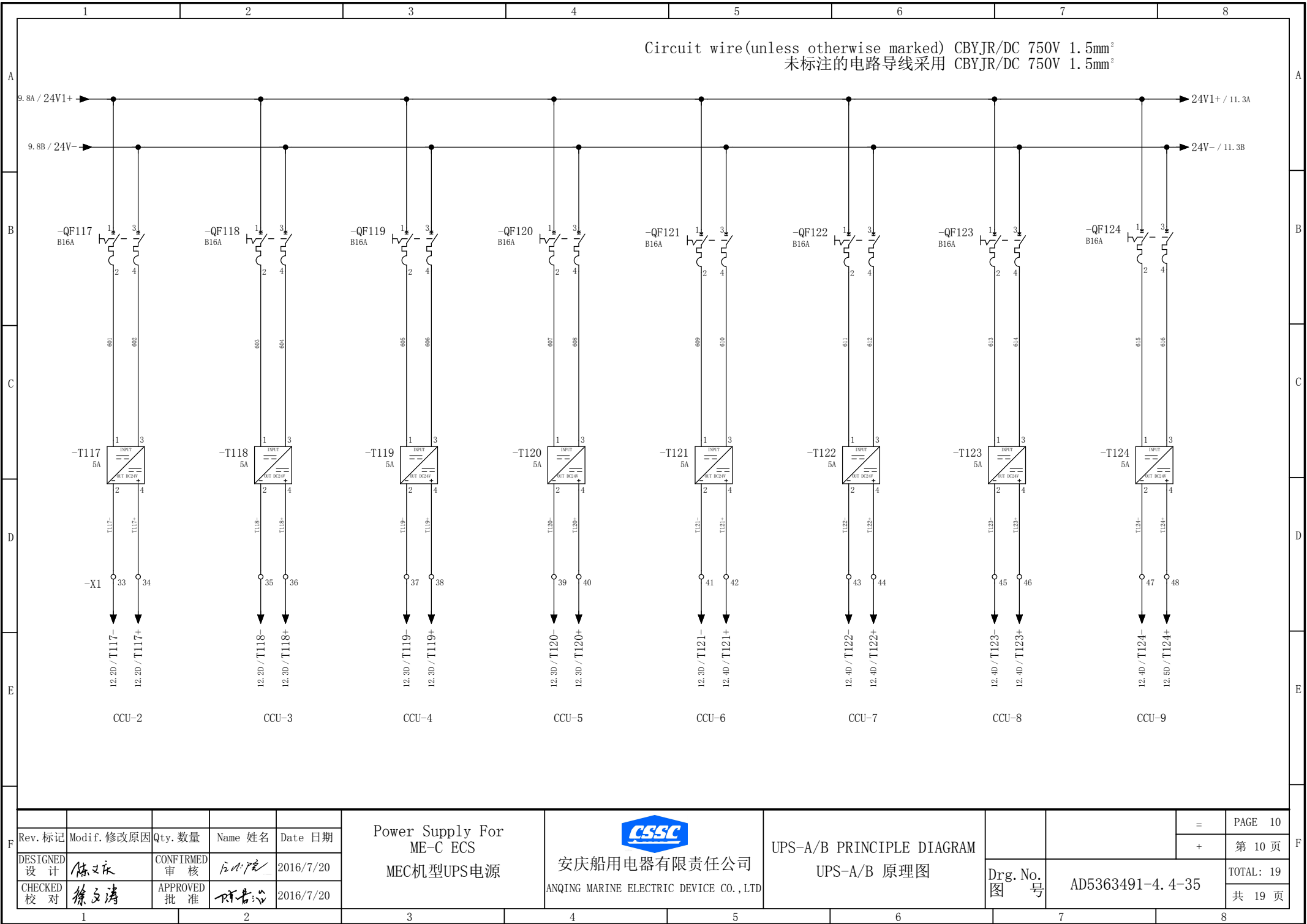
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Rev. 标记	Modif. 修改原因	Qty. 数量	Name 姓名	Date 日期				+	第 6 页		
DESIGNED 设计	陈文永	CONFIRMED 审核	陈文永	2017/3/10	Drg. No. 图 号			AD5363491-4. 4-31	TOTAL: 19		
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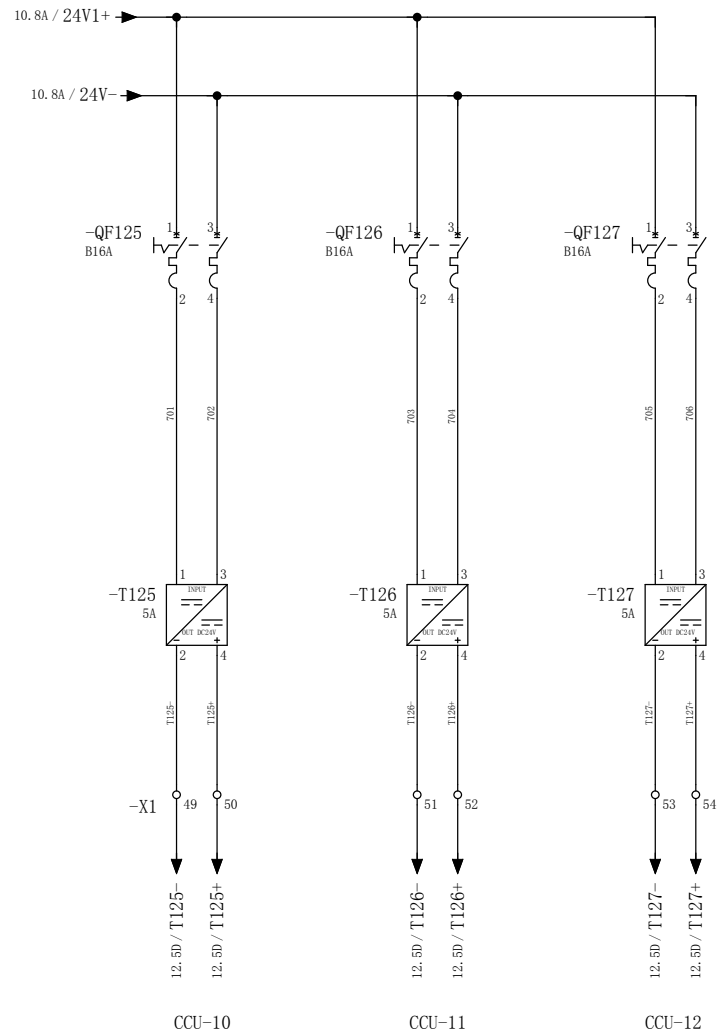


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	CHECKED 校对	徐文涛	APPROVED 批准	陈文永	2017/3/10							

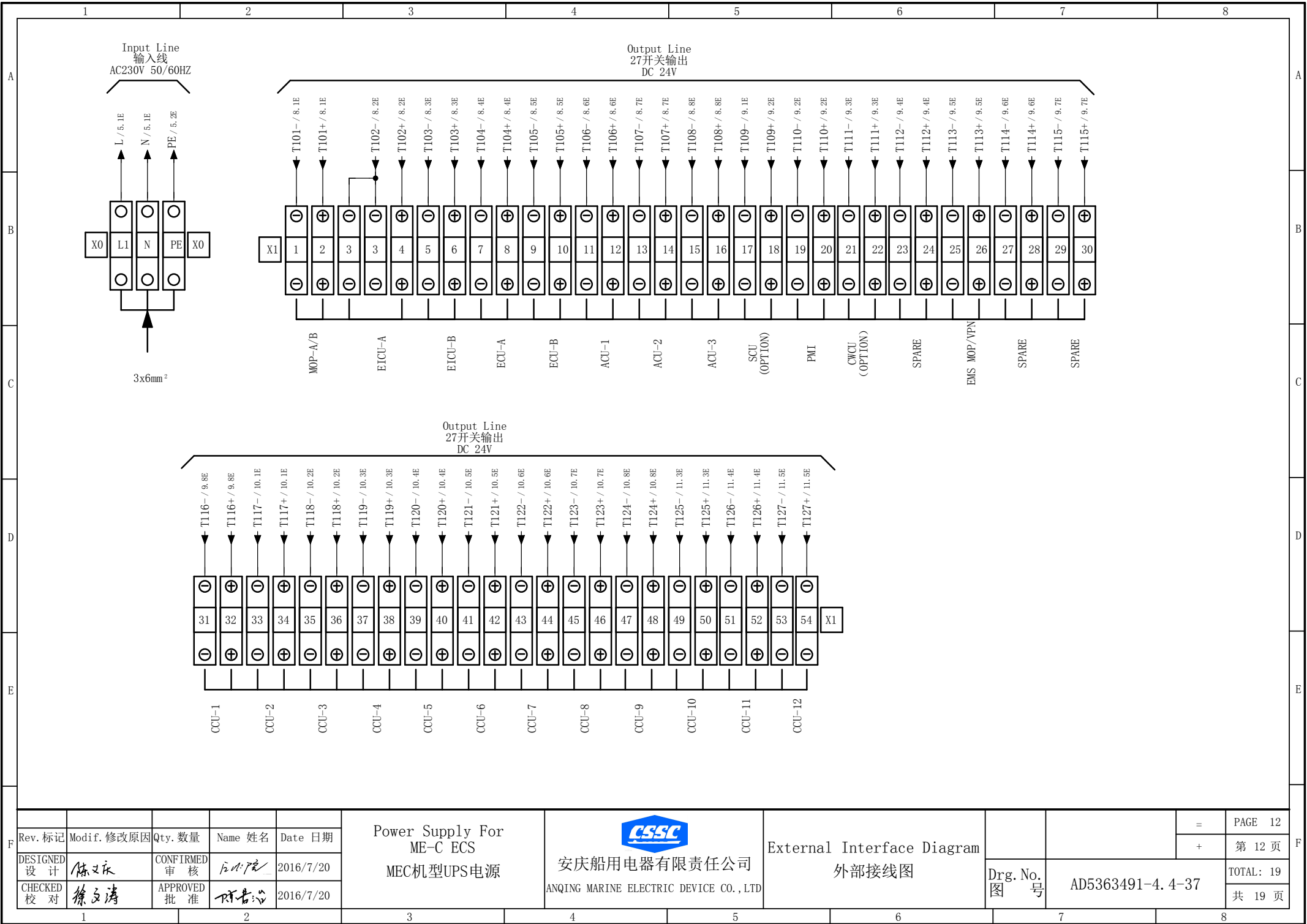


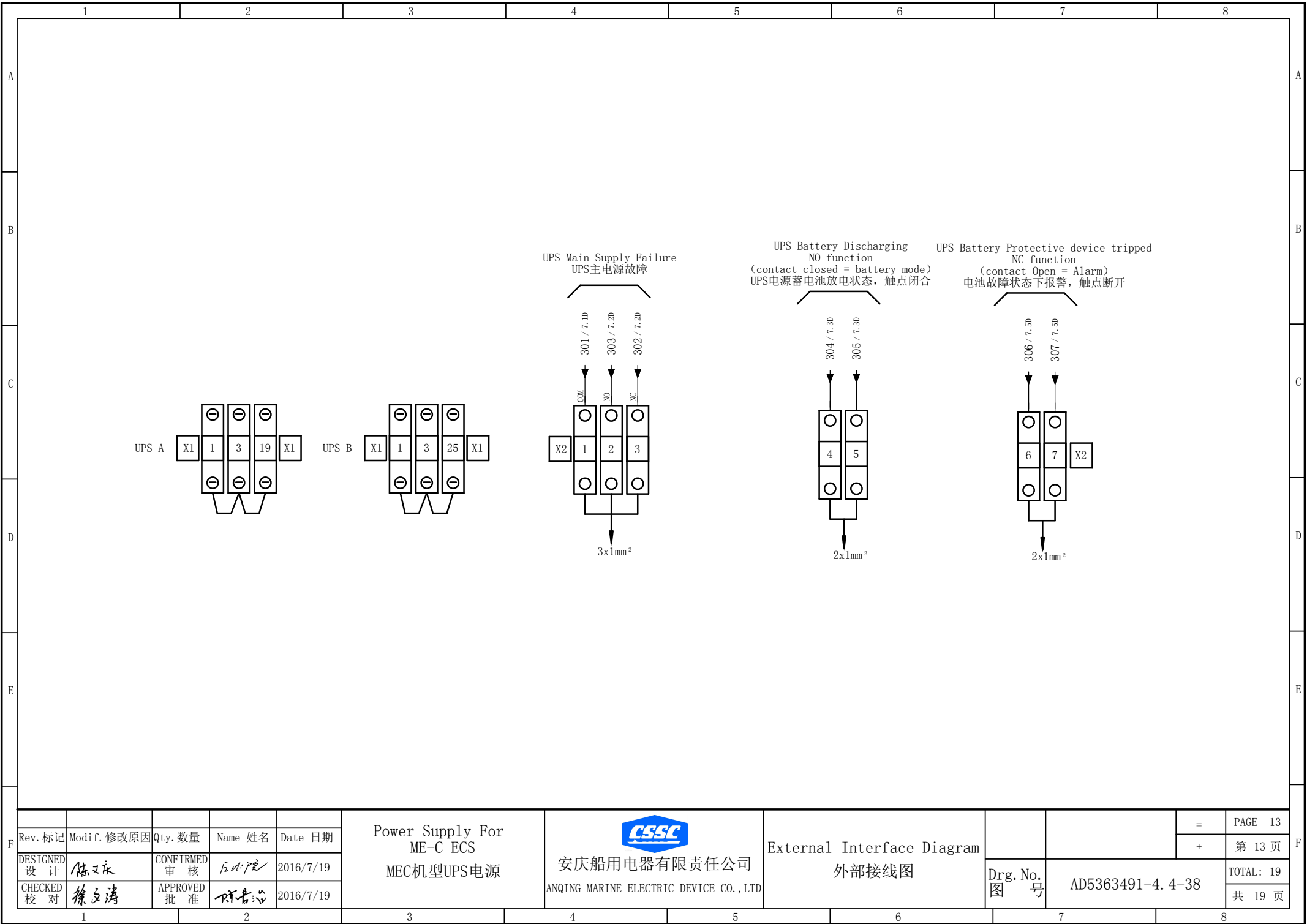


Circuit wire(unless otherwise marked) CBYJR/DC 750V 1.5mm²
未标注的电路导线采用 CBYJR/DC 750V 1.5mm²



F	Rev. 标记	Modif. 修改原因	Qty. 数量	Name 姓名	Date 日期	Power Supply For ME-C ECS MEC机型UPS电源	 安庆船用电器有限责任公司 ANQING MARINE ELECTRIC DEVICE CO., LTD	UPS-A/B PRINCIPLE DIAGRAM UPS-A/B 原理图	Drg. No. 图 号	AD5363491-4. 4-36	=	PAGE 11
	DESIGNED 设计	陈义永	CONFIRMED 审核	陈义永	2016/7/20							第 11 页
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Rev. 标记	Modif. 修改原因	Qty. 数量	Name 姓名	Date 日期	Power Supply For ME-C ECS MEC机型UPS电源	 安庆船用电器有限责任公司 ANQING MARINE ELECTRIC DEVICE CO., LTD	External Interface Diagram 外部接线图	Drg. No. 图 号	AD5363491-4. 4-38	=	PAGE 13
											第 13 页
											TOTAL: 19
											共 19 页

1		2		3		4		5		6		7		8										
序号		代号		名称		型 号 规 格		技术参数		备 注		数 量		制造商										
A	1	C1		蓄电池		LC-X1238APG		DC12V 38Ah		配电池底座		1		松下										
	2	C2		蓄电池		LC-X1238APG		DC12V 38Ah		配电池底座		1		松下										
	3	H1		指示灯		XB4BVB3C		GRN 绿色		DC24V 绿色		1		施耐德										
	4	H2		指示灯		XB4BVB5C		YE 黄色		DC24V 黄色		1		施耐德										
B	5	H3		指示灯		XB4BVB3C		GRN 绿色		DC24V 绿色		1		施耐德										
	6	KA1		中间继电器		LY2NJ		DC24V		配PTF08A-E插座及固定卡		1		欧姆龙										
	7	KA3		中间继电器		LY2NJ		DC24V		配PTF08A-E插座及固定卡		1		欧姆龙										
	8	KA4		中间继电器		LY2NJ		DC24V		配PTF08A-E插座及固定卡		1		欧姆龙										
	9	KT2		时间继电器（通电）		H3Y-2		DC24V		1-10s		1		欧姆龙										
C	10	KT2-1		时间继电器插座及固定配件		PYF08A				配 H3Y-2		1		欧姆龙										
	11	M1		轴流风扇		SR25F		DC24/19W		配过滤网组件		1		上海卡固										
	12	M1-1		过滤网组件		SR25				外形尺寸：255x255		1		上海卡固										
	13	P1		直流电流表		F96-DCB（AMMETER）		0-100A/75mV		1.5级配定值分流器		1		CCS 上海怡泰仪表有限公司										
	14	P2		直流电压表		F96-DCB（VOLTMETER）		DC：0-40V		1.5级		1		CCS 上海怡泰仪表有限公司										
	15	QF1		小型断路器		5SY6210-2		B10A		2P B10A		1		西门子										
	16	QF2		小型断路器		5SY6210-2		B10A		2P B10A		1		西门子										
	17	QF3		小型断路器		5SY6210-2		B10A		2P B10A		1		西门子										
	18	QF4		小型断路器		5SY6210-2		B10A		2P B10A		1		西门子										
	19	QF101		小型断路器		5SY6216-2		B16A		2P B16A		1		西门子										
	20	QF101-1		汇流条（微型断路器用）		5ST3704				Cu 80A、2P、1m 配端盖5ST3704 6个		1		西门子										
D	21	QF102		小型断路器		5SY6216-2		B16A		2P B16A		1		西门子										
	22	QF103		小型断路器		5SY6216-2		B16A		2P B16A		1		西门子										
	23	QF104		小型断路器		5SY6216-2		B16A		2P B16A		1		西门子										
	24	QF105		小型断路器		5SY6216-2		B16A		2P B16A		1		西门子										
	25	QF106		小型断路器		5SY6216-2		B16A		2P B16A		1		西门子										
	26	QF107		小型断路器		5SY6216-2		B16A		2P B16A		1		西门子										
	27	QF108		小型断路器		5SY6216-2		B16A		2P B16A		1		西门子										
	28	QF109		小型断路器		5SY6216-2		B16A		2P B16A		1		西门子										
	29	QF110		小型断路器		5SY6216-2		B16A		2P B16A		1		西门子										
	30	QF111		小型断路器		5SY6216-2		B16A		2P B16A		1		西门子										
F	Rev. 标记		Modif. 修改原因		Qty. 数量		Name 姓名		Date 日期		Power Supply For ME-C ECS MEC机型UPS电源		 安庆船用电器有限责任公司 ANQING MARINE ELECTRIC DEVICE CO.,LTD		Chinese Elements List 1 中文元件清单1						= PAGE 14 + 第 14 页			
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NO.	MARK	NAME		DESCRIPTION AND SPECIFICATION		TECHNICAL PARAMETER		REMARK		QTY.	MANUFACTURER													
A	1	C1	Battery		LC-X1238APG		DC12V 38Ah		For Battery Socket		1	Panasonic												
	2	C2	Battery		LC-X1238APG		DC12V 38Ah		For Battery Socket		1	Panasonic												
	3	H1	INDICATING LAMP		XB4BVB3C		GRN 绿色		DC24V GRN		1	Schneider												
	4	H2	INDICATING LAMP		XB4BVB5C		YE 黄色		DC24V YE		1	Schneider												
B	5	H3	INDICATING LAMP		XB4BVB3C		GRN 绿色		DC24V GRN		1	Schneider												
	6	KA1	RELAY		LY2NJ		DC24V		For Socket Of PTF08A-E and Fix		1	OMRON												
	7	KA3	RELAY		LY2NJ		DC24V		For Socket Of PTF08A-E and Fix		1	OMRON												
	8	KA4	RELAY		LY2NJ		DC24V		For Socket Of PTF08A-E and Fix		1	OMRON												
	9	KT2	TIME RELAY		H3Y-2		DC24V		1-10s		1	OMRON												
	10	KT2-1	RELAY SOCKET		PYF08A				FOR H3Y-2		1	OMRON												
C	11	M1	Propeller Fan		SR25F		DC24/19W		For Inlet Filter		1	KaGu												
	12	M1-1	Filter net		SR25				Boundary Dimension: 255x255		1	Schneider												
	13	P1	AMMETER DC		F96-DCB (AMMETER)		0-100A/75mV		CL. 1.5 For Current Divider		1	CCS SHANGHAI YITAI I&M Ltd												
	14	P2	VOLTMETER DC		F96-DCB (VOLTMETER)		DC: 0-40V		CL. 1.5		1	CCS SHANGHAI YITAI I&M Ltd												
	15	QF1	MINITYPE BREAKER		5SY6210-2		B10A		2P B10A		1	SIEMEN												
	16	QF2	MINITYPE BREAKER		5SY6210-2		B10A		2P B10A		1	SIEMEN												
D	17	QF3	MINITYPE BREAKER		5SY6210-2		B10A		2P B10A		1	SIEMEN												
	18	QF4	MINITYPE BREAKER		5SY6210-2		B10A		2P B10A		1	SIEMEN												
	19	QF101	MINITYPE BREAKER		5SY6216-2		B16A		2P B16A		1	SIEMEN												
	20	QF101-1	Bus-Bar (MINITYPE BREAKER)		5ST3704				Cu 80A、2P、1m For End Cap to 5ST3704		1	Schneider												
	21	QF102	MINITYPE BREAKER		5SY6216-2		B16A		2P B16A		1	SIEMEN												
	22	QF103	MINITYPE BREAKER		5SY6216-2		B16A		2P B16A		1	SIEMEN												
E	23	QF104	MINITYPE BREAKER		5SY6216-2		B16A		2P B16A		1	SIEMEN												
	24	QF105	MINITYPE BREAKER		5SY6216-2		B16A		2P B16A		1	SIEMEN												
	25	QF106	MINITYPE BREAKER		5SY6216-2		B16A		2P B16A		1	SIEMEN												
	26	QF107	MINITYPE BREAKER		5SY6216-2		B16A		2P B16A		1	SIEMEN												
	27	QF108	MINITYPE BREAKER		5SY6216-2		B16A		2P B16A		1	SIEMEN												
	28	QF109	MINITYPE BREAKER		5SY6216-2		B16A		2P B16A		1	SIEMEN												
	29	QF110	MINITYPE BREAKER		5SY6216-2		B16A		2P B16A		1	SIEMEN												
F	30	QF111	MINITYPE BREAKER		5SY6216-2		B16A		2P B16A		1	SIEMEN												
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NO.		MARK		NAME		DESCRIPTION AND SPECIFICATION		TECHNICAL PARAMETER		REMARK		QTY.		MANUFACTURER								
A	31	QF112		MINITYPE BREAKER		5SY6216-2		B16A		2P B16A		1		SIEMEN								
	32	QF113		MINITYPE BREAKER		5SY6216-2		B16A		2P B16A		1		SIEMEN								
	33	QF114		MINITYPE BREAKER		5SY6216-2		B16A		2P B16A		1		SIEMEN								
	34	QF115		MINITYPE BREAKER		5SY6216-2		B16A		2P B16A		1		SIEMEN								
B	35	QF116		MINITYPE BREAKER		5SY6216-2		B16A		2P B16A		1		SIEMEN								
	36	QF117		MINITYPE BREAKER		5SY6216-2		B16A		2P B16A		1		SIEMEN								
	37	QF118		MINITYPE BREAKER		5SY6216-2		B16A		2P B16A		1		SIEMEN								
	38	QF119		MINITYPE BREAKER		5SY6216-2		B16A		2P B16A		1		SIEMEN								
C	39	QF120		MINITYPE BREAKER		5SY6216-2		B16A		2P B16A		1		SIEMEN								
	40	QF121		MINITYPE BREAKER		5SY6216-2		B16A		2P B16A		1		SIEMEN								
	41	QF122		MINITYPE BREAKER		5SY6216-2		B16A		2P B16A		1		SIEMEN								
	42	QF123		MINITYPE BREAKER		5SY6216-2		B16A		2P B16A		1		SIEMEN								
D	43	QF124		MINITYPE BREAKER		5SY6216-2		B16A		2P B16A		1		SIEMEN								
	44	QF125		MINITYPE BREAKER		5SY6216-2		B16A		2P B16A		1		SIEMEN								
	45	QF126		MINITYPE BREAKER		5SY6216-2		B16A		2P B16A		1		SIEMEN								
	46	QF127		MINITYPE BREAKER		5SY6216-2		B16A		2P B16A		1		SIEMEN								
E	47	QS1		Break Switch		P1-25/EA/SVB/HI11		25A				1		Moeller								
	48	R1		Active Redundancy Modle		QUINT-ORING/24DC/2×40A/1×80A		80A		24V DC/2×40A		1		PHOENIX CONTACT								
	49	R3		Diverter		0-100A/75mV		100A/75mV		For F96-DCB Ammeter		1		CCS SHANGHAI YITAI I&M Ltd								
	50	T1		Switch Power Supply		QUINT-PS/1AC/24DC/40		40A		AC-DC		1		PHOENIX CONTACT								
F	51	T2		UPS-IQ (UPS Power Manage)		QUINT-UPS/24DC/24DC/40		40A				1		PHOENIX CONTACT								
	52	T3		Switch Power Supply		QUINT-PS/1AC/24DC/40		40A		AC-DC		1		PHOENIX CONTACT								
	53	T5		UPS Battery Module		UPS-BAT/VRLA/24DC/38Ah				For SFB Converter		1		PHOENIX CONTACT								
	54	T101		QUINT DC/DC Converter		QUINT-PS/24DC/24DC/10		10A				1		PHOENIX CONTACT								
G	55	T102		QUINT DC/DC Converter		QUINT-PS/24DC/24DC/10		10A				1		PHOENIX CONTACT								
	56	T103		QUINT DC/DC Converter		QUINT-PS/24DC/24DC/10		10A				1		PHOENIX CONTACT								
	57	T104		QUINT DC/DC Converter		QUINT-PS/24DC/24DC/10		10A				1		PHOENIX CONTACT								
	58	T105		QUINT DC/DC Converter		QUINT-PS/24DC/24DC/10		10A				1		PHOENIX CONTACT								
H	59	T106		QUINT DC/DC Converter		QUINT-PS/24DC/24DC/10		10A				1		PHOENIX CONTACT								
	60	T107		QUINT DC/DC Converter		QUINT-PS/24DC/24DC/10		10A				1		PHOENIX CONTACT								
	Rev. 标记		Modif. 修改原因		Qty. 数量		Name 姓名		Date 日期		Power Supply For ME-C ECS		MEC机型UPS电源		English Elements List 2 英文元件清单2		Drg. No. 图 号		AD5363491-4. 4-44		PAGE 18 第 18 页 TOTAL: 19 共 19 页	
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1		2		3		4		5		6		7		8							
NO.	MARK	NAME		DESCRIPTION AND SPECIFICATION		TECHNICAL PARAMETER		REMARK		QTY.	MANUFACTURER										
A	61	T108		QUINT DC/DC Converter		QUINT-PS/24DC/24DC/10		10A				1	PHOENIX CONTACT								
	62	T109		QUINT DC/DC Converter		QUINT-PS/24DC/24DC/10		10A				1	PHOENIX CONTACT								
	63	T110		QUINT DC/DC Converter		QUINT-PS/24DC/24DC/10		10A				1	PHOENIX CONTACT								
	64	T111		QUINT DC/DC Converter		QUINT-PS/24DC/24DC/10		10A				1	PHOENIX CONTACT								
B	65	T112		QUINT DC/DC Converter		QUINT-PS/24DC/24DC/10		10A				1	PHOENIX CONTACT								
	66	T113		QUINT DC/DC Converter		QUINT-PS/24DC/24DC/5		5A				1	PHOENIX CONTACT								
	67	T114		QUINT DC/DC Converter		QUINT-PS/24DC/24DC/5		5A				1	PHOENIX CONTACT								
	68	T115		QUINT DC/DC Converter		QUINT-PS/24DC/24DC/5		5A				1	PHOENIX CONTACT								
C	69	T116		QUINT DC/DC Converter		QUINT-PS/24DC/24DC/5		5A				1	PHOENIX CONTACT								
	70	T117		QUINT DC/DC Converter		QUINT-PS/24DC/24DC/5		5A				1	PHOENIX CONTACT								
	71	T118		QUINT DC/DC Converter		QUINT-PS/24DC/24DC/5		5A				1	PHOENIX CONTACT								
	72	T119		QUINT DC/DC Converter		QUINT-PS/24DC/24DC/5		5A				1	PHOENIX CONTACT								
D	73	T120		QUINT DC/DC Converter		QUINT-PS/24DC/24DC/5		5A				1	PHOENIX CONTACT								
	74	T121		QUINT DC/DC Converter		QUINT-PS/24DC/24DC/5		5A				1	PHOENIX CONTACT								
	75	T122		QUINT DC/DC Converter		QUINT-PS/24DC/24DC/5		5A				1	PHOENIX CONTACT								
	76	T123		QUINT DC/DC Converter		QUINT-PS/24DC/24DC/5		5A				1	PHOENIX CONTACT								
E	77	T124		QUINT DC/DC Converter		QUINT-PS/24DC/24DC/5		5A				1	PHOENIX CONTACT								
	78	T125		QUINT DC/DC Converter		QUINT-PS/24DC/24DC/5		5A				1	PHOENIX CONTACT								
	79	T126		QUINT DC/DC Converter		QUINT-PS/24DC/24DC/5		5A				1	PHOENIX CONTACT								
	80	T127		QUINT DC/DC Converter		QUINT-PS/24DC/24DC/5		5A				1	PHOENIX CONTACT								
F	81	X		End Eracket		E/NS 35N						12	PHOENIX CONTACT								
	82	X-1		SK TERMINAL STAND		AB-SK TOP INSULATED						2	PHOENIX CONTACT								
	83	X-2		Bus-Bar		NLS-CU 3/10Sn				Cu 10x3x1000		1	PHOENIX CONTACT								
	84	X0		TERMINAL		PT6-TWIN		6mm2		One Input and Two Output		2	PHOENIX CONTACT								
E	85	X0-1		Ground TERMINAL		PT6-TWIN-PE		6mm2		One Input and Two Output		1	PHOENIX CONTACT								
	86	X1		TERMINAL		PT 2.5-TWIN		2.5mm2		One Input and Two Output		55	PHOENIX CONTACT								
	87	X2		TERMINAL		PT 2.5-TWIN		2.5mm2		One Input and Two Output		7	PHOENIX CONTACT								
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DC24V Uninterruptible Power Supply

Type:UPS2400-3

User Guide & Instruction Manual

Anqing Marine Electric Device CO., LTD

2016-08-08

Table of Contents

TABLE OF CONTENTS	2
1、SYSTEM CHARACTERISTICS	3
2、INTRODUCTION	3
2.1 ME UPS2400-3 Introduction.....	3
2.2 ME UPS2400-3 figure and structure.....	4
3 、MAIN COMPONENTS	9
3.1 Power supply unit(QUINT-PS/1AC/24DC/40).....	9
3.2 Uninterruptible power supply (QUINT-UPS/24DC/24DC/40)	11
3.3 Redundancy module (QUINT-ORING/24DC/2×40A/1×80A)	15
3.4 DC/DC converter (QUINT-PS/24DC/24DC/10; QUINT-PS/24DC/24DC/5)	16
3.5 Battery and Figure	19
4、USER GUIDE	20
4.1 Cable laying of input and output connection panels	20
4.2 Connecting Switches.....	21
4.3 Operation testing.....	21
5、ALARM & TROUBLESHOOTING	22
6、SYSTEM SPECIFICATIONS(TABLE 14)	24
7、UPS2400-3 ORDERING INFORMATION	25
7.1 UPS2400-3 type meaning:	25
7.2 UPS2400-3 scope of supply (Table 15)	25

1、System Characteristics

ME UPS2400-3 has the following characteristics:

1. single-phase on-line uninterruptible DC system;
2. offers rating 1400W, up to 2000W stable power supply (clean energy);
3. integrated figure with stable performance;
4. DC module operation, reduces linearity conflict;
5. provides environmentally-friendly energy, the output resembles a straight line;
6. the power module with IQ technology and SFB technology, high performance and stability, and can work under abominable conditions;
7. DC UPS with standby input, interchange between AC and DC freely, and functions of over-current, over-voltage, under-voltage and short circuit protection.

2、Introduction

2.1 ME UPS2400-3 Introduction

ME UPS2400-3 can provide uninterruptible and stable DC24V, which applies to ME 12 cylinders, with a chargeable battery, and provide the output of no less than 80A clean and invariable current. The set capacity of the circuit 16A and 6A air switch protection. In case of over-current or over-load, the switch will operate protecting, which includes two parts: the extra system of DC24V Supply A、DC24V Supply B, shown as Fig.1:

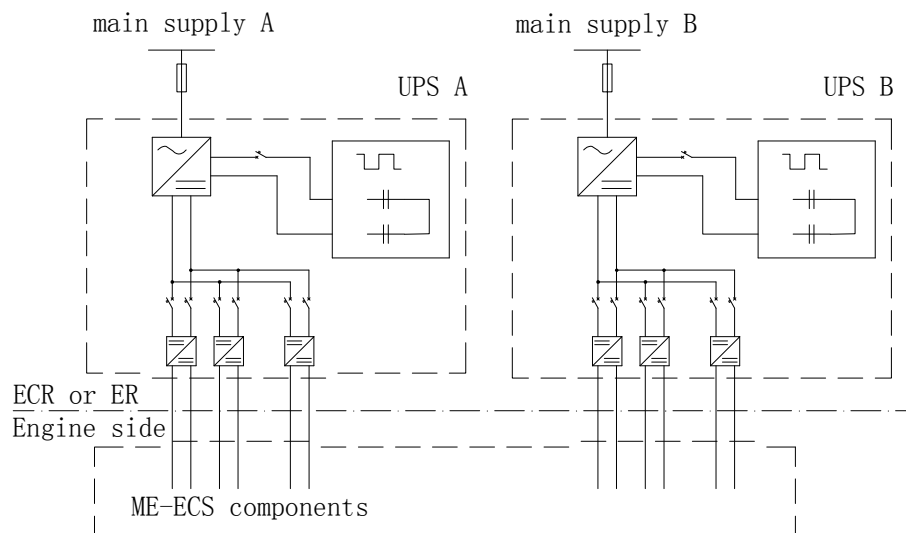


Fig.1 Diagram of power supply system for ME-ECS

2.2 ME UPS2400-3 figure and structure

2.1.1 UPS2400-3 figure

The power system of UPS2400-3 includes two parts: POWER A and POWER B, the dimensions of the two parts are same, i.e. 600mm×600mm×2100mm, see Fig. 2:

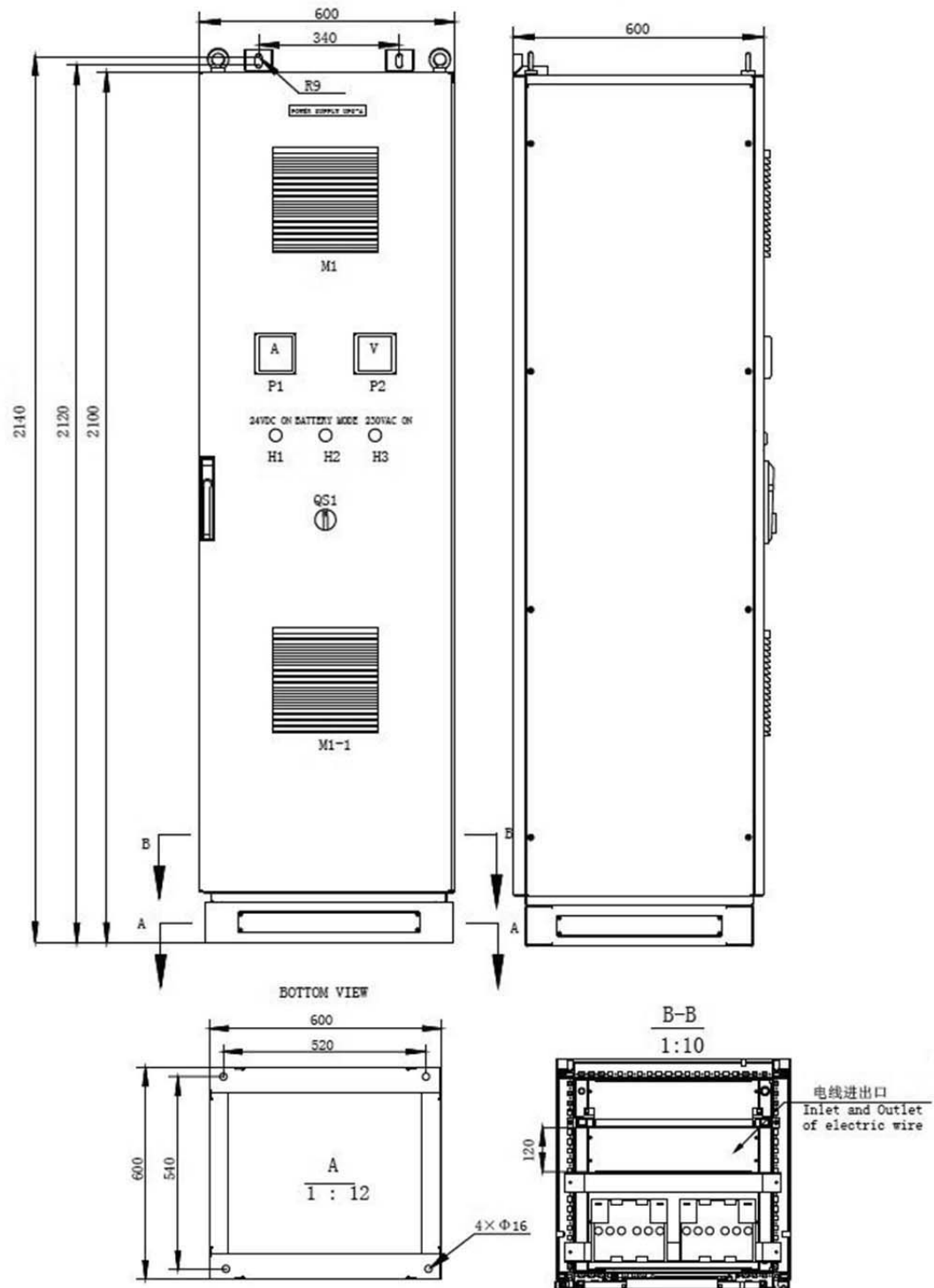


Fig.2 POWER A/B Dimensions

2.1.2 UPS2400-3 figure, structure and functions of main components:

Its basic components are as follows:

- A. AC input switches
- B. Power module
- C. Back-up battery
- D. DC output switches
- E. Input and output connecting panel

For exterior collocation of UPS2400-3 power panel POWER A and POWER B, see Fig.

3, Fig. 4 and Fig. 5. For functions of each component, see Table 1.

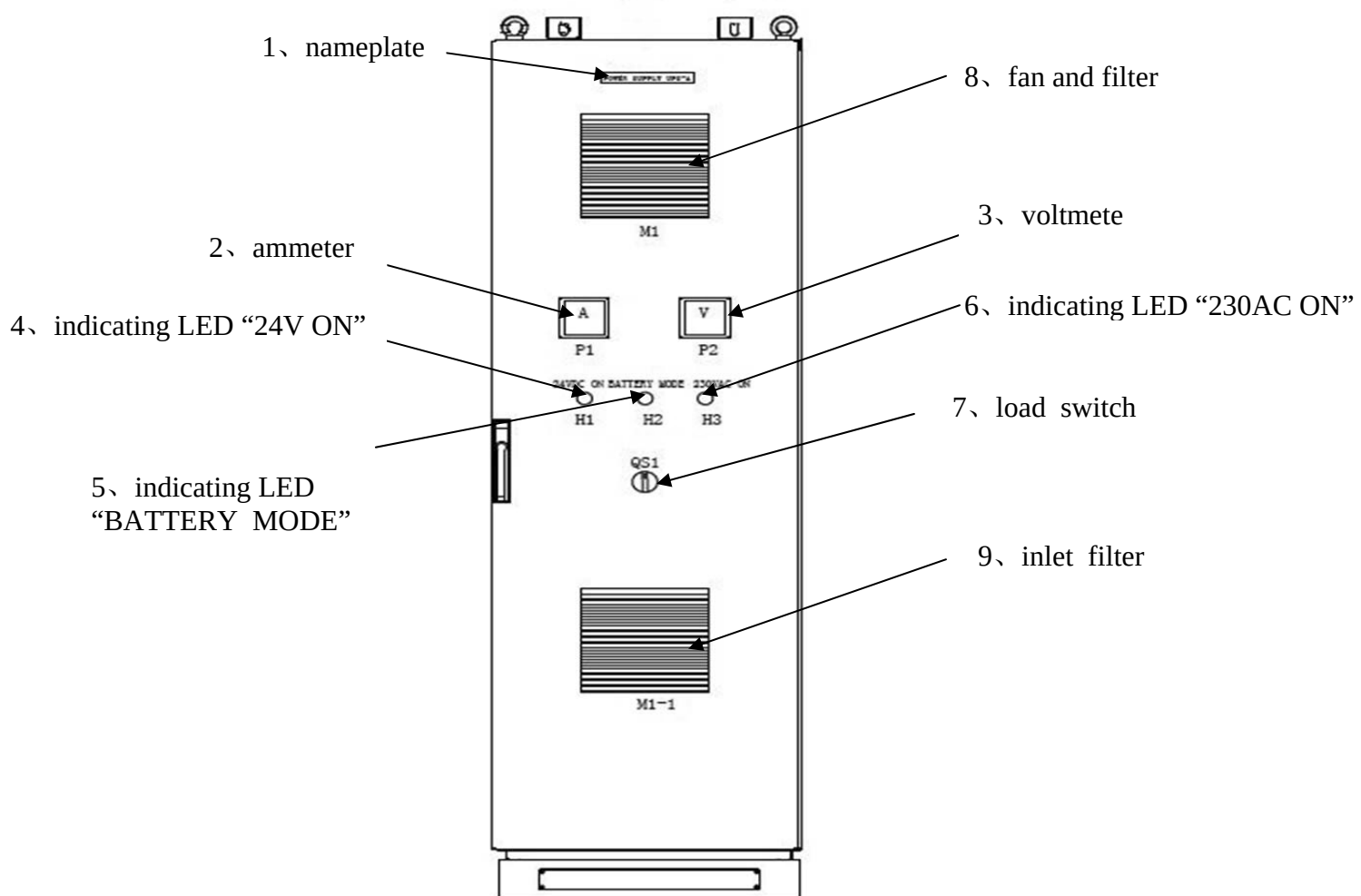


Fig.3 Power A/B external layout drawing

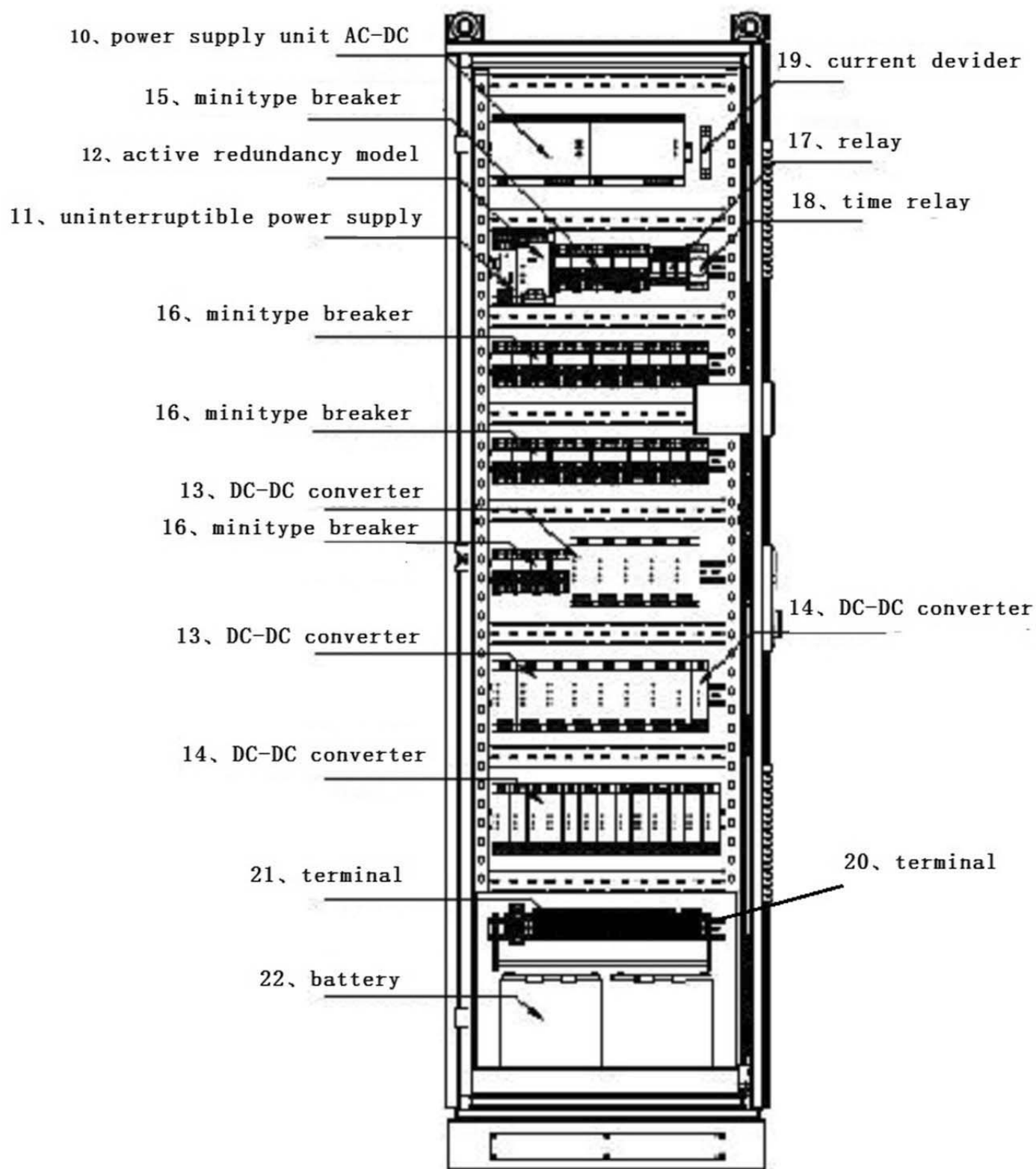


Fig.4 Power A/B internal layout drawing

Table 1 UPS2400-3 components and Desc.&Spec

No.	Component name	Mark	Desc.&Spec	Remark
1	nameplate		UPS-A/B Uninterruptible PowerSupply A/B	
2	ammeter	P1	F96-DCB CL1.5 DC0-100A	
3	voltmeter	P2	F96-DCB CL1.5 DC0-50V	
4	Indicating LED “24VDC ON ”	H1	XB4BVB3C GR	
5	Indicating LED “BATTERY MODE”	H2	XB4BVB3C YE	
6	Indicating LED “230AC ON”	H3	XB4BVB3C GR	
7	Load switch	QS1		
8	Fan and filter	M1	SR25F	
9	Inlet filter	M1-1	SR25	
10	Power supply unit AC-DC	T1、 T3	QUINT-PS/1AC/24DC/40	
11	Uninterruptible power supply	T2	QUINT-UPS/24DC/24DC/40	
12	Active redundancy model	R1	QUINT-ORING/24DC/2×40A /1×80A	
13	DC-DC converter	T101-T112	QUINT-PS/24DC/24DC/10	
14	DC-DC converter	T113-T127	QUINT-PS/24DC/24DC/5	
15	Minitype break	QF1-QF4	5SY6210-2 B10	
16	Minitype break	QF101-QF127	5SY6210-2 B16	
17	Relay	KA1、 KA3、 KA4	LY2NJ	
18	Time relay	KT2	H3Y-2	
19	Current divider	R3	DC0-100A 100A/75mV	
20	Terminal	X0	PT6-TWIN	
21	Terminal	X1、 X2	PT2.5-TWIN	
22	battery	T5、 C1、 C2	UPS-BAT/VRLA/24DC/38AH	

UPS2400-3 electric diagram is shown as Fig.5

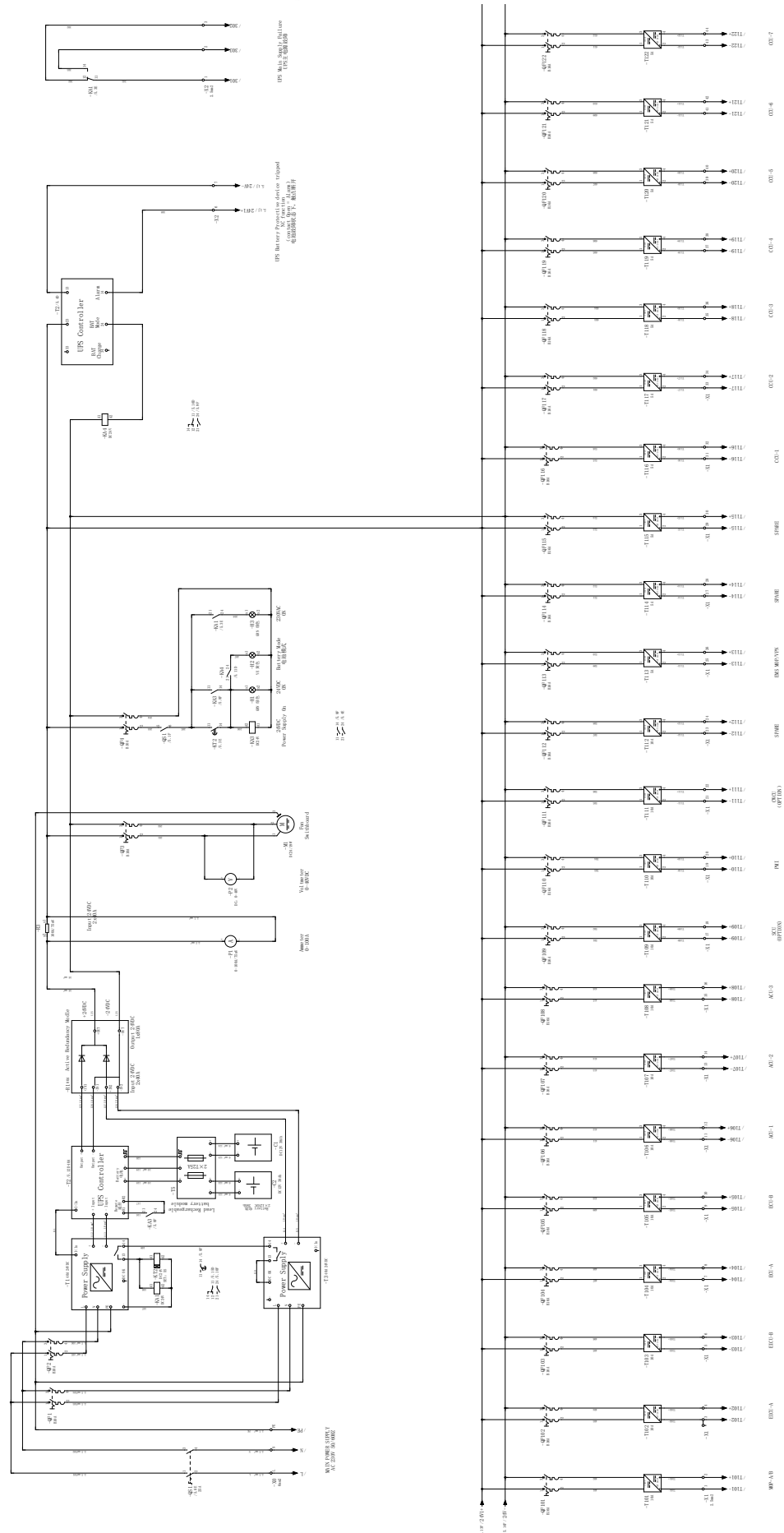


Fig.5 UPS2400-3 electric diagram

3 、 Main Components

3.1 Power supply unit(QUINT-PS/1AC/24DC/40)

3.1.1 Introduction

The power supply unit input nominal voltage range is AC100V~AC240V, AC frequency range is 45Hz~65Hz, DC input voltage is $DC24V \pm 1\%$. Power supply unit with the SFB technology (Selective Fuse Breaking Technology), six times the nominal current for 12 ms, even the standard power circuit-breakers can now also be triggered reliably and quickly. Faulty current paths are switched off selectively, the fault is located and important system parts continue to operate. Comprehensive diagnostics are provided through constant monitoring of output voltage and current.

3.1.2 The appearance and interface specification of power supply unit (Fig.6)

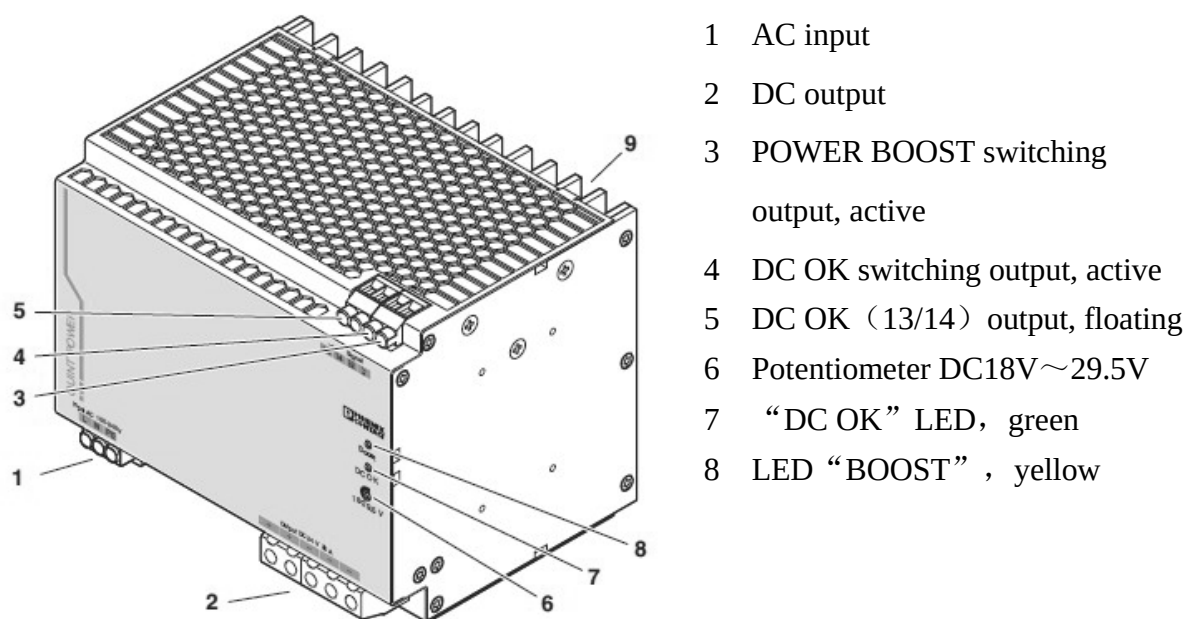


Fig.6 the appearance and interface diagram of power supply unit

3.1.3 Signal description of power supply unit (Table 2)

Table 2 Signal description table of power supply unit

State	$I < I_N$ Normal operation of the power supply unit	$I > I_N$ POWER BOOST operation, e.g. to start loads	$U_{OUT} < 0.9 \times U_N$ Overload mode, e.g. consumer short circuit or overload
-------	--	--	--

	($U_{OUT} > 21.5V$)		
“DC OK” LED	ON	ON	Flashing
“BOOST” LED	OFF	ON	ON
Active DC OK switching output	ON	ON	OFF
Floting DC OK (13/14) output	closed	closed	open
Active POWER BOOST switching output	ON	OFF	OFF

3.1.4 The power supply unit specification (Table 3)

Table 3 the power supply unit specification

technical data for power supply unit	
Ambient conditions	
Ambient temperature (operation)	-25℃~ +70℃, (60℃~70℃: derating 2.5%/K)
Ambient temperature (storage/transport)	-40℃~ +85℃
Max. permissible relative humidity (operation)	≤95%, (at 25 °C, no condensation)
Input data	
Input nominal voltage range	AC100V~AC240V/ DC120V~DC300V
input voltage range	AC85V~AC264V/ DC90V~DC300V
frequency range	45Hz~65Hz / 0Hz
Power failure bypass	>20ms(AC120V)/ >20ms(AC230V)
Output data	
Nominal output voltage / Setting range of the output voltage	DC24V / DC18V~ DC29.5V
Output current	40A
SFB technology (12ms)	215A
POWER BOOST	45A ($U_{IN} \geq AC100V$, $\geq DC120V$)

Resistance to reverse feed	DC35V
General data	
Efficiency	>92%
Degree of protection	IP20
Dimensions W / H / D (state of delivery)	180mm×130mm×125mm
Weight	3.3kg

3.2 Uninterruptible power supply (QUINT-UPS/24DC/24DC/40)

3.2.1 Introduction

Uninterruptible power supplies (UPS) continue to deliver power even if the mains breaks down. Intelligent technology enables the system to play great availability, it can quickly charge the battery, UPS with SFB(selective fuse) technology. In mains mode (DC input voltage present), the output voltage corresponds to the applied input voltage. In the event of a failure of the voltage supply, switching to battery mode takes place without interruption. The output voltage is not directly dependent on the battery voltage. UPS with IQ technology, when connected to the $I < I_N$ output of the QUINT POWER power supply unit, the power supply unit is charged with the maximum charging current as quickly as possible (fast battery charging). Supply of the buffered DC load always has priority. This function is available when the power supply unit makes a static power reserve available with corresponding signal contact e. g., QUINT POWER with POWER BOOST and preventive function monitoring. Without this, charging is performed at reduced current.

3.2.2 UPS appearance and interface specification (Fig. 7)

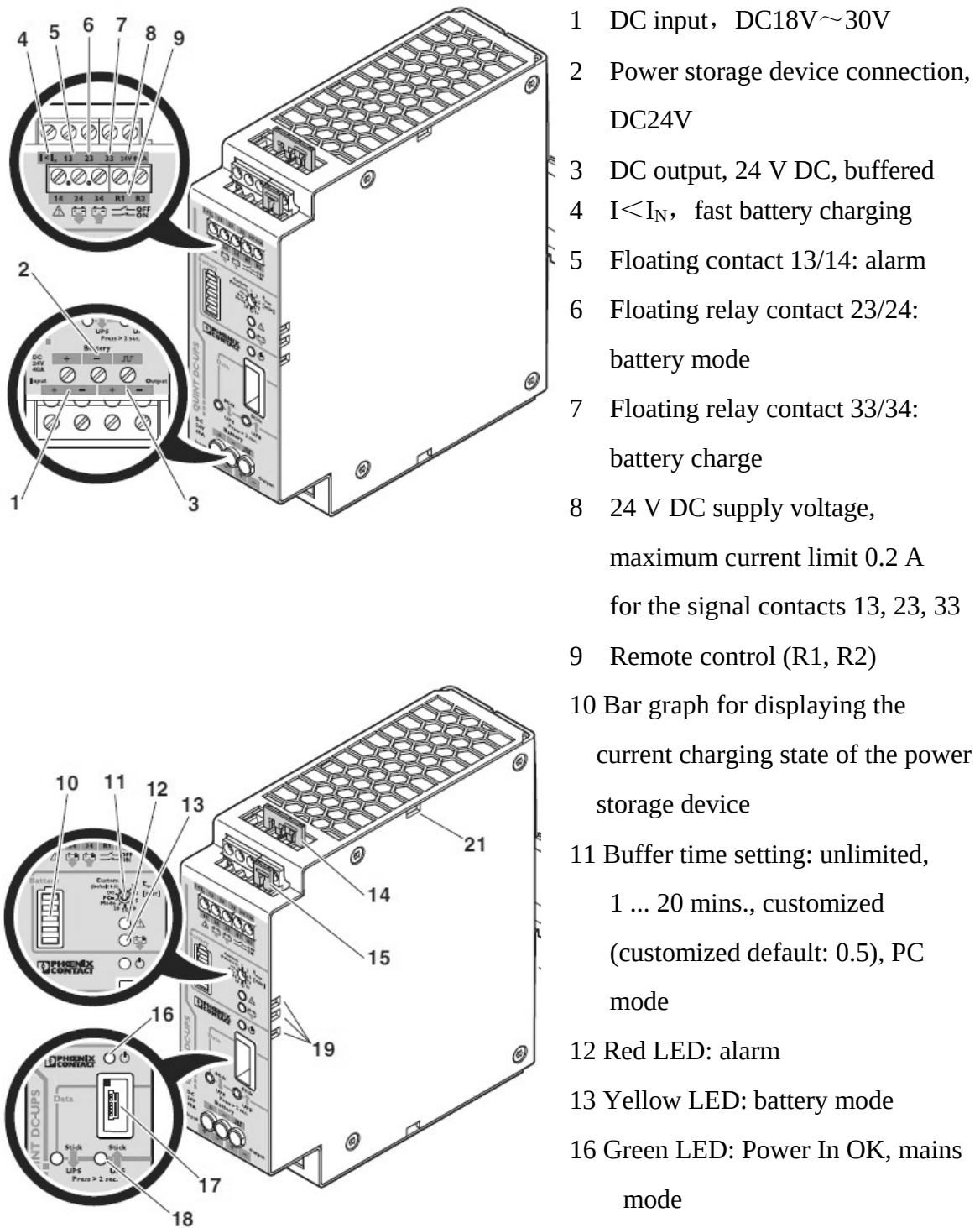


Fig. 7 UPS appearance and interface diagram

3.2.3 UPS signal specification (Table 4 and Table 5)

An LED test is performed automatically during startup of the device. After test, Green LED lights up, yellow LED is off: the load connected to the UPS is supplied from the mains. Green LED off, yellow LED lights up: mains is not available. The load connected to the UPS

is supplied by the power storage device. In mains mode ,Red LED lights up, the lower bar graph LED flashes red: there is a problem with the power storage device. If the lower bar graph LED does not flash, the alarm indicates overload or service mode. In battery mode, Red LED lights up: the power storage device is almost completely discharged. If no communication cable is installed between the UPS and the power storage device , during startup of the UPS in mains mode, The upper 4 LEDs are off. If the lower LED Flashing: power storage device is being charged. If the lower LED Off: power storage device is not being charged. If the lower LED Red: battery problem.

Table 4 Indicator and the contact state

State	LED	Switching output	Signal, default
Power In OK, mains mode	Green	—	—
Alarm	Red	13/14	Active low
Battery mode	Yellow	23/24	Active high
Battery charge	Bar graph (the lower LED Flashing)	33/34	Active high

Table 5 LED specification

State	Green LED	Red LED	Yellow LED	Description
1	OFF	OFF	Lit	Battery mode, bar graph displays current charging state
2	OFF	Lit	Lit	Battery mode, power storage device is almost empty, lower bar graph LED is red
3	Lit	OFF	OFF	Mains mode, bar graph displays current charging state
4	Lit	Lit	OFF	Mains mode, alarm in the event of battery problem: lower bar graph LED flashes red

3.2.4 UPS specification (Table 6)

Table 6 UPS specification

technical data for UPS	
Ambient conditions	
Ambient temperature (operation)	-25℃~ +70℃, (60℃~70℃: derating 2.5%/K)
Ambient temperature (storage/transport)	-40℃~ +85℃
Max. permissible relative humidity (operation)	≤95%, (25℃, no condensation)
Input data	
Nominal input voltage	DC24V
DC input voltage range	DC18V~ DC30V
Output data (mains mode)	
Nominal output voltage	DC24V
Output voltage range	DC18V~ DC30V
Nominal output current	40A (-25℃~ +50℃)
SFB technology (15ms)	215A (-25℃~ +60℃)
POWER BOOST	45A (-25℃~ +40℃)
Output data (battery mode)	
Nominal output voltage	DC24V
Output voltage range (Depending on the battery voltage)	DC19.2V~ DC27.6V $U_{out} = U_{bat} - 0.5V$
Nominal output current	40A (-25℃~ +60℃)
SFB technology (15ms)	215A (-25℃~ +60℃)
POWER BOOST	45A (-25℃~ +40℃)
Power storage device	
Nominal voltage UN	DC24V
End-of-charge voltage (Temperature compensation)	DC24V~ DC29V
Nominal capacity range	7Ah~200Ah
Max. charge current	5A

General data	
Efficiency	> 98.7%
Degree of protection	IP20
Dimensions W / H / D	47mm × 130mm × 125mm
Weight	0.7kg

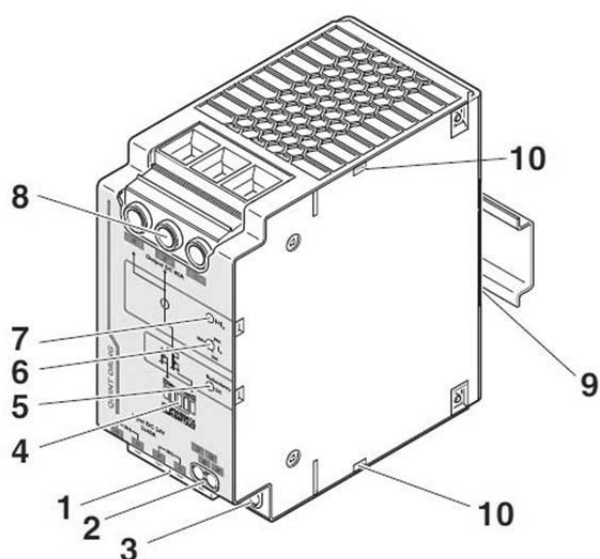
3.3 Redundancy module (QUINT-ORING/24DC/2×40A/1×80A)

3.3.1 Introduction

QUINT ORING is the DIN-rail mountable active redundancy module from the QUINT POWER product range. With the help of the redundancy module, two power supply units of the same type switched for redundancy on the output side are decoupled 100% from each other. Redundant systems are used in plants that make particularly high demands on operational safety. The power supply units involved must be dimensioned to enable the total current requirements of all loads to be covered by one single power supply unit. If the total requirement increases, e. g., due to additionally installed loads, and exceeds the nominal current of the power supply units, the power supply unit system is no longer redundant. A defect in the power supply unit or the wiring can also lead to loss of redundancy. This can be detected immediately via a floating signal contact and a corresponding LED.

The Auto Current Balance (ACB) technology allows even current distribution of the load current to the connected power supply units, which decisively increases the service life of the redundant system

3.3.2 redundancy module appearance and interface specification (Fig. 8)



- 1、DC input IN1/IN2:
24V input voltage, $I_N = 2 \times 40A$
- 2、Floating relay contact
13/14 “Redundancy OK”
(max.30V,100mA,short-circuit-proof)
- 3、Floating relay contact
23/24 “ACB OK”
(max.30V,100mA,short-circuit-proof)
- 4、Bar graph for displaying the circuit balance I_1/I_2
- 5、“Redundancy OK” LED, green
- 6、Rotary selector switch for selecting the nominal current of the power supply units
- 7、LED “ $I < I_N$ ”, green
- 8、DC output approx.0.2V<DC input
- 9、Universal snap-on foot for EN DIN rails
- 10、Strain relief for connecting cables

Fig. 8 redundancy module appearance and interface diagram

3.3.3 redundancy module specification (Table 7)

Table 7 redundancy module specification

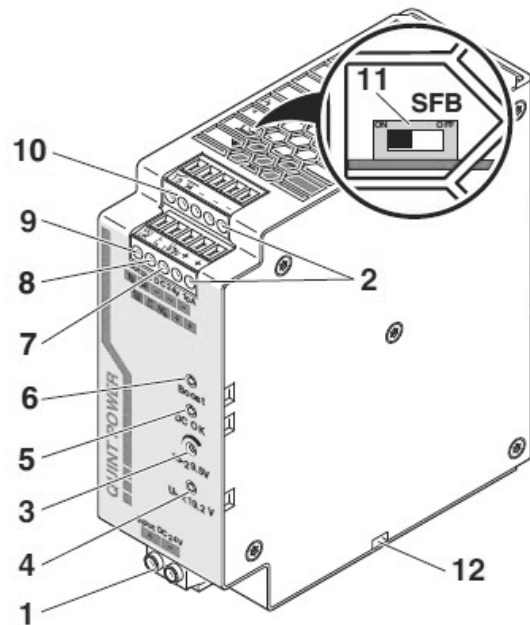
technical data for redundancy module	
Ambient conditions	
Ambient temperature (operation)	-25℃~ +70℃, (>60℃: Derating 2.5%/K)
Ambient temperature (storage/transport)	-40℃~ +85℃
Max. permissible relative humidity	≤95%, (at 25 °C, no condensation)
Input data	
Nominal input voltage	24V DC
Input voltage range	18V DC~ 28V DC(SELV)
Nominal current	2 × 40A (-25℃~ +60℃) 1 × 80A (-25℃~ +60℃)
Protection against polarity reversal	Yes, <60V
output data	
Voltage drop, input/output	0.2V(I _{out} =80A)
General data	
Insulation voltage input,output/housing	500V
Degree of protection	IP20
Dimensions W / H / D	66mm × 130mm × 125mm
Weight	0.9kg

3.4 DC/DC converter (QUINT-PS/24DC/24DC/10; QUINT-PS/24DC/24DC/5)

3.4.1 Introduction

The DC/DC converter converts a DC voltage of 18V ~32V to an adjustable, regulated, and electrically isolated 24V output voltage. If no regulated and stable 24 V DC voltage is available to supply a load, the DC/DC converter ensures the adjustment of the 24 V load: from an unregulated DC voltage, an adjustable output voltage of 18 V~29.5V is generated. reverse polarity protection and preventive function monitoring, DC/DC converter With the SFB technology (Selective Fuse Breaking Technology), six times the nominal current for 12 ms, even the standard power circuit-breakers can now also be triggered reliably and quickly. Faulty current paths are switched off selectively, the fault is located and important system parts continue to operate.

3.4.2 DC/DC converter appearance and interface specification (Fig. 9)



- 1 DC input
- 2 DC output
- 3 Potentiometer:
DC18V~DC29.5V
- 4 LED “ $U_{IN} < 19.2V$ ”, yellow
- 5 LED “DC OK”, green
- 6 LED “BOOST”, yellow
- 11 SFB switch (left: SFB activated,
right: SFB deactivated)

Fig. 9 DC/DC converter appearance and interface diagram

3.4.3 DC/DC converter signal specification (Table 8)

Table 8 DC/DC converter signal specification

State	$I < I_N$ Normal operation	$I > I_N$ POWER BOOST active	$U_{OUT} < 0.9 \times U_N$ Overload	$U_{IN} > DC19.2V$	$U_{IN} < DC19.2V$
LED “DC OK”, green	Lit	Lit	Flashing	—	—
LED “BOOST”, yellow	OFF	Lit	Lit	—	—
LED “ $U_{IN} < 19.2V$ ”, yellow	—	—	—	OFF	Lit

3.4.4 DC/DC converter specification (Table 9)

Table 9 DC/DC converter specification

technical data for DC/DC converter		
	QUINT-PS/24DC/24DC/10	QUINT-PS/24DC/24DC/5
Ambient conditions		
Ambient temperature	-25℃~ +70℃, (60℃~70℃: derating 2.5%/K)	
(operation)		
Ambient temperature	-40℃~ +85℃	
Max. permissible relative	≤95%, (at 25 °C, no condensation)	
Input data		
Nominal input voltage	DC24V	
Nominal input voltage range	DC18V~ DC32V	
Power failure bypass	> 12ms (DC24V)	> 10ms (DC24V)
Nominal input voltage	DC24V	
Nominal input voltage range	DC18V~ DC32V	
Power failure bypass	> 12ms (DC24V)	> 10ms (DC24V)
Output data		
Nominal output voltage/Setting range of the output voltage	DC24V±1% / DC18V~ DC29.5V	
Output current I _N	10A	5A
Output current I _{BOOST} /SFB	12.5A/60A	6.25A/30A
Resistance to reverse feed	DC35V	DC35V
General data		
Efficiency	>92%	
Degree of protection	IP20	
Dimensions W/H/D	48mm×130mm×125mm	32mm×130mm×125mm
Weight	0.9kg	0.7kg

3.5 Battery and Figure

3.5.1 Introduction

UPS2400 adopts a flexible structure for the convenience of maintenance and repair. It includes two pieces of UPS-BAT/VRLA/24DC/38AH. See Fig. 8 for its figure, dimension: 197mm× 165mm×175mm, weight (per unit) 13.0kg, 38Ah, please pay attention to battery's polarity when connecting.

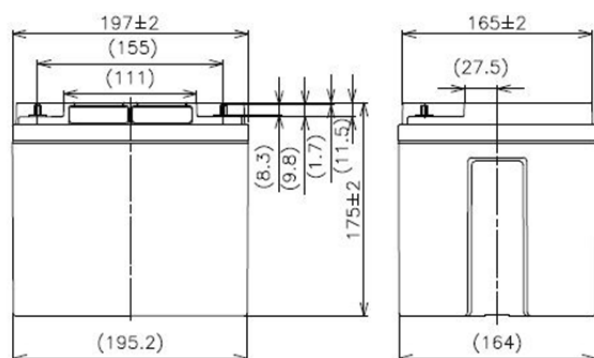


Fig. 10 figure of battery

3.5.2 Battery specification (Table 10)

Table 10 Battery Specification

Input data	
Nominal input voltage	24V DC
Buffer time	72 min.(20A) 35 min.(20A)
Output data	
Nominal output data	24V DC
Output current I _{max}	45A
Output fuse	2×25A ATOF 32V
Ambient Conditions	
Degree of protection	IP20
Ambient temperature(operation)	0℃~40℃
Ambient temperature(storage/transport)	0℃~40℃
Max. permissible relative humidity (operation)	95%

Table 11 UPS2400-3 terminals of connecting panel and meanings of output signals

No.	Terminal	Function	Normal status	Failure status
1	X0: L	AC input live		
	X0: N	AC input null		
2	X0: PE	earth		
3	X1: 1~54	DC output switch “-” “+” for 27 shunt		
4	X2: 1、 2 and 3	Main Power Failure Alarm	1 and 2 connected; 1 and 3 disconnected	1 and 3 connected ; 1 and 2 disconnected
5	X2: 4 and 5	Alarm DC24V battery mode open in battery mode	connected	1 and 3 connected ; 1and 2 disconnected
6	X2: 6、 7	Alarm Fuse battery fail	6 and 7 connected	6 and 7 disconnected ;

4.2 Connecting Switches

Connect power module switch with AC input switch and battery input switch, after output is connected and DC polarity connection is checked. Close switch F1, F2, F3 and F4, Afterwards , Load switch on the panel to “on” position. “AC230V” indicator light on the panel. After 5 seconds delay, “DC24V” indicator light, connect output switch of each output, and then it can get down to work.

4.3 Operation testing

Every indicator and relay output terminals have correspondence with UPS2400-3 conditions. User could estimate trouble situation remotely output signals. See table 12.

Table 12 UPS2400-3 indicator and relay output signals function

Operation mode	“AC230V” indicator	“DC24V” indicator	“Battery Mode” indicator	X2: 1、 2 and 3 switching output	X2: 4 and 5 switching output	X2: 6、 7 switching output
Main mode (regular work)	Lit	Lit	OFF	1 and 2 connected; 1 and 3 disconnected	connected	6 and 7 connected
Battery mode (the main power failure)	OFF	Lit	Lit	1 and 3 connected; 1 and 2 disconnected	1 and 3 connected; 1 and 2 disconnected	6 and 7 connected
Fuse battery fail alarm (main mode)	Lit	OFF	OFF	1 and 2 connected; 1 and 3 disconnected	connected	6 and 7 disconnected

5、 Alarm & Troubleshooting

As for UPS2400-3 system, failure types can be judged through status indicator and status contact. The following introduces typical phenomena of failure (Table 13), but we do not recommend direct internal repair, so please contact the supplier before taking measures.

Table 13 Typical failure phenomena and eliminating methods

No.	Phenomenon	Cause	Eliminating methods
1	Load switch abnormal trip	Output overload or short circuit	Disconnect to main output switch, and eliminate overload terminal
2	AC input indicator OFF and the main	AC input power off	Check AC supply circuit
3	The main power failure, not immediately to the battery	1、 Battery-supplying circuit break off 2、 Battery expired	1、 check whether DC input switches combinations are all closed or cables are connected 2、 when the main power is ok, if low bar graph LED is red or flashes red of UPS module, change batteries of the same type.
4	Alarm Fuse battery fail	Battery failure	change batteries of the same type.
5	The LED indicator of UPS module is abnormal	UPS module damage	Please contact manufacturer for further examination.

6、System Specifications(Table 14)

Table 14 system specifications

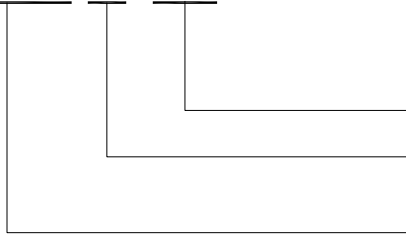
System technical data (Power A/ Power B)	
System	IT (Floating) ; DC system w. individually isolated outputs;
Input voltage	AC 100-240V
Frequency	46-65Hz
Output voltage	DC24V
Rated power output	1400W
Max. power output	2000W
Cell number and specification	2×12V/38Ah
Battery capacity	Deliver 40 amp in 30 min, after 30 minutes UPS output voltage must be minimum DC21.6V
protection	Input over current; output over current; output low voltage (DC18V) ; output high voltage (DC31V) , high/low voltage protection may be integrated in DC/DC converter functionality or implemented separately.
Alarms as potential free contacts	AC power failure; UPS battery mode; batteries not available(fuse fail)
Ambient temperature (storage/transport)	-40℃ ~ +85℃
Max. permissible relative	≤95%, (at 25℃,no condensation)
Degree of protection	IP44
Dimensions W/H/D	600mm×600mm×2100mm (with the bottom frame
Weight	225kg×2

temperature(storage/transport)	
Max. permissible relative humidity(operation)	≤95%, (at 25℃,no condensation)
Degree of protection	IP44
Dimensions W/H/D	600mm×600mm×2100mm (with the bottom frame 100mm)
Weight	225kg×2

7、UPS2400-3 ordering information

7.1 UPS2400-3 type meaning:

UPS2400-□. □□



The number of cylinders ;
eg.06 means the version
number for the product;
eg.3 represents the
third generation UPS
type of ECS system

7.2 UPS2400-3 scope of supply (Table 15)

Table 15 UPS2400-3 types

No.	Type	Cylinders	Capacity(W)	No. of beakers	DC/DC converter	
					5A	10A
1	UPS2400-3.05	5	1200	20×2	8×2	12×2
2	UPS2400-3.06	6	1200	21×2	9×2	12×2
3	UPS2400-3.07	7	1300	22×2	10×2	12×2
4	UPS2400-3.08	8	1300	23×2	11×2	12×2
5	UPS2400-3.09	9	1300	24×2	12×2	12×2
6	UPS2400-3.10	10	1400	25×2	13×2	12×2
7	UPS2400-3.11	11	1400	26×2	14×2	12×2
8	UPS2400-3.12	12	1400	27×2	15×2	12×2

Note: “×2” represents the total number of Power A and Power B.

MEC主机 DC24V 不间断电源

型号:UPS2400-3

用户指南及说明书

安庆船用电器有限责任公司

2016-08-08

目录

1、系统特征	3
2、介绍	3
2.1 ME主机UPS2400-3 介绍	3
2.2 ME主机UPS2400-3 外形及结构	3
3、主要元器件	9
3.1 电源模块（QUINT-PS/1AC/24DC/40）	9
3.2 不间断电源模块（QUINT-UPS/24DC/24DC/40）	11
3.3 冗余模块（QUINT-ORING/24DC/2×40A/1×80A）	13
3.4 DC/DC 转换器（QUINT-PS/24DC/24DC/10；QUINT-PS/24DC/24DC/5）	15
3.5 蓄电池及外形	17
4、使用说明	18
4.1 输入输出接线排的电缆敷设	18
4.2 接通开关	19
4.3 工作状态检查	19
5、故障报警及排除	20
6、系统规格(表 13)	21
7、UPS2400-3 订货信息	22
7.1 UPS2400-3 型号含义为：	22
7.2 UPS2400-3 的供货范围（表 14）	22

1、系统特征

ME 主机UPS2400-3 具有以下特点：

1. 单相在线不间断直流系统；
2. 可提供额定1400W，最高2000W 功率的清洁能源；
3. 采用一体化结构，性能高度稳定；
4. 采用直流模块运行，减少线性冲突；
5. 可提供绿色能源、输出近似一条直线；
6. 电源模块部分具有IQ 技术和SFB 技术，质量高可靠性，能耐受恶劣的工作环境；
7. 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、欠压、过压及短路保护功能。

2、介绍

2.1 ME主机UPS2400-3 介绍

ME 主机UPS2400-3 可提供不间断的稳定的DC24V 直流电源，其适用于ME 主机12 缸机，同时具有充电功能，并提供输出不低于80A 的清洁恒定电流。电路设直流容量为16A 和10A 空气开关保护。当外界在一定的时间内发生严重过流或过载时，开关会产生保护性动作。其包含两个部分：DC24V Supply A、DC24V Supply B 的冗余系统，如图1 所示

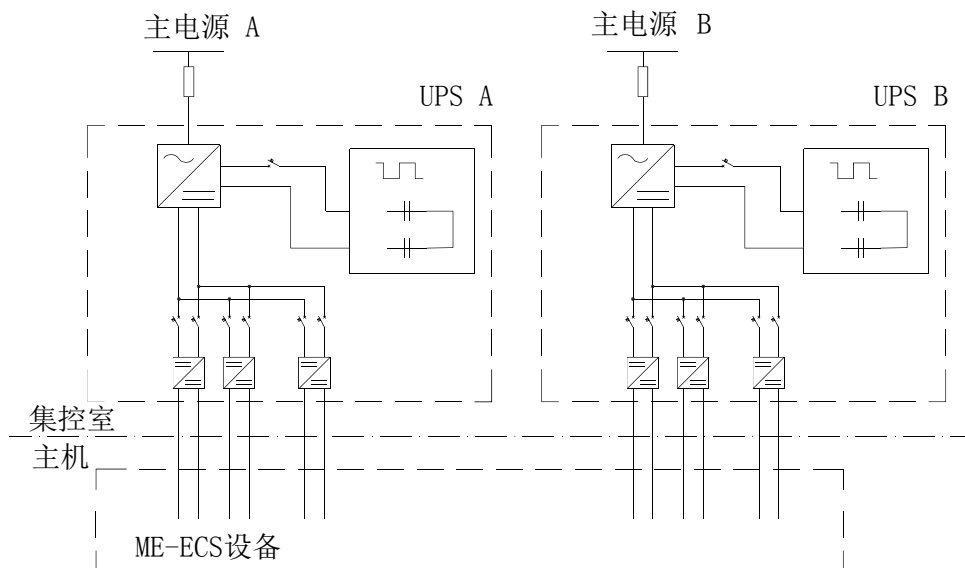


图1 UPS 系统图

2.2 ME主机UPS2400-3 外形及结构

2.2.1 UPS2400-3 外形

UPS2400-3 电源系统包括两个部分POWER A 和POWER B，两个电箱外形尺寸相同即

600mm*600mm*2100mm,如图2 所示

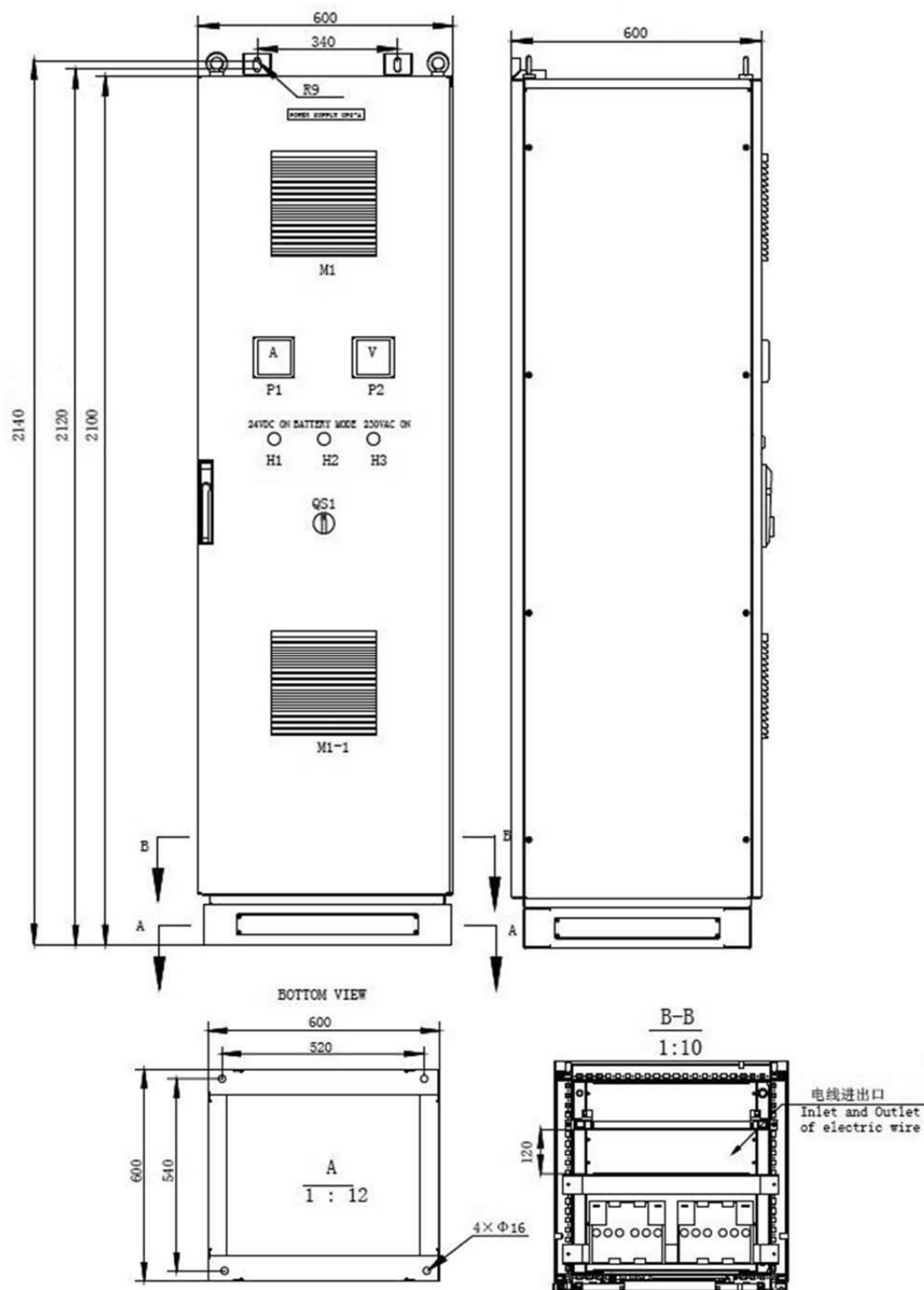


图2 POWER A/B 外形尺寸

2.2.2 UPS2400-3 外部、内部结构及各部件作用

其基本配置如下：

- A. 交流输入开关
- B. 电源模块
- C. 后备电池
- D. 直流输出开关组合
- E. 输入及输出接线板

UPS2400-3 电源箱外部和内部部件布置详见图3 和图4，结合图5和表1可见各个部件的功能与型号。

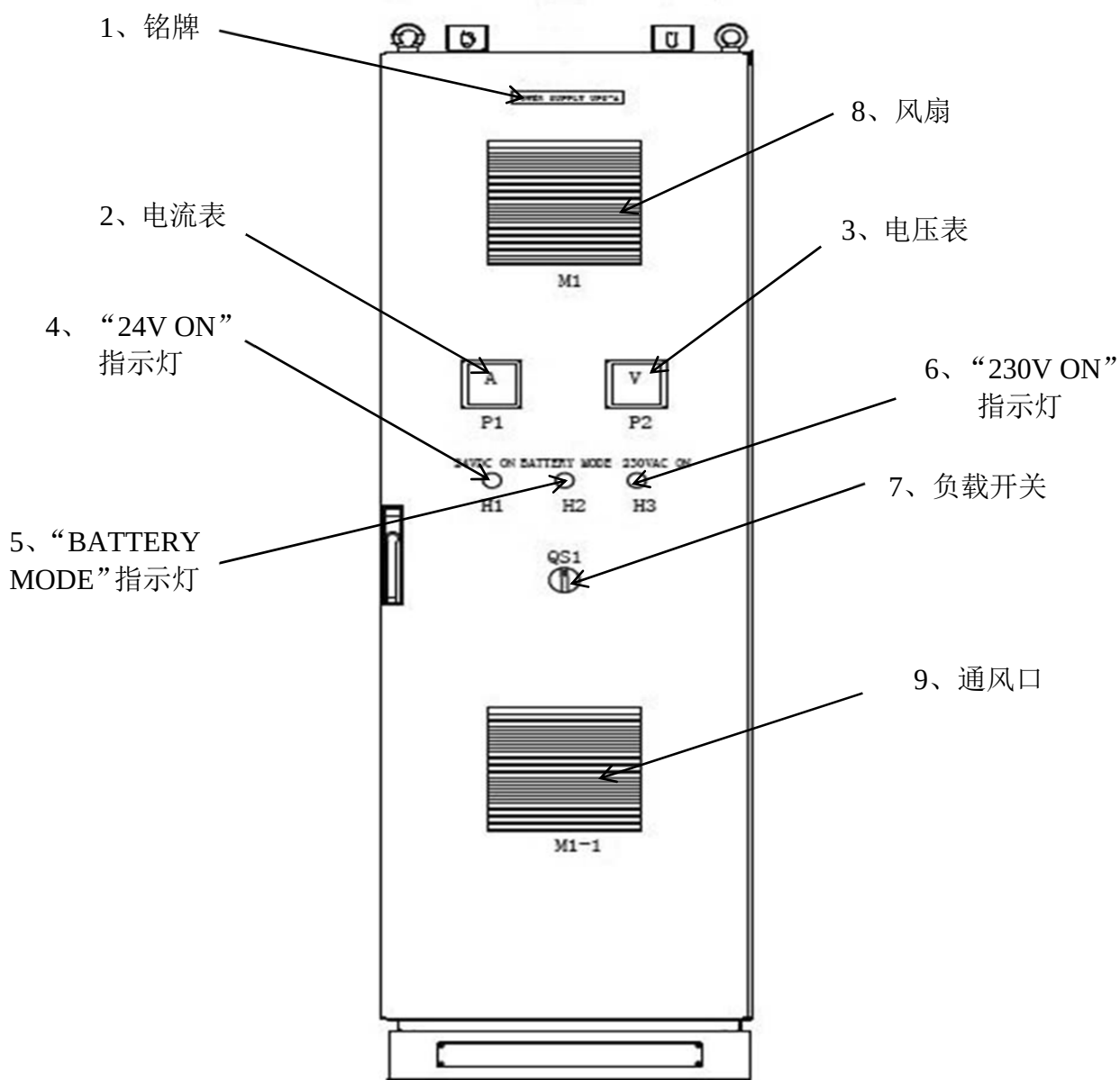


图3 Power A/B 外部布置图

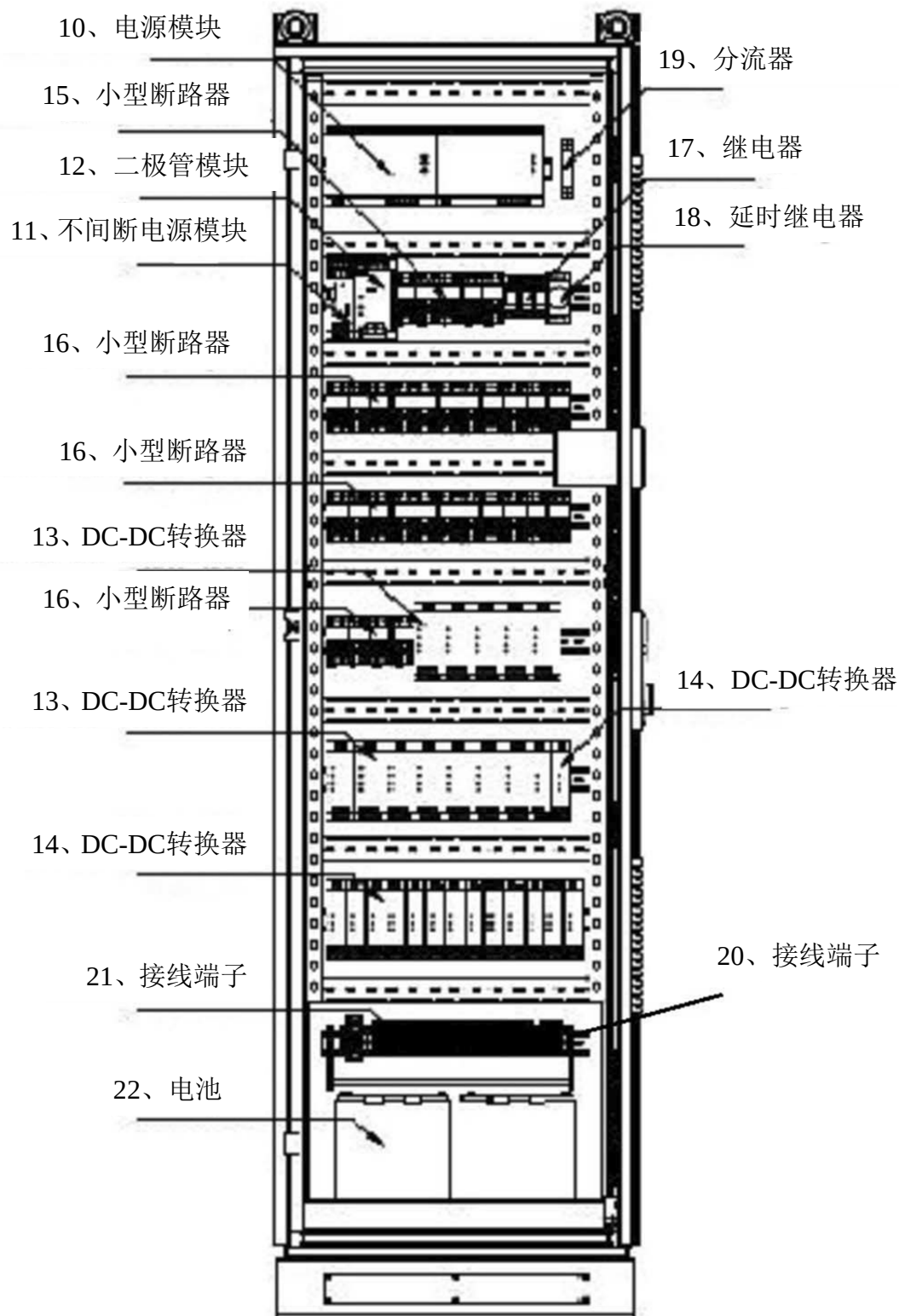


图4 Power A/B 内部布置图

表1 UPS2400-3 部件和型号

序号.	部件名称	标记	型号	备注
1	铭牌		UPS-A/B Uninterruptible Power Supply A/B	
2	电流表	P1	F96-DCB CL1.5 DC0-100A	
3	电压表	P2	F96-DCB CL1.5 DC0-50V	
4	"24VDC ON " 指示灯	H1	XB4BVB3C GR	
5	"BATTERY MODE" 指示灯	H2	XB4BVB3C YE	
6	"230AC ON"指示灯	H3	XB4BVB3C GR	
7	负载开关	QS1		
8	风扇	M1	SR25F	
9	通风口	M1-1	SR25	
10	AC-DC电源模块	T1、T3	QUINT-PS/1AC/24DC/40	
11	不间断电源模块	T2	QUINT-UPS/24DC/24DC/40	
12	冗余模块	R1	QUINT-ORING/24DC/2×40A /1×80A	
13	DC-DC 转换器	T101-T112	QUINT-PS/24DC/24DC/10	
14	DC-DC 转换器	T113-T127	QUINT-PS/24DC/24DC/5	
15	小型断路器	QF1-QF4	5SY6210-2 B10	
16	小型断路器	QF101-QF127	5SY6210-2 B16	
17	继电器	KA1、KA3、KA4	LY2NJ	
18	时间继电器	KT2	H3Y-2	
19	分流器	R3	DC0-100A 100A/75mV	
20	接线端子	X0	PT6-TWIN	
21	接线端子	X1、X2	PT2.5-TWIN	
22	电池	T5、C1、C2	UPS-BAT/VRLA/24DC/38AH	

2.2.3 UPS2400-3 电气原理图

UPS2400-3 电气原理图如图 5 所示

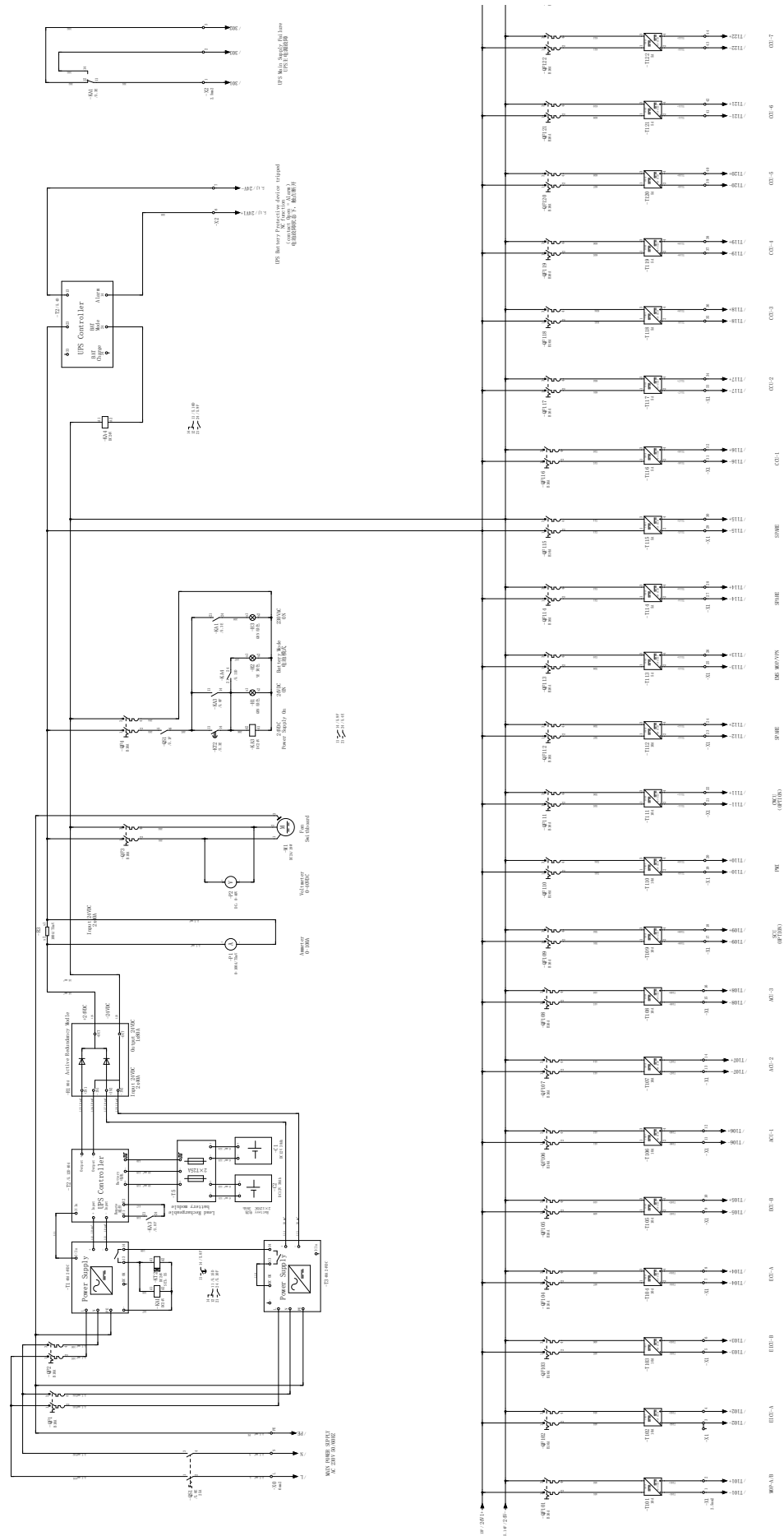


图 5 UPS 电气原理图

3、主要元器件

3.1 电源模块（QUINT-PS/1AC/24DC/40）

3.1.1 概况

电源模块额定输入AC100V~AC240V,频率45Hz~65Hz,额定输出DC24V±1% 的整流模块。输出电压可设置在DC18V~DC29.5V 范围内。该电源采用SFB 技术（选择性熔断技术），可在12ms 内发出6 倍于额定电流的电流，从而可靠、快速地触发标准断路器。电源选择性地断开故障电源通道，从而将故障限制在一定范围内，而重要的系统部分仍可继续运行。通过对输出电压和电流的持续监视，可提供全面的诊断功能。

3.1.2 电源模块外形及接口说明（图6）

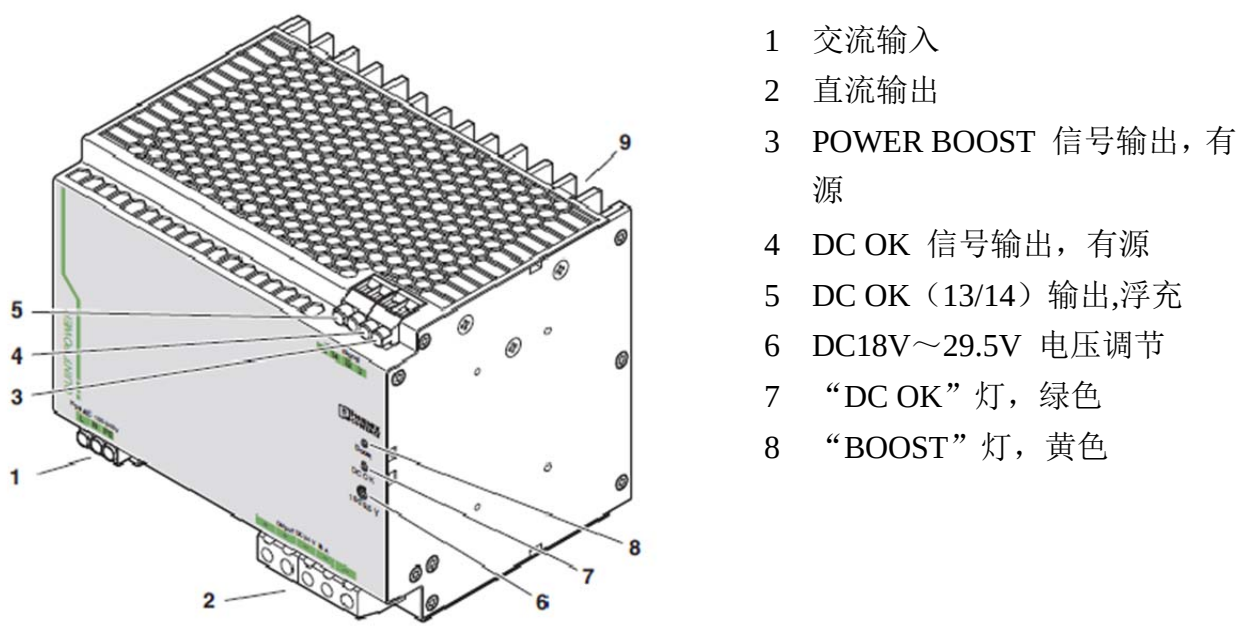


图6 电源模块的外形及接口图

3.1.3 电源模块信号说明（表2）

表2 电源模块状态与信号表

状态	$I < I_N$	$I > I_N$	$U_{OUT} < 0.9 \times U_N$
	电源正常运行 ($U_{OUT} > 21.5V$)	POWER BOOST运行, 如起 动负载	过载模式, 如短路或过载
“DC OK” 灯	开	开	闪烁
“BOOST” 灯	关	开	开
DC OK 信号	开	开	关
DC OK (13/14) 浮充	闭合	闭合	断开
POWER BOOST 信号	开	关	关

3.1.4 电源模块规格（表3）

表3 电源模块规格表

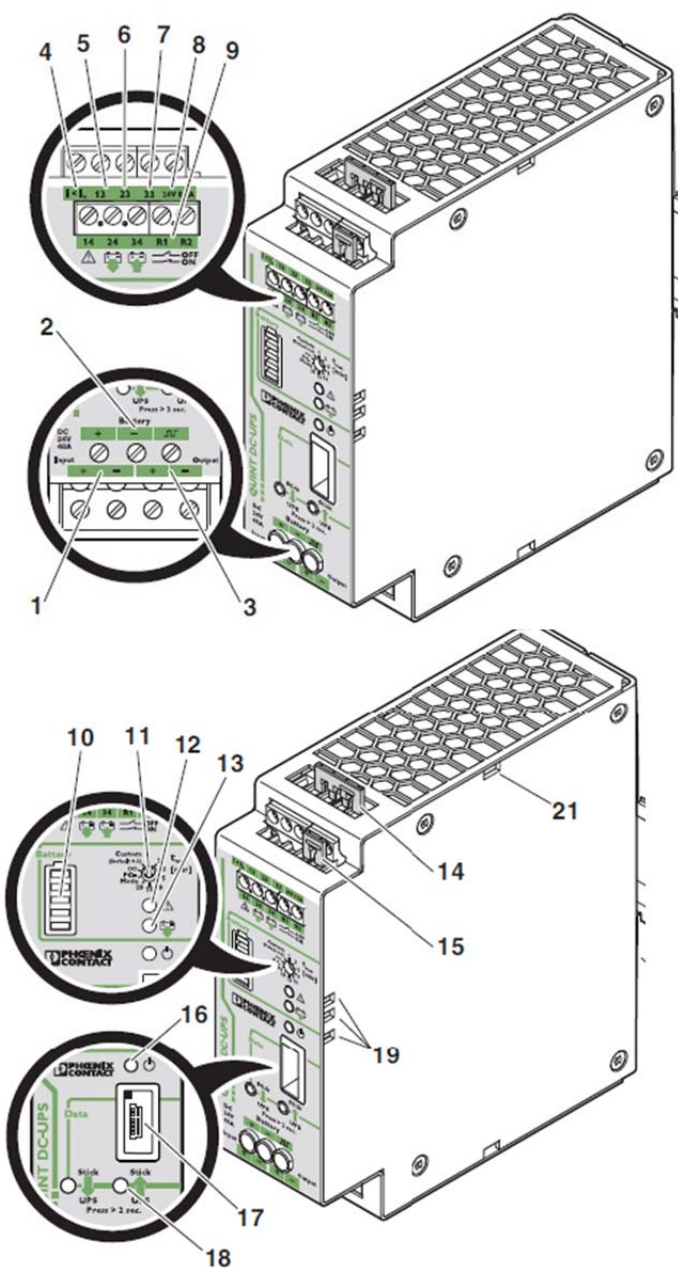
电源模块技术参数	
环境条件	
工作温度	-25℃~+70℃，（60℃~70℃需降额使用，2.5%/K）
存储温度	-40℃~+85℃
相对湿度	≤95%，无凝露（25℃时）
输入特性	
额定输入电压	AC100V~AC240V/ DC120V~DC300V
输入电压范围	AC85V~AC264V/ DC90V~DC300V
频率	45Hz~65Hz / 0Hz
电源缓冲	>20ms(AC120V) / >20ms(AC230V)
输出特性	
额定输出电压 U_N 时/范围	DC24V / DC18V~ DC29.5V
额定输出电流	40A
SFB 技术（12ms）	215A
POWER BOOST	45A（ $U_{IN} \geq AC100V$ ， $\geq DC120V$ ）
内部过电压保护	DC35V
一般数据	
效率	>92%
保护等级	IP20
尺寸(宽×高×深)	180mm×130mm×125mm
重量	3.3kg

3.2 不间断电源模块（QUINT-UPS/24DC/24DC/40）

3.2.1 概况

当主电源突然断电时，不间断电源（UPS）可以继续供电。智能技术使系统发挥极大可用性，其可对蓄电池进行快速充电，拥有 SFB(选择性熔断)技术。在主电源模式下(有直流电压输入)，UPS输出电压相当于输入电压，当输入电压出现故障时，实现零秒切换。UPS具有 IQ技术，当UPS检测到 $I < I_N$ 时，其确保短时间内快速充电，同时给负载提供足够的容量，若负载需要更大的电流，UPS会优先给负载提供大电流，这种情况下，蓄电池充电会减慢，提高了系统有效性。

3.2.2 UPS外形及接口说明（图7）



- 1 直流输入，DC18V~30V
- 2 蓄电池连接，DC24V
- 3 直流输出，DC24V，缓冲
- 4 $I < I_N$ ，蓄电池快速充电
- 5 浮充触点（13/14）：报警
- 6 浮充触点（23/24）：电池模式
- 7 浮充触点（33/34）：电池充电
- 8 DC24V 电压，和信号13,23,33
的最大电流限制在0.2A。
- 9 遥控（R1/R2）
- 10 指示蓄电池充电状态
- 11 缓冲时间设定：∞，1~
20mins.,
系统默认值0.5，PC 模式
- 12 红色指示灯：报警
- 13 黄色指示灯：电池模式
- 16 绿色指示灯：电源OK，主模式

图7 UPS 外形及接口图

3.2.3 UPS 信号说明（表4和表5）

启动UPS,设备自检,所有LED 灯亮。自检结束后,在主模式下运行时,绿灯亮,黄灯灭。若主电源断电,由蓄电池供电时,绿灯灭,黄灯亮。在主模式运行时,当红灯亮,柱状灯变成红色且闪烁,说明蓄电池有故障,若柱状灯不闪烁,只有红灯亮,说明过载或预检模式。在蓄电池模式下,红灯亮,说明蓄电池电量几乎为空。UPS与蓄电池间没有通信电缆,在主模式下,柱状灯上面四格灯灭,当最底下一格灯闪烁时,说明在给蓄电池充电;当最底下一格灯灭时,说明没有给蓄电池充电,当最底下一格灯为红色时,说明蓄电池故障。

表4 指示灯和触点状态说明表

状态	LED 灯	触点输出	信号, 系统默认值
电源OK, 主模式	绿	—	—
报警	红	13/14	有效, 低
电池模式	黄	23/24	有效, 高
电池充电	柱状 最底下一格LED 闪烁	33/34	有效, 高

表5 LED 指示灯说明表

状态	绿LED	红LED	黄LED	描述
1	关	关	亮	电池模式, 柱状灯显示电流充电状态
2	关	亮	亮	电池模式, 蓄电池的电量几乎为空, 柱状灯红色
3	亮	关	关	主模式, 柱状灯显示电流充电状态
4	亮	亮	关	主模式, 电池故障报警: 柱状灯为红色且闪烁

3.2.4 UPS 规格（表6）

表6 UPS 规格表

UPS 模块技术参数	
环境条件	
工作温度	-25℃~+70℃, (60℃以上需降额使用)
存储温度	-40℃~+85℃
相对湿度	≤95%, 无凝露 (25℃时)
输入特性	
额定输入电压	DC24V
输入电压范围	DC18V~ DC30V
输出特性（市电供电运行）	
额定输出电压	DC24V
输出电压范围	DC18V~ DC30V
输出电流	40A (-25℃~+50℃)
SFB 技术 (15ms)	215A (-25℃~+60℃)
POWER BOOST	45A (-25℃~+40℃)
输出特性（市电供电运行）	
额定输出电压	DC24V
输出电压范围	DC19.2V~ DC27.6V
(取决于电池电压)	$U_{out} = U_{bat} - 0.5V$
输出电流	40A (-25℃~+60℃)
SFB 技术 (15ms)	215A (-25℃~+60℃)
POWER BOOST	45A (-25℃~+40℃)
电容储能模块	
额定电压	DC24V
充电结束(温度补偿)	DC24V~ DC29V
额定容量范围	7Ah~200Ah
最大充电电流	5A
一般数据	
效率	>98.7%
保护等级	IP20
尺寸(宽×高×深)	47mm×130mm×125mm
重量	0.7kg

3.3 冗余模块（QUINT-ORING/24DC/2×40A/1×80A）

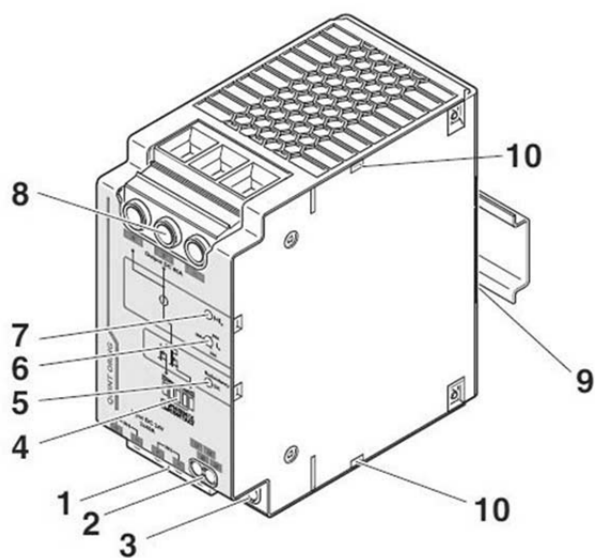
3.3.1 概况

QUINT ORING 是 QUINT POWER产品系列中的可安装在DIN导轨上的带电冗余模块。透过冗余模块的协助，两个同型号电源模块为输出侧的冗余切换，100%互相关断。冗余系统用于那些要求特别高的操作安全的设备中。电源必须足够强大，以确保所有负载的电流要求只需一个电源既可满足。若总电量需求增加，例如：因为额外的安装负载，及超过电源之额定电流，供电系统则不在冗余。供电系统的故障或接线也可导致冗余遗

失。此可经由浮地信号和对应的LED直接查出。

自动电流平衡技术（ACB）甚至可分散连接电源系统之负载电流的电流，如此提高了冗余系统的使用期限。

3.3.2 冗余模块外形及接口说明（图8）



- 1、DC 输入IN1/IN2：
24 V 输入电压， $IN = 2 \times 40\text{ A}$
- 2、浮地继电器触点
13/14 "冗余 OK"
(max. 30 V, 100 mA, 短路保护)
- 3、浮地继电器触点
23/24 "ACB OK"
(max. 30 V, 100 mA, 短路保护)
- 4、用于显示电流平衡的柱形图 I1/I2
- 5、“冗余OK” LED，绿色
- 6、轮盘选型切换器，
用于选择电源的额定电流
- 7、LED "I < IN"，绿色
- 8、DC 输出约. $0.2\text{ V} < \text{DC 输入}$
- 9 、用于EN DIN 导轨的通用卡接支脚
- 10、连接电缆的固线夹

图8 冗余模块外形及接口图

3.3.3 冗余模块规格（表7）

表7 冗余模块规格表

冗余模块技术参数	
环境条件	
工作温度	-25℃~ +70℃, (60℃~70℃ 需降额使用， 2.5%/K)
存储温度	-40℃~ +85℃
相对湿度	≤95%，无凝露（25℃时）
输入特性	
额定输入电压	DC24V
输入电压范围	DC18V~ DC28V
额定输入电流	2×40A（-25℃~ +60℃） 1×80A（-25℃~ +60℃）
防止极性逆转	<60V
输出数据	
电压降，输入/输出	0.2V（输出电流80A时）
一般数据	
绝缘电压输入 / 输出 / 外壳	500V

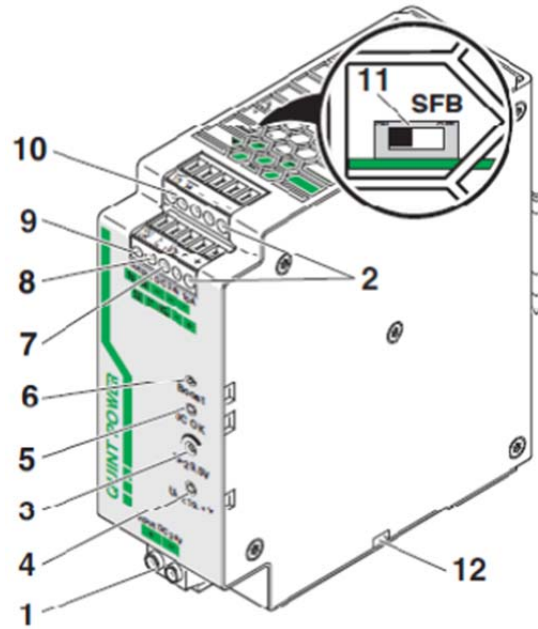
保护等级	IP20
尺寸(宽×高×深)	66mm×130mm×125mm
重量	0.9kg

3.4 DC/DC 转换器（QUINT-PS/24DC/24DC/10；QUINT-PS/24DC/24DC/5）

3.4.1 概况

DC/DC 转换器将直流电压从18V~32V 输出成可调节、稳定且电气隔离为24V的输出电压。如果没有规范和稳定的24V 直流电压供给负载使用，DC/DC转换器保障了24V负载调整：从非调节直流电压生成一个可调的18V~29.5V 输出电压。其具有反向极性保护，预防功能的监测，该转换器采用SFB 技术（选择性熔断技术），可在12ms内发出6倍于额定电流的电流，从而可靠、快速地触发标准断路器。电源选择性地断开故障电源通道，从而将故障限制在一定范围内，而重要的系统部分仍可继续运行。

3.4.2 DC/DC 转换器外形及接口图（图9）



- 1 直流输入
- 2 直流输出
- 3 电压调节：DC18V~ DC29.5V
- 4 LED 灯 “U_{IN}<19.2V”，黄色
- 5 LED 灯 “DC OK”，绿色
- 6 LED 灯 “BOOST”，黄色
- 11 SFB 开关（左：开；右：关）

图9 DC/DC 转换器外形及接口图

3.4.3 DC/DC 转换器信号说明（表8）

表8 DC/DC 转换器信号说明表

状态	$I < I_N$ 正常运行	$I > I_N$ POWER BOOST 有源	$U_{OUT} < 0.9 \times U_N$ 过载	$U_{IN} > DC19.2V$	$U_{IN} < DC19.2V$
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LED 灯 “DC OK”，绿色	亮	亮	闪烁	—	—
LED 灯 “BOOST”，黄色	关	亮	亮	—	—
LED 灯 “ $U_{IN} < 19.2V$ ”，黄色	—	—	—	关	开

3.4.4 DC/DC 转换器规格（表9）

表9 DC/DC 转换器规格表

DC/DC 转换器技术参数		
	QUINT-PS/24DC/24DC/10	QUINT-PS/24DC/24DC/5
环境条件		
工作温度	-25℃~ +70℃, (60℃~70℃ 需降额使用, 2. 5%/K)	
存储温度	-40℃~ +85℃	
相对湿度	≤95%, 无凝露（25℃时）	
输入特性		
额定输入电压	DC24V	
输入电压范围	DC18V~ DC32V	
电源缓冲	>12ms（DC24V）	>10ms（DC24V）
输出数据		
额定输出电压U _N 时/范围	DC24V±1% / DC18V~ DC29.5V	
额定输出电流I _N	10A	5A
输出电流I _{BOOST} /SFB	12.5A/60A	6.25A/30A
内部过电压保护	DC35V	DC35V
一般数据		
效率	>92%	
保护等级	IP20	
尺寸(宽×高×深)	48mm×130mm×125mm	32mm×130mm×125mm
重量	0.9kg	0.7kg

3.5 蓄电池及外形

3.5.1 UPS介绍

UPS2400能够方便安装与维修，它包含两块UPS-BAT/VRLA/24DC/38AH电池。图8是其外形尺寸图，尺寸为：197mm×165mm×175mm，每块电池重为13kg，容量为38Ah，连接时注意电池正负极顺序。)

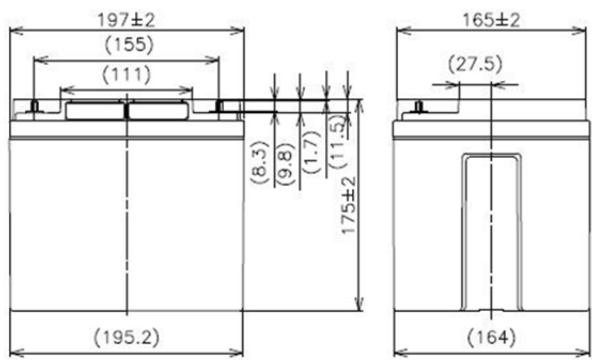


图10 蓄电池外形图

3.5.2 电池规格表（表10）

表10 电池规格表

输入数据	
额定输入电压	24V DC
缓冲时间	72 min.(20A) 35 min.(20A)
输出数据	
额定输出电压	24V DC
最大输出电流	45A
保险电流	2×25A ATOF 32V
环境条件	
防护等级	IP20
环境温度(运行)	0℃~40℃
环境温度(储存/运输)	0℃~40℃
最大相对湿度(运行)	95%

4、使用说明

4.1 输入输出接线排的电缆敷设

输入输出接线排排布示意图和实物见图11。它包括交流输入端子、接地端子、直流分路输出端子和状态输出端子等。

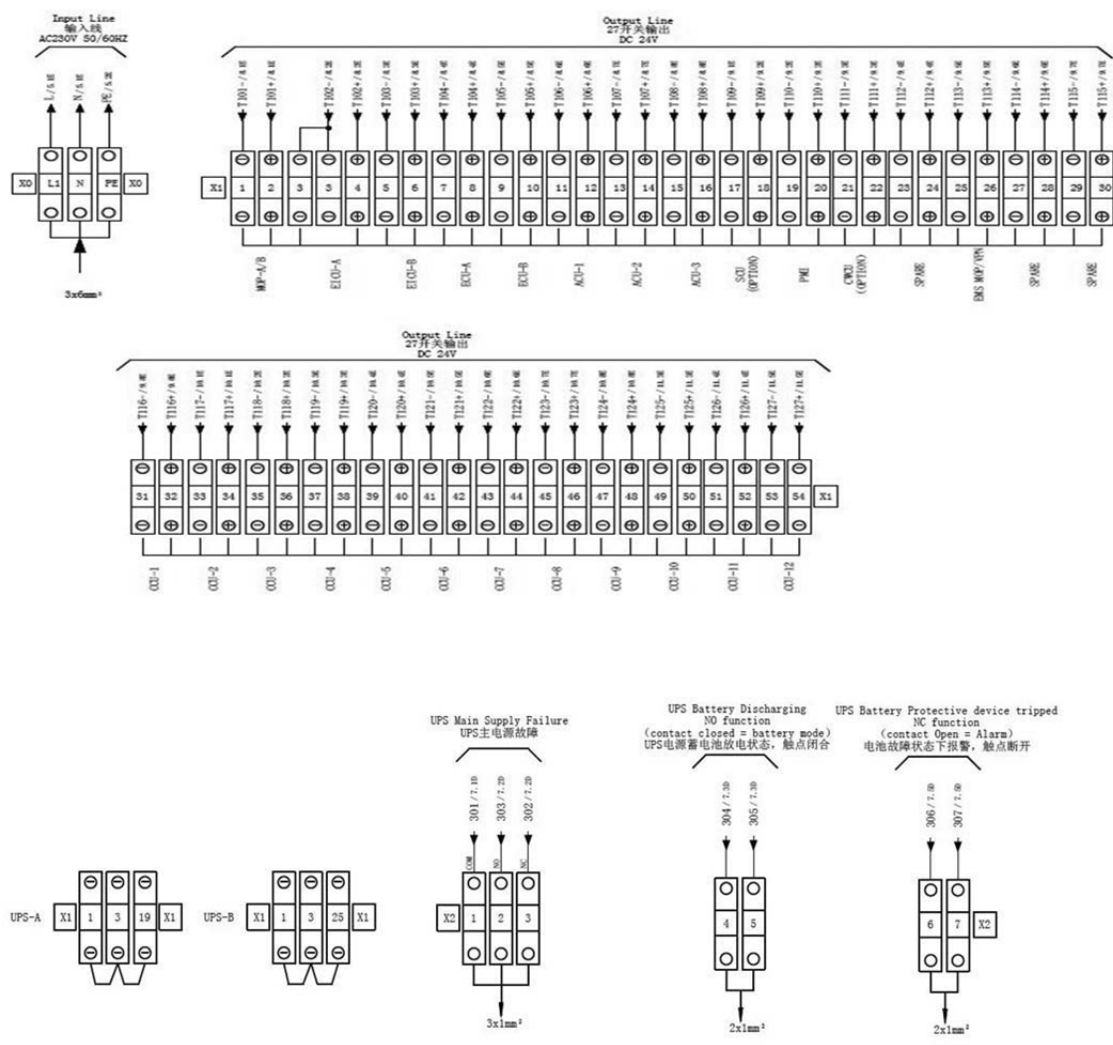


图11 电缆敷设图

电源柜内部接线板上设有端子排，非常便于外部接线。敷设电缆时，首先要确定好输入、输出对应关系（见表10），特别要注意直流输入、输出的极性。然后根据各线路相应的电流大小选择相应截面积的电 缆，一般选择标准为 4A/mm²。同时根据线路的电压等级选择相应电压等级的电 缆。操作时一定要注 意安 装强度。

表10 UPS2400-3 接线排端子及输出信号定义表

序号	端子号	功能	正常状态	故障状态
1	X0: L	交流输入相线		
	X0: N	交流输入零线		
2	X0: PE	接地		
3	X1: 1~54	直流输出27路分路 开关负正端		
4	X2: 1、2 和3	主电源失败报警	1 和 2 接通; 1 和3 断开	1 和 3 接通; 1 和2 断开
5	X2: 4 和5	DC24V 电池模 式 断开报警	接通	1 和 3 接通; 1 和2 断开
6	X2: 6和7	电池保险失败报警	6和7 导通	6 和 7 断开

4.2 接通开关

将输出连接好, 检查直流正负极接线无误后, 即可将开关F1,F2,F3,F4合上, 面板的负荷开关QS1 旋到“on”的位置, 面板上“AC230V”指示灯亮, 延时5s后“DC24V”指示灯亮。最后, 接通各路输出开关, 即可投入工作。

4.3 工作状态检查

UPS2400-3 的工作状态与各指示灯及输出信号的对应关系见表11, 如有不正常状态, 则需要检修。

表11 UPS2400-3 指示灯及输出信号功能表

工作状态	“AC230V” 指示灯	“DC24V” 指示灯	“Battery Mode” 指示灯	X2: 1、2 和3 结点	X2: 4 和5结点	X2:6和7 结点
主模式 (正常工 作)	亮	亮	关	1和2接通; 1和3断开	接通	6和7 接通
蓄电池模 式(主电 源失电)	关	亮	亮	1和3接通; 1和2断开	1和3接通; 1和2断开	6和7 接通
电池开关 跳闸(主 模式)	亮	关	关	1和2接通; 1和3断开	接通	6和7 断开

5、故障报警及排除

对于UPS2400-3 系统完全可以通过状态指示灯和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(表12)，但建议不要直接对其进行内部维修，请与供货商联系确认后相应操作。

表12 典型的故障现象与排除方法表

序号	故障现象	故障原因	排除方法
1	负载开关异常跳闸	输出是否过载或短路	断开输出总开关，排除过载点
2	交流输入指示灯灭及主电源失败报警	交流输入掉电	检查交流供电回路
3	主电源断电时不能立即转为蓄电池工作	1、电池给供电回路断路 2、电池失效	1、检查直流输入开关组合是否全闭合，否则检查连线；2、主电源正常工作时若UPS 模块柱状灯红色或红色且闪烁，则需更换同型号的电池组
4	电池保险失败报警	电池故障	需更换同型号的电池组

6、系统规格(表 13)

表13 系统规格

系统技术数据 (电源A/电源B)	
系统	IT (浮充); 直流系统; 输出各路分别隔离;
输入电压	AC100-240V
频率	46-65Hz
输出电压	DC24V
输出额定功率	1400W
最大输出功率	2000W
电池数量及规格	2×12V/38Ah
电池容量	30 分钟内输出电流为40A,30 分钟后输出的最小电压不能低于DC21.6V
保护	输入过流;输出过流;输出低电压(DC18V); 输出高电压 (DC31V), 高低压保护综合在 DC/DC 转换器中
报警	主电路失电; UPS电池未接通; 蓄电池故障
周围温度	-40℃~+85℃
最大相对环境湿度	≤95%, 无凝露 (25℃时)
机壳	IP44
尺寸	600mm×600mm×2100mm (含底框100mm)
重量	225kg×2

7、UPS2400-3 订货信息

7.1 UPS2400-3 型号含义为:



7.2 UPS2400-3 的供货范围（表 14）

表14 UPS2400-3 的型号列表

序号	型号	缸数	容量(W)	输出开关 数量	隔离模块配置数量	
					5A	10A
1	UPS2400-3.05	5	1200	20×2	8×2	12×2
2	UPS2400-3.06	6	1200	21×2	9×2	12×2
3	UPS2400-3.07	7	1300	22×2	10×2	12×2
4	UPS2400-3.08	8	1300	23×2	11×2	12×2
5	UPS2400-3.09	9	1300	24×2	12×2	12×2
6	UPS2400-3.10	10	1400	25×2	13×2	12×2
7	UPS2400-3.11	11	1400	26×2	14×2	12×2
8	UPS2400-3.12	12	1400	27×2	15×2	12×2

注：“×2”表示A 柜和B 柜的总数量。

PORTUGUÊS

Acumulador de chumbo, dispensa manutenção

O módulo de baterias de chumbo/AGM livre de manutenção é uma forma inteligente de armazenar energia e dar suporte a tecnologia IQ. O módulo de baterias controlado por um processador comunica com o equipamento QUINT-UPS-IQ e é continuamente monitorado.

- Características**
- Armazenamento de energia na tecnologia IQ
 - Elevado tempo de bateria
 - Eletrônica de comando com linhas de conexão de bateria pré-montadas
 - Linhas de conexão de bateria com tampas de isolamento para os pólos de bateria
 - Sensor de temperatura integrado para carga otimizada da bateria

 Outras informações encontram-se respectiva na ficha técnica em phoenixcontact.net/products.

Escopo do fornecimento

- 2 x módulo de bateria (12 V DC / 38 Ah)
- 1 x eletrônica de comando (com linhas de conexão de bateria pré-confeccionadas, incl. tampas de isolamento para os pólos de bateria)
- 1 x fita velcro (autoadesiva)
- 6 x agrupador de cabos para fixação das linhas de conexão de bateria (resistente a UV)

 Avisos de segurança e alertas

- O equipamento somente pode ser instalado e colocado em funcionamento por pessoal técnico qualificado. Observar as especificações do respectivo país.
- Nunca trabalhar sob tensão.
 - Executar conexão de rede profissional e garantir proteção contra impacto.
 - Apenas para uso em área interna.
 - Observar a polaridade dos módulos de bateria e evitar curtos nos terminais dos pólos.
 - Após a instalação, cobrir a área de bornes, para evitar o contato não permitido com peças energizadas (por ex. instalação no quadro de comando).
 - Observar os limites mecânicos e térmicos.
 - As baterias dispensam manutenção e não podem ser abertas.
 - Uma ventilação suficiente deve ser garantida através da seguinte constatação (a ser verificada): A caixa final deve ser construída de modo que o nível H2 nela contido não exceda 2% V/V após 48 horas.

 Aviso sobre a bateria

- Antes da entrega, as baterias são carregadas em fábrica de forma otimizada e podem ser colocadas em operação imediatamente. A data de carga (AAAA-MM-DD) está identificada de forma claramente visível.
- Na operação paralela de módulos de baterias numa alimentação ininterrupta com corrente, sempre devem ser usadas baterias do mesmo lote de fabricação.
- Na troca de baterias, sempre devem ser usadas duas baterias novas do mesmo lote de fabricação.
- Em caso de armazenamento do módulo de bateria por período maior ou transporte, observar sempre o prazo máximo para colocação em funcionamento.
- Antes do transporte ou no caso de não utilizar a instalação por um período maior, retirar o fusível DC do sistema de comando eletrônico.
- Observar o torque de aperto máximo da porca nos pólos de bateria: 2,8 Nm

1. Conexões do equipamento (1 + 9)

1. Eletrônica de comando
2. Fusíveis
3. Borne de conexão +
4. Borne de conexão -
5. Comunicação USV (Bitola do condutor > 0,75 mm²)
6. Bateria A +/- (Comprimento de cabo 340 mm)
7. Bateria B +/- (Comprimento de cabo 110 mm)

ITALIANO

Accumulatore al piombo senza manutenzione

Il modulo batteria al piombo AGM esente da manutenzione è un accumulatore di energia intelligente e supporta la tecnologia IQ. Il modulo batteria controllato da processore comunica con il dispositivo QUINT-UPS-IQ collegato e viene continuamente monitorato.

- Caratteristiche**
- Accumulatore con tecnologia IQ
 - Tempo di buffer elevato
 - Elettronica di comando con cavi di connessione preassemblati per batterie
 - Cavi di collegamento batterie con cappucci isolanti per i poli della batteria
 - Sensore di temperatura integrato per una carica ottimale della batteria

 Ulteriori informazioni sono disponibili nella scheda tecnica alla pagina phoenixcontact.net/products.

Volume di consegna

- 2 x modulo batteria (12 V DC / 38 Ah)
- 1 x elettronica di comando (con cavi di collegamento batterie preconfezionati e cappucci isolanti per i poli della batteria)
- 1 x velcro autoadesivo
- 6 x serracavi per il fissaggio dei cavi di collegamento batterie (resistenti UV)

 Avvertenze sulla sicurezza e sui pericoli

- Solo il personale specializzato può occuparsi dell'installazione dell'apparecchio e della sua messa in servizio. Rispettare le norme specifiche del paese.
- Non eseguire mai interventi con la tensione inserita.
 - Effettuare una connessione corretta e garantisce la protezione contro le scosse elettriche.
 - Solo per l'impiego in interni.
 - Rispettare la polarità dei moduli a batteria ed evitare i corto circuiti sui morsetti della batteria.
 - Dopo l'installazione coprire il vano di connessione in modo da evitare contatti delle parti sotto tensione (ad es. montaggio nel quadro elettrico).
 - Rispettare i limiti meccanici e termici.
 - Le batterie non richiedono manutenzione e non devono essere aperte.
 - È necessario garantire una sufficiente aerazione mediante le seguenti indicazioni (da verificare): la custodia finale deve essere costruita in modo che il livello H2 contenuto non superi 2% V/V dopo 48 ore.

 Note relative alla batteria

- Al momento della consegna le batterie presentano una carica ottimale, eseguita in fabbrica, e possono essere impiegate da subito. La data di carica (AAAA-MM-GG) è riportata in maniera ben visibile.
- Per il funzionamento in parallelo di moduli batteria su un gruppo di continuità, utilizzare sempre batterie della stessa carica di produzione.
- In caso di cambio delle batterie, utilizzare sempre due batterie nuove della stessa carica di produzione.
- In caso di immagazzinamento prolungato o di trasporto del modulo batteria, tenere sempre conto dell'ultima messa in servizio delle batterie.
- Prima del trasporto o in caso di inattività prolungata dell'impianto, rimuovere il fusibile DC dell'elettronica di comando.
- Rispettare la coppia di serraggio massima del dado del polo della batteria: 2,8 Nm

1. Connessioni di apparecchiature (1 + 9)

1. Elettronica di comando
2. Fusibili
3. Morsetto di collegamento +
4. Morsetto di collegamento -
5. Comunicazione UPS (Sezione delle linee > 0,75 mm²)
6. Bateria A +/- (Lungh. cavo 340 mm)
7. Bateria B +/- (Lungh. cavo 110 mm)

FRANÇAIS

Accumulateur au plomb, sans entretien

Le module de batterie AGM au plomb sans entretien est un accumulateur d'énergie intelligent et compatible avec la technologie IQ. Commandé par microprocesseur, il communique avec l'appareil raccordé QUINT-UPS-IQ et il est surveillé en permanence.

- Caractéristiques**
- Accumulateur d'énergie avec technologie IQ
 - Durée de sauvegarde importante
 - Electronique de commande et câbles de raccordement pré-équipés pour pile
 - Câbles de raccordement de batterie avec capuchons isolants pour les cosses
 - Capteur de température intégré, pour un chargement optimisé des piles

 Vous trouverez de plus amples informations dans la fiche technique correspondante sur le site phoenixcontact.net/products.

Livraison

- 2 x module de batterie (12 V DC / 38 Ah)
- 1 x module électronique de commande (avec câbles de raccordement de batterie préconfectionnés et capuchons isolants pour cosses de batterie)
- 1 x bande velcro (autocollante)
- 6 x attache-câble pour fixer les câbles de raccordement de batterie (résistant aux UV)

 Consignes de sécurité et avertissements

- Seul du personnel qualifié doit installer et mettre en service l'appareil. Les prescriptions propres à chaque pays doivent être respectées.
- Ne jamais travailler lorsqu'une tension est appliquée !
 - Procéder au raccordement dans les règles de l'art et garantir la protection contre l'électrocution.
 - Utilisation en intérieur seulement.
 - Respecter la polarité des modules de batterie et éviter les courts-circuits.
 - Après installation, recouvrir la zone des bornes pour éviter tout contact fortuit avec des pièces sous tension (par exemple, montage en armoire).
 - Respecter les limites mécaniques et thermiques.
 - Les batteries ne nécessitent aucun entretien et il est interdit de les ouvrir.
 - Une aération suffisante doit être assurée comme suit (à vérifier) : le boîtier terminal doit être conçu de sorte que le niveau H2 qu'il contient ne dépasse pas 2 % V/V après 48 heures.

 Remarques concernant les batteries

- Avant leur livraison, les batteries sont chargées à fond en usine, elles peuvent ainsi être mises immédiatement en service. La date de charge (AAAA-MM-JJ) est apposée de manière bien visible.
- Lorsque des modules de batteries fonctionnent en parallèle sur une seule alimentation sécurisée, veiller à toujours utiliser des batteries provenant de la même charge de production.
- Lors d'un remplacement, toujours utiliser deux batteries neuves provenant de la même charge de production.
- En cas de stockage prolongé ou de transport du module de batteries, toujours tenir compte de la date maximum de mise en service et recharger les batteries si nécessaire.
- Avant de les transporter ou en cas d'arrêt prolongé de l'installation, extraire le fusible DC du dispositif électronique de commande.
- Respecter le couple de serrage maximum des écrous des cosses de batterie : 2,8 Nm

1. Eléments de connexion de l'appareil (1 + 9)

1. Electronique de commande
2. Fusibles
3. Borne de raccordement +
4. Borne de raccordement -
5. Communication USV (Section du câble > 0,75 mm²)
6. Pile A +/- (Longueur du câble 340 mm)
7. Pile B +/- (Longueur du câble 110 mm)

ENGLISH

Maintenance-free lead battery

The maintenance-free lead rechargeable battery module is an intelligent power storage device and supports IQ technology. The process-controlled battery module communicates with the connected QUINT-UPS-IQ device, and is continuously monitored.

- Features**
- Energy storage with IQ technology
 - Long buffer time
 - Control electronics with pre-assembled battery connecting cable
 - Battery connecting cable with insulating caps for battery terminals
 - Integrated temperature sensor for optimized battery charging

 For additional information, please refer to the corresponding data sheet at phoenixcontact.net/products.

Scope of supply

- 2 x battery module (12 V DC / 38 Ah)
- 1 x electrical control unit (with pre-assembled battery connecting cable incl. insulating caps for battery terminals)
- 1 x adhesive velcro strip (self-adhesive)
- 6 x cable binder for fixing the battery connecting cables (UV resistant)

 Safety and warning instructions

- Only professionals may install and start up the device. Regulations specific to the country must be observed.
- Never carry out work on live parts.
 - Establish connection correctly and ensure protection against electric shock.
 - For indoor use only.
 - Pay attention to the polarity of the battery module to avoid short circuits at the pole terminals.
 - Following installation, cover the terminal area to prevent accidental contact with live parts (e.g., installation in a control cabinet).
 - Observe mechanical and thermal limits.
 - The batteries are maintenance free and may not be opened.
 - Sufficient ventilation may be ensured by the following statement (needs to be approved by reviewer): The construction of the end enclosure shall be such that the H2 level in it shall not exceed 2 % V/V after 48 hours.

 Notes on the battery

- By default, the batteries are optimally charged prior to delivery and can thus be used immediately. The date of charge (YYYY-MM-DD) is clearly visible.
- When operating battery modules in parallel at an uninterruptible power supply, always use batteries from the same production batch.
- When replacing batteries, always use two new batteries from the same production batch.
- When storing or transporting the battery module for a longer time, always observe the latest startup date of the battery module.
- Remove the DC fuse of the control electronics prior to transport or when the system is not used for a longer period.
- Maximum torque for the battery terminal nut: 2.8 Nm

1. Device connections (1 + 9)

1. Control electronics
2. Fuses
3. Connection terminal block +
4. Connection terminal block -
5. UPS communication (Cable cross section > 0.75 mm²)
6. Battery A +/- (Length of cable 340 mm)
7. Battery B +/- (Length of cable 110 mm)

DEUTSCH

Wartungsfreier Blei-Akkumulator

Das wartungsfreie Blei-AGM Batteriemodul ist ein intelligenter Energiespeicher und unterstützt die IQ Technology. Das prozessorgesteuerte Batteriemodul kommuniziert mit dem angeschlossenen QUINT-UPS-IQ Gerät und wird dabei kontinuierlich überwacht.

- Merkmale**
- Energiespeicher in IQ Technology
 - Hohe Pufferzeit
 - Steuerungselektronik mit vorkonfektionierten Batterieanschlussleitungen
 - Batterieanschlussleitungen mit Isolierkappen für Batteriepole
 - Integrierter Temperatursensor zur optimierten Batterieladung

 Weitere Informationen finden Sie im zugehörigen Datenblatt unter phoenixcontact.net/products.

Lieferumfang

- 2 x Batteriemodul (12 V DC / 38 Ah)
- 1 x Steuerungselektronik (mit vorkonfektionierten Batterieanschlussleitungen inkl. Isolierkappen für Batteriepole)
- 1 x Klettklebeband (selbstklebend)
- 6 x Kabelbinder zur Befestigung der Batterieanschlussleitungen (UV-beständig)

 Sicherheits- und Warnhinweise

- Nur qualifiziertes Fachpersonal darf das Gerät installieren und in Betrieb nehmen. Landesspezifische Vorschriften sind einzuhalten.
- Niemals bei anliegender Spannung arbeiten.
 - Anschluss fachgerecht ausführen und Schutz gegen elektrischen Schlag sicherstellen.
 - Nur für den Einsatz im Innenbereich.
 - Polarität der Batteriemodule beachten und Kurzschlüsse an den Polklemmen vermeiden.
 - Nach der Installation den Klemmenbereich abdecken, um unzulässiges Berühren spannungsführender Teile zu vermeiden (z. B. Einbau im Schaltschrank).
 - Mechanische und thermische Grenzen sind einzuhalten.
 - Die Batterien sind wartungsfrei und dürfen nicht geöffnet werden.
 - Eine ausreichende Belüftung muss durch folgende Aussage sichergestellt werden (ist zu überprüfen): Das Endgehäuse muss so konstruiert sein, dass der darin enthaltene H2-Pegel nach 48 Stunden 2% V/V nicht übersteigt.

 Hinweise zur Batterie

- Die Batterien werden vor der Auslieferung werkseitig optimal geladen und können sofort in Betrieb genommen werden. Das Ladedatum (JJJJ-MM-TT) ist gut sichtbar aufgebracht.
- Im Parallelbetrieb von Batteriemodulen, an einer unterbrechungsfreien Stromversorgung, sollten immer Batterien aus der gleichen Fertigungsladung verwendet werden.
- Bei einem Batteriewechsel sollten immer zwei neue Batterien aus der gleichen Fertigungsladung verwendet werden.
- Bei längerer Lagerung oder Transport des Batteriemoduls immer die späteste Inbetriebnahme der Batterien beachten.
- Vor dem Transport oder bei längerer Nichtbenutzung der Anlage, die DC-Sicherung der Steuerungselektronik entfernen.
- Maximales Drehmoment der Batteriepolmutter beachten: 2,8 Nm

1. Geräteanschlüsse (1 + 9)

1. Steuerungselektronik
2. Sicherungen
3. Anschlussklemme +
4. Anschlussklemme -
5. USV-Kommunikation (Leitungsquerschnitt > 0,75 mm²)
6. Batterie A +/- (Kabellänge 340 mm)
7. Batterie B +/- (Kabellänge 110 mm)



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DE

Einbauanweisung für den Elektroinstallateur

EN

Installation notes for electricians

FR

Instructions d'installation pour l'électricien

IT

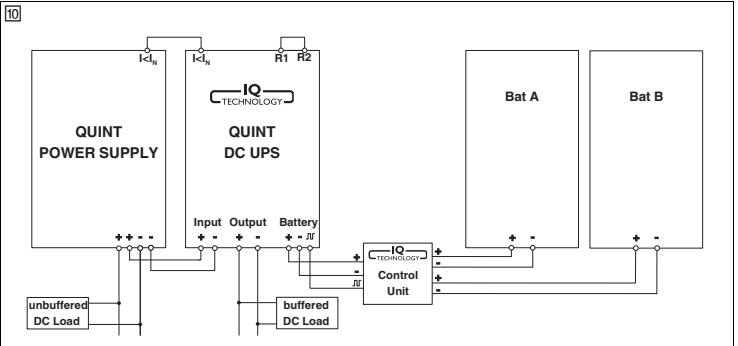
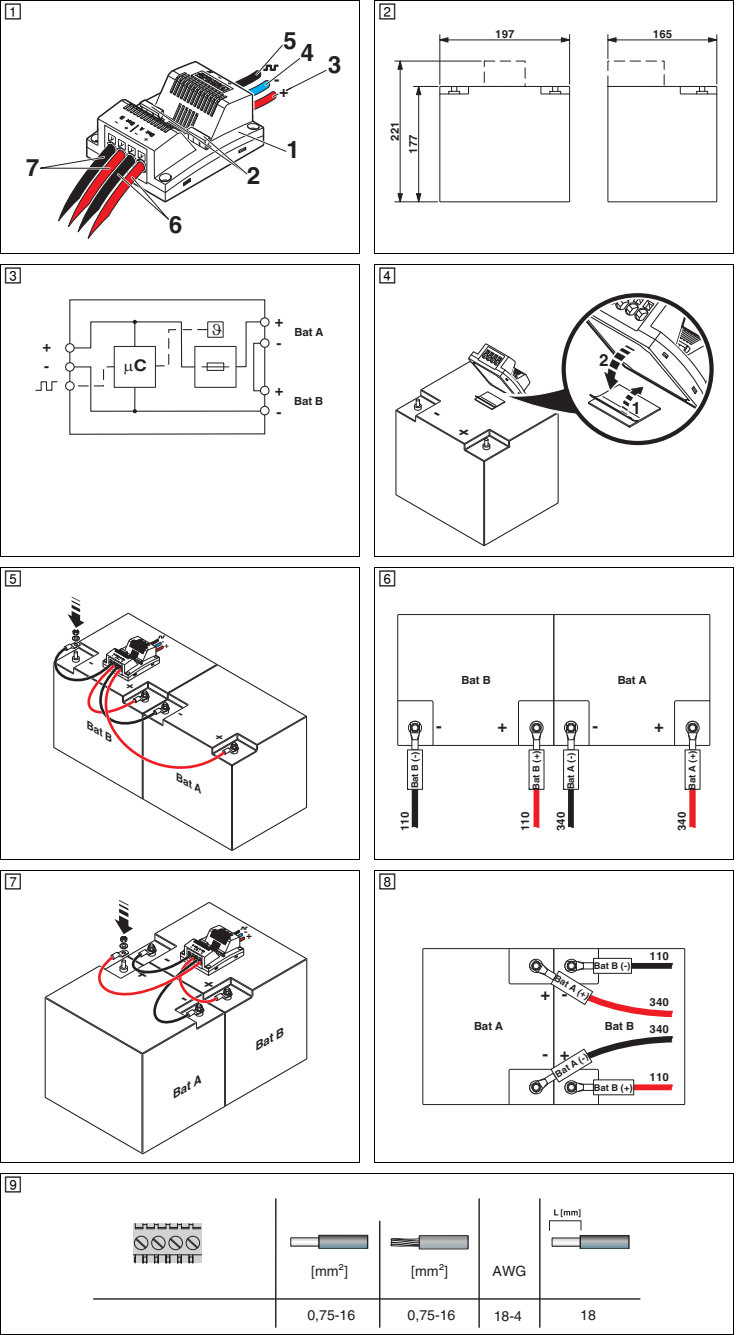
Istruzioni di montaggio per l'elettricista installatore

PT

Instrução de montagem para o eletricista

UPS-BAT/VRLA/24DC/38AH

2320335



中文

铅电池，无需保养

可充电铅电池无需保养，它是一个智能功率存储设备，支持 IQ 技术。由过程控制的电池模块与相连的 QUINT-UPS-IQ 设备进行通信，并始终得到监控。

特性

- 带 IQ 技术的能量存储
- 缓冲时间长
- 带预装充电电池和连接电缆的电子控制设备
- 电池连接电源，带用于电池端子的绝缘帽
- 给优化电池充电的集成温度传感器

 更多信息请参看 phoenixcontact.net/products 中的相应数据表。

供货范围

- 2 x 电池模块 (12 V DC / 38 Ah)
- 1 x 电控单元 (带预装电池连接电缆，包括用于电池端子的绝缘帽)
- 1 x 背胶粘扣带 (自粘式)
- 6 x 电缆捆扎条，用于固定电池连接电缆 (抗紫外线)

 安全和警告说明

仅具备从业资质的专业人员才可以对设备进行安装和调试。必须遵守相关国家的法规。

- 绝对不得操作带电元件！
- 正确建立连接，确保对电气冲击的保护。
- 仅用于室内。
- 请注意电池模块的极性，以避免在极性模块上短路。
- 安装完成后，覆盖端子区域以避免与带电部分产生意外接触（如，控制柜内的安装）。
- 注意机械和温度方面的限制。
- 电池无需保养，也不准打开。
- 如有下列说明则表示有足够的通风（需由审阅者批准）：封头的设计应保证在 48 小时后，其中的 H2 水平不得超过 2 % V/V。

 电池注意事项

- 在默认情况下，电池在交付前已充好电，因此可以立即使用。充电日期（年 - 月 - 日）清楚可见。
- 将电池模块与不间断电源并联使用时，只能使用同一生产批号的电池。
- 更换电池时，只能用同一生产批号的两个新电池。
- 需较长时间存放或运输电池时，必须注意电池模块上一次的调试日期。
- 在运输前或者长时间不会用到该系统，要拔掉电子控制元件的直流保险丝。
- 电池端子螺母的最大扭矩：2.8 Nm

1. 设备连接 +

- 控制电气元件
- 保险丝
- 连接接线端子 +
- 连接接线端子 -
- UPS 通信 (电缆截面积 > 0,75 mm²)
- 电池 A +/- (电缆长度 340 mm)
- 电池 B +/- (电缆长度 110 mm)

РУССКИЙ

Аккумулятор свинцовый необслуживаемый

Необслуживаемый свинцовый аккумуляторный модуль по технологии AGM представляет собой интеллектуальный накопитель энергии и поддерживает IQ-технологии. Управляемый процессором аккумуляторный модуль взаимодействует с подключенным ИБП QUINT-UPS-IQ и находится под постоянным контролем.

Особенности:

- Накопитель энергии по IQ-технологии
- Высокое время автономной работы
- Блок электронного управления с готовыми проводками для аккумулятора
- Соединительные кабели аккумулятора, включая изоляционные колпачки для полюсов аккумулятора
- Встроенный датчик температуры для оптимальной зарядки аккумуляторной батареи

 С дополнительной информацией можно ознакомиться в соответствующем техническом описании по адресу phoenixcontact.net/products.

Комплект поставки

- 2 x аккумуляторный модуль (12 В пост. ток / 38 Ач)
- 1 x блок электронного управления (с подготовленными соединительными кабелями аккумулятора, включая изоляционные колпачки для полюсов аккумулятора)
- 1 x Лента-липучка (самоклеющаяся)
- 6 x кабельная стяжка для крепления соединительных кабелей аккумулятора (УФ-стойкие)

 Указания и предупреждения по технике безопасности

Устройство должен монтировать и вводить в эксплуатацию только квалифицированный специалист. Необходимо соблюдать соответствующие национальные предписания.

- Никогда не работать на оборудовании под напряжением!
- Выполните квалифицированное подключение к сети и обеспечьте защиту от поражения электрическим током.
- Только для применения в помещении.
- Выдерживать полярность на аккумуляторных модулях и избегать коротких замыканий на полюсных зажимах.
- После выполнения электромонтажа закройте клеммы, чтобы не допустить соприкосновения с токоведущими деталями (например, установка в электрошкафу).
- Придерживаться допустимых границ в отношении механики и температуры.
- Аккумуляторный модуль не требует теххода и не подлежит вскрытию.
- Необходимо обеспечить достаточную вентиляцию, для этого нужно проконтировать следующее: Корпус должен быть сконструирован таким образом, чтобы уровень содержащегося H2 через 48 часов не превышал 2% объема.

 Указания по использованию аккумуляторной батареи

- Перед поставкой аккумуляторные батареи оптимально заряжают на заводе, и они сразу готовы к использованию. Дата зарядки (ГГГГ-ММ-ДД) нанесена в хорошо видимом месте.
- При параллельном режиме работы аккумуляторных модулей, подключенных к источнику бесперебойного электропитания, всегда следует использовать аккумуляторы с таким же номером партии.
- При замене аккумуляторных модулей всегда следует использовать аккумуляторы с таким же номером партии.
- При длительном хранении или транспортировке аккумуляторного модуля всегда учитывать крайний срок ввода в эксплуатацию.
- Перед транспортировкой, а также при продолжительном неиспользовании устройства удалить предохранитель постоянного тока управляющей электроники.
- Соблюдать максимальный момент затяжки гайки полюса аккумулятора: 2,8 Нм.

1. Подключения устройств +

- Управляющая электроника
- Предохранители
- Соединительная клемма +
- Соединительная клемма -
- Связь с ИБП (Сечение жил кабеля > 0,75 мм²)
- Аккумуляторная батарея A +/- (Длина кабеля 330 мм)
- Аккумуляторная батарея B +/- (Длина кабеля 110 мм)

TÜRKÇE

Bakım gerektirmeyen kurşunlu akü

Bakım gerektirmeyen şarj edilebilir kurşun akü modülü akıllı bir güç depolama cihazıdır ve IQ teknolojisini destekler. Proses kontrollü akü modülü bağlı QUINT-UPS-IQ cihazı ile haberleşir ve sürekli olarak izlenir.

Özellikler

- IQ teknolojisine sahip enerji depolama
- Uzun tampon süresi
- Ön montajlı şarj edilebilir akü bağlantı kablolu elektronik kontrol ünitesi
- Akü uçları için izolasyon kapaklı akü bağlantı kablosu
- Akü şarjının optimizasyonu için entegre sıcaklık sensörü

 Ek bilgi için lütfen phoenixcontact.net/products adresindeki ilgili teknik veri sayfası' e bakın.

Teslimat kapsamı

- 2 x akü modülü (12 V DC / 38 Ah)
- 1 x elektrikli kontrol ünitesi (ön montajlı akü uçları için izolasyon kapaklı akü bağlantı kablosu ile)
- 1 x yapışkan cırt cırt bant (kendinden yapışkan)
- akü bağlantı kablolarını tespit etmek için 6 x kablo bağı (UV ışınlarına karşı dirençli)

 Güvenlik ve uyarı talimatları

Sadece nitelikli personel cihazı monte edip çalıştırabilir. Ülkeye özel yönetmelikler dikkate alınmalıdır.

- Aktif kısımlarda hiçbir zaman çalışma yapmayın!
- Bağlantıyı düzgün şekilde gerçekleştirin ve elektrik çarpmalarına karşı koruma sağlayın.
- Yalnızca dahili kullanım içindir.
- Kutup klemenslerinde kısa devre olmasını önlemek için akü modülünün kutupluğuna dikkat ediniz.
- Montajdan sonra canlı parçalarla teması önlemek için klemens bölgesini kapatın (örneğin kontrol panosuna montaj yapılırken).
- Mekanik ve termal sınırlara dikkat edin.
- Aküler bakım gerektirmez ve açılmamalıdır.
- Yeterli havalandırma aşağıdaki açıklamaya göre sağlanabilir (kontrolör tarafından onaylanması gerekir): Uç muhafazasının konstrüksiyonu 48 saat sonra içerisindeki H2 seviyesi % 2 V/V değerini aşmayacak şekilde olmalıdır.

 Akü ile ilgili açıklamalar

- Aküler sevk edilmeden önce fabrikada en uygun şekilde şarj edilmektedir, böylece hemen kullanılabilir. Şarj tarihi (YYYY-AA-GG) açıkça belirtilmiştir.
- Akü modüllerini bir kesintisiz güç kaynağında paralel olarak kullanırken, daima aynı partiye ait aküleri kullanın.
- Aküleri değiştirirken daima aynı partiye ait iki yeni akü kullanın.
- Akü modülünün uzun bir süre saklanması veya taşınması sırasında, akü modülünün son devreye alma tarihine her zaman dikkat edin.
- Taşımadan önce veya sistem uzun bir süre kullanılmayacak ise, elektronik kontrol birimindeki DC sigortayı sökün.
- Akü bağlantı klemensi somunu için maksimum tork: 2,8 Nm

1. Cihaz bağlantıları +

- Kontrol elektronikleri
- Sigortalar
- Bağlantı klemensi +
- Bağlantı klemensi -
- UPS haberleşmesi (Kablo kesit alanı > 0,75 mm²)
- Akü A +/- (Kablo uzunluğu 340 mm)
- Akü B +/- (Kablo uzunluğu 110 mm)

ESPAÑOL

Batería de plomo exento de mantenimiento

El módulo de batería de AGM de plomo libre de mantenimiento es un acumulador de energía inteligente y compatible con la tecnología IQ. El módulo de batería controlado por procesador comunica con el aparato QUINT-UPS-IQ conectado, a la vez que es monitorizado continuamente.

Características

- Acumulador de energía en tecnología IQ
- Alto tiempo buffer
- Electrónica de control con cables de conexión de batería preconfeccionados
- Cables de conexión de la batería con capuchones aislantes para los bornes de la batería
- Sensor de temperatura integrado para una carga optimizada de la batería

 Encontrará más información en la ficha de datos correspondiente en phoenixcontact.net/products.

Volumen de suministro

- 2 módulos de batería (12 V CC / 38 Ah)
- 1 electrónica de control (con cables de conexión de batería preconfeccionados, incl. capuchones aislantes de bornes de batería)
- 1 cinta de velcro (autoadhesiva)
- 6 sujetacables para fijar los cables de conexión de la batería (resistentes a rayos ultravioleta)

 Indicaciones de seguridad y advertencia

El aparato sólo lo puede instalar y poner en funcionamiento personal cualificado. Respetar las prescripciones específicas del país.

- No trabaje nunca estando la tensión aplicada.
- Realizar una conexión profesional y asegurar la protección contra descargas eléctricas.
- Solo para el empleo en interiores.
- Tenga en cuenta la polaridad de los módulos de batería y evite los cortocircuitos en los bornes de los polos.
- Después de la instalación, cubrir la zona de los bornes para evitar un contacto involuntario de las piezas conductoras de tensión (p. ej. montaje en el armario de distribución).
- Deben respetarse los límites mecánicos y térmicos.
- Las baterías están libres de mantenimiento y no deben abrirse.
- Debe garantizarse una ventilación suficiente a través del siguiente mensaje (debe comprobarse): la carcasa superior debe construirse de tal manera que los niveles H2 que contiene no superen el 2% tras 48 horas.

 Notas acerca de la batería

- Las baterías han sido cargadas de fábrica de forma óptima y pueden ponerse inmediatamente en servicio. La fecha de carga (AAAA-MM-DD) está expuesta de forma bien visible.
- Parar el funcionamiento en paralelo de módulos de batería con un sistema de alimentación ininterrumpida, deben emplearse siempre baterías del mismo lote de producción.
- Cuando se cambian baterías, deben emplearse siempre dos baterías nuevas del mismo lote de producción.
- En caso de transporte o de un largo almacenamiento del módulo de batería, tenga en cuenta el tiempo máximo que pasará hasta su puesta en servicio.
- Antes de su transporte o cuando no se use la instalación durante un período largo de tiempo, retire el fusible DC de la electrónica de control.
- Observe el par de apriete máximo de la tuerca del borne de la batería: 2,8 Nm

1. Conexiones del equipo +

- Electrónica de control
- Fusibles
- Borne +
- Borne -
- Comunicación UPS (Sección de línea > 0,75 mm²)
- Batería A +/- (Longitud de cable 340 mm)
- Batería B +/- (Longitud de cable 110 mm)



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MNR 9053668 - 06
2016-07-27

ES

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ZH

Instrucciones de montaje para el instalador eléctrico

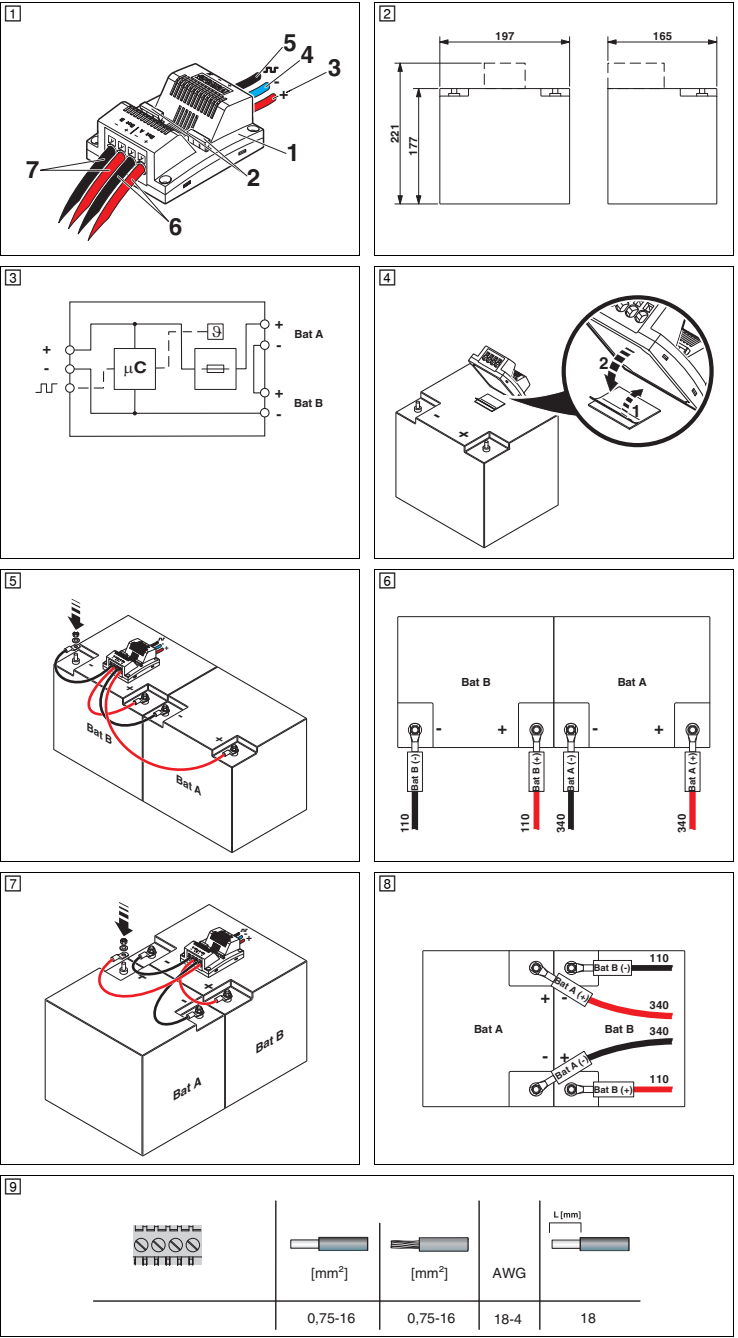
Elektrik personeli için montaj talimatı

Инструкция по установке для элeктромонтажника

电气人员安装须知

UPS-BAT/VRLA/24DC/38AH

2320335



中文	РУССКИЙ	TÜRKÇE	ESPAÑOL
2. 安装 电池模块位于控制柜底板上，必须易于接近。该模块应水平安装在控制柜内最凉爽的地方。可以用提供的自粘式魔术贴 / 不干胶封条将控制电子装置贴到电池模块上，也可以用固定螺钉将其固定在电池安装盒（2320458）的电池固定支架上。 2.1 表面安装 可以用提供的自粘式粘胶带将控制电子装置贴到电池模块上。  遵守工艺说明 清洁表面 – 清洁时请佩戴合适的防护手套，该手套必须符合清洁剂的规格要求（不得使用油性清洁剂）。 – 清洁表面时，请使用无绒的清洁布。 – 清洁表面，直到清除干净所有油脂。 粘贴粘胶带 – 请注意背胶粘胶带的工艺温度：> 10 °C – 撕下粘胶带的保护膜，并将其固定到清洁过的表面上。避免出现气泡。 – 用约 50 Nm 的压力压背胶粘胶带。 – 在室温下（20° C），72 小时后可达到最大粘度。 2.2 Battery Mounting Case (2320458) 控制电子装置也可以用固定螺钉拧到电池安装盒的电池固定支架上。 废料处理注意事项  勿将废旧电池放入生活垃圾中！按当前有效的国家法规处理这些电池。	2. Монтаж Аккумуляторные модули устанавливаются со свободным доступом на полу распределителя. Монтаж следует производить по горизонтали в наиболее охлаждаемом месте распределителя. Блок электронного управления крепится либо посредством входящей в комплект поставки самоклеющейся ленты-липушки к аккумуляторному модулю, либо крепежными винтами к скобе корпуса аккумуляторной батареи Battery Mounting Case (2320458). 2.1 Напольный монтаж Блок электронного управления наклеивается при помощи входящей в комплект поставки самоклеющейся ленты-липушки на один из аккумуляторных модулей.  Соблюдать указания по применению Очистка поверхностей – При очистке использовать подходящие защитные перчатки, соответствующие спецификации средства для очистки (не использовать средства для очистки, смазывающие поверхность). – Для очистки поверхности использовать безворсовую ткань. – Очистить поверхность до полного обезжиривания. Наклеить ленты-липушки – Соблюдать температуру применения самоклеющейся ленты-липушки: > 10° C – Снять защитную пленку с самоклеющейся ленты-липушки и всей	2. Montaj Akü modülleri pano tabanına konumlandırılmalı ve kolayca ulaşılabilir olmalıdır. Modül yatay olarak ve panonun en soğuk bölgesine monte edilmelidir. Kontrol elektroniği modülü, birlikte verilen kendiliğinden yapışkan cırt cırt/ yapışkan şeritleri kullanarak bir akü modülüne takılabilir veya akü montaj gövdesindeki (2320458) akü bağlantı braketine vidalanabilir. 2.1 Yüzeysel montaj Kontrol elektroniği modülü, birlikte verilen kendiliğinden yapışkan cırt cırt şeritleri kullanarak bir akü modülüne takılabilir.  Proses açıklamalarını göz önünde bulundurun Yüzeyi temizleyin – Temizlemek için temizleme maddesinin teknik özelliklerine uygun bir koruyucu eldiven giyin (yağlı temizleme maddeleri kullanmayın). – Yüzeyi temizlemek için lifsiz bir bez kullanın. – Yüzeyi yağlardan tamamen arındırılana kadar temizleyin. Cırt cırt bant yapıştırılması – Yapışkan cırt cırt bandı işleme sıcaklığını göz önünde bulundurun: > 10° C – Cırt cırt bant üzerindeki koruyucu filmi çıkartın ve bandı temizlenen yüzeye tespit edin. – Yapışkan cırt cırt bandı yaklaşık 50 Nm ile bastırın. – Maksimum yapışma derecesine oda sıcaklığında (20° C) 72 saat sonra erişilir. 2.2 Battery Mounting Case (2320458) Kontrol elektroniği modülü bağlantı vidalarını kullanarak akü montaj kutusundaki akü bağlantı braketine vidalanabilir	2. Instalación Los módulos de batería se colocarán en el suelo del armario de forma libremente accesible. El montaje debería realizarse en posición horizontal y en el lugar menos caliente del armario de distribución. La electrónica de control podrá adherirse con la cinta de velcro autoadhesiva adjunta a un módulo de batería o atornillarse con los tornillos de fijación a la sujeción de la caja de la batería (2320458). 2.1 Montaje en suelo La electrónica de control podrá adherirse con la cinta de velcro autoadhesiva adjunta a un módulo de batería.  Observe las indicaciones de aplicación Limpieza de la superficie – Para la limpieza use guantes adecuados que cumplan las especificaciones del agente limpiador (no use limpiadores grasientos). – Para limpiar la superficie use paños de limpieza que no desprendan pelusas. – Limpie las superficies hasta dejarlas libres de grasa. Colocación de la cinta de velcro – Observe la temperatura de aplicación de la cinta de velcro: > 10° C – Despegue la lámina de la cara adhesiva de la cinta de velcro y adhiera la cinta de forma plana sobre la superficie limpiada. Evite que se formen burbujas en la cinta. – Presione la cinta de velcro, para que quede plana, con una fuerza de aprox. 50 Nm.

可将其送回至 Phoenix Contact 或生产厂家。 标准 / 注意事项 / 认证 508 注意： 使用铜质电缆，工作温度为 > 75 °C（环境温度 < 55 °C） > 90 °C（环境温度 < 75 °C）。 60950 注意： 柔性电缆使用冷压头。 封闭未使用的接线区域。	пузырей воздуха. - Прижать самоклеющуюся ленту-липучку всей поверхностью с усилием в прим. 50 Нм. - Максимальная прочность склеивания достигается при температуре помещения (20° C) по истечении 72-х часов. 2.2 Battery Mounting Case (2320458) Блок электронного управления прикручивается крепежными винтами на монтажном уголке для аккумуляторных модулей монтажного набора Battery Mounting Case. Указание по утилизации Не выбрасывать старые батареи и аккумуляторы в бытовые мусоросборники! Их утилизация должна осуществляться согласно действующим национальным требованиям. Старые батареи и аккумуляторы могут быть также обратно высланы на Phoenix Contact или возвращены производителю. Норма / Указание / Допуск 508 УКАЗАНИЕ: Использовать медный кабель, рабочая температура > 75 °C (температура окружающей среды < 55 °C) и > 90 °C (температура окружающей среды < 75 °C). 60950 УКАЗАНИЕ: Используйте наконечники для гибких кабелей. Закройте неиспользуемые клеммные отсеки.	Atkı bertaraf bilgileri Kullanılmış aküleri ev atıklarına karıştırmayın. Geçerli ulusal yönetmeliklere uygun olarak atın. Phoenix Contact'a veya üreticiye geri de gönderilebilirler. Standard/Not/Onay 508 NOT: Aşağıda belirtilen çalışma sıcaklıkları için bakır kablolar kullanın > 75 °C (ortam sıcaklığı < 55 °C) > 90 °C (ortam sıcaklığı < 75 °C). 60950 NOT: Çok telli kablolarda yüksek kullanın. Kullanılmayan bağlantı alanlarını mühürler.	- La máxima fuerza de adhesión se logra a una temperatura ambiente de 20 °C cabo de 72 horas. 2.2 Battery Mounting Case (2320458) La electrónica de control podrá fijarse con tornillos de fijación a la sujeción de la caja de baterías. Indicación para el desecho ¡No deseche las pilas y las baterías usadas como basura doméstica! Deséchelas tal y como ordene la pertinente normativa nacional en vigor. Las pilas y baterías usadas pueden asimismo devolverse a Phoenix Contact o al respectivo fabricante. Norma / Nota / Homologación 508 NOTA: Cable de cobre, empleado con un temperatura de servicio > 75 °C (temperatura ambiente < 55 °C) y > 90 °C (temperatura ambiente < 75 °C). 60950 NOTA: Utilizar punteras para cable flexible. Cerrar recept. de conexión que no se han utilizado.
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[illegible]



Axial Vibration Monitor
Mounting and Set-up Instruction
for
LC-AVM-01



4399, No.PuSan Road.Shanghai.China

Telephone:0086 21-51961688

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SHANGHAI LECHUN
HEAVY MACHINERY & ELECTRONIC EQUIPMENT CO.,LTD.



Contents	Page
1、 Introduction	2
1.1 System description	2
1.2 Product support	2
2、 Specifications for the LC-AVM-01	4
3、 Functional description	5
4、 Unpacking	6
5、 Mounting of the LC-AVM-01	8
5.1 Mechanical mounting	8
5.2 Electrical mounting	8
5.2.1 Cabling	9
5.2.2 Registration of the installation	9
6、 System set-up	10
7、 Trouble Shooting	12
7.1 Standard procedures	12
7.1.1 Check of power supply to probe	12
7.1.2 Check of unit behavior during power on	13
7.1.3 Check of probe input & display	14
7.1.4 Check of current output for alarm system	15
7.1.5 Check of Slow Down Set-point and output	16
7.1.6 Check of the probe	17
7.2 Replacing parts	18
7.2.1 Replacing the probe	18
7.2.2 Replacing the circuitboard	18
8、 Appendix	19



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

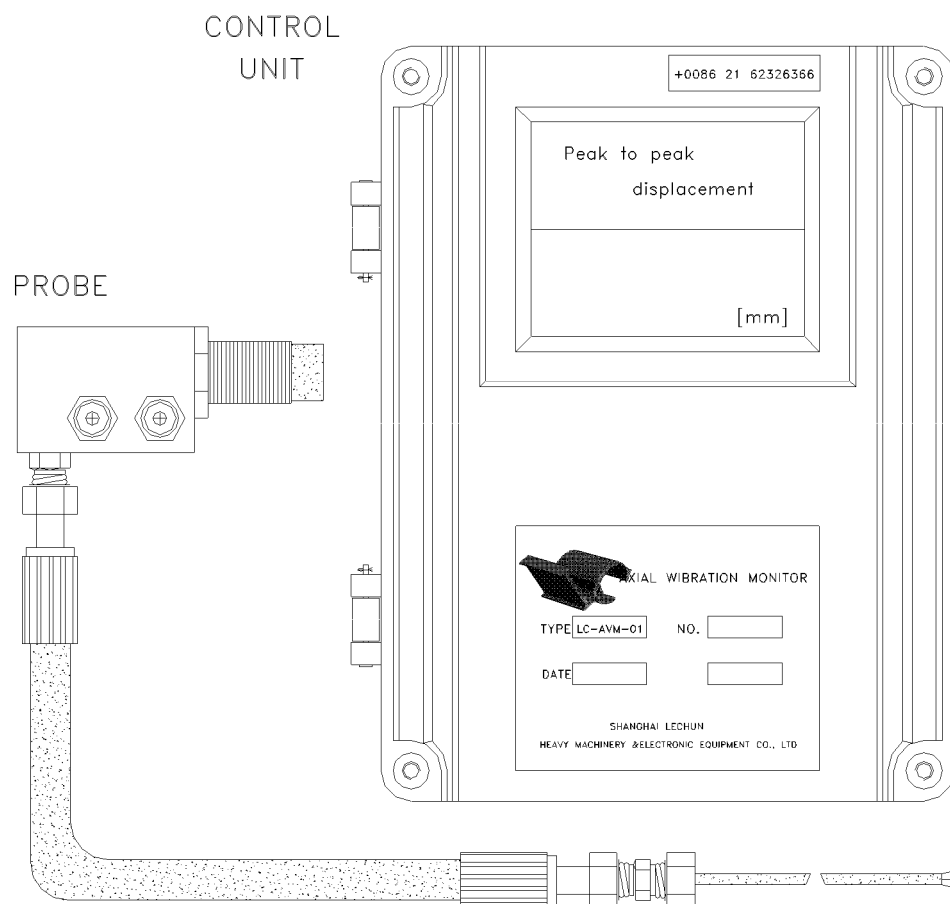
In order to assist You in the most efficient way, please prepare and include the following information:

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: $-10^{\circ}\text{C}+70^{\circ}\text{C}$

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 $\pm 20\%$
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 $\Rightarrow$ 4 mA

10 mm peak-to-peak $\Rightarrow$ 20 mA

$I_{out}[\text{mA}] = 1.6 \times (\text{displacement in mm peak-to-peak}) + 4$

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 : $\pm 5\%$
Slow down Delay time : $\pm 15\%$

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

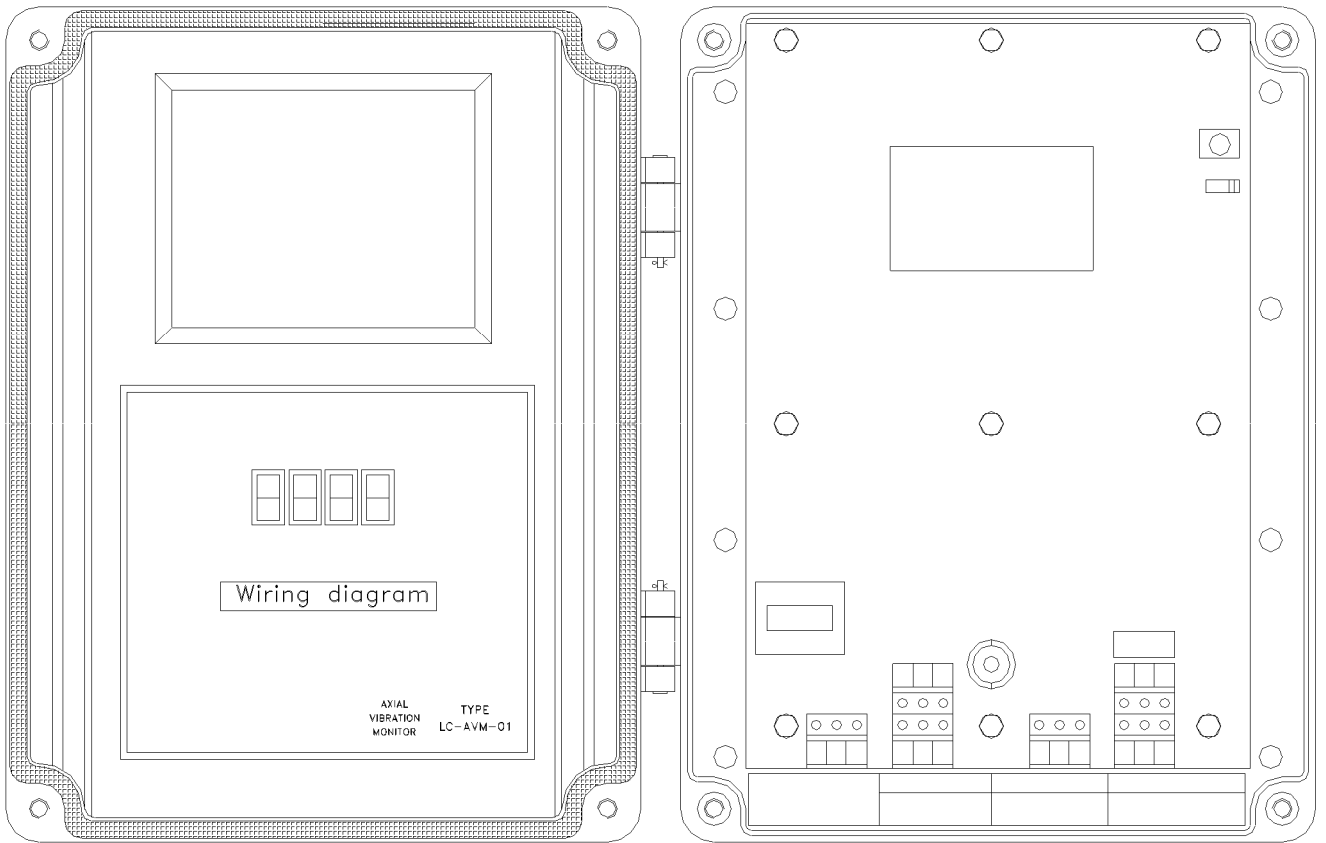
On delivery always check to ensure that the AVM system package is complete and undamaged. The contents of the package is as follows:

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.

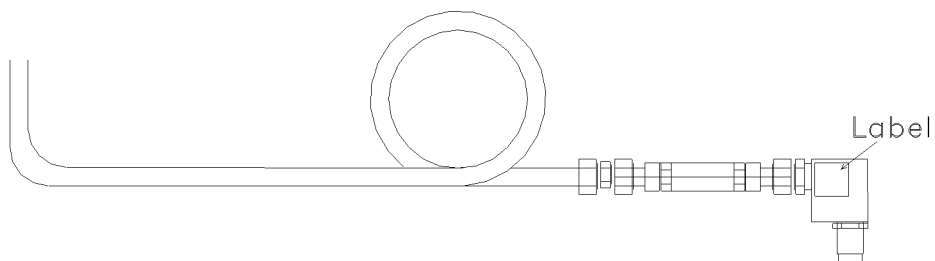
2、Axial Vibration Monitor Control Unit

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

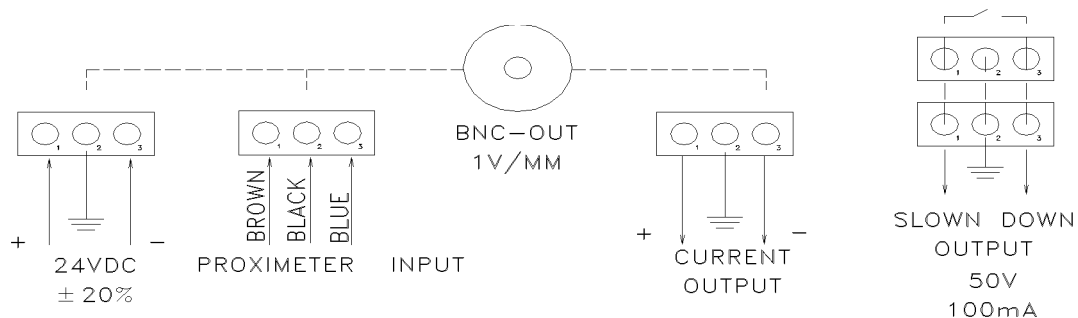
The LC-AVM-01 probe is to be mounted referring to the **Mechanical Mounting Instruction** drawing found in appendix. To ensure correct readout of peak-to -peak values it is important that the gap between the probe and the damper is correct. For the LC-AVM-01 probe, the correct mounting gap is **8.5 mm**.

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.





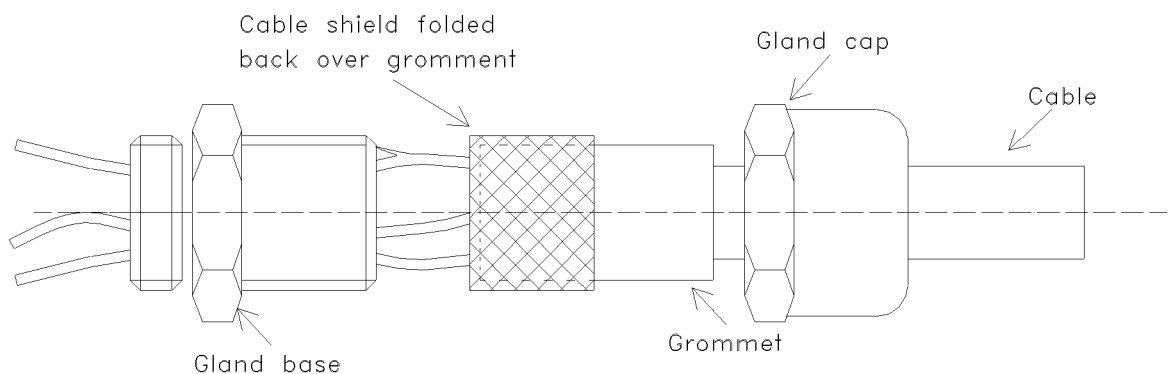
When the power is turned on, the system will indicate error by displaying 18.88., After approximately 8 seconds, the system will return to normal operating condition, and indicate 0.00–0.05 mm.

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.

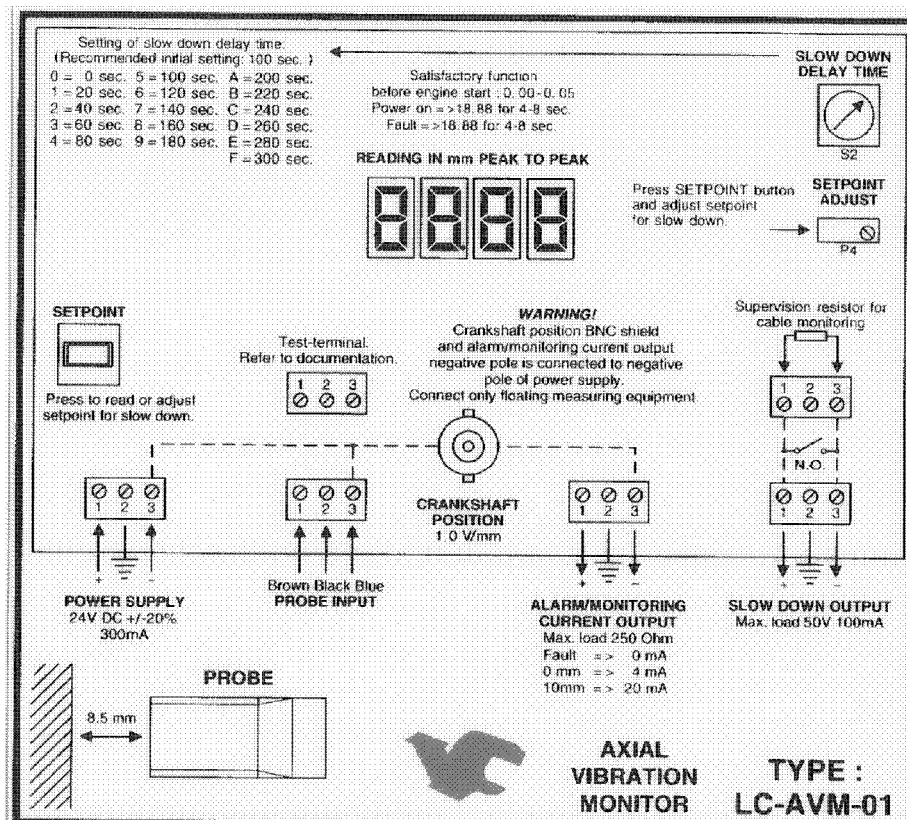
5.2.2 Registration of the installation

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 circuitboard 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

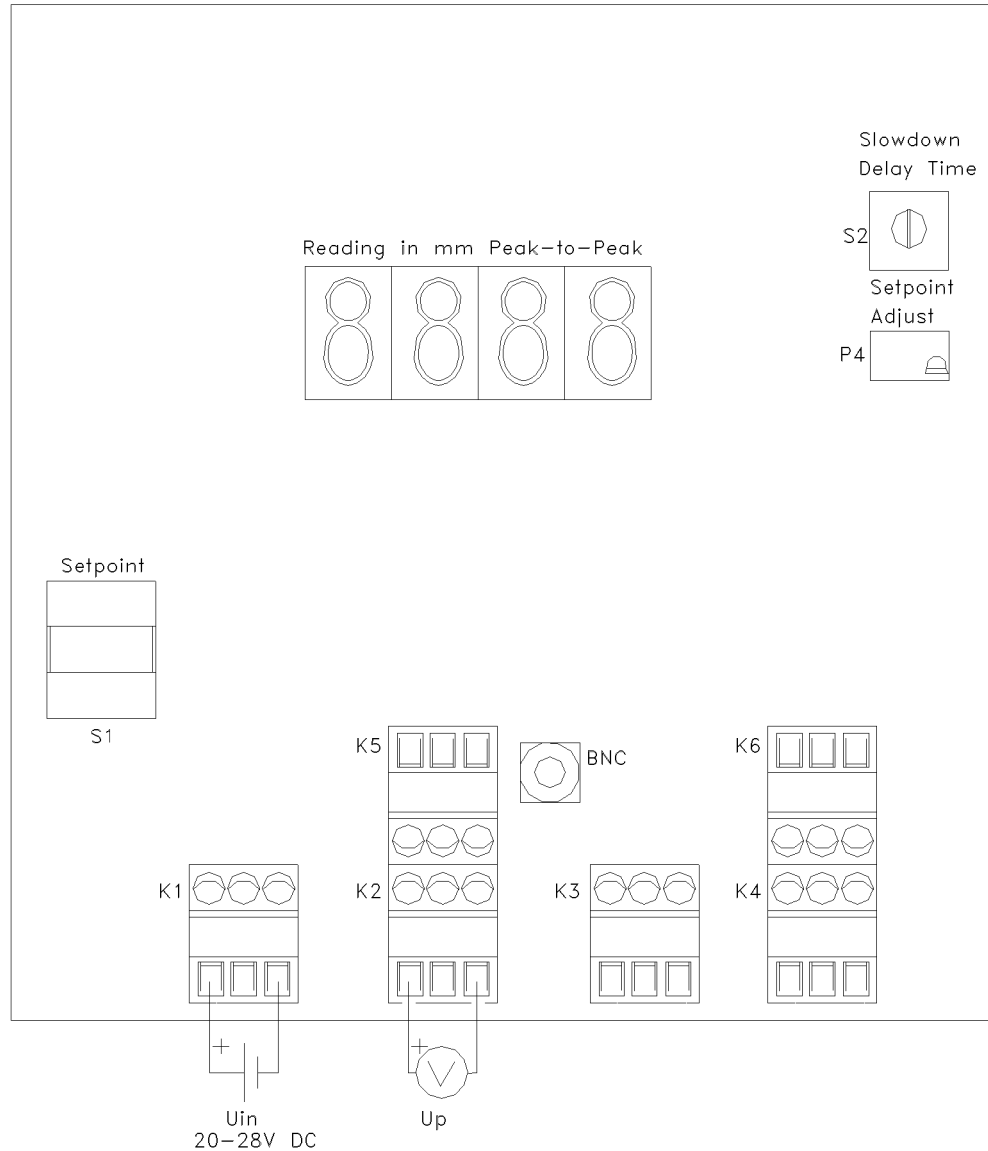


7、Trouble shooting

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)

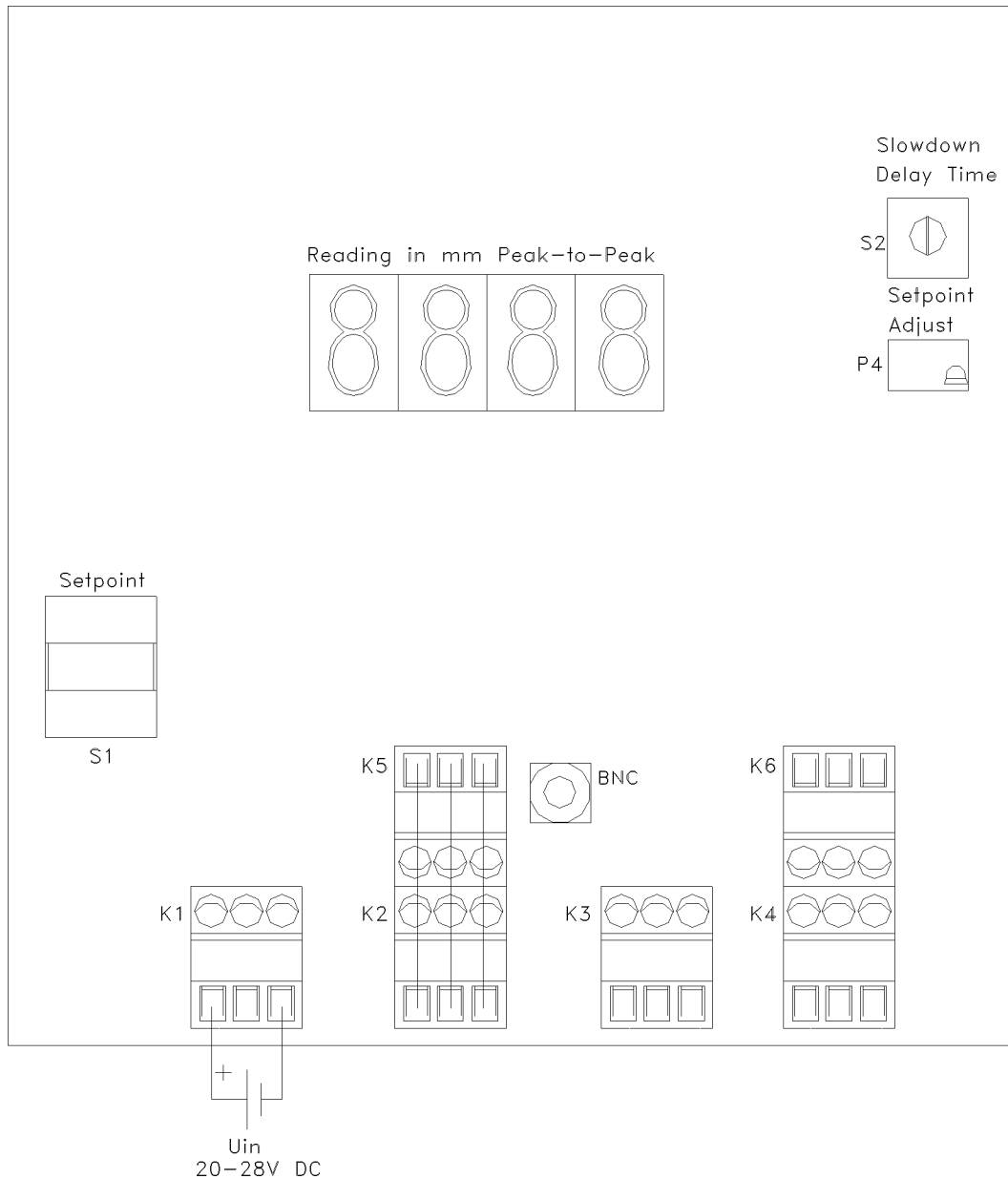
Check the voltage on K2

For the LC-AVM-01 the U_p 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).



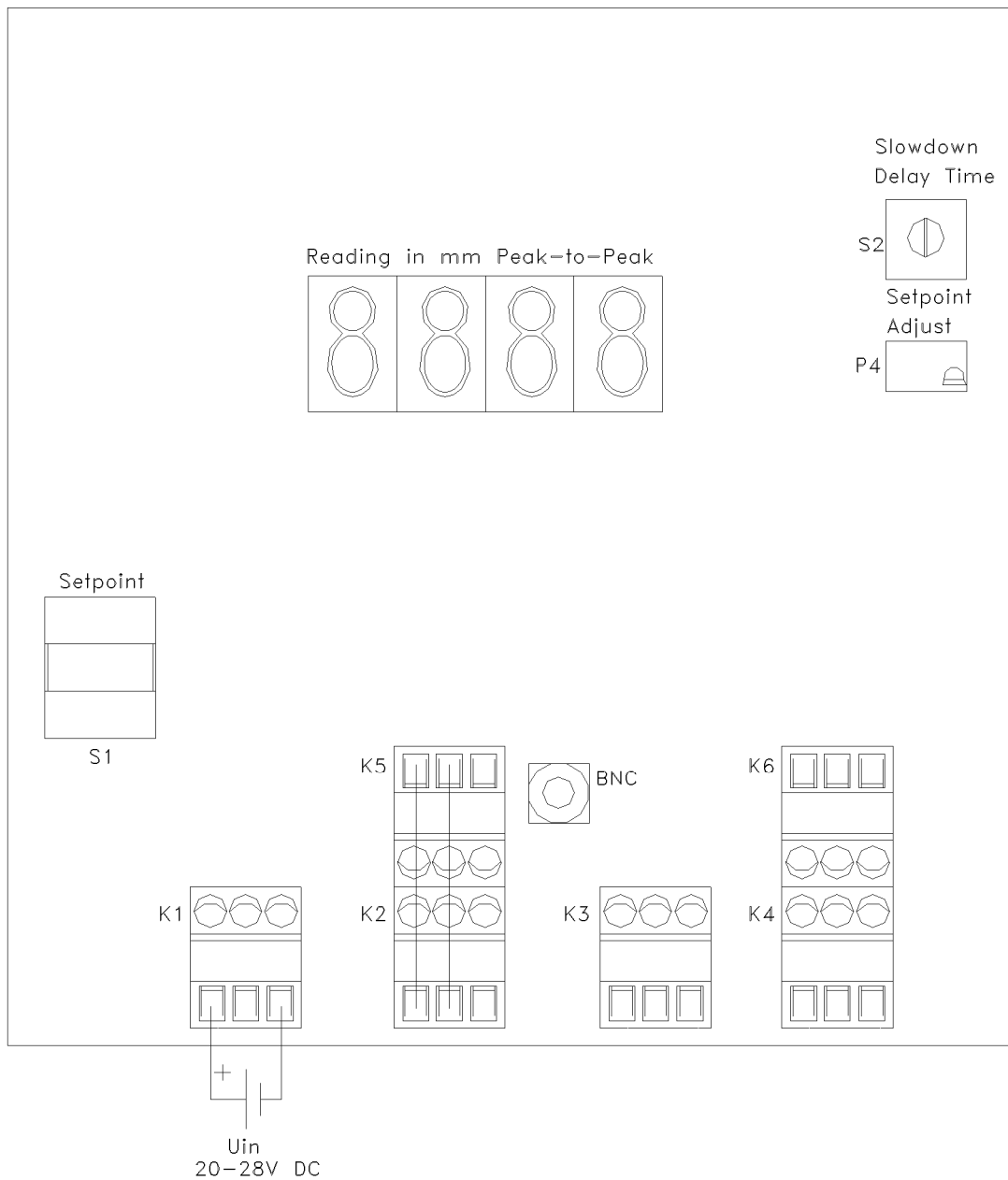
7.1.2 Check of unit behavior during power on



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).



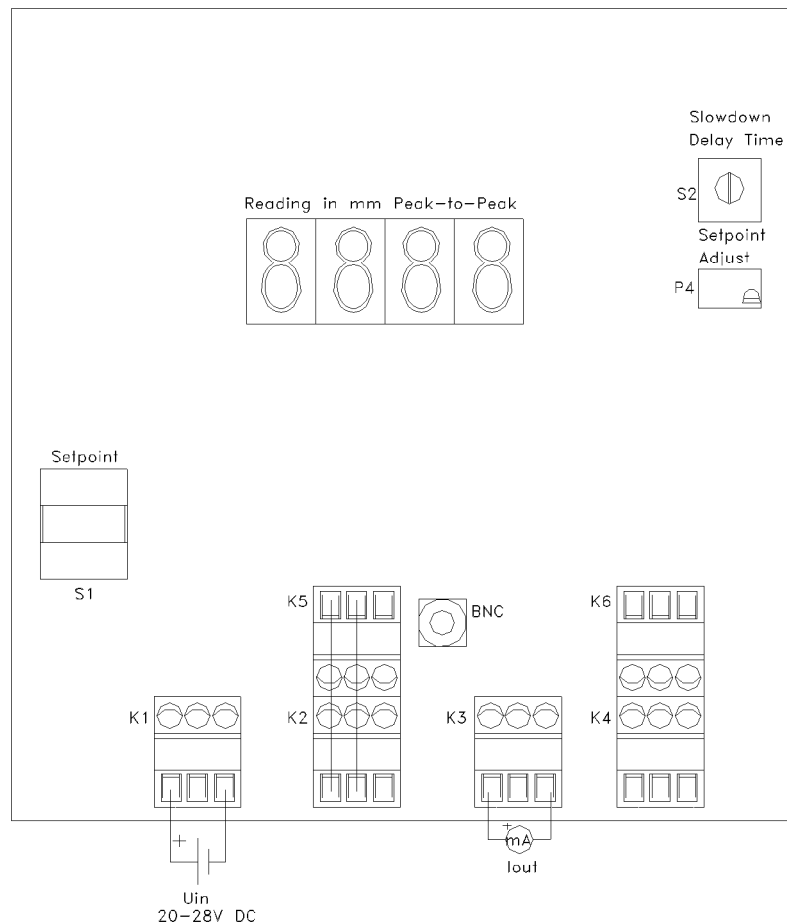
7.1.3 Check of probe input & display



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 $6.5\text{mm} \pm 1\text{mm}$. 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:

$$I_{out} [\text{mA}] = 1.6 \times (\text{display indication} [\text{mm}]) + 4$$

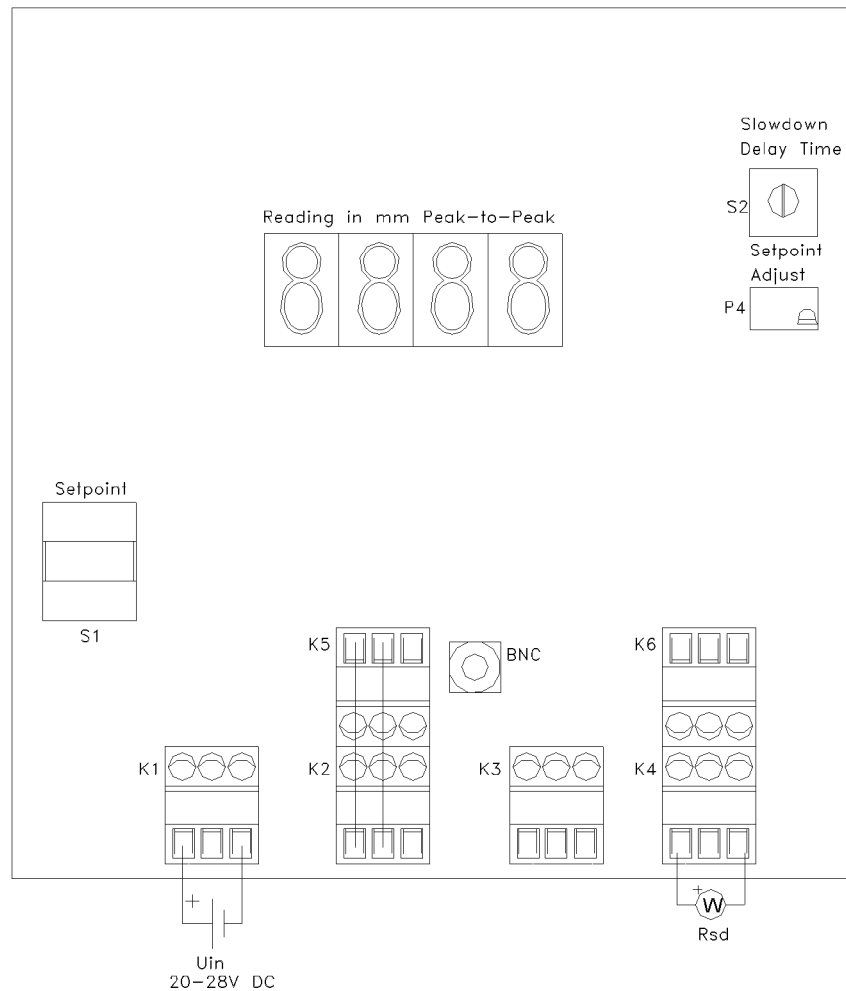
For the LC-AVM-01, 4 mA corresponds to 0 mm and 20 mA corresponds to 10 mm.

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: $R_{sd}=0\ \Omega$.

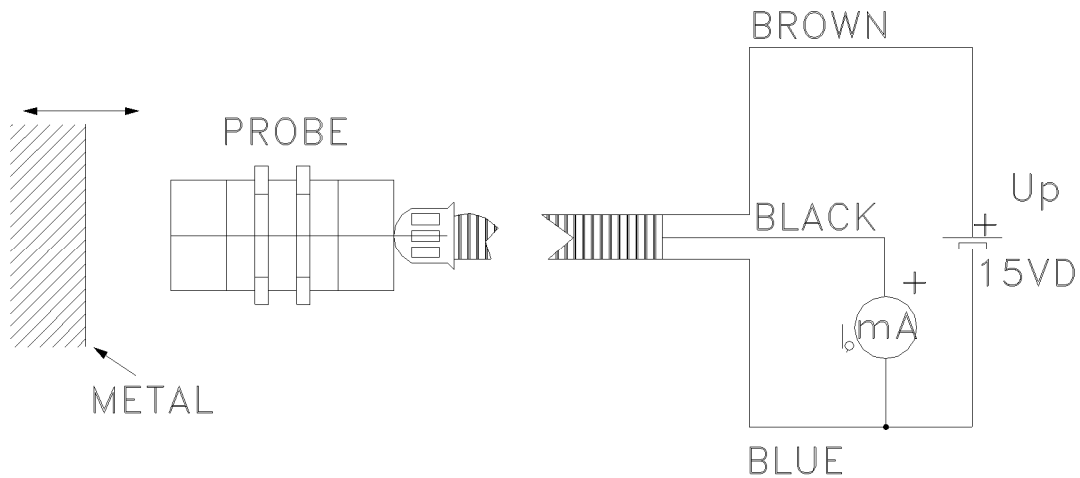
Connect K2.3 to K5.3 and watch the reading on the ohm-meter as the display reading descends. At display indications lower than the adjusted Set-point, the Slow Down relay will be deactivated: $R_{sd}=\infty$ or $R_{sd}=R_{supervision}$, if a supervision resistor is mounted between K6.1 and K6.3.

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 dismantled 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:

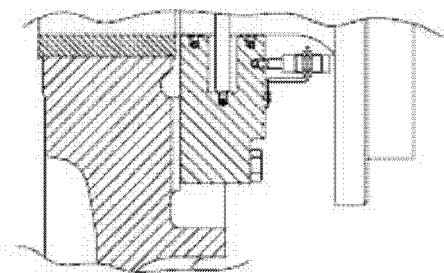
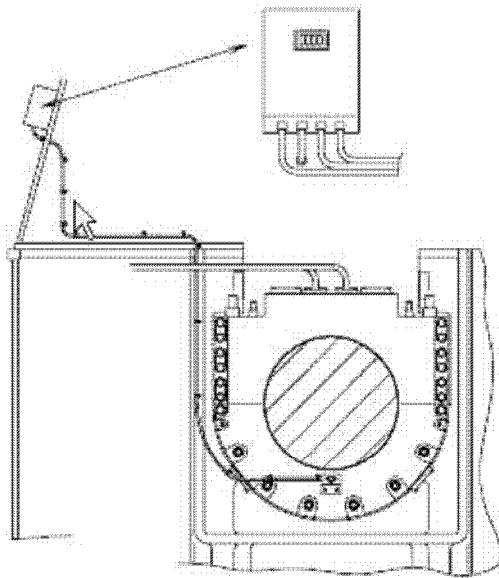
- Mechanical Mounting Instruction
- Calibration sheet for the AVM Complete unit
- Registration form (To be returned to us)



Mechanical Mounting Instruction

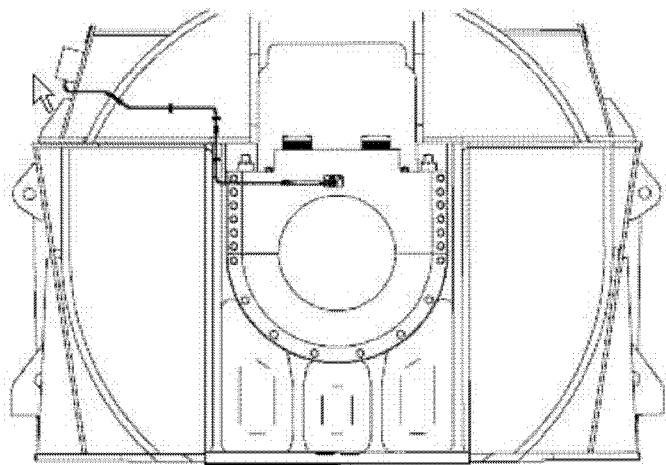
The probe is connected to a control unit which displays peak-to-peak movements and sends signals to the engine control system.

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. _____

气缸油加热柜 **HTCO37A**
Heating Tank For Cylinder Oil

用户指南及说明书
User Guide & Instruction Manual

安庆船用电器有限责任公司
ANQING MARINE ELECTRIC DEVICE CO., LTD

气缸油加热柜用户指南及说明书

气缸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

气缸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、球阀和电气控制箱等组成。

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/3 φ

四、 安装、调试（主机停车时）

1. 按照外形图 HTC037A.1-WXA 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。
3. 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、 维护

1. 汽缸油加热柜配有两只滤器，互为备用。当加热柜工作一段时间后，处于工作状态的滤器滤芯内沉淀了一定的杂质。这时应通过三通球阀切换至另一台滤器，使其工作。
2. A&B阀手柄都在左位时，左边滤器油路通；A&B阀手柄都在右位时，右边滤器油路通；A阀手柄在左位置且B阀手柄在右位置，或者A阀手柄在右位置且B阀手柄在左位置，左右两边滤器油路都不通。
3. 滤芯清洗步骤：
 - 3.1. 将滤器盖板上的四只内六角螺栓卸下，打开滤器盖板。
 - 3.2. 取出滤网压板后，将滤芯取出。
 - 3.3. 将取出的滤芯放入柴油,用软毛刷清洗，清洗完成后用压缩空气吹干。清洗杂质时，应检查滤芯有无破损。如滤芯破损，需及时更换。
 - 3.4. 将清洁的滤芯放入滤器壳体内。确认滤器放置到位后，将滤芯压板置于滤芯的顶部，盖上滤器盖板，均匀拧紧螺栓。
 - 3.5. 清洗或更换滤芯的同时检查密封件完好情况。

六、 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℃加热，不得任意调。
2. 低液位时不得启动电加热器。

User Guide & Instruction Manual

Heating Tank For Cylinder Oil

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 、 Volume: 37L
- 2 、 Working temperature: 40 ~ 50°C
- 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 stop)

1 、 According with external view HTCO37A.1-WXA,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 、 Maintenance

1. two strainers were equipped on the Heating Tank For Cylinder Oil being alternate each other. After period of working time, there will be some deposit of impurity inside the strainer which is at the active status. While this happens, another strainer should be put in use by the shift of the three way valve.
2. A & B valve locate left · left filter oil-way open. A & B valve locate right · right filter oil-way open . A valve locate left & B valve locate right · or A valve locate right & B valve locate left · two filter oil-way block.
3. Cleaning procedure of the filter element
 - 3.1.Dismantle the four socket head hexagon bolts on the cover of the strainer, open the cover;
 - 3.2.Take out the press plate and then take out the filter;
 - 3.3.Dip the filter into the diesel and clean it with soft brush, then dry it with compressed air. Check if there is any damage of the filter element while cleaning the impurities and replace the filter in time if any;
 - 3.4.Put the clean filter element back into the strainer shell and make sure it is fitted in position, after this, put the press plate on the top of the filter element, close the strainer lid, then fasten the bolts;
 - 3.5.Check if the sealing gasket is still in good condition while cleaning or replacing the filter element.

F 、 Note

- 1 、 Heating tank can auto heating. The temperature has been set by 45°C before delivery and can't be adjusted arbitrarily.
- 2 、 Do not turn on the heater while the low liquid level.

00-709DV999

注：安装外接管路时，请移除盲兰
REMARK : remove the blank flange before
installing external connection piping

External connection piping must have asupport to
strengthen,which in order to reduce vibration
外接管路必须支撑加强，减少振动

16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40

~ 648 ~ 313 ~ 120 88 107 ~ 190 1070 1140 4-Ø19 G3/8"泄放口
drain from tray

法兰外径Ø140
4-Ø18节圆100
与气缸油日用油柜连接
flange:Ø140 4-Ø18 PCD100
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 PCD100
to venting of cylinder oil service tank

法兰外径Ø140
4-Ø18节圆100
与主机连接
flange:Ø140
4-Ø18 PCD100
to engine connection AC

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
油箱容积 vloume of tank

MUNSELL 2.5G 7/2
37L

40 DIN3869 密封圈 WD R3/8 2 丁晴橡胶 NBR

39 Q/NHJ122 螺塞 plug 2 钢 steel

38 635AD600-14-0 出油口接管 tube of outlet 1 Q235-A

37 Q11F-16T 球阀DN32 globe valve 1 黄铜 BRASS

36 IPST9565 温度开关 temperature switch 1 组件 module

35 635AD600-15 密封垫 1 丁晴橡胶 NBR

34 WTY-301N-C 温度表 thermometer 1 组件 module

33 DIN3869 密封圈 WD R1/2 2 丁晴橡胶 NBR

32 Q/NHJ122 螺塞 1 钢 steel

31 635AD602-6 扎线架 3 Q235-A

30 GB/T70. 1-2000 内六角圆柱头螺钉M6×20 4 钢 steel

29 635AD600-12 密封垫 1 非石棉橡胶板

28 UQK-300W 液位开关 lever switch 1 组件 module

27 635AD602-8-0 控制箱 electric cabinet 1 组件 module

26 635AD602-5 排气管压板 1 Q235-A

25 635AD602-4 排气管支座 1 Q235-A

24 635AD600-11 滤器压板 2 Q235-A

23 635AD600-10 滤器支座 2 Q235-A

22 635AD600-9 铭牌 1 黄铜 BRASS

21 635AD600-7-0 排气口接管 tube 1 Q235-A

20 635AD600-16-0 滤器 stainer 2 组件 module

19 635AD600-21-0 管接头组件 1套 组件 module

18 KB3-DN32 三通选择球阀(球体L型) 2 内螺纹M42×2

17 635AD600-6 进油法兰 flange of inlet 1 Q235-A

16 635AD601-5 管接头 joint 1 SUS304

15 635AD601-4 过渡管 1 SUS304

14 GB/T6170-2000 六角螺母M10 8 钢 steel

13 GB93-1987 弹簧垫圈10 4 65Mn

12 GB97. 1-2002 平垫圈10 4 钢 steel

11 635AD602-3-0 油箱 tank 1 组件 module

10 GB/T70. 1-2000 内六角圆柱头螺钉M10×40 4 钢 steel

9 GB/T15389-1994 螺杆M10×25 8 钢 steel

8 GB3452.1 0形密封圈170×5.3 1 丁晴橡胶 NBR

7 GB923-1988 盖形螺母 M10 4 钢 steel

6 635AD600-4 油箱盖 cover 1 Q235-A

5 GB3452.1 0形密封圈60×3.55 1 丁晴橡胶 NBR

4 GB/T70. 1-2000 内六角圆柱头螺钉M10×20 14 钢 steel

3 635AD600-3-0 加热器 750W elec. heater 1 组件 module

2 635AD602-2 安装座 supporting rock 2 Q235-A

1 635AD602-1-0 安装板 supporting plate 1 Q235-A

序号 代号 名称 数量 材料

单件 总计 备注

重量

安庆船用电器有限公司

HTCO-37A.1型气缸油加热柜

635AD602-00

1:6

共 张 第 张

技术参数

1. 工作压力：3.0-4.0bar

2. 工作温度：40-50° C

3. 加热温度设定：45° C

4. 高温报警：110° C

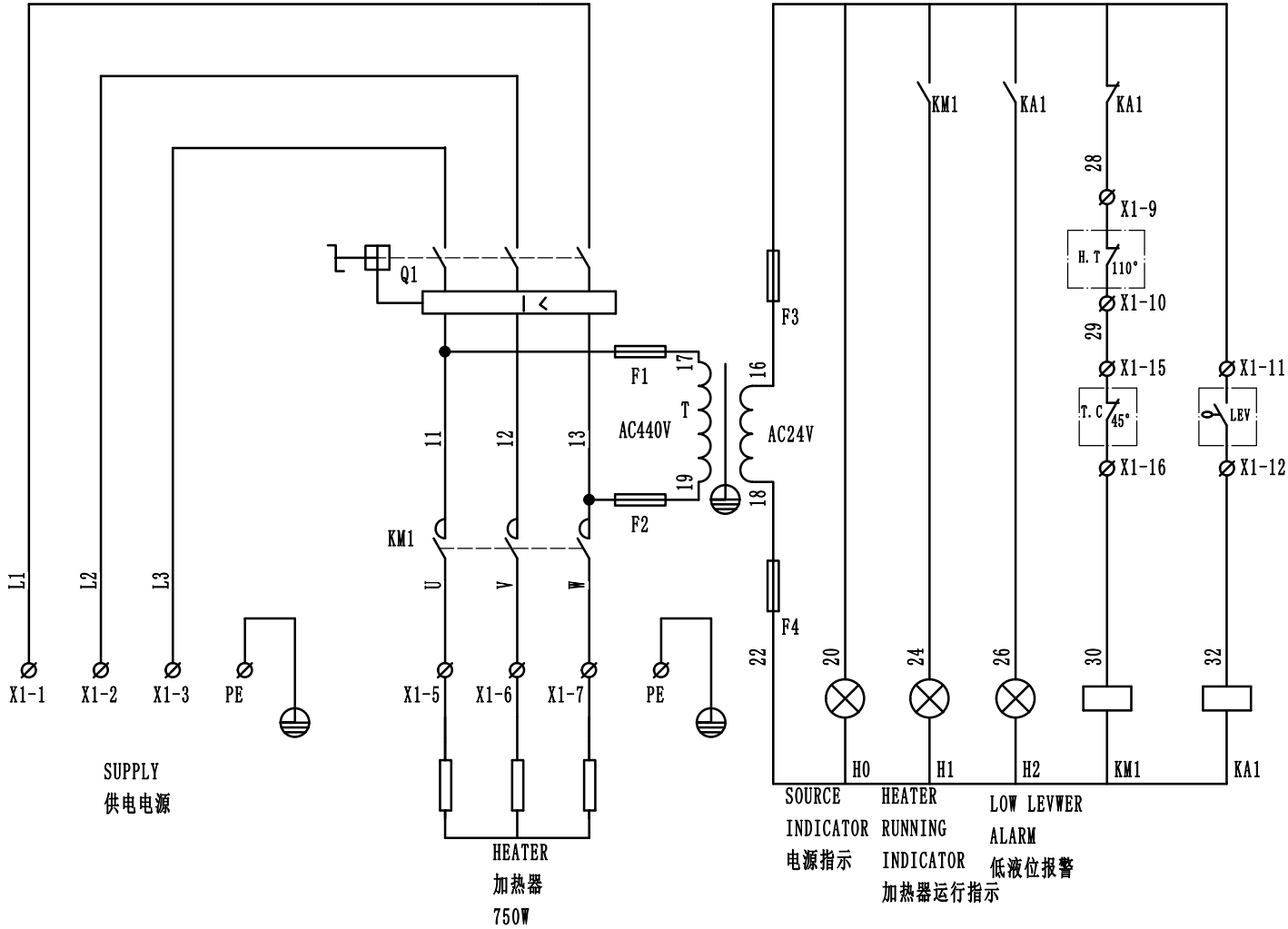
技术要求

1. 组装后，进行油箱密封试验（试验介质：润滑油），通过油泵油循环，箱体和接口不得有渗漏现象。

2. 加热器检验：滑油温度40—50° C.

6/14

主供电电源 SOURCE	加热器 HEATER	变压器 TRANSORMER	信号指示灯 SIGNAL LAMP	温度开关 TEMP. SWITCH	液位开关 LEVEL SWITCH	低液位报警信号 LOW LEVEL ALARM
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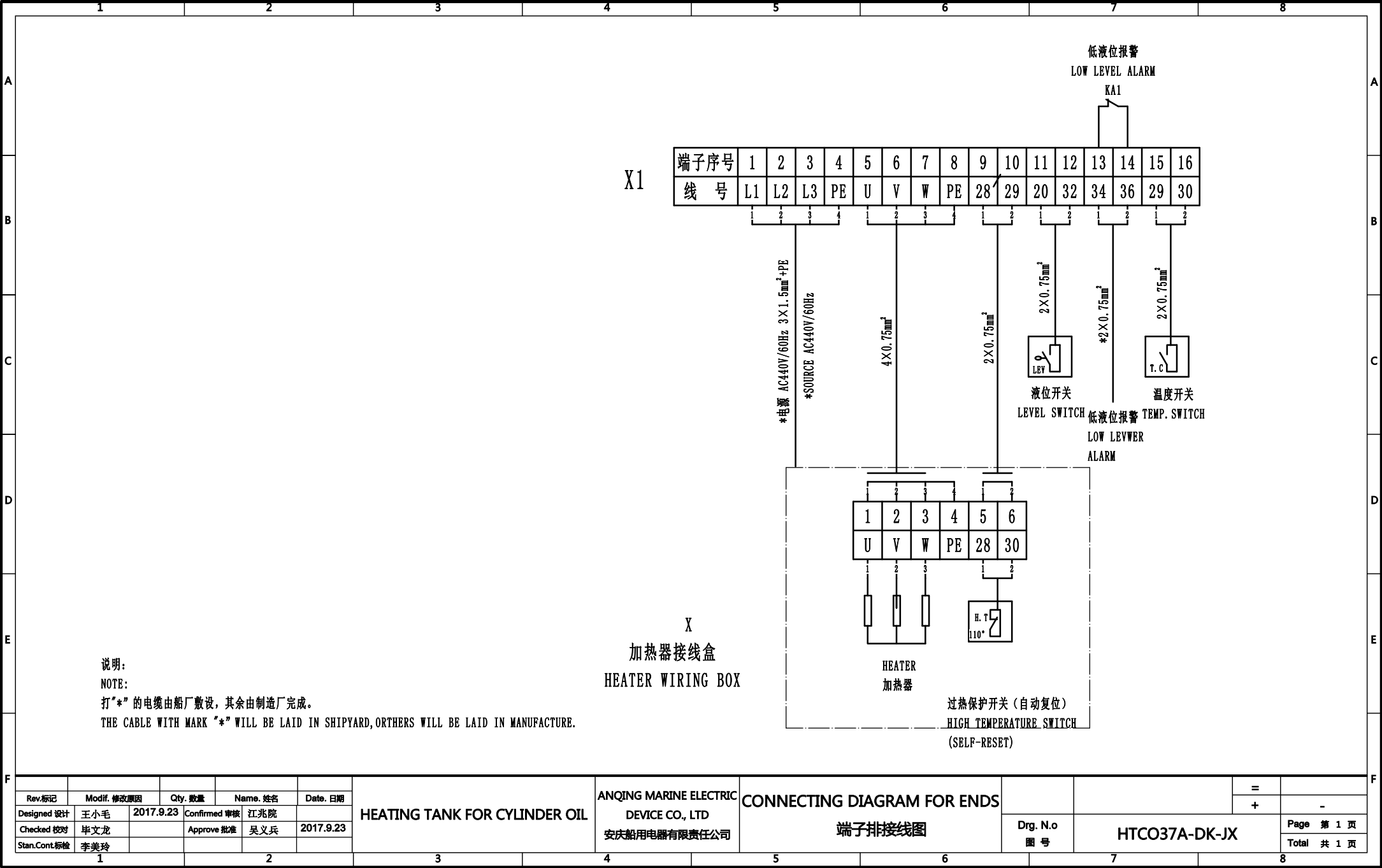


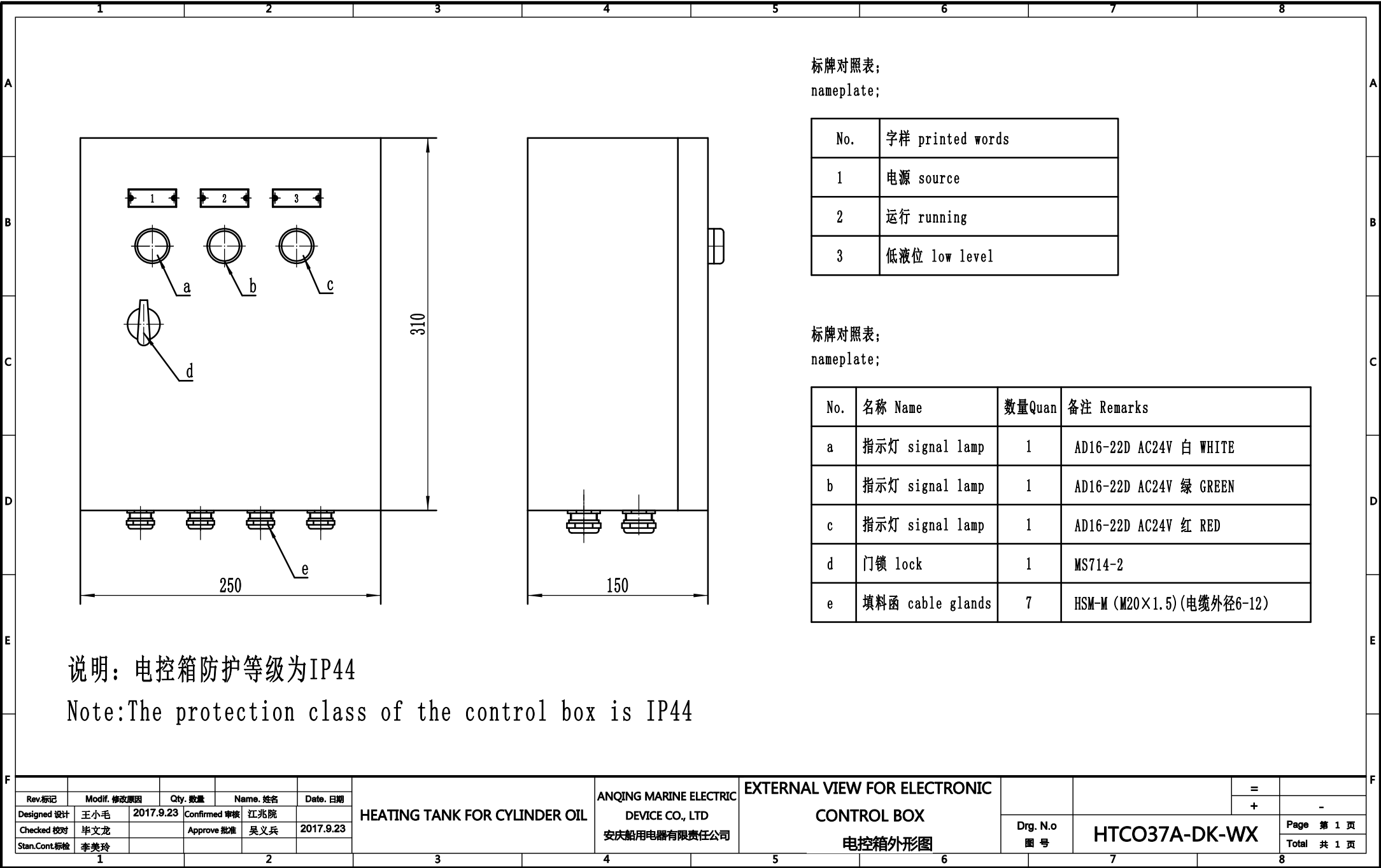
说明:
NOTE:
液位开关 Oil level switch
Low level:close;High level:open

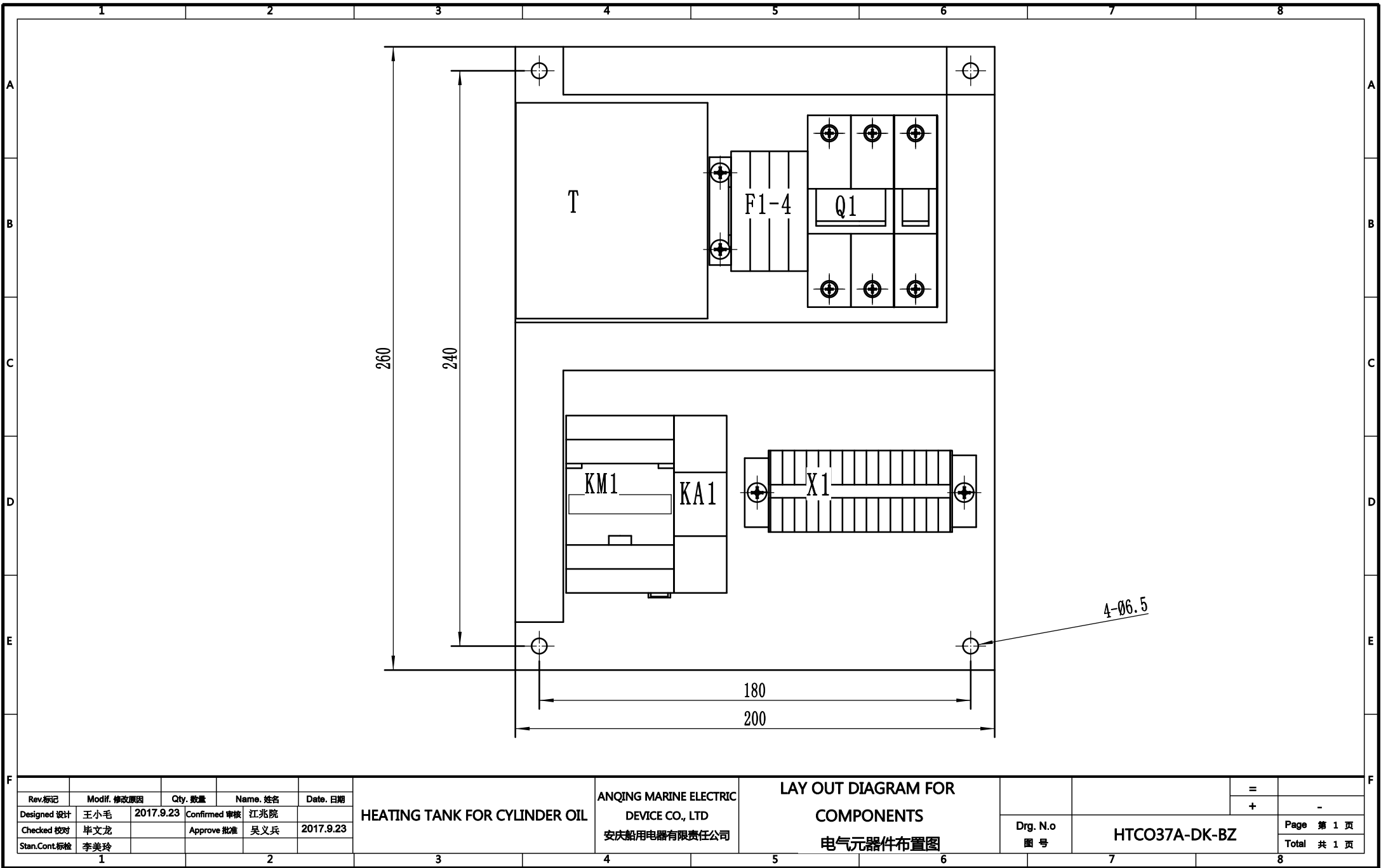
温度开关 T.C
Set point:45° C
<45° C:close; >45° C:open
temperature range:5° C-95° C

过热保护开关 (自动复位) H.T
<110° C:close; >110° C:open
self-reset

Rev.标记	Modif. 修改原因	Qty. 数量	Name. 姓名	Date. 日期	HEATING TANK FOR CYLINDER OIL	ANQING MARINE ELECTRIC DEVICE CO., LTD 安庆船用电器有限责任公司	PRINCIPLE DIAGRAM 原理图	Drg. No 图号	HTCO37A-DK-DL	Page 第 1 页 Total 共 1 页
Designed 设计	王小毛	2017.9.23	Confirmed 审核	江兆院						
Checked 校对	毕文龙		Approve 批准	吴义兵						
Stan.Cont.标检	李美玲									
1	2	3	4	5	6	7	8			

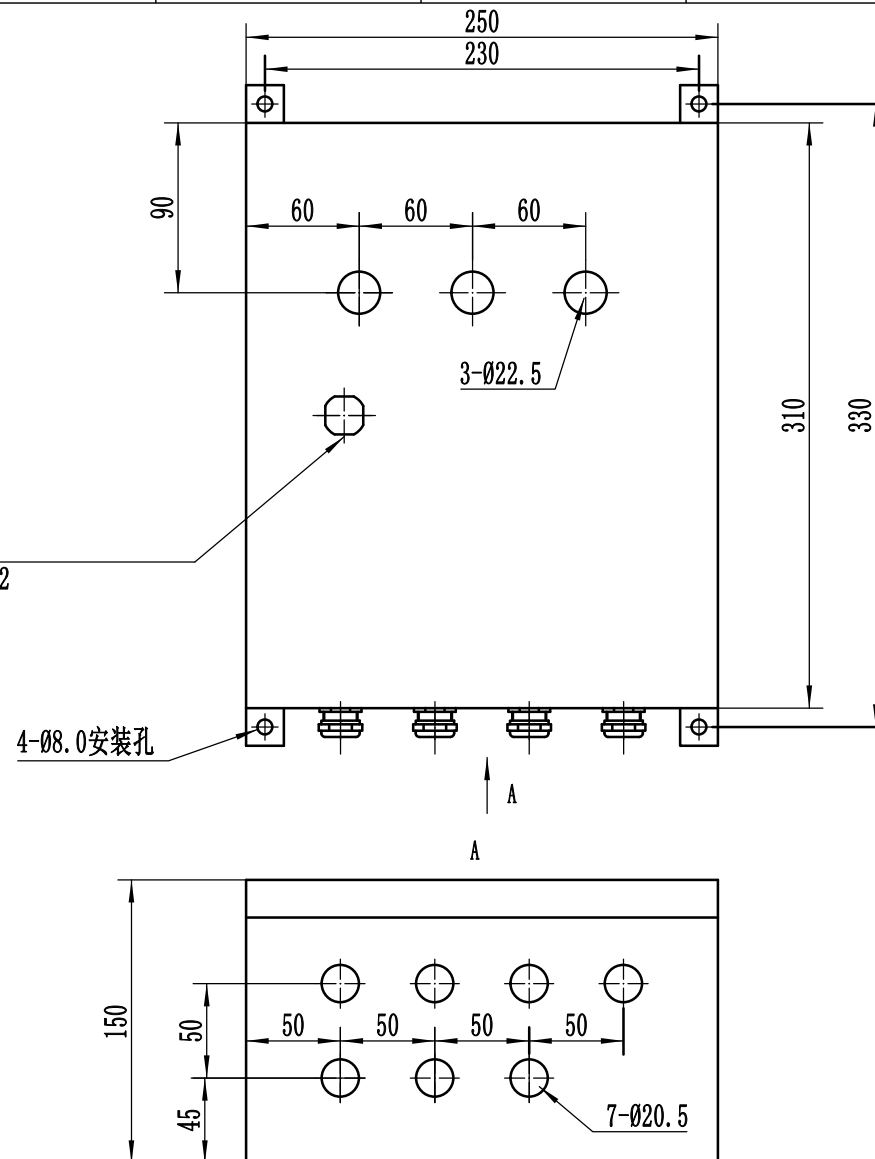






按锁 (MS714-2) 配作
OPEN HOLE ACCORDING TO LOCK MS714-2

4-Ø8.0 安装孔



Rev. 标记	Modif. 修改原因	Qty. 数量	Name. 姓名	Date. 日期
Designed 设计	王小毛	2017.9.23	Confirmed 审核 江兆院	
Checked 校对	毕文龙		Approve 批准 吴义兵	2017.9.23
Stan. Cont. 标检	李美玲			

HEATING TANK FOR CYLINDER OIL

ANQING MARINE ELECTRIC
DEVICE CO., LTD
安庆船用电器有限责任公司

CUT SIZE FOR ELECTROL BOX

电控箱开孔图

Drg. No.
图号

HTCO37A-DK-KK

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Page	第 1 页
Total	共 1 页

1		2		3		4		5		6		7		8																	
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		635AD600-16-0		滤芯 filter element		200 μ m		1		set																					
2		GB3452.1		O型圈 O-ring		60×3.55 NBR		1		set																					
3		G2R-2-SN AC24V		微型功率继电器 relay		AC24V		1		set																					

气缸油加热柜
HEATING TANK
FOR CYLINDER OIL

D/E NO. (机型): 6G60ME-C9.5

Hull NO. (船号): 0311113/14/15/16/17/18/19/20

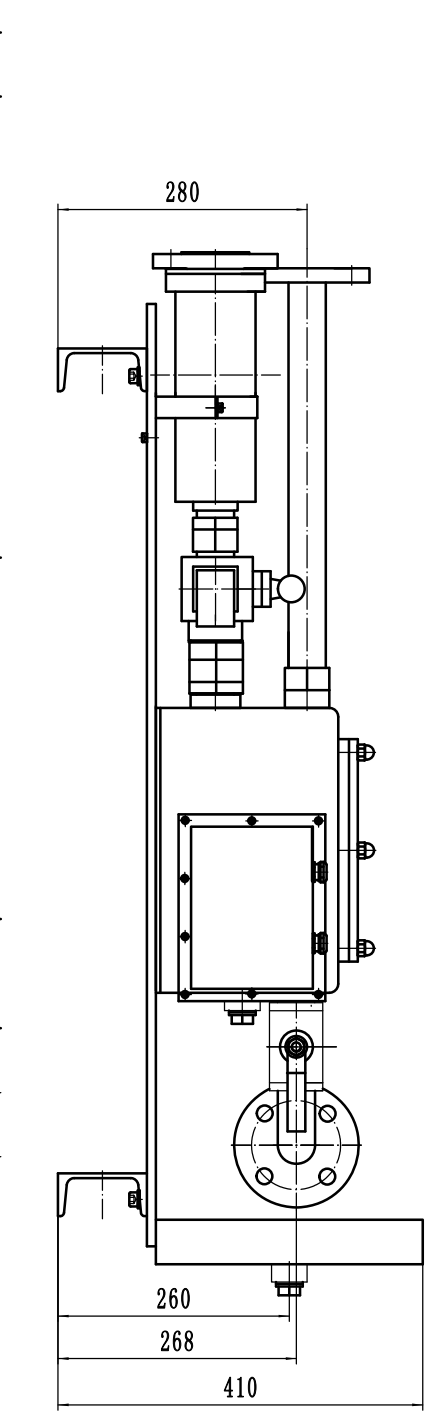
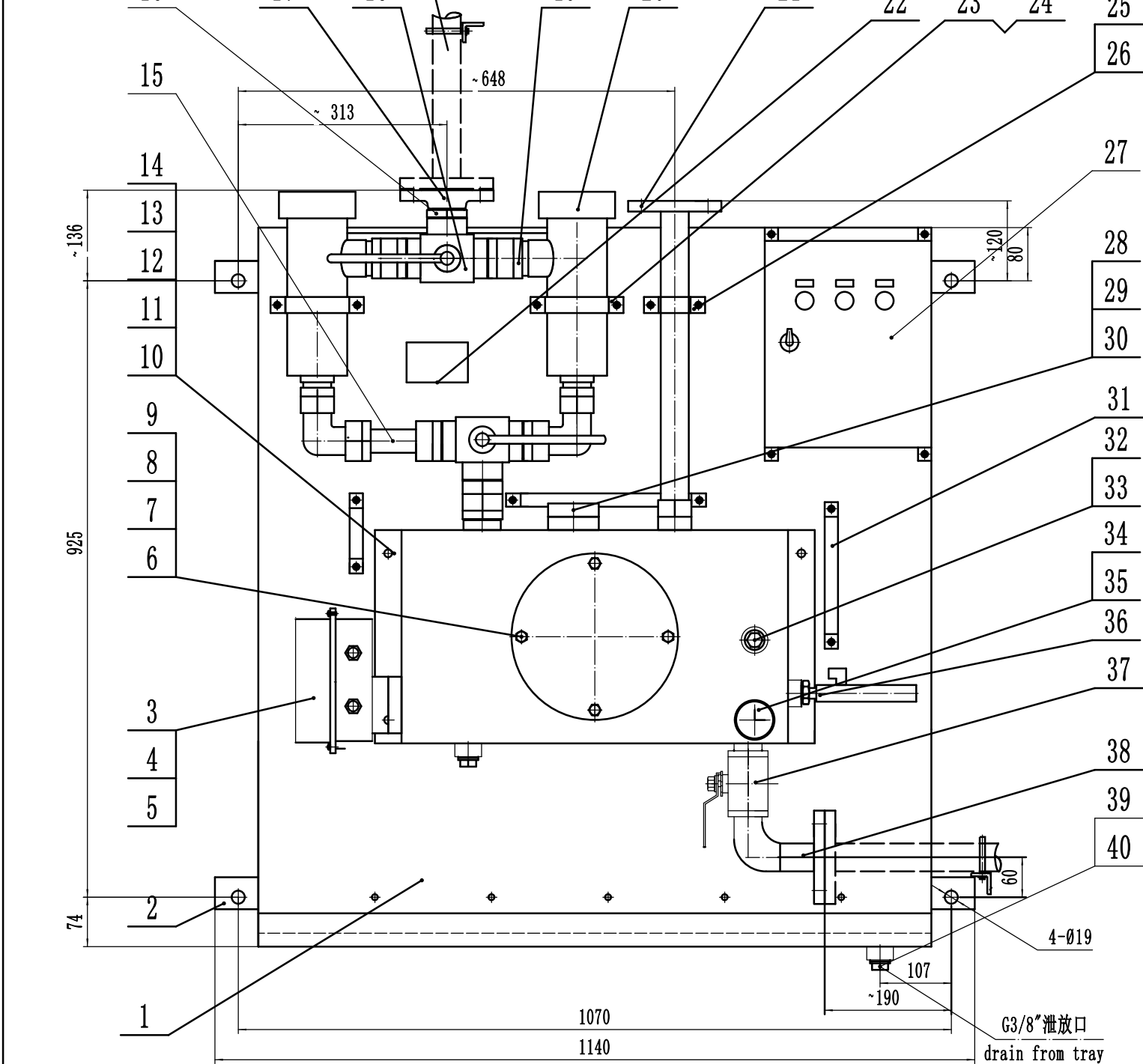
Class 船级社: ABS

完工资料
FINISHED DOCUMENTS

安庆船用电器有限责任公司
Anqing Marine Electric Device CO., LTD

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5															HTCO37A-DK-JX															CONNECTING DIAGRAM FOR ENDS 端子排接线图															1																																																																																																																																						
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8															HTCO37A-DK-KK															CUT SIZE FOR ELECTROL BOX 电控箱开孔图															1																																																																																																																																						
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Rev.标记															Modif. 修改原因															Qty. 数量															Name. 姓名															Date. 日期															HEATING TANK FOR CYLINDER OIL															ANQING MARINE ELECTRIC DEVICE CO., LTD 安庆船用电器有限责任公司															CONTENTS (图纸) 目录															Drg. N.o 图 号															HTCO37A-TM.1															=																													
Designed 设计															王小毛															2017.10.13															Confirmed 审核															江兆院																																																																																										+															-														
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00-709DV999				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 2.5G 7/2	
				油箱容积 vloume of tank		37L	



技术参数

- 工作压力：3.0-4.0bar
- 工作温度：40-50° C
- 加热温度设定：45° C
- 高温报警：110° C

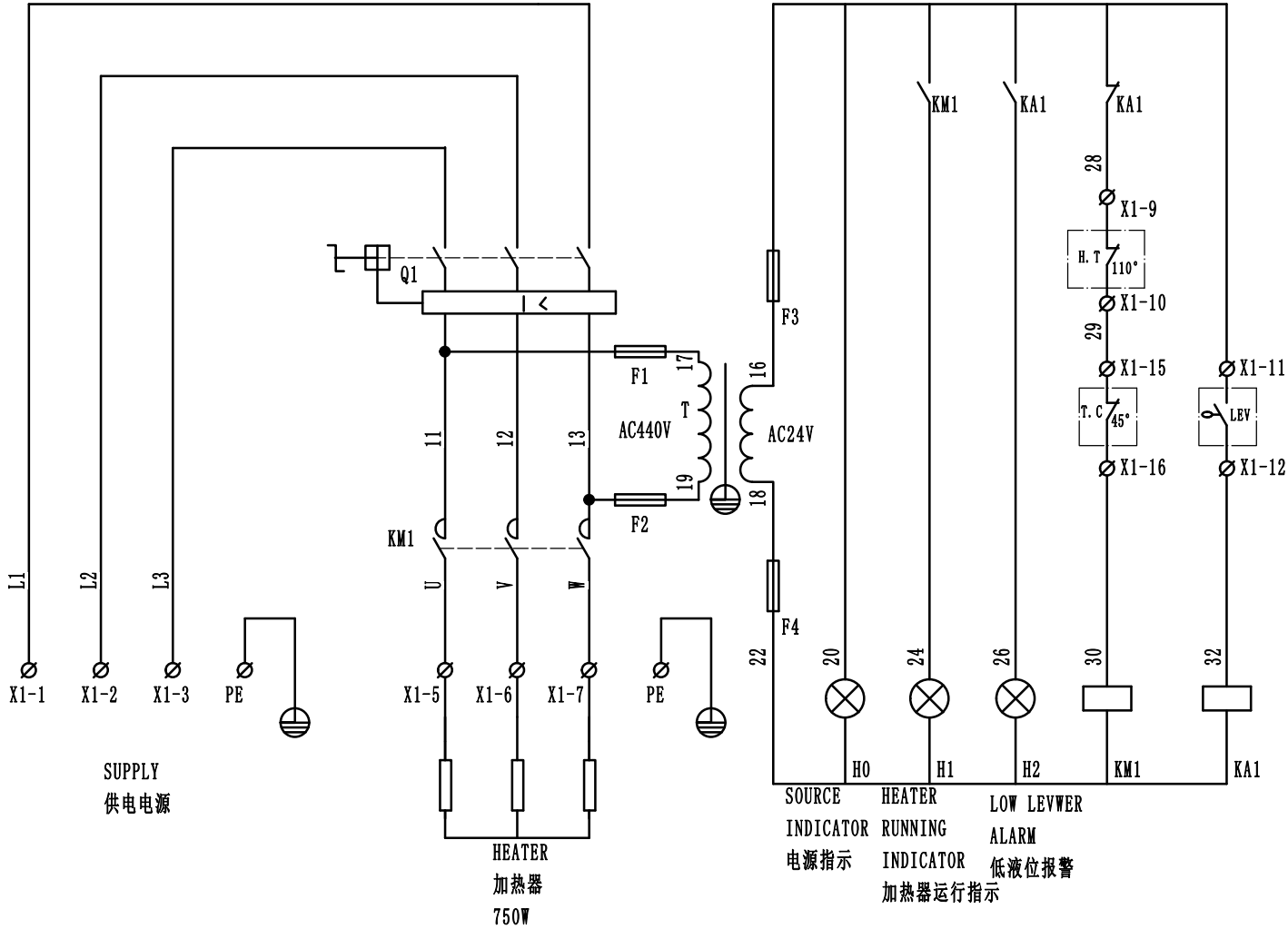
技术要求

- 组装后,进行油箱密封试验（试验介质:润滑油），通过油泵油循环,箱体和接口不得有渗漏现象。
- 加热器检验：滑油温度40—50° C.

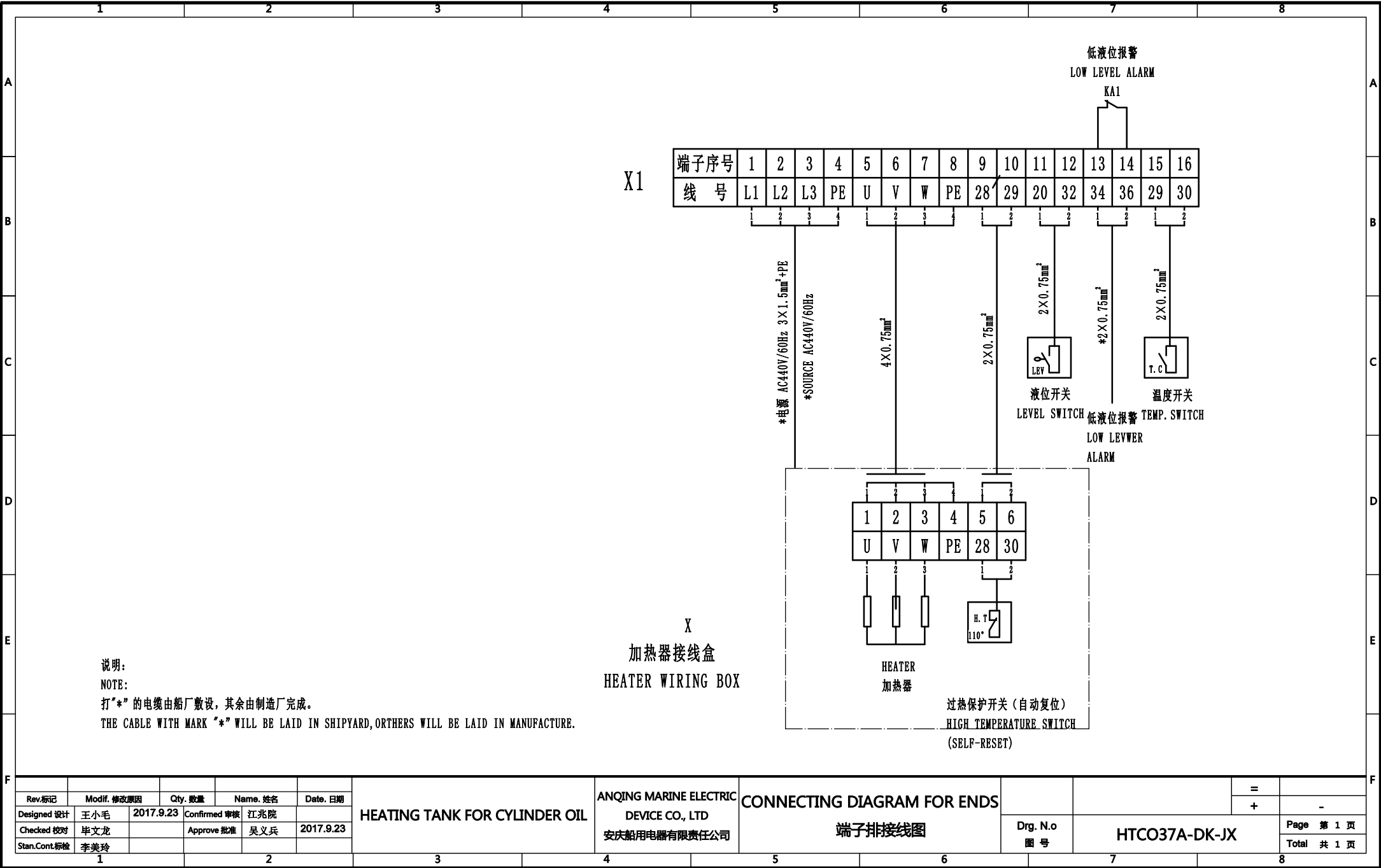
40	DIN3869	密封圈 WD R3/8	2	丁晴橡胶 NBR			
39	Q/NHJ122	螺塞 plug	2	钢 steel			G3/8"
38	635AD600-14-0	出油口接管 tube of outlet	1	Q235-A			
37	Q11F-16T	球阀DN32 globe valve	1	黄铜 BRASS			R1 1/4"
36	IPST9565	温度开关 temperature switch	1	组件 module			G1/2"
35	635AD600-15	密封垫	1	丁晴橡胶 NBR			
34	WTY-301N-C	温度表 thermometer	1	组件 module			G1/2"
33	DIN3869	密封圈 WD R1/2	2	丁晴橡胶 NBR			
32	Q/NHJ122	螺塞	1	钢 steel			G1/2"
31	635AD602-6	扎线架	3	Q235-A			
30	GB/T70. 1-2000	内六角圆柱头螺钉M6×20	4	钢 steel			
29	635AD600-12	密封垫	1	非石棉橡胶板			
28	UQK-300W	液位开关 lever switch	1	组件 module			
27	635AD602-8-0	控制箱 electric cabinet	1	组件 module			
26	635AD602-5	排气管压板	1	Q235-A			
25	635AD602-4	排气管支座	1	Q235-A			
24	635AD600-11	滤器压板	2	Q235-A			
23	635AD600-10	滤器支座	2	Q235-A			
22	635AD600-9	铭牌	1	黄铜 BRASS			
21	635AD600-7-0	排气口接管 tube	1	Q235-A			
20	635AD600-16-0	滤器 stainer	2	组件 module			200 μ m
19	635AD600-21-0	管接头组件	1套	组件 module			
18	KB3-DN32	三通选择球阀(球体L型)	2	内螺纹M42×2			
17	635AD600-6	进油法兰 flange of inlet	1	Q235-A			
16	635AD601-5	管接头 joint	1	SUS304			
15	635AD601-4	过渡管	1	SUS304			
14	GB/T6170-2000	六角螺母M10	8	钢 steel			
13	GB93-1987	弹簧垫圈10	4	65Mn			
12	GB97. 1-2002	平垫圈10	4	钢 steel			
11	635AD602-3-0	油箱 tank	1	组件 module			
10	GB/T70. 1-2000	内六角圆柱头螺钉M10×40	4	钢 steel			
9	GB/T15389-1994	螺杆M10×25	8	钢 steel			
8	GB3452.1	O形密封圈170×5.3	1	丁晴橡胶 NBR			
7	GB923-1988	盖形螺母 M10	4	钢 steel			
6	635AD600-4	油箱盖 cover	1	Q235-A			
5	GB3452.1	O形密封圈60×3.55	1	丁晴橡胶 NBR			
4	GB/T70. 1-2000	内六角圆柱头螺钉M10×20	14	钢 steel			
3	635AD600-3-0	加热器 750W elec. heater	1	组件 module			set:45° C
2	635AD602-2	安装座 supporting rock	2	Q235-A			
1	635AD602-1-0	安装板 supporting plate	1	Q235-A			

序号	代号	名称	数量	材料	单件	总计	备注
					重量	重量	
							安庆船用电器有限公司
							HTCO-37A.1型气缸油加热柜
设计	王小毛	2017.10.13	标准化	李美玲			
校对	毕文龙		质量会签				
审核	吴义兵	2017.10.13					
工艺			批准				
				阶段标记	重量	比例	
						1:6	635AD602-00
				共张	第张		

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	液位开关 LEVEL SWITCH	低液位报警信号 LOW LEVEL ALARM
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					HEATING TANK FOR CYLINDER OIL	ANQING MARINE ELECTRIC DEVICE CO., LTD 安庆船用电器有限责任公司	PRINCIPLE DIAGRAM 原理图																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
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Rev. 标记	Modif. 修改原因	Qty. 数量	Name. 姓名	Date. 日期
Designed 设计	王小毛	2017.9.23	Confirmed 审核	江兆院
Checked 校对	毕文龙		Approve 批准	吴义兵
Stan.Cont. 标检	李美玲			

HEATING TANK FOR CYLINDER OIL

ANQING MARINE ELECTRIC
DEVICE CO., LTD
安庆船用电器有限责任公司

CONNECTING DIAGRAM FOR ENDS

端子排接线图

Drg. No
图号

HTCO37A-DK-JX

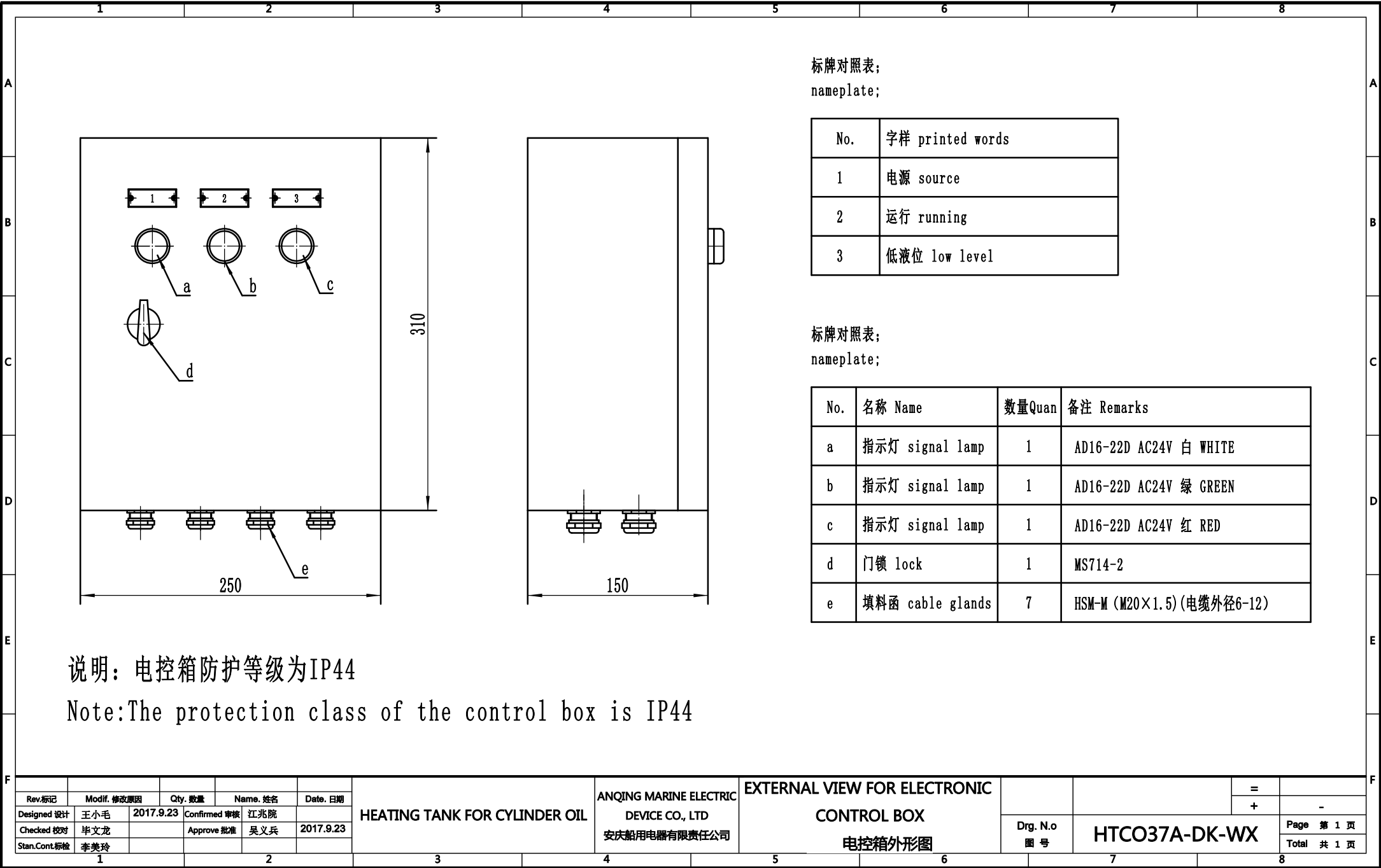
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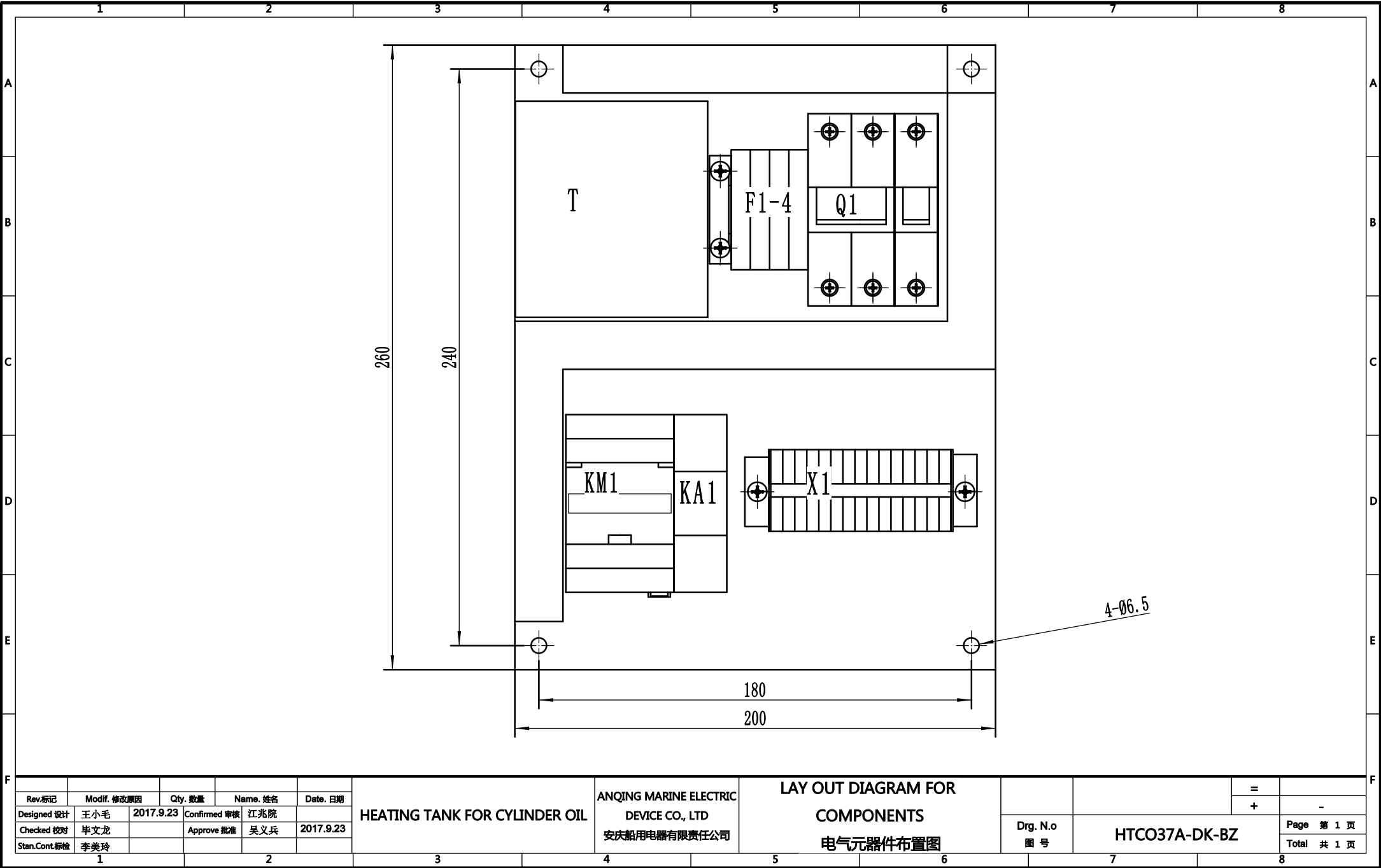
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Total 共 1 页





Rev.标记	Modif. 修改原因	Qty. 数量	Name. 姓名	Date. 日期
Designed 设计	王小毛	2017.9.23	Confirmed 审核 江兆院	
Checked 校对	毕文龙		Approve 批准 吴义兵	2017.9.23
Stan.Cont.标检	李美玲			

HEATING TANK FOR CYLINDER OIL

ANQING MARINE ELECTRIC
DEVICE CO., LTD
安庆船用电器有限责任公司

LAY OUT DIAGRAM FOR
COMPONENTS
电气元器件布置图

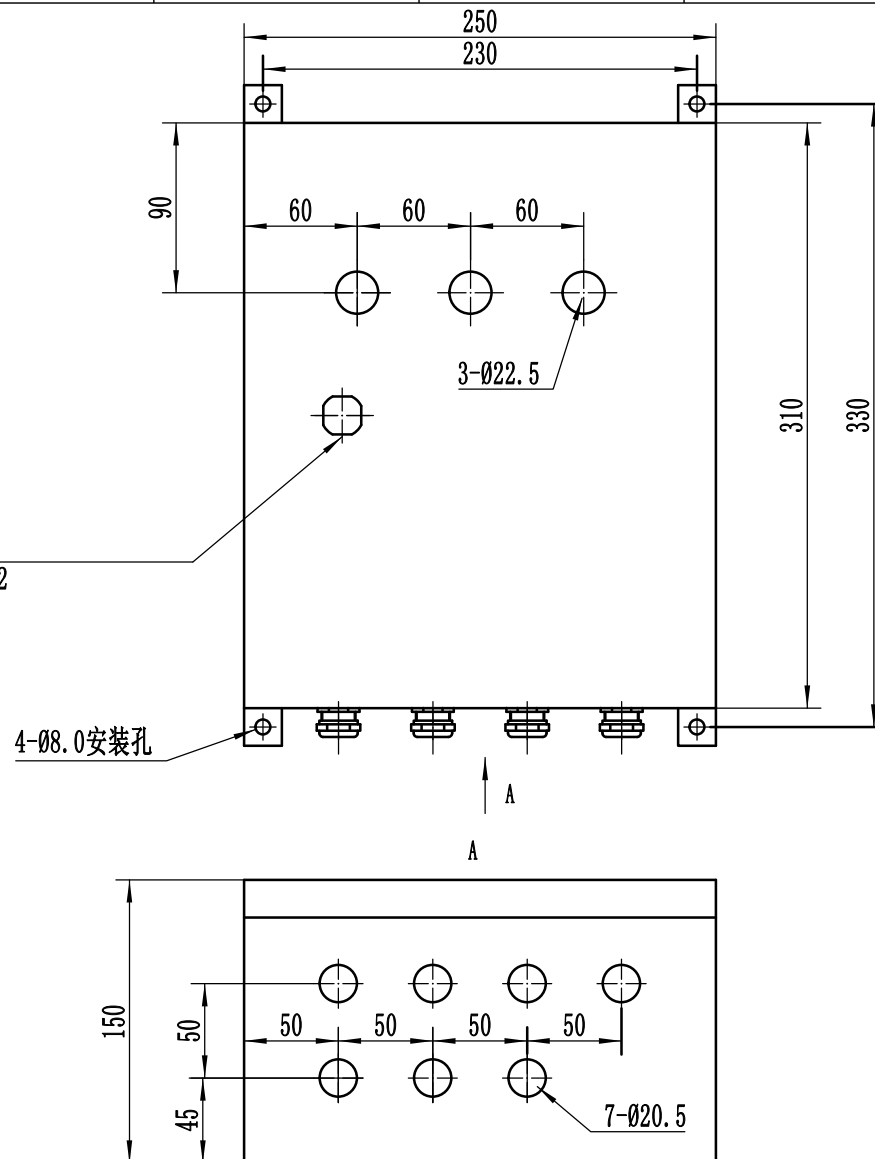
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HTCO37A-DK-BZ

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按锁 (MS714-2) 配作
OPEN HOLE ACCORDING TO LOCK MS714-2

4-Ø8.0 安装孔



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HEATING TANK FOR CYLINDER OIL

ANQING MARINE ELECTRIC
DEVICE CO., LTD
安庆船用电器有限责任公司

CUT SIZE FOR ELECTROL BOX

电控箱开孔图

Drg. No.
图号

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1		2		3		4		5		6		7		8											
序 号		代 号		名 称		型 号 规 格		数 量		备 注															
A	1	T		变压器transformer		JBK3-100 AC380, 440/24V		1		上海红旗															
	2	F1-F4		熔断器型端子Fuse terminal		UK5-HESI 配熔芯2A, Φ5×25		4		菲尼克斯															
	3	KM1		接触器contactor		LC1-0910 B7 AC24V		1		Schneider															
	4	Q1		断路器relay module		C65N 3P 6A		1		Schneider															
B	5	KA1		微型功率继电器		G2R-2-SN AC24V 配P2RF-08-E插座及固定卡		1		OMRON															
	6	H0		指示灯 signal lamp		AD16-22D AC24V white		1		A. P. T															
	7	H1		指示灯 signal lamp		AD16-22D AC24V green		1		A. P. T															
	8	H2		指示灯 signal lamp		AD16-22D AC24V red		1		A. P. T															
C	9			填料函 cable glands		HSM-M M20×1.5(电缆外径6-12)		7		LANKELEC															
	10			填料函 cable glands		PG13.5(电缆外径6-12) 铜镀镍		2																	
	11			门锁 lock		MS714-2		1																	
	12			端子排 terminal		UK2.5B 16节 配端板及固定卡		1		菲尼克斯															
D	13			端子排 terminal		UK2.5B 7节 配端板及固定卡		1		菲尼克斯															
	14	H. T		过热保护开关 overheat protection switch		TS-120SR 范围: 0° -120° C, 设定110° C		1		RAINBOW															
	15	T. C		温度开关 temperature switch		IPST9565 范围: 5° -95° C, 设定45° C, G1/2		1		TRAFAG															
	16	LEV		液位开关 level switch		UQK-652-C/K		1		江苏远望															
E																									
F																									
Rev.标记		Modif. 修改原因		Qty. 数量		Name. 姓名		Date. 日期		HEATING TANK FOR CYLINDER OIL		ANQING MARINE ELECTRIC DEVICE CO., LTD 安庆船用电器有限责任公司		ELEMENTS LIST 元件清单		Drg. N.o 图 号		HTCO37A-DK-MX		=					
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1		2		3		4		5		6		7		8																	
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		635AD600-16-0		滤芯 filter element		200 μ m		1		set																					
2		GB3452.1		O型圈 O-ring		60×3.55 NBR		1		set																					
3		G2R-2-SN AC24V		微型功率继电器 relay		AC24V		1		set																					
</																															

Instructions for assembly and operation

Bearing Distance and Temperature Monitoring System

BDMS/BTMS

(BTMS optionally available)



© Dr. E. Horn
Sensors-Monitoring-Systems
Im Vogelsang 1
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1	General	7
1.1	Information on this Manual	7
1.2	Explanation of symbols	8
1.3	Limitation of liability	9
1.4	Copyright	9
1.5	Spare parts	10
1.6	Warranty terms	10
1.7	Customer Service	10
2	Safety	11
2.1	Customer's responsibility	11
2.2	Personnel requirements	12
2.2.1	Qualifications	12
2.2.2	Unauthorized persons	13
2.3	Intended use	14
2.4	Personal protective equipment	15
2.5	Specific dangers	16
2.6	Conduct in a dangerous situation and in case of accidents	21
2.7	Environmental protection	22
3	Technical data	23
3.1	Indication unit	23
3.1.1	Type MDA312	23
3.1.2	Type MDA312... in field housing GHG02631	24
3.2	Line Converter box	24
3.2.1	Type GHG02611-4	24
3.2.2	Type GHG02611-5	25
3.3	Terminal box GHG2621-3	26
3.4	Distance sensor IW000184	26
3.5	Water-in-oil sensor FRG00032-6_AW	27
3.6	Main bearing temperature sensor TGL00921	28
3.7	Emissions	28
4	Structure and function	29
4.1	Overview	29
4.2	Brief description	30
4.3	Description of assemblies	31
4.3.1	Sensors	31
4.3.1.1	Distance sensor	31



Table of contents

4.3.1.2	Water-in-oil sensor	32
4.3.1.3	Main bearing temperature sensor (optionally available).....	33
4.3.2	Sensor brackets.....	34
4.3.2.1	Tube type sensor brackets.....	34
4.3.2.2	Profile type sensor brackets.....	35
4.3.3	Terminal box	37
4.3.4	Line Converter box	38
4.3.5	Indication unit.....	39
4.4	Connections	41
4.5	Work and danger zones.....	43
4.6	Operating elements.....	44
5	Transport, packing and storage	45
5.1	Safety notes for transport.....	45
5.2	Transport inspection.....	46
5.3	Transport.....	46
5.4	Packing	47
5.5	Storage.....	48
6	Installation, fixing and commissioning.....	49
6.1	Safety	49
6.2	Preparations.....	51
6.2.1	Preparing the installation into new engines under assembly	51
6.2.2	Preparing the installation as a retrofit.....	51
6.3	Installation	53
6.3.1	Preface	53
6.3.2	Mounting the sensor brackets	55
6.3.3	Implementation of alignment pins.....	60
6.3.4	Mounting and adjusting the sensors.....	61
6.3.5	Placing and fixing of cables inside the engine	70
6.3.5.1	Placing and fixing of cables inside new engines under construction	71
6.3.5.2	Placing and fixing of cables for retrofit installation	74
6.3.6	Mounting a Terminal box	75
6.3.7	Connecting the Terminal box.....	76
6.3.7.1	Connecting sensors.....	78
6.3.7.2	Connecting the bus cable.....	78
6.3.8	Mounting the Line Converter box	79
6.3.9	Connecting the Line Converter box.....	81

**Table of contents**

6.3.9.1	Connecting the bus cables from the Terminal boxes	83
6.3.9.2	Connecting to the ship's/plant's power supply	83
6.3.9.3	Connecting the bus cable of the Indication unit	85
6.3.10	Mounting the Indication unit	85
6.3.11	Connecting the Indication unit	86
6.3.11.1	Connecting the power supply	88
6.3.11.2	Connecting the bus cable from the Line Converter box	89
6.3.11.3	Connecting the engine alarm and engine safety system	90
6.3.11.4	Other connectors	91
6.4	Checks	93
6.5	Commissioning	95
7	Operation	96
7.1	Safety	96
7.2	Operating the Indication unit	96
7.3	Testing a water-in-oil-sensor	99
8	Maintenance	100
8.1	Safety	100
8.2	Maintenance schedule	102
8.3	Maintenance tasks	103
8.3.1	Changing distance sensors	103
8.3.2	Inspecting a main bearing after production test run	105
8.4	Screw tightening torques	106
8.5	Measures after maintenance	106
9	Troubleshooting	107
9.1	Safety	107
9.2	Troubleshooting chart	110
9.3	Troubleshooting	111
9.3.1	Checking the electrical connection of the Indication unit	111
9.3.2	Checking the bus cables of the Indication unit and power supply	111
9.3.3	Checking distance sensors	113
9.3.4	Checking main bearing temperature sensor	114
9.3.5	Checking water-in-oil sensor	115
9.3.6	Checking function of the Terminal box	116



Table of contents

9.4 Startup after eliminating fault 117

10 Appendix 118

10.1 Installation schemata for the distance sensors..... 118

10.2 Counting of sensors 129

10.3 System installation schemata 130

11 Index 132



1 General

1.1 Information on this Manual

This Manual provides important information on how to work with the device safely and efficiently.

The Manual is part of the device, must always be kept in the device's direct proximity and should be available for the personnel at any time. All personnel working with the device is obliged to have this Manual read and understood before starting any work. Strict compliance with all specified safety notes and instructions is a basic requirement for safety at work.

Moreover, the accident prevention guidelines and general safety regulations applicable at the place of use of the device must also be complied with.

For better representation of circumstances the illustrations used are not necessarily to scale and may vary from the actual design of the device.

The enclosed manuals for the installed components apply alongside this Manual.

The information in this manual is valid for all systems. The chapters Commissioning, Operation and Troubleshooting have slightly changed in systems ordered after 1. January 2009. For this systems please see document "User Interface Manual" DK002208.



General

1.2 Explanation of symbols

Warnings

Warnings are identified by symbols. These warnings are introduced by signal words, which express the severity of a danger. Adhere to these warnings and act cautiously in order to avoid accidents, personal injuries and damage to property.



DANGER!

... indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.



WARNING!

... indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.



CAUTION!

... indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.



CAUTION!

... indicates a potentially hazardous situation which, if not avoided, may result in property damage.

Hints and recommendations



NOTE!

... emphasizes useful hints and recommendations as well as information for efficient and trouble-free operation.

Special safety notes

The following symbols are used in connection with the safety notes to highlight particular dangers:



... highlights hazards caused by electric current. There is a danger of serious injury or death if the safety notes are not complied with.



1.3 Limitation of liability

All information and notes in this Manual were compiled under due consideration of valid standards and regulations, the present status of technology and our years of knowledge and experience.

The manufacturer can not be made liable for damage resulting from:

- n disregarding this Manual
- n unintended use
- n employment of untrained personnel
- n unauthorized conversions
- n technical modifications
- n use of unapproved spare parts

In case of customised versions the actual scope of delivery can vary from the explanations and representations in this Manual, because of the utilization of additional options or due to latest technical changes.

Apart from this, the obligations agreed upon in the delivery contract, the general terms and conditions and the delivery conditions of the manufacturer and the legal regulations valid at the time of contract do apply.

We reserve the right to make technical modifications without further notice in order to improve usability.

1.4 Copyright

This Manual is protected by copyright law and exclusively to be used for internal purposes.

Passing this Manual on to third parties, duplication of any kind – even in form of excerpts – as well as the use and/or disclosure of the contents without the written consent of the manufacturer is not permitted, except for internal purposes.

Violations oblige to compensation. The right for further claims remains reserved.



General

1.5 Spare parts



WARNING!

Safety hazard caused by wrong spare parts!

Wrong or faulty spare parts can adversely affect safety and cause damage, malfunctions or total failure.

Therefore:

- Use only genuine spare parts from the manufacturer.

Purchase spare parts from authorised dealers or directly from the manufacturer. For address, see page 2.

The spare-parts list can be found in the appendix.

1.6 Warranty terms

The warranty terms are provided in the manufacturer's terms and conditions.

1.7 Customer Service

Our Customer Service is always available for technical information.

Notes on the responsible contact partner are on call by phone, fax, e-mail or via internet, see address of manufacturer on page 2.

Apart from that, our members of staff are permanently interested in receiving new information and experience resulting from the use of our products and which could be of great value for future improvements.



2 Safety

This paragraph provides an overview of all important safety aspects for optimal protection of personnel as well as safe and trouble-free operation.

Disregarding this Manual and safety regulations specified therein may result in considerable danger.

2.1 Customer's responsibility

The device is implemented commercially. Thus the owner of the device is subject to legal industrial safety obligations.

In addition to the safety instructions in this Manual, the safety, accident prevention guidelines and environmental protection regulations, applicable at the site of implementation must be complied with. In particular:

- n Owner must inform himself of applicable industrial safety regulations and determine additional hazards that arise due to the specific working conditions prevailing at the site where the device is implemented, in a risk analysis. The risk assessment must be implemented in the form of work instructions for device operation.
- n Owner must check throughout the entire implementation period of the device, whether the work instructions that owner has created satisfy current legislation, and must adapt the instructions if necessary.
- n Owner must clearly regulate and specify the responsibilities for installation, operation, maintenance, and cleaning.
- n Owner must ensure that all employees who deal with the device have read and understood this Manual.
In addition, owner must train personnel at regular intervals and inform personnel of the hazards.
- n Owner must provide personnel with the required protective equipment.

In addition, owner is responsible to ensure that the device is always in a technically perfect condition, and therefore the following applies:

- n Owner must ensure that the maintenance intervals described in these operating instructions are complied with.
- n Owner must have all safety devices inspected regularly for function and completeness.



Safety

2.2 Personnel requirements

2.2.1 Qualifications

**WARNING!****Danger of injury if insufficiently qualified!**

Improper operation can lead to serious personal injuries or property damage.

Therefore:

- Have all activities performed only by qualified personnel.

The following qualifications are specified for different areas of activity listed in the Manual.

- n **An instructed person**
has been instructed by the customer in an orientation session on the assigned tasks and possible dangers in case of improper behavior.
- n **Qualified personnel**
based on their professional training, know-how and experience as well as knowledge of the applicable standards and regulations is able to perform assigned work activities and to detect and avoid possible dangers on their own.
- n **A professional electrician**
based on his/her professional training, know-how and experience as well as knowledge of the applicable standards and regulations is able to perform work on electrical systems and to detect and avoid possible dangers on his/her own.
The professional electrician has been trained for the special location where he/she works and knows the relevant standards and regulations.

Only persons who are expected to perform their tasks reliably are permitted as personnel. Persons whose reaction capability is impaired, e.g. through drugs, alcohol or medication are not permitted.

- n When selecting the personnel, the stipulations regarding age and occupation applying at the location must be observed.



2.2.2 Unauthorized persons



WARNING!

Danger for unauthorized persons!

Unauthorized persons not meeting the requirements outlined here are not aware of the dangers in the work area.

Therefore:

- Keep unauthorized persons away from the work area.
- If in doubt, address the persons and direct them to leave the work area.
- Interrupt work activities as long as unauthorized persons are present in the work area.



Safety

2.3 Intended use

The device has been designed and constructed exclusively for the purpose mentioned here.

The device must only be used for the monitoring of bearing distances and temperatures of 2-stroke diesel engines with 4-14 cylinders.

Only the optionally available components described in these instructions may additionally be installed.



WARNING!

Danger in case of unintended use!

Every use of the appliance above and/or different from the intended use may lead to dangerous situations.

Therefore:

- Use the appliance only in compliance with the regulations.
- Follow all instructions contained in these installation instructions.

Claims of any kind concerning damages caused by unintended use are excluded.

The operator is liable for all damages through unintended use.



2.4 Personal protective equipment

Wearing of personal protective equipment is required when working to minimize the health hazards.

- n Always wear the protective equipment that is necessary for the respective task when working.
- n Follow the instructions on personal protective equipment that are posted in the work area.

Wear generally

Generally wear for all kind of work:



Protective clothing

are tight fitting working clothes with low tear resistance, with light sleeves and without any sticking out parts. These clothes are mainly a protection against being caught by moving machine parts. Do not wear rings, chains, necklaces, and other jewellery.



Safety boots

to protect against heavy parts falling down or slipping on slippery ground.

Personal protective equipment for special tasks

When performing special tasks it is necessary to wear personal protective equipment. This personal protective equipment will be separately specified in the chapters of this Manual. This special protective equipment is explained below.



Hard hat

to protect against parts and materials falling down and flying around.



Protective gloves

to protect the hand against friction, graze, punctures or deep cuts as well as contact with hot surfaces.



Safety belt

to protect against falling, if there is a higher risk of falling.

This risk is imminent if certain differences in height are exceeded and the working area is not protected by a banister.

Wear the safety belt so that the safety rope is attached to the belt and to a fixed anchoring point. If necessary use a fall damper.

Safety belts must be used only by persons who have been specially trained for this purpose.



Safety



Ear defenders

to protect against hearing damage.

2.5 Specific dangers

The following section lists the residual risks that have been determined by the risk assessment.

- n Heed the safety instructions listed here, and the warnings in subsequent chapters of this Manual, to reduce health hazards and to avoid dangerous situations.

Electric current



DANGER!

Danger to life caused by electric current!

Touching conductive parts causes a direct danger to life. Damage to insulations or individual components can cause danger to life.

Therefore:

- In the event of damage to insulation switch off the power supply immediately and have the defective parts repaired.
- Work on the electric system must be carried out only by skilled electricians.
- De-energize the machine for all work on the electrical system.
- Before maintenance, cleaning or repair work, switch off the power supply and secure it against being switched on again.
- Do not bridge fuses or make them ineffective. When changing fuses make sure you use the correct amperage.
- Keep moisture away from conductive parts. This can cause short circuit.

Engine



WARNING!

Danger to life caused by engine in progress!

Starting the engine while working on or inside of it may cause very serious injury or even lead to death.

Therefore:

- Switch off the engine before performing any work and make sure that it cannot be switched on accidentally.



Pneumatics



WARNING!

Danger of injury caused by pneumatic energies!

Pneumatic energies can cause severe injuries.

Pneumatically driven parts may start to move unexpectedly.

In the event of damage to individual components, air can escape under high pressure and e.g. damage the eyes.

Therefore:

- Have work on the pneumatic system carried out only by trained expert personnel.
- Before starting work on the pneumatic system, shut down the system and relieve the pressure. Be careful of pressure accumulators. Relieve also the pressure in accumulators.
- Do not change pressures to values higher than the specified maximum values.

Oil pressure



WARNING!

Danger of injury caused by oil under pressure!

In case of defective lines or machine parts oil may escape under pressure. This can cause severe injuries.

Therefore:

- Do not open pipelines under pressure.
- Depressurize pipelines before starting any work.
- Have defective parts repaired.

Vibrations



WARNING!

Health hazard caused by strong vibrations!

Exposure to strong vibrations over a long time can cause considerable damage to health.

The source of vibration is to be isolated from the environment by means of vibration dampers.

Therefore:

- Do not adversely affect the function of the vibration dampers.
- Do not remain inside the danger zone during operation.



Safety

Highly flammable materials



WARNING!

Fire hazard by highly flammable materials!

Highly flammable materials, liquids or gases may catch fire causing serious and even fatal injuries.

Therefore:

- Do not smoke within the danger zone and the immediate vicinity. Avoid using open flames or ignition sources.
- Keep a fire extinguisher ready.
- Report suspicious materials, liquids or gases immediately to the person in charge.
- Suspend any work activities in case of fire. Leave the danger zone until the all clear signal is given.

Hot operating materials



WARNING!

Danger of burning by hot operating materials!

Operating materials may become very hot during operation and cause burns when contacted.

Therefore:

- Before handling operating materials check their temperature. Allow to cool down, if necessary.

Adhesive



WARNING!

Danger of poisoning through solvents!

Adhesives contain toxic solvents. The contact with adhesives may cause serious injuries such as poisoning, allergies or skin irritations.

Therefore:

- Obey safety data sheets of manufacturer!
- Never take in or swallow adhesives. When taken unintentionally, visit a physician immediately. Show package to physician.
- Avoid skin contact. Wear protective gloves. In case of skin contact, rinse immediately under running water.
- Do not eat or drink while working.
- Wash hands before breaks and after work completion.

Noise



WARNING!

Hearing damage caused by noise!

The noise level in the working area can cause severe hearing damage.

Therefore:

- Wear ear defenders when prescribed.
- Stay inside the danger zone only as long as absolutely necessary.



Safety

Engine oil and fuel



WARNING!

Fire hazard due to engine oil and fuel!

Steam from oil and fuel may inflame in case of contact to ignition source.

Therefore:

- No open fire when working on the engine.
- Do not smoke.
- Remove any residues of oil and fuel from engine and floor.



CAUTION!

Danger of poisoning through engine oil and fuel!

Contact with engine oil and fuel may lead to serious health problems.

Therefore:

- Avoid skin contact with engine oil.
- Get splashes from engine oil and fuel off the skin immediately.
- Do not inhale steams of engine oil and fuel.

Hot surfaces



CAUTION!

Danger of burning on hot surfaces!

Contact with hot components can cause severe burns.

Therefore:

- Always wear protective clothes and protective gloves when working on hot components.
- Before starting work make sure that all components have cooled down to ambient temperature.

Sharp corners and pointed edges



CAUTION!

Danger of injuring on corners and edges!

Sharp corners and pointed edges can cause graze and cuts in the skin.

Therefore:

- Take care when working near sharp corners and pointed edges.
- Wear protective gloves, if in doubt.



Dirt and objects laying around



CAUTION!

Slipping and tripping hazard!

Dirt and objects laying around are sources for slipping and tripping over and can lead to severe injury.

Therefore:

- Keep the working area clean and tidy.
- Remove objects that are no longer needed.
- Mark sources of tripping over with yellow-black marking tape.

2.6 Conduct in a dangerous situation and in case of accidents

Preventive action

- n Always be prepared for accidents or fire!
- n Keep first aid equipment (first aid kit, covers, etc.) and fire extinguisher close at hand.
- n Instruct your personnel about accident reporting, first aid and rescuing facilities.
- n Keep escape routes and access ways clear for rescue vehicles.

In case of emergencies

- n Operate the emergency stop immediately.
- n Initiate first aid measures.
- n Rescue persons from the danger zone.
- n Inform responsible persons at the place of action.
- n Call for rescue service.
- n Keep access ways clear for rescue vehicles.



Safety

2.7 Environmental protection



CAUTION!

Environmental hazard caused by incorrect handling!

Incorrect handling of environmentally hazardous substances, especially incorrect waste disposal, can cause considerable damage to the environment.

Therefore:

- Always comply with the following information.
- If environmentally hazardous substances are accidentally released into the environment, you must immediately apply appropriate countermeasures. If in doubt, consult the responsible municipal authority to inform about the damage.

The following environmentally hazardous substances are used:

Lubricants

Lubricants like greases and oils contain toxic substances. These must not be released into the environment. They must be disposed of by a special waste disposal company.



3 Technical data

3.1 Indication unit

3.1.1 Type MDA312...

Specification	Value	Unit
Weight	2,100	kg
Length	230	mm
Width	164	mm
Height	82	mm

Electrical connection values

Specification	Value	Unit
Supply voltage	24	V DC
Supply current, maximal	1	A
Power consumption, maximal	25	W
External fuse** (delayed action)	2	A
Protection	IP66	front
	IP20	back

Relay data

Specification	Value	Unit
Load voltage	60	V DC
Load current, maximal	250	mA SCP



Technical data

3.1.2 Type MDA312... in field housing GHG02631

Specification	Value	Unit
Weight	6,250	kg
Length	300	mm
Width	268	mm
Height	180	mm

Electrical connection values

Specification	Value	Unit
Supply voltage	24	V DC
Supply current, maximal	1	A
Power consumption, maximal	25	W
External fuse** (delayed action)	2	A
Protection	IP66	

Relay data

Specification	Value	Unit
Load voltage	60	V DC
Load current, maximal	250	mA SCP

3.2 Line Converter box

3.2.1 Type GHG02611-4

Specification	Value	Unit
Weight	8,200–9,200	kg*
Length	400	mm
Width	268	mm
Height	180	mm

**Technical data****Electrical connection values**

Specification	Value	Unit
Supply voltage	24	V DC
Supply current, maximal	6	A
Power consumption, maximal	125	W
External fuse** (delayed action)	10	A
Protection	IP66	

3.2.2 Type GHG02611-5

Specification	Value	Unit
Weight	8,200–9,200	kg*
Length	400	mm
Width	268	mm
Height	180	mm

Electrical connection values

Specification	Value	Unit
Supply voltage	115/230	V AC
Supply current, maximal	2	A
Power consumption, maximal	125	W
External fuse** (delayed action)	3	A
Protection	IP66	

- Depending on engine cylinder numbers:
 - | 8,200 for engines with 4–7 cylinders
 - | 9,200 for engines with 8–14 cylinders

** Not part of Dr. Horn's scope of supply



Technical data

3.3 Terminal box GHG2621-3

Specification	Value	Unit
Weight	4,000	kg
Length	300	mm
Width	190	mm
Height	128	mm

Electrical connection values ***

Specification	Value	Unit
Supply voltage	24	V DC
Supply current, maximal	1	A
Power consumption, maximal	0,2	W
Protection	IP66	front

3.4 Distance sensor IW000184

Specification	Value	Unit
Weight	0,120	kg
Length	132	mm
Diameter	19	mm
Linear measuring range	2-6	mm

Electrical connection values ***

Specification	Value	Unit
Supply voltage	15-30	V DC
Current consumption	50	mA
Protection	IP67	

Environment

Specification	Value	Unit
Temperature range	0 - +70	°C
Target	24x24x1 steel acc. to S235	mm

**3.5 Water-in-oil sensor FRG00032-6_AW**

Specification	Value	Unit
Weight	0,328	kg
Length	186.5	mm
Diameter, maximal	60	mm

Electrical connection values ***

Specification	Value	Unit
Supply voltage	24	V DC
Current consumption	50	mA
Protection	IP65	
Output current, maximal	200	mA SCP

Environment

Specification	Value	Unit
Temperature range	0 - +85	°C
Pressure resistance against medium	10	bar



Technical data

3.6 Main bearing temperature sensor TGL00921

Specification	Value	Unit
Weight	0,200	kg
Length	50	mm
Width	22	mm
Height	6	mm

Electrical connection values ***

Specification	Value	Unit
Supply voltage	24	V DC
Current consumption	50	mA
Protection	IP67	

Environment

Specification	Value	Unit
Temperature range	-10 - +90	°C
Connection cables	4 x 0,34	mm ²

*** Power 24VDC is supplied through the Line converter box GHG02611 -4 or -5

3.7 Emissions

There are no emissions expected.



4 Structure and function

4.1 Overview

This overview Fig. 1 is valid for principal installation on 6S50MC-C.

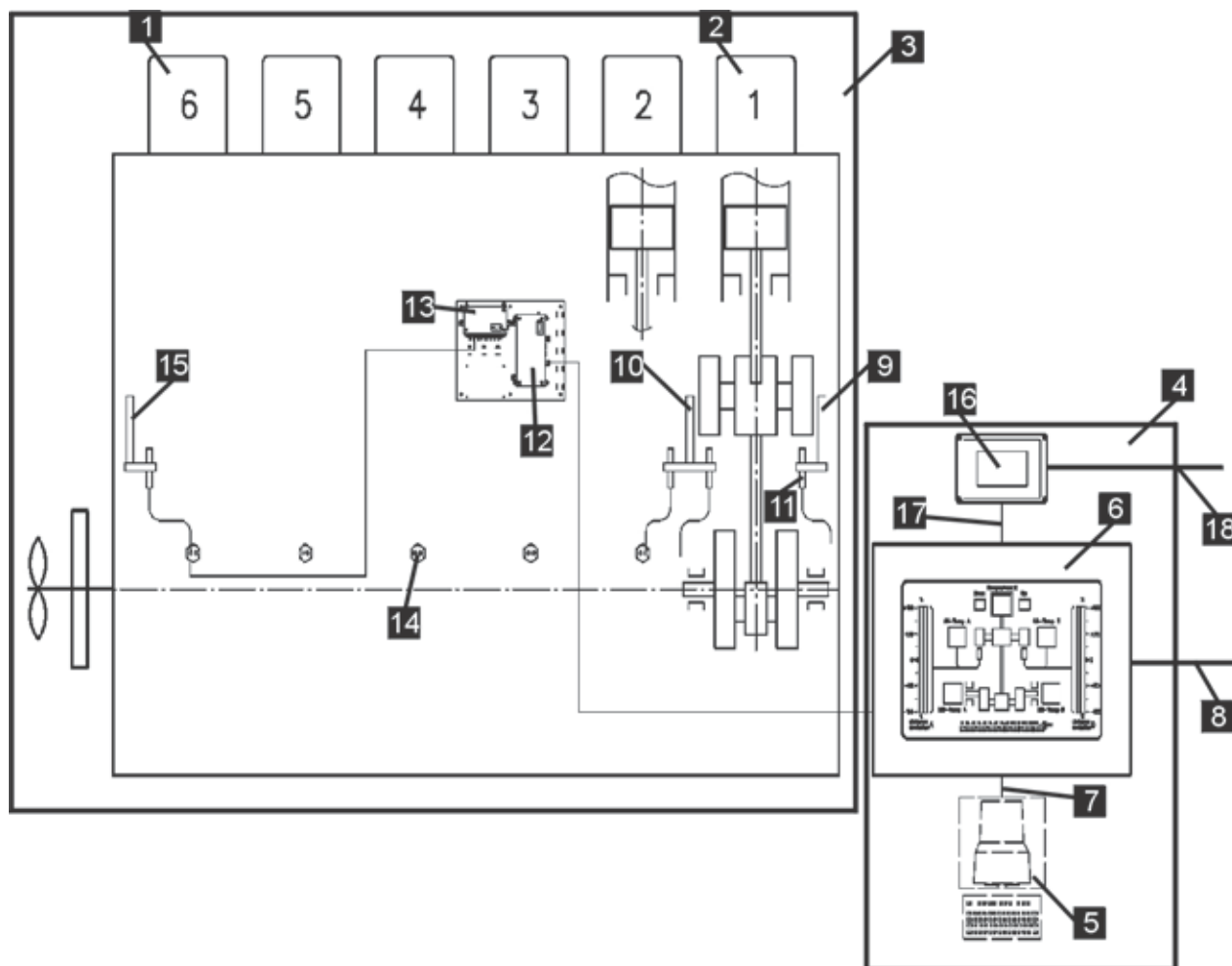


Fig. 1: System overview

- | | | | |
|---|-------------------------------------|----|--------------------------------------|
| 1 | Cylinder number 6 | 9 | Bracket HAG00xxx |
| 2 | Cylinder number 1 | 10 | Bracket HAG00xxx |
| 3 | Engine room | 11 | Sensor IW000184 |
| 4 | Engine control room | 12 | Line Converter box GHG02611-4/-5 |
| 5 | Personal computer (customer supply) | 13 | Terminal box GHG02621-3 |
| 6 | Indication unit MDA312 | 14 | Cable gland KV000xxx |
| 7 | Connection cable | 15 | Bracket HAG00xxx |
| 8 | Power supply | 16 | User Interface |
| | | 17 | Connection cable |
| | | 18 | Connection cable for sensor IW000184 |



Structure and function

4.2 Brief description

The Bearing Distance and Temperature Monitoring System (BDMS/BTMS) is a system that allows the continuous control of the distance between the surface of the distance sensor and the crosshead in the bottom dead centre of a 2-stroke diesel engine.

Additionally the sensor is able to measure the temperature of the splash oil around its location. Measured values are calculated into real distance values in mm and °C by the sensor stored in an internal memory inside the sensor.

Another optional sensor is able to measure the water content in the lube oil. It is called the water-in-oil sensor. This sensor is installed in the pressure line close to the engine.

The BDMS/BTMS can be installed as a retrofit into engines already in service.

The BDMS/BTMS is Type Approved by Germanischer Lloyd (GL) and other classification societies.

All sensors transfer the respective measured values via Terminal boxes to a Line Converter box and into the Indication unit.

Mainly the BDMS/BTMS consists of the following components:

- n Sensors
- n Sensor brackets
- n Terminal box
- n Line Converter box
- n Indication unit



4.3 Description of assemblies

4.3.1 Sensors

There are a few sensors that can be assembled within the system. Some of them are within scope of supply, some are optional:

- n Distance sensor
- n Water-in-oil sensor (optional)
- n Main bearing temperature sensor (optional)

4.3.1.1 Distance sensor

- n Item no.: IW000184



Fig. 2: Distance sensor

The distance sensor type IW000184 (Fig. 2/1) with protection IP67 is a high speed intelligent sensor measuring the distance between the surface of the sensor itself and the bottom dead centre point position of the crosshead. It is able to measure the distance in a range between 2.0 mm to maximum 5.5 mm with a resolution of 0.01 mm. Additionally it measures the splash oil temperature in the area around the sensor with a tolerance of ± 2 °C.

The sensor detects the crosshead within his distance range and calculates the lowest air gap in mm. The value is stored in an internal buffer and updated constantly at every revolution.

On request of the Indication unit which acts as a master the buffer information is delivered via the serial link (Terminal box > Line Converter box > Indication unit) and compared against limits by software.

The sensor has no thread; the fastening in the engine is arranged by clamping in the brackets. For correct installation to the serial net the sensor is marked with a special ID allowing the installer to identify the sensor to ensure that fwd- and aft-sensor per cylinder is connected correctly to the network. Additionally the sensor has a LED under the connection point indicating correct power supply.

For connection to the outside through the cable glands in the engine wall the sensor is delivered with an angle connector and 15 m oil resistant PUR cable. By this connection an easy exchange is possible in case an exchange should become necessary.

Measured values are transferred as a RS232 signal via the Terminal box to the Line Converter box.



Structure and function

4.3.1.2 Water-in-oil sensor

n Item no.: FRG00032-6_AW

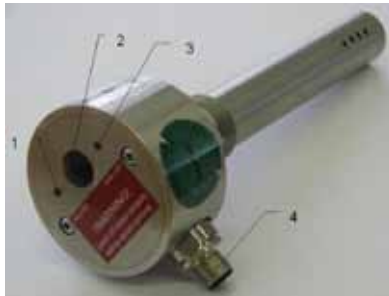


Fig. 3: Water-in-oil sensor

- 1 Alarm LED
- 2 Function test button
- 3 Ready LED
- 4 Connection

The water-in-oil sensor (Fig. 3) is designed to monitor the amount of water in the engine lube oil. The measuring principle is the change of the dielectric value of the oil due to the water content. The capacitive design recognizes these changes and the built-in microprocessor calculates the values for pre-warning and alarm threshold. Default values are 0.5 and 0.9aw. For further Information please see the WaterInOil BDMS Manual DK002112.

This sensor has to be installed in the pressure line or near the engine (pressure outlet of the lube oil filter) in a non turbulence area (behind the filter unit) inside the oil stream.

Measured values are transferred as a RS232 signal via the Terminal box to the Line Converter box.

A green and a red LED indicate a special status:

Green LED	Red LED	Indication
flashing	off	water content less than 0.5aw
flashing	flashing	water content between 0.5 and 0.9aw
flashing	on	water content higher than 0.9aw
off	off	fault or sensor not connected



4.3.1.3 Main bearing temperature sensor (optionally available)

n Item no.: TGL00921



Fig. 4: Main bearing temperature sensor

The main bearing temperature sensor type TGL00921 (Fig. 4/1) is an optional component. It can be ordered separately. The main bearing temperature sensor is designed to measure the splash oil temperature out of the main bearing. The minimised flat design allows mounting the sensor at the main bearing support close to the bearing shell.

The temperature sensor can easily be placed at the support with the help of internal magnetos. When correctly placed it must be secured by oil resistant glue.

The temperature data are measured within a tolerance of ± 1.5 °C and transferred via the serial link of the BDMS/BTMS to the Indication unit. The refreshment of these measured values is made with a lower priority within every 1500 ms. The maximum operating temperature is 90 °C, for short time 115 °C. If a bearing has been overheated above the short time tolerable value the sensor has to be replaced.



Structure and function

4.3.2 Sensor brackets

The sensor brackets guarantee a correct and vibration-free installation of the distance sensors.

Depending on the type of engine either

n tube type sensor brackets or

n profile type sensor brackets

have to be mounted.

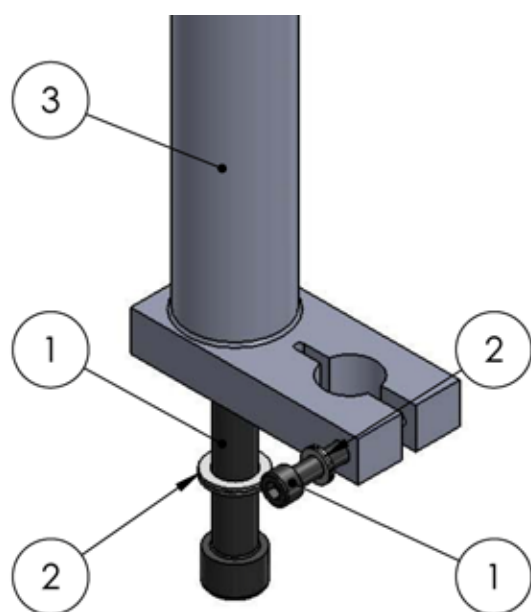


NOTE!

A table indicating the different types of engine and the respective sensor brackets is given in the chapter "Mounting the sensor brackets".

4.3.2.1 Tube type sensor brackets

n Item no.: HAG00xxx (depending on engine type)



The single sensor bracket (Fig. 5) is mounted on both sides under the crosshead sliding plate. Therefore a mounting surface has to be made about 2 mm more in diameter than the bracket to allow a correct vertical and horizontal placing. In the centre a threaded hole with M10 or M12 is needed to fix the bracket in place with a high tensile M10 bolt with a torque moment of 70 Nm, or a M12 bolt with a torque moment of 120 Nm. This bracket can be turned to place the sensor correctly under the crosshead.

- 1 Bolt
- 2 NordLock® disc
- 3 Sensor bracket

Fig. 5: Single sensor bracket



4.3.2.2 Profile type sensor brackets

There are two different types of profile type sensor brackets:

- n Single profile type sensor bracket for one distance sensor
- n Double profile type sensor bracket for two distance sensors

Single sensor bracket

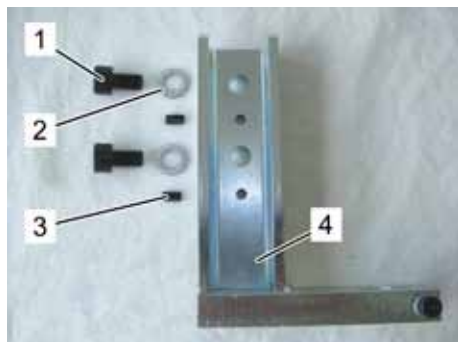
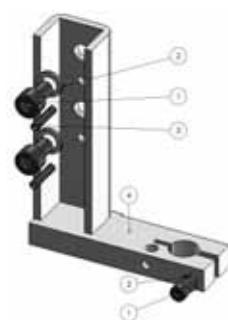


Fig. 6: Single profile type sensor bracket type HAG00xxx-L

- n Item no.: HAG00xxx-L (depending on engine type)
- n Item no.: HAG00xxx-R (depending on engine type)

- 1 Bolt
- 2 NordLock® disc
- 3 Alignment pin
- 4 Sensor bracket



The single sensor bracket for one sensor is placed under the crosshead of the first (HAG00xxx-L, Fig. 6) and the last cylinder (HAG00xxx-R, Fig. 7) because there only one distance sensor has to be mounted.

The single sensor brackets are mounted by two M8 or M10 bolts.

Recommended :

For a higher accuracy, alignment pins can be used. After the sensor bracket is installed correctly with the two bolts, the two holes for the alignment pins can be drilled and the pins inserted. The pins ensure a correct positioning of the sensor bracket and are part of delivery.

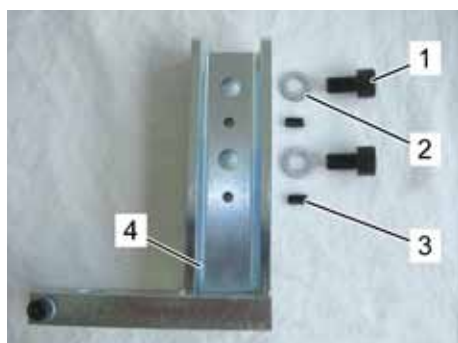
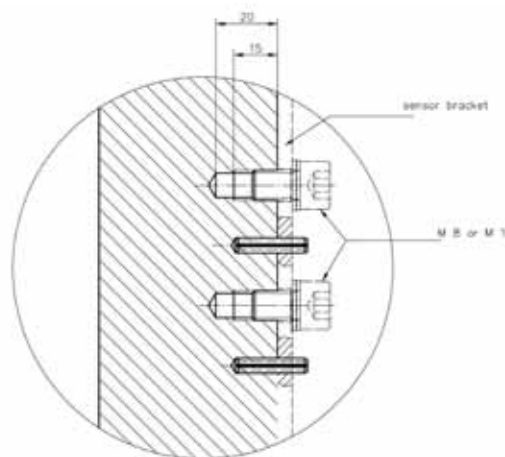
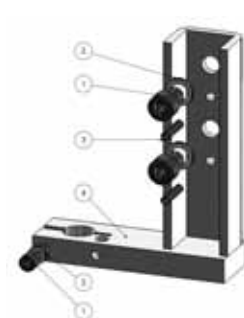


Fig. 7: Single profile type sensor bracket type HAG00xxx-R

- 1 Bolt
- 2 NordLock® disc
- 3 Alignment pin
- 4 Sensor bracket





Structure and function

Double sensor bracket

n Item no.: HAG00xxx (depending on engine type)

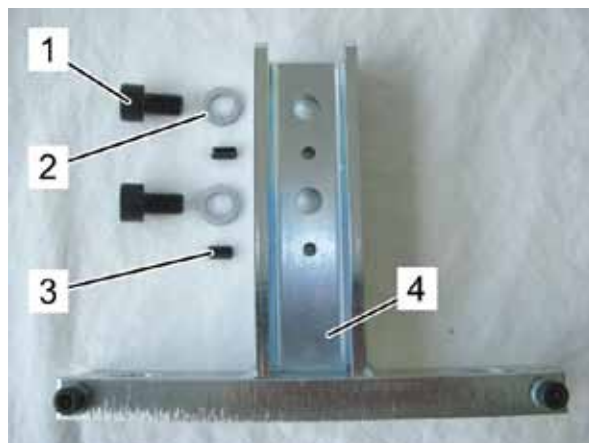
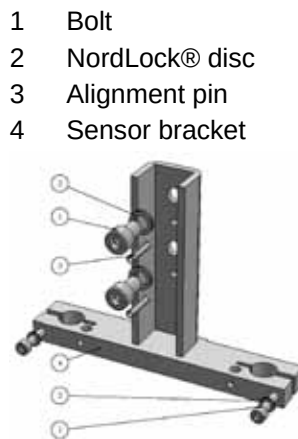


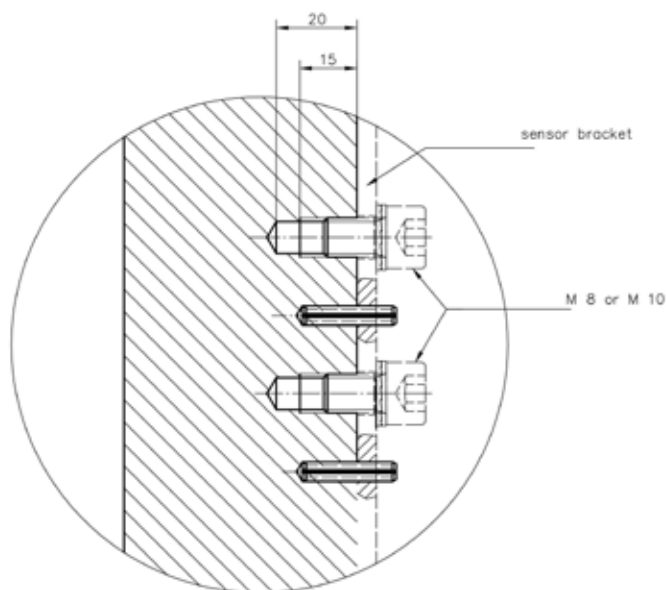
Fig. 8: Double profile type sensor bracket type HAG00xxx



The double sensor bracket for two sensors (Fig. 8) must be placed in the centre under the crosshead sliding plate. Therefore two M8 or M10 bolts are needed.

Recommended :

For a higher accuracy, alignment pins can be used. After the sensor bracket is installed correctly with the two bolts, the two holes for the alignment pins can be drilled and the pins inserted. The pins ensure a correct positioning of the sensor bracket and are part of delivery.



All dimensions in mm



4.3.3 Terminal box

n Item no: GHG02621-3



Fig. 9: Terminal box closed

A Terminal box includes the connection board which is needed to connect the sensors and to deliver the necessary galvanic power received from the Line Converter box to the sensors. On the other hand they establish the serial data link from the sensors to the Line Converter box.

In one Terminal box up to 16 sensors can be assembled, for example 14 distance sensors and one water-in-oil sensor for a seven-cylinder engine. If more sensors are installed in a system a second Terminal box has to be installed. This is necessary when the BDMS/BTMS is installed in an engine with more than seven cylinders or additional main bearing temperature sensors are installed too.



NOTE!

Inside the Terminal box the distance sensors, water-in-oil sensors and the main bearing temperature sensors can be connected to any available connector without following a routine.



Fig. 10: Terminal box opened

A green LED and an electronic fuse are placed on the board at every connection socket for each of the 16 sensors. The LED indicates correct power supply. The fuse protects all other connections and connected units in case of a short circuit in one of the connected sensors.



Structure and function

4.3.4 Line Converter box

- n Item no.: GHG02611-4 for 24 V DC supply
- n Item no.: GHG02611-5 for 115/230 V AC 50/60 cycle supply



Fig. 11: Line Converter box closed

The Line Converter box (Fig. 11) delivers the galvanic isolated power and receives the data from all sensors connected to the system. The RS232 data from the sensors are changed into RS422 in the Line Converter box and transferred to the Indication unit.



Fig. 12: Line Converter box type GHG02611-4 opened

Fig. 12 shows a Line Converter box for maximal 60 sensors.



4.3.5 Indication unit

The Indication unit presents data from all connected sensors within a certain priority chain. The measured values are compared against limits given by the engine manufacturer. Pre-alarm/load reduction relays are available for selection by the user.

Received data are stored in a normal SD card. The so called short term storage allows the view of the last 24 hours in real time. The long term storage contains maximum, minimum and average values for every 6 running hours. The event log contains alarms, slow downs and other important informations. Storage capacity is about 10 years. For the purpose of presentation to surveyors from classification societies one xml file can be made.

The customer can connect the USB link of the unit to any engine PC (not supplied by Dr. E. Horn) and additionally store the data here.

**NOTE!**

Only windows 2000 or XP operating system.

For this storage as well as for special views to the behaviour of the bearing wear a programme called LagMon is optionally available from Dr. E. Horn. If this programme is installed the crew/superintendents/classification surveyors and service specialists can easily track the wear record and download the values.

The Indication unit is available in two executions:

- n Mounted in field housing for direct installation in the engine room or the engine control room
- n Mounted in a switchboard panel or engine control console



Fig. 13: Indication unit with field housing

Indication unit to be mounted inside the engine room

- n Item no.: MDA312...
- n Protection class: IP66

- 1 Display
- 2 Connections with cable glands

The Indication unit to be installed inside the engine room has cable glands (Fig. 13/2) allowing the connection of:

- n serial link bus cable
- n 24 V power supply
- n connection of the USB to ship or engine PC



Structure and function

- n relay outputs

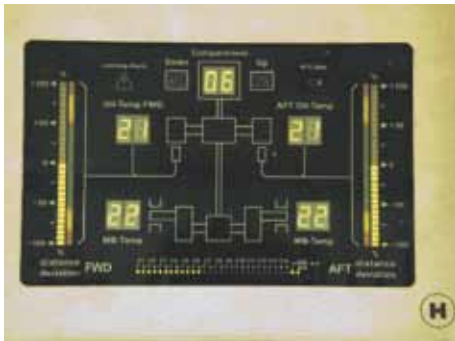


Fig. 14: Indication unit for control console

Indication unit to be mounted in a switchboard panel or control console

- n Item-no.: MDA312...
- n Protection class front: IP66
- n Protection class back: IP20

The Indication unit to be installed in a switchboard panel or a control console has all connections on its back secured by connectors. They allow the connection of:

- n serial link bus cable
- n 24 V power supply
- n connection of the USB-Serial Port to ship or engine PC (not part of delivery from Dr. E. Horn)
- n relay outputs



4.4 Connections

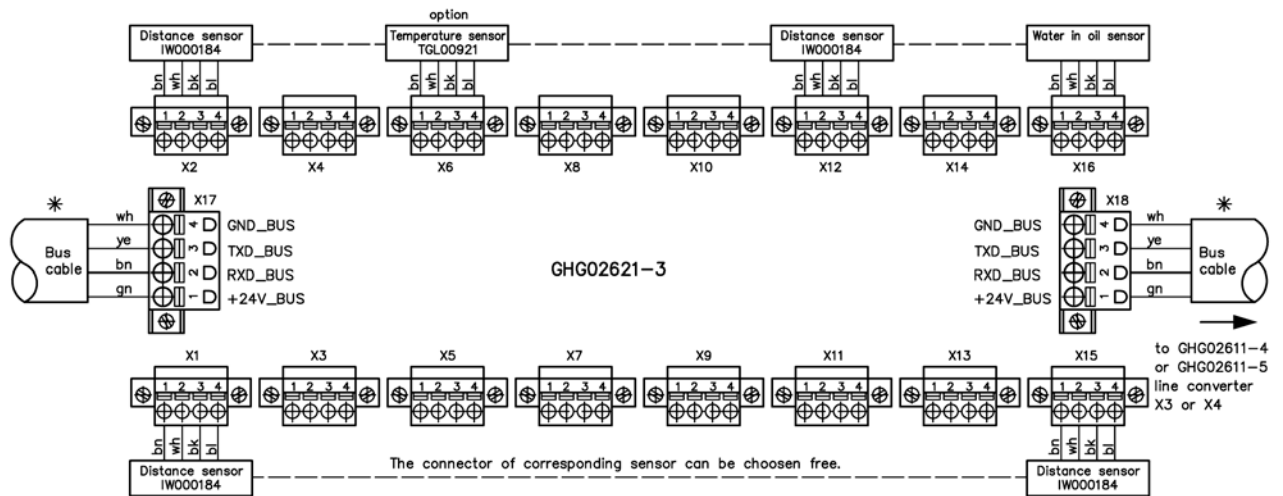


Fig. 15: Connection plan Terminal box GHG02621-3 (proposal)

- depending on the position of the Terminal box

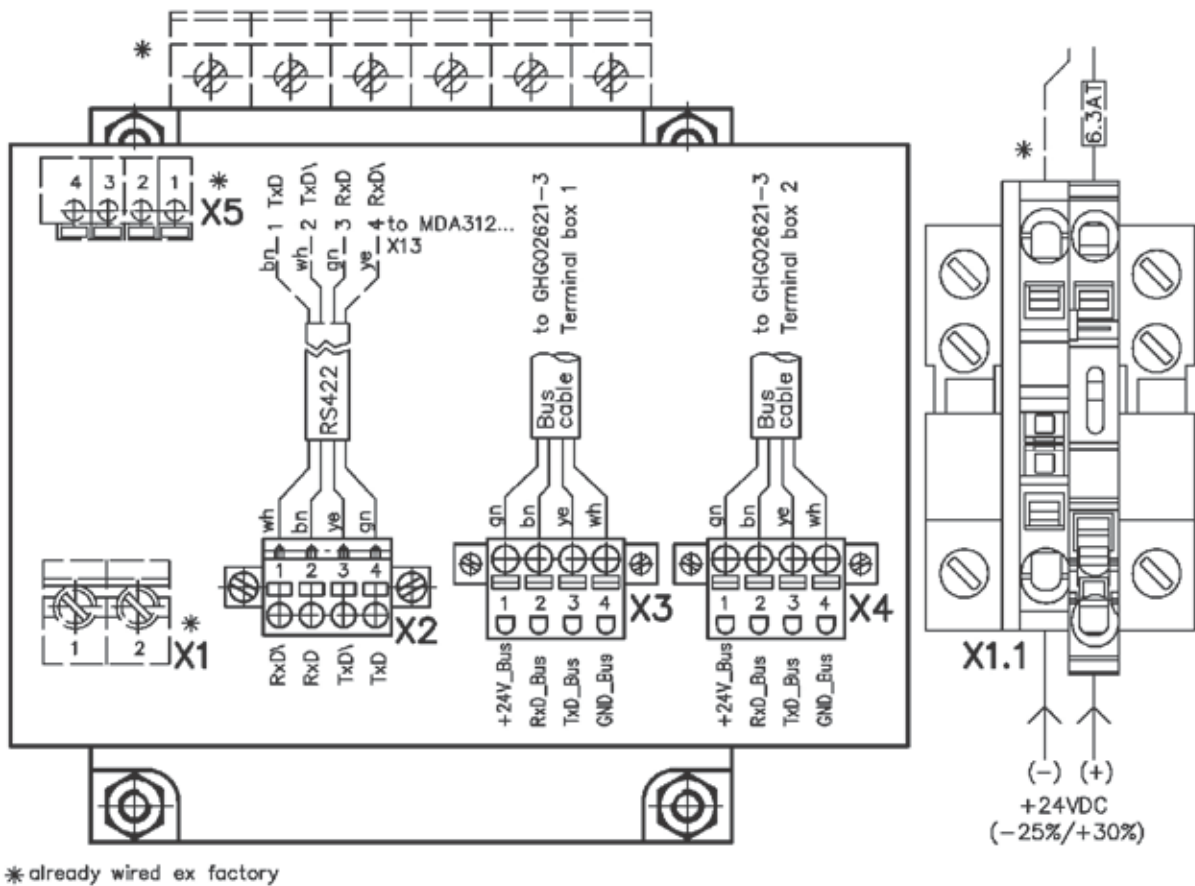


Fig. 16: Connection plan Line Converter box GHG02611-4

- already wired ex factory



Structure and function

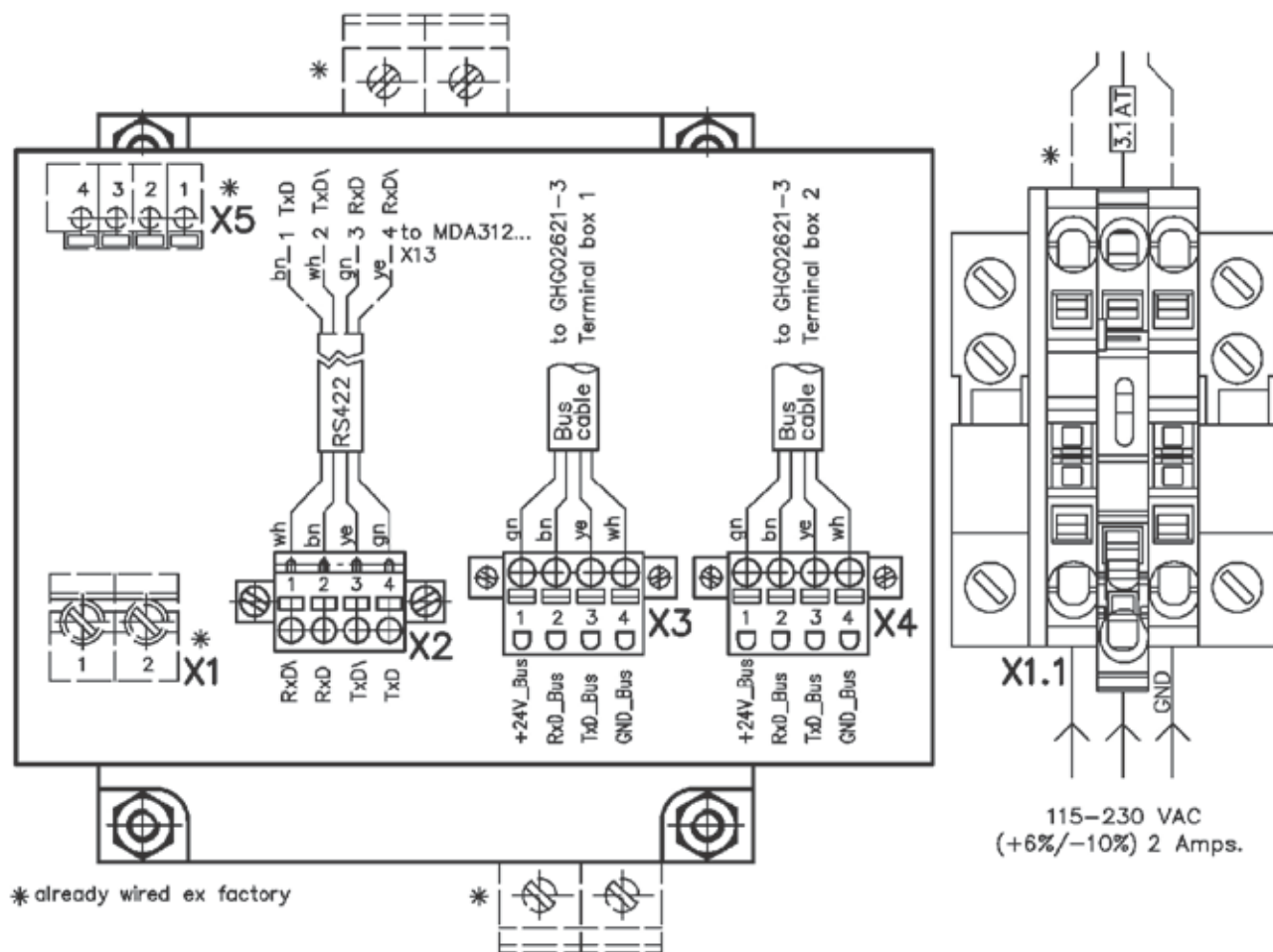


Fig. 17: Connection plan Line Converter box GHG02611-5

- already wired ex factor

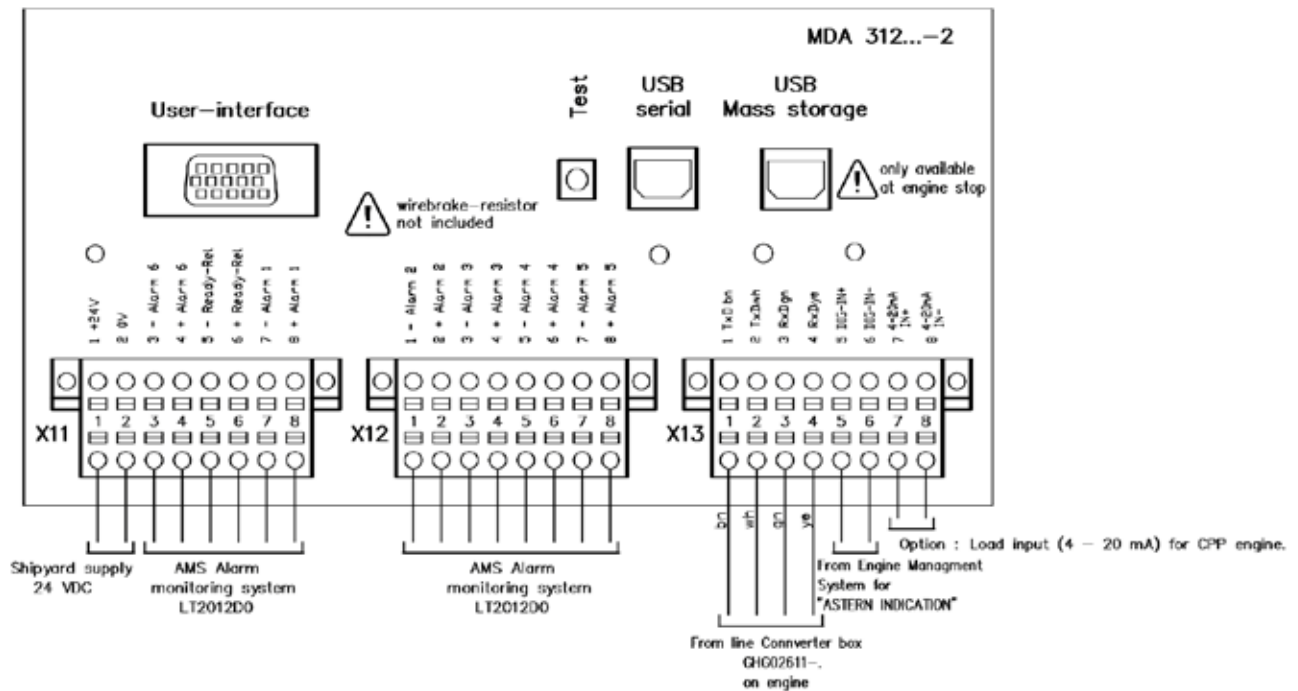


Fig. 18: Connection plan Indictation unit MDA312-2

4.5 Work and danger zones

Work and danger zones may only be mentioned because these zones depend on the position and the environment in which the components of the system are mounted.

Work zones

- n In front of the Indication unit
 - l in the control room
 - l in the engine room

Danger zones

- n Inside the engine (Fig. 19/1)
- n Inside the engine room (Fig. 19/2)

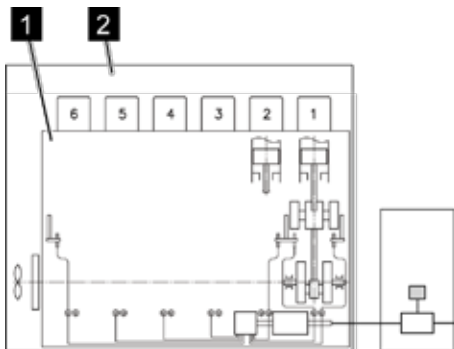


Fig. 19: Danger zones



Structure and function

4.6 Operating elements

The design of the Indication unit may differ depending on the components installed in the system.

All available components installed

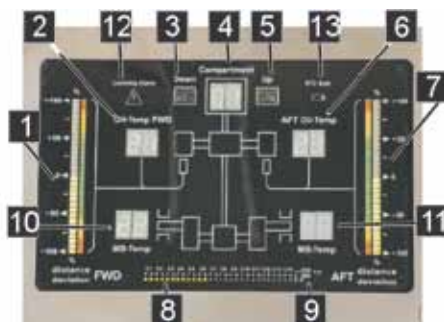


Fig. 20: Indication unit, full configuration

- 1 Distance deviation measured by FWD distance sensor
- 2 splash oil temperature at FWD distance sensor
- 3 Optical button "Down"
- 4 Compartment number
- 5 Optical button "Up"
- 6 splash oil temperature at AFT distance sensor
- 7 Distance deviation measured by AFT distance sensor
- 8 LED indicating the number of installed distance sensors
- 9 LED indicating installed H₂O sensor
- 10 Main bearing splash oil temperature
- 11 Main bearing splash oil temperature
- 12 Learning alarm
- 13 Real-Time-clock battery level low

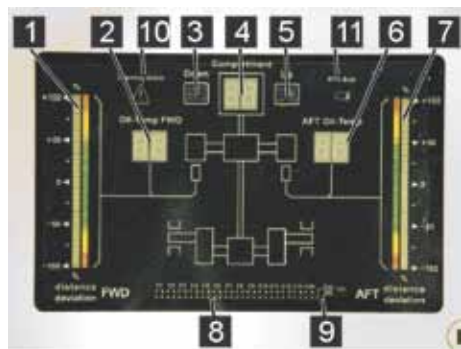


Fig. 21: Indication unit, basic configuration

Only distance and water-in-oil sensor installed

- 1 Distance deviation measured by FWD distance sensor
- 2 splash oil temperature at FWD distance sensor
- 3 Optical button "Down"
- 4 Compartment number
- 5 Optical button "Up"
- 6 splash oil temperature at AFT distance sensor
- 7 Distance deviation measured by AFT distance sensor
- 8 LED indicating the number of installed distance sensors
- 9 LED indicating installed H₂O sensor
- 10 Learning alarm
- 11 Real-Time-clock battery level low



5 Transport, packing and storage

5.1 Safety notes for transport

Suspended loads



WARNING!

Life-threatening hazard due to suspended loads!

When lifting loads a life-threatening hazard is posed by falling loads or swinging parts.

Therefore:

- Never position yourself under a suspended load!
- Heed the instructions concerning the intended lifting points.
- Do not attach to projecting machine components or to the eyes of attached components; ensure that the sling gear is securely seated.
- Only use approved lifting gear and slings with sufficient bearing capacity.
- Do not use frayed or scored rope or belts.
- Do not lay ropes and belts on sharp edges and corners, do not knot or twist ropes and belts.

Eccentric center of gravity



WARNING!

Danger of falling due to eccentric center of gravity!

Packing crates can have an eccentric center of gravity. The wrong kind sling gear attachment can tilt the packing crate and cause life-threatening injuries.

Therefore:

- Comply with the instructions marked on packing crates.
- Attach the crane hook in such a manner that it is over the center of gravity.
- Lift carefully and observe if the load tips. If required change the position of the sling gear.



Transport, packing and storage

Improper transport



CAUTION!

Improper transport can result in damage!

Improper transport can cause extensive material damage.

Therefore:

- When unloading the packing units upon delivery and during in-house transport, exercise caution and observe the symbols on the package.
- Use only the provided attachment points.
- Do not remove packaging material until units are ready for assembly.

5.2 Transport inspection

Check the delivery immediately on receipt for completeness and transport damage.

If externally detectable transport damage is found, proceed as follows:

- n Do not accept the delivery, or only with reservation.
- n Record the extent of transport damage in the transport documents or on the delivery note of the forwarding agent.
- n Start complaints procedure.



NOTE!

*Claim any damage as soon as it is detected.
Compensation claims can only be submitted within the applicable complaints periods.*

5.3 Transport

Transport of packages by crane

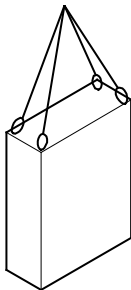


Fig. 22

Packages with lifting eyes can be transported by crane under the following conditions:

- n Crane and lifting tackle must be sufficiently dimensioned for the weight of the package.
- n The operator must have authorization for operating the crane.

Hooking up:

1. Fasten ropes, belts or multi-point tackle as shown in Fig. 22.
2. Make sure that the package is hanging straight, if necessary observe an eccentric centre of gravity.
3. Start transport.



Transport, packing and storage

Transport of pallets by crane

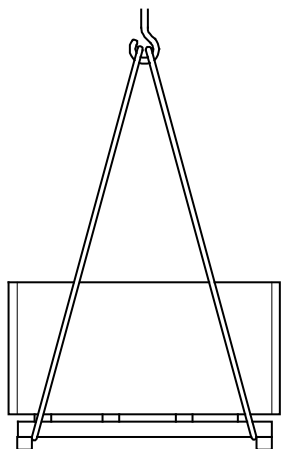


Fig. 23

Packages on pallets can be transported by crane under the following conditions:

- n Crane and lifting tackle must be sufficiently dimensioned for the weight of the package.
- n The operator must have authorization for operating the crane.

Fastening lifting tackle:

1. Fasten ropes, belts or multi-point tackle on the pallet as shown in Fig. 23.
2. Make sure that the package will not be damaged by the lifting tackle. If necessary use other lifting tackle.
3. Start transport.

Transport of pallets by forklift truck

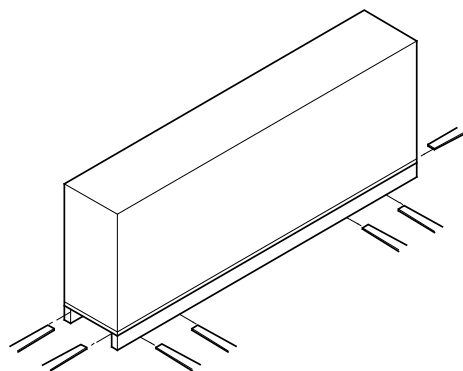


Fig. 24

Packages on pallets can be transported by forklift truck under the following conditions:

- n The forklift truck must match the weight of the transport units.
- n The operator must have authorization for operating the forklift truck.

Picking up:

1. Insert the forks of the forklift truck between or under the pallet beams.
2. Insert the forks until they appear on the opposite side.
3. Make sure that pallets with eccentric centre of gravity will not tip over.
4. Lift the package and start transport.

5.4 Packing

Concerning packing

The individual packages have been packed to match the transport conditions that can be expected. Only environmentally friendly materials were used for packing.

The packing has the function of protecting the individual components against damage, corrosion, etc., until they are finally assembled. The packing material must therefore not be damaged and should only be removed just before assembly takes place.



Transport, packing and storage

Handling packing materials

If there is no returns agreement for the packing, separate materials according to type and size and direct to further use or recycling.



CAUTION!

Environmental damage caused by incorrect waste disposal!

Packing materials are valuable raw materials and can continue to be used in many cases or sensibly reconditioned and recycled.

Therefore:

- Dispose of packing materials environmentally.
- Follow the locally valid waste disposal regulations. If necessary employ a special waste disposal company to dispose of packing material.

5.5 Storage

Storage of packages

Store packages under the following conditions:

- n Do not store outdoors.
- n Store in a dry and dust-free environment.
- n Do not subject to aggressive media.
- n Protect against direct sunlight.
- n Avoid mechanical vibrations.
- n Storage temperature: 15 to 60 °C.
- n Relative air humidity: max. 60 %.
- n For storage periods longer than 3 months check the general condition of all parts and packaging regularly. If necessary refresh or renew the conservation.



NOTE!

Packages may be marked with notes for storage, which may exceed the requirements mentioned here. These must be adhered to.



6 Installation, fixing and commissioning

6.1 Safety

Personnel

- n Installation and commissioning may be executed only by qualified personnel.
- n All work on the electrical system must be performed by a qualified electrician.

Personal protective equipment

Wear the following personal protective equipment at all installation and commissioning work:

- n Protective clothing
- n Safety boots
- n Hard hat

Wear the following personal protective equipment when entering the engine room:

- n Protective gloves
- n Safety belt if it is necessary to bridge big heights



NOTE!

Other personal protective equipment that has to be worn at particular work will be mentioned in the warning notices in this chapter.

Electrical system



DANGER!

Danger to life due to electric current!

A life-threatening hazard exists if there is contact with live components. Switched on electrical components can execute uncontrolled movements and cause the most serious injuries.

Therefore:

- Prior to starting work switch off the power supply and safeguard it from being switched on again.



Installation, fixing and commissioning

Engine



WARNING!

Danger to life caused by engine in progress!

Starting the engine while working on or inside of it may cause very serious injury or even lead to death.

Therefore:

- Switch off the engine before performing any installation work and make sure that it cannot be switched on accidentally.



WARNING!

Danger of injury due to improper installation and commissioning!

Improper installation and commissioning can result in severe personal injury or material damage.

Therefore:

- Prior to beginning installation, ensure that there is sufficient space to work.
- Handle open sharp-edged components with care.
- Make sure that the assembly location is clean and well organized. Components that are loosely stacked or lying around can cause accidents.
- Assemble components properly. Comply with specified screw tightening torques.
- Secure components so that they cannot fall or tip over.

Securing against switching on



DANGER!

Danger to life caused by uncontrolled switching on again!

There is a risk of the electric power supply being switched on again when installing the device. This imposes danger to the life of persons in the danger zone.

Therefore:

- Before starting work, switch off all power supplies and secure against switching on again.



Installation, fixing and commissioning

6.2 Preparations

Cable glands



CAUTION!

Damages to cables caused by sharp hole edges!

The cables might get damaged by sharp edges when they are guided through the holes.

Therefore:

- Insert two cable glands one inside and one outside the engine crankcase.
- Have defective cable glands repaired immediately.

Before beginning with the installation of the BDMS/BTMS the cable glands (Fig. 26) have to be mounted into the drillings.

6.2.1 Preparing the installation into new engines under assembly

Drillings

All necessary drillings for the installation of the BDMS/BTMS and the mounting of the cable glands already exist.

In new engines under construction each sensor has its own cable gland. Therefore only cable glands of type “A” are used.



Fig. 25: Cable gland type “A”

1. Insert the cable glands type “A” (Fig. 25, M20x1.5) into the drillings from the first to the last cylinder. One cable gland inside and one cable gland outside of the engine wall!



NOTE!

The number of cylinders depends on the type of engine. Therefore the number of cable glands that have to be mounted may differ.

6.2.2 Preparing the installation as a retrofit



Installation, fixing and commissioning

n Required tools:

- | Core-hole drill 18.5 mm
- | Thread drill M20x1.5 mm

When the system is installed as a retrofit into engines already in service cable glands with one, two or more outlets are used for leading the cables out of the engine.

Drillings

The respective holes have to be drilled into the engine wall before the cable glands are inserted.

1. Drill the holes with the core-hole drill (18.5 mm) into the engine wall according to the drawings.
2. Use the thread drill to insert the thread M20x1.5 into the holes.
3. Insert the cable glands type "B" (Fig. 26, M20x1.5) into the drillings at all cylinders; one cable gland inside and one outside the crankcase.



Fig. 26: Cable gland type B



NOTE!

The number of cylinders depends on the type of engine. Therefore the number of cable glands that have to be mounted may differ.



6.3 Installation

6.3.1 Preface

Preparing cables

The following sections describe general aspects which are significant for the correct installation of the device.

Cables have to be prepared before they can be assembled in the system.

1. Remove the outer sheath of the cable

Fig. 27/1) to such an extent that the spring

Fig. 27/3) inside of the cable glands may come to lie on the naked screen

Fig. 27/6). For assembly compress the spring (Fig. 27/3) slightly and insert in cable gland casing (Fig. 27/2)

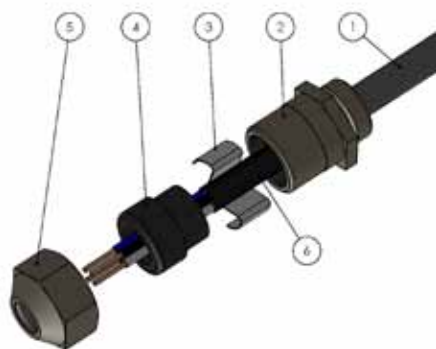


Fig. 27: Screen of a cable



NOTE!

It is also possible to remove only a small ring of the outer sheath at that point where the spring is in its final position in the cable gland.

But it is necessary that the spring is in full contact with the screen. The screen itself can be led into the box.

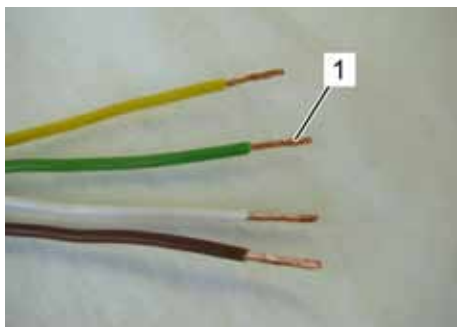


Fig. 28: Stripping insulation

4. Strip the insulation of each conductor (Fig. 28/1) to approximately 1 cm.



Installation, fixing and commissioning



CAUTION!

Danger of short-circuit due to improperly connected cables!

Conductors that contact each other may short-circuit. This may cause damages to the device.

Therefore:

- Connect each conductor of a cable to its connector with cable lugs.
- Make sure the wires of the conductor do not contact each other.

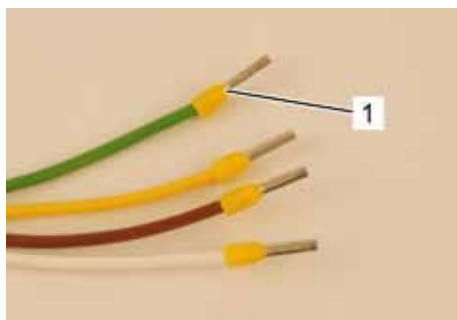


Fig. 29: Cable lug

5. Put each conductor into a suitable cable lug (Fig. 29/1) and squeeze it.

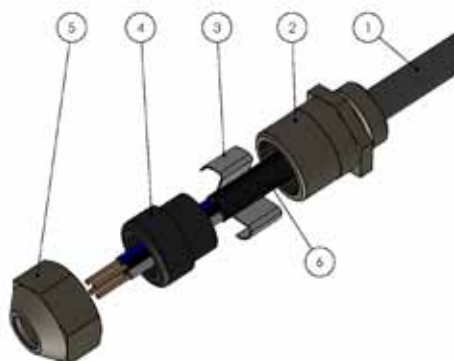


Fig. 30: Assembly of a cable gland

6. Assemble the cable gland according to Fig. 30.



NOTE!

The spring of the cable gland (Fig. 30/3) has to lie on the naked screen (Fig. 30/6) of the cable. For assembly compress the spring (Fig. 27/3) slightly and insert in cable gland casing (Fig. 27/2)



Installation, fixing and commissioning

6.3.2 Mounting the sensor brackets

- n Construction only by qualified personnel.
- n Additionally required protective equipment:
 - l Hard hat
 - l Safety boots
 - l Safety belt if it is necessary to bridge big heights
- n Required tools:
 - l Torque wrenches with hexagon insert 5, 6, 8, and 10
 - l Hammer
 - l 5 mm drill (for the alignment pin holes necessary at the profile type sensors)

Types of sensor brackets

Depending on the type of motor two different types of sensor brackets may have to be installed:

- n Tube type sensor brackets
- n Profile type sensor brackets two sensors

The following table shows the type of brackets to be used depending on the type of engine. (further configuration available)

Engine type	Number of cylinders	Tube type bracket	Profile type bracket	NordLock®
S26 MC6	5-12	x		
L35 MC6	5-12	x		
S35 MC7	5-12	x		
S35 ME-B9	5-8		x	2xM10
S40 ME-B9	5-8		x	2xM10
S42 MC7	5-12	x		
S46 MC-C7	5-8		x	2xM10
S46 MC-C8	5-8		x	2xM10
S50 MC-C7	5-9		x	2xM10
S50 MC-C8	5-9		x	2xM10
S50 MC6	5-8	x		1xM10
S50 ME-B8	5-9		x	2xM10
S50 ME-C7	5-9		x	2xM10



Installation, fixing and commissioning

Engine type	Number of cylinders	Tube type bracket	Profile type bracket	NordLock®
S50 ME-C8	5-9		x	2xM10
L60 MC-C7	5-9		x	2xM10
L60 MC-C8	5-9		x	2xM10
S60 ME-C7	5-8		x	2xM10
S60 ME-C8	5-8		x	2xM10
S60 MC6	5-8	x		1xM10
S65 ME-C8	5-8		x	2xM10
L70 MC-C7	5-8		x	2xM10
L70 MC-C8	5-8		x	2xM10
L70 ME-C7	5-8		x	2xM10
L70 ME-C8	5-8		x	2xM10
S70 ME-C7	5-8		x	2xM10
S70 ME-C8	5-8		x	2xM10
S70 MC-C7	5-8		x	2xM10
S70 MC-C8	5-8		x	2xM10
S70 MC6	5-8	x		1xM12
K80 MC-C6	6-12	x		1xM12
S80 MC-C7	6-8		x	2xM10
S80 MC-C8	6-8		x	2xM10
K80 ME-C6	6-12	x		1xM12
K80 ME-C9	6-12		x	2xM12
S80 ME-C7	6-8		x	2xM10
S80 ME-C8	6-8		x	2xM10
S80 ME-C9	6-9		x	2xM10
S80 MC6	6-8	x		1xM12
S90 MC-C7	6-9		x	2xM10

**Installation, fixing and commissioning**

Engine type	Number of cylinders	Tube type bracket	Profile type bracket	NordLock®
S90 MC-C8	6-9		x	2xM10
S90 ME-C7	6-9		x	2xM10
S90 ME-C8	6-9		x	2xM10
K90-ME-C6	6-12	x		1xM12
K90-ME-C9	6-12		x	2xM10
K90-MC-C6	6-12	x		1xM12
K90-ME9	6-12		x	2xM10
K98 MC-C6	6-12+14		x	2xM10
K98 MC-C7	6-12+14		x	2xM10
K98 ME-C6	6-12+14		x	2xM10
K98 ME-C7	6-12+14		x	2xM10
K98 ME6	6-12+14		x	2xM10
K98 MC6	6-12+14		x	2xM10
K98 MC7	6-12+14		x	2xM10
K98 ME7	6-12+14		x	2xM10
K108ME-C6	6-12+14		x	2xM10



Installation, fixing and commissioning

Mounting a tube type sensor bracket



NOTE!

The sensor brackets can only be mounted if all holes have been drilled into the web plate and threads (M10 or M12) have been inserted according to MAN Diesel drawings.



Fig. 31: Tube type sensor bracket

1. Attach two NordLock® discs (Fig. 31/3) on the bolt M10 or M12 (Fig. 31/2).



Fig. 32: Mounted tube type sensor bracket

2. Tighten the tube type sensor bracket (Fig. 32/2) with the bolt M10 or M12 (Fig. 32/1) in the web plate on left (first cylinder) or right (last cylinder) hand side of the crosshead.
 - | M10: 70 Nm
 - | M12: 120 Nm



NOTE!

*Both NordLock® discs are fitted with glue and must not be separated.
Do not use Loctite® or any other screw locking for mounting the tube type sensor brackets.*



Installation, fixing and commissioning

Mounting a profile type sensor bracket



NOTE!

The sensor brackets can only be mounted if all holes have been drilled into the web plate and threads (M10 or M12) have been inserted according to MAN Diesel drawings.

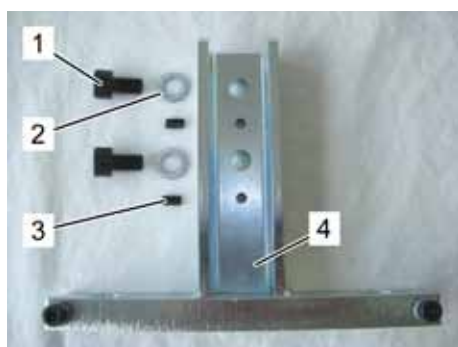


Fig. 33: Profile type sensor bracket

- 1 Bolt
- 2 NordLock® disc
- 3 Alignment pin
- 4 Sensor bracket

1. Attach two NordLock® discs (Fig. 33/2) on every bolt M8, M10 or M12 (Fig. 33/1).



NOTE!

Both NordLock® discs are fitted with glue and must not be separated.
Do not use Loctite® or any other screw locking for mounting the tube type sensor brackets.



Fig. 34: Mounted double profile type sensor bracket

2. Tighten the profile type sensor bracket (Fig. 34/1) for two sensors with the bolts M8 or M10 (Fig. 34/2) centrally between the crosshead web plate.
 - | M8: 35 Nm
 - | M10: 50 Nm

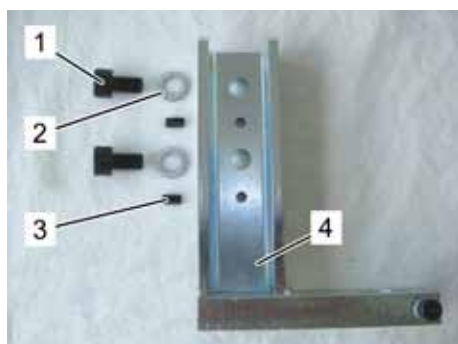


Fig. 35: Single profile type sensor bracket

- 1 Bolt
- 2 NordLock® disc
- 3 Alignment pin
- 4 Sensor bracket

3. Tighten the profile type sensor bracket (Fig. 35/4) for one sensor (here bracket for cylinder no. 1 left hand side) with the bolts M8 or M10 (Fig. 35/1) and NordLock® discs (Fig. 35/2) under the crossheads of the first and the last cylinder.
 - | M8: 35 Nm
 - | M10: 50 Nm



Installation, fixing and commissioning



NOTE!

See Appendix for installation schemas on how to mount sensor brackets in dependency of the number of cylinders.



Fig. 36: Drillings for alignment pins

4. Drill two holes through the existing drill holes (Fig. 36/1+2) of each sensor bracket with a depth of 10 mm into the engine material by using the 5 mm drill.
5. Insert the alignment pins (Fig. 36) into these holes carefully by using the hammer.

6.3.3 Implementation of alignment pins.

For a higher accuracy, alignment pins are recommended.

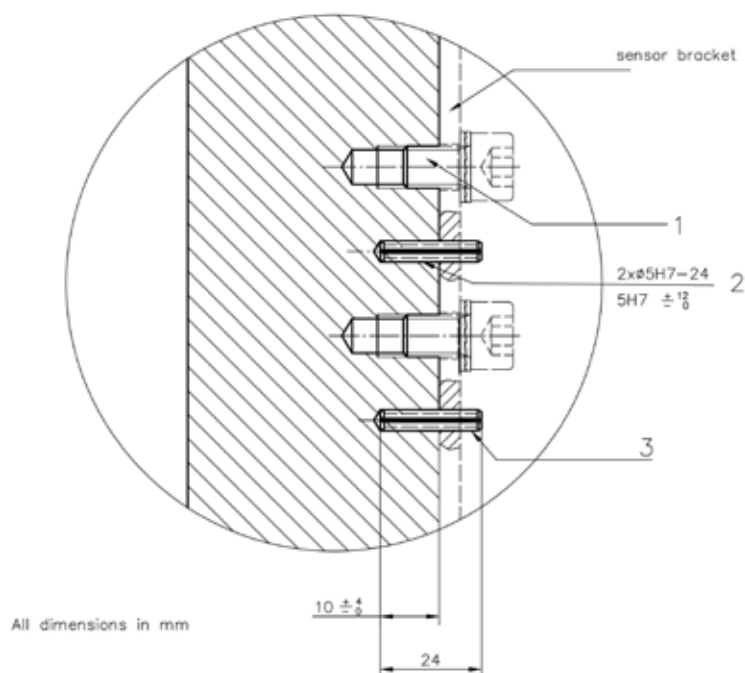
Only after the sensor bracket is installed with 2 bolts (Fig. 37/1).

2 additional holes (Fig. 37/2) for the alignment pins can be drilled and the pins (Fig. 37/3) inserted.

The depth of the holes (Fig. 37/3) should not exceed 10 mm !

Please use an accurate 5 mm drill. Insert the alignment pins (Fig. 37/3).

Slightly insert the alignment pins into the holes by carefully use of a hammer.





Installation, fixing and commissioning

6.3.4 Mounting and adjusting the sensors

Disfunction



CAUTION!

Danger of malfunction through wrongly installed distance sensors!

The BDMS/BTMS will not work if sensors are installed incorrectly.

Therefore:

- Install the distance sensors in the sequence given in Fig..
- Use the right connector for the respective sensor.



NOTE!

The cylinder with the highest number is that one at the flywheel side. Opposite from the flywheel there is the cylinder with the lowest number. This is valid for MAN B&W engines; Wärtsilä / Sulzer engines have opposite counting therefore verify the sensor positions against the drawings valid for the specific engine!!



Installation, fixing and commissioning

Example:

- n Sensors 11 and 21 have to be mounted in the brackets of cylinder 1
- n Sensors 12 and 22 have to be mounted in the brackets of cylinder 2 and so on

The respective number of a sensor is:

- n written on its cap (Fig39/1)



Fig.39: Number written

Mounting a sensor in a tube type sensor bracket into the engine

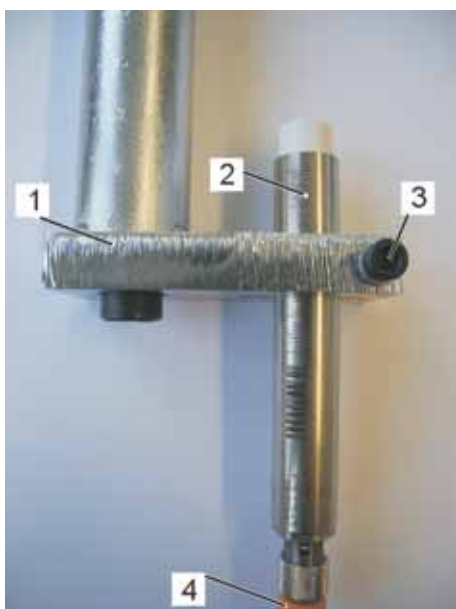


Fig.40: Sensor connected to bracket

1. Turn the engine so that the crosshead of the respective compartment is in the bottom dead center (ð see operating instructions of the engine manufacturer).
2. Connect the sensor cable (Fig.40/4) to the sensor to have a correct alignment of the connector.
 - Cable: KSG03248-15 for angle connectors
 - Cable: KSG03252-15 for straight connectors
3. Insert the sensor (Fig. 40/2) into the sensor bracket (Fig.40/1).
4. Clamp the sensor by lightly tightening the clamp screw (Fig.40/3).



NOTE!

Don't move the sensors forcibly by means of the connector! This can lead to destruction of the sensors!



Installation, fixing and commissioning

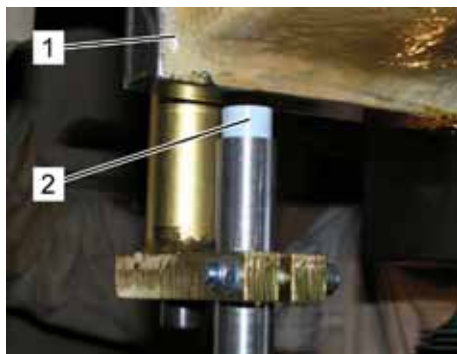


Fig. 37: Sensor mounted

5. Check if the crosshead (Fig. 41/1) is fully covering the sensor tip (Fig. 41/2).

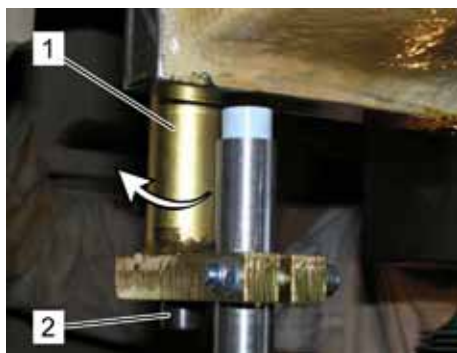


Fig. 38: Sensor under crosshead

6. If the crosshead is not fully covering the sensor tip loosen the bracket fixing bolt (Fig. 38/2) and then turn the bracket (Fig. 38/1), until the crosshead is fully covering the sensor tip (Fig. 38/arrow).
7. Then tighten the bracket fixing bolt (Fig. 38/2).

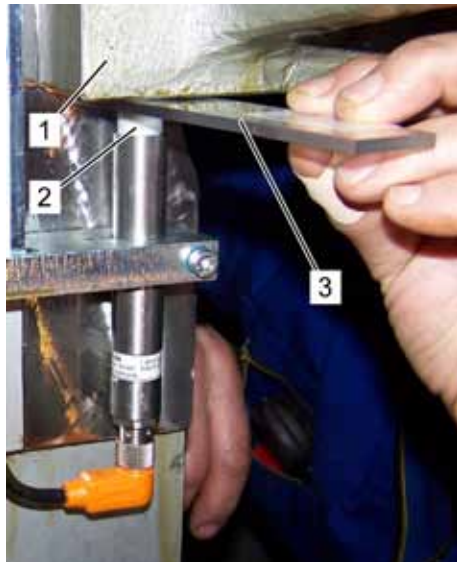


Fig. 39: Calibrating sensor

8. Insert the calibration tool (Fig. 39/3) between crosshead (Fig. 39/1) and sensor tip (Fig. 39/2).



NOTE!

The illustrations in Fig. 39 and Fig. 40 show a profile type sensor bracket. The procedure is the same as for adjusting the tube type sensor brackets.



Installation, fixing and commissioning

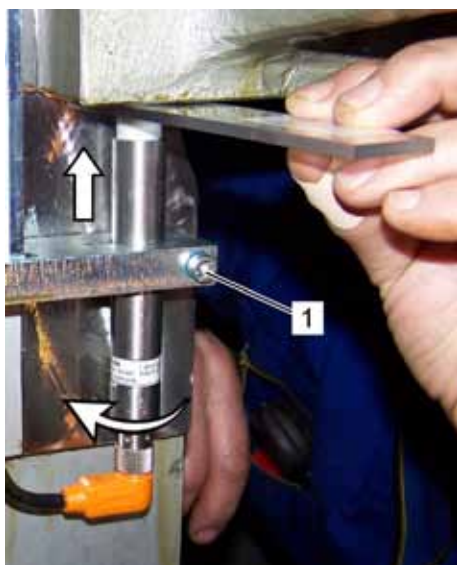


Fig. 40: Adjusting sensor

7. Push the sensor upward until it rests on the calibration tool which has to be in contact with the lower part of the crosshead.
8. Turn the sensor in a way that the sensor cable connector shows in the foreseen way of cabling inside the engine. (this step is not necessary in case of straight connectors as shown in Fig. 43a)



NOTE!

Don't move the sensors forcibly by means of the connector! This can lead to destruction of the sensors!

9. Clamp the sensor by tightening the clamp screw (Fig. 40/1).
 - | Torque moment: 16 Nm
 - | **don't forget the NordLock® discs to interlock the clamp screw**



Fig. 41a: sensor with straight connectors



NOTE!

Repeat these steps with every sensor to be mounted.



Installation, fixing and commissioning

Mounting a sensor in a profile type sensor bracket into the engine

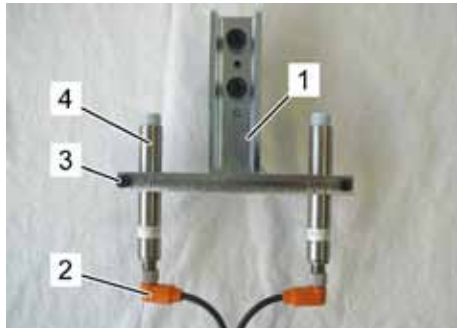


Fig. 42: Cables and sensor connected

1. Turn the engine so that the crosshead of the respective compartment is in the bottom dead centre (ð see operating instructions of the engine manufacturer).
2. Connect the sensor cable (Fig. 42/2) to the sensor at the respective compartment (the side where the crosshead is in the bottom dead centre) (Fig. 42/4) to have a correct alignment of the connector.
 - Cable: KSG03248-15 for angle connectors
 - Cable: KSG03252-15 for straight connectors



NOTE!

Don't move the sensors forcibly by means of the connector! This can lead to destruction of the sensors!

3. Insert the sensors in the sensor bracket (Fig. 42/1) at the respective compartment (the side where the crosshead is in the bottom dead centre)
4. Place the calibration tool (Fig. 43/2) correctly under the surface of the crosshead in the bottom dead centre



Fig. 43: Calibrating sensor



Installation, fixing and commissioning

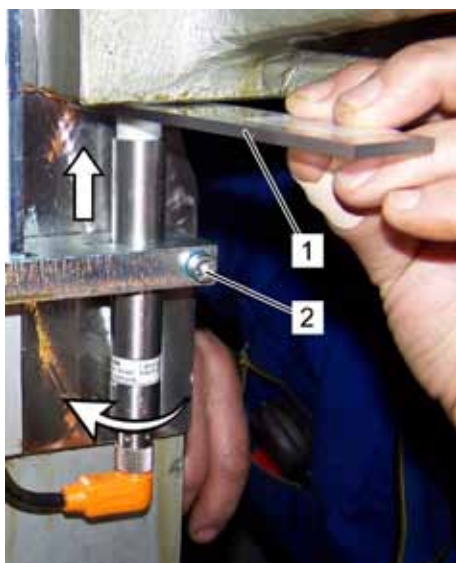


Fig. 44: Adjusting sensor

5. Bear this sensor against the plastic sheet until it rests on the calibration tool (Fig. 44/1) which has to be in contact with the machined crosshead surface.
6. Turn the sensor in a way that the sensor cable connector shows towards the other sensor. (this step is not necessary in case of straight connectors as shown in Fig. 43a)



NOTE!

Don't move the sensors forcibly by means of the connector! This can lead to destruction of the sensors!

7. Tighten the respective clamp screw (Fig. 44/2) with 16 Nm.
 - **don't forget the NordLock® discs to interlock the clamp screw**

8. Remove the calibration tool.
 - Ä Between sensor and surface should be a gap of 4 mm.



Fig. 45: Adjusting second sensor

9. Carry out the same procedure at the other sensors and adjust them in the same way to 4 mm gap between sensor and machined crosshead surface in the bottom dead centre (repeat steps 4 to 8).
10. Tighten the clamp screw with 16 Nm (Fig. 45/1).

- **don't forget the NordLock® discs to interlock the clamp screw!**



Fig. 46: Cable tie

11. Fix both cables (Fig. 46/2) with a cable tie (Fig. 46/1) and lead them towards the magnetic clips (grip magnets) or screwable fastening clamps.
 - **Don't squeeze the cables with the cable ties in that way that the downsizing of the cross-section leads to any damage of the conductors inside the cables!**



NOTE!

Don't move the sensors forcibly by means of the connector! This can lead to destruction of the sensors!



Installation, fixing and commissioning

Mounting a water-in-oil sensor

The water-in-oil sensor has to be installed into the pressure line previous to the engine (Fig. 47).

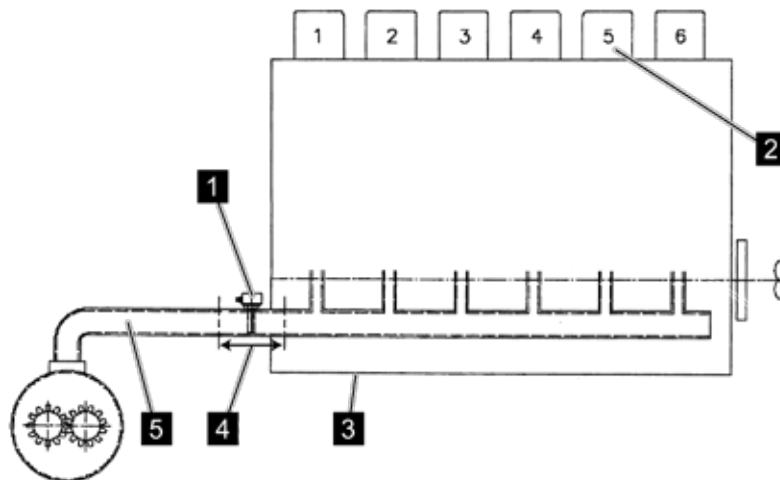


Fig. 47: Mounting area for the water-in-oil sensor

- 1 Water-in-oil sensor
- 2 Cylinder
- 3 Engine
- 4 Area where the water-in-oil sensor should be mounted
- 5 Pressure line



WARNING!

Danger of injury caused by oil under pressure!

In case of defective lines or machine parts oil may escape under pressure. This can cause severe injuries.

Therefore:

- Do not open pipelines under pressure.
- Depressurize pipelines before starting any work.
- Have defective parts repaired.



Fig. 48: Mounting position

1. Choose an appropriate position (Fig. 48/1) in the pressure line for the sensor to be mounted.
2. Depressurize the oil pipe.
3. Remove a part of the pressure line according to Fig. 48.



Installation, fixing and commissioning

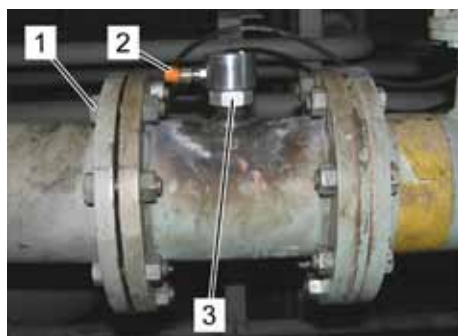


Fig. 49: Sensor mounted

- 1 Bolt
- 2 Connector of sensor cable
- 3 Water-in-oil sensor

4. Install the water-in-oil sensor according to Fig. 49.



Fig. 50: Alternative mounting position

Fig. 50 shows an alternative mounting position of the water-in-oil sensor (Fig. 50/1).

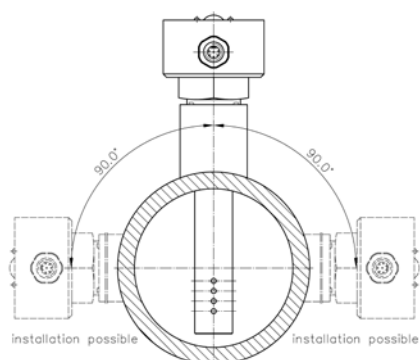


Fig. 51: Positioning



NOTE!

We recommend mounting the sensor in a position range of 90°).



Installation, fixing and commissioning

6.3.5 Placing and fixing of cables inside the engine



CAUTION!

Damage to cables caused by improper laying!

Cables might get damaged if they are laid improperly.

Therefore:

- Follow the instructions in this Manual corresponding to the placement of cables.
- Avoid placing cables around sharp corners.
- Make sure cables are not buckled.
- Lead cables only through the respective cable glands.



Installation, fixing and commissioning

6.3.5.1 Placing and fixing of cables inside new engines under construction

Cables of the sensors inside the engine have to be placed according to the following instruction and drawings.

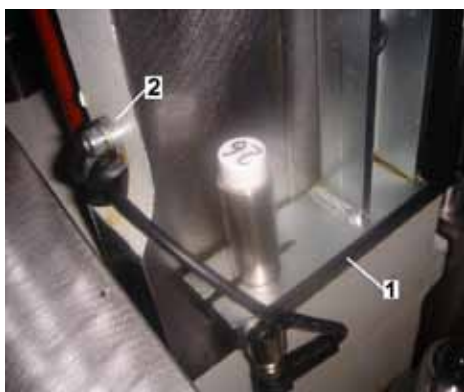


Fig. 52: Cables through fastening clamp

1. Lead the cables from the sensor bracket (Fig. 52/1) through the fastening clamp (Fig. 52/2) on the bed plate (if necessary).



NOTE!

Start the cabling from the inside out (from the sensor to the cable glands out of the engines) to avoid the form of the cable loops inside the engine!



NOTE!

Don't move the sensors forcibly by means of the connector! This can lead to destruction of the sensors!



Fig. 53: Cable tie

2. Fix cables by cable ties wherever possible according to the picture 57: Cable tie



NOTE!

Don't squeeze the cables with the cable ties in that way that the downsizing of the cross-section leads to any damage of the conductors inside the cables!

For new buildings the cables inside the engine are guided by magnetic clips (grip magnets) or screwable fastening clamps



The engine manufacturers MAN as well as WÄRTSILÄ prefer the method of cable installation in the engine with magnetic clips. This method saves the drilling in the engines and prevents consequently an attenuation of the engine frame. Dr. E. Horn GmbH strongly recommends to use magnetic clips for cable installation within the engines.



Installation, fixing and commissioning

cable installation inside the engine by means of magnetic clips

Fig.58: Schematic for placing the magnetic clips inside the engine

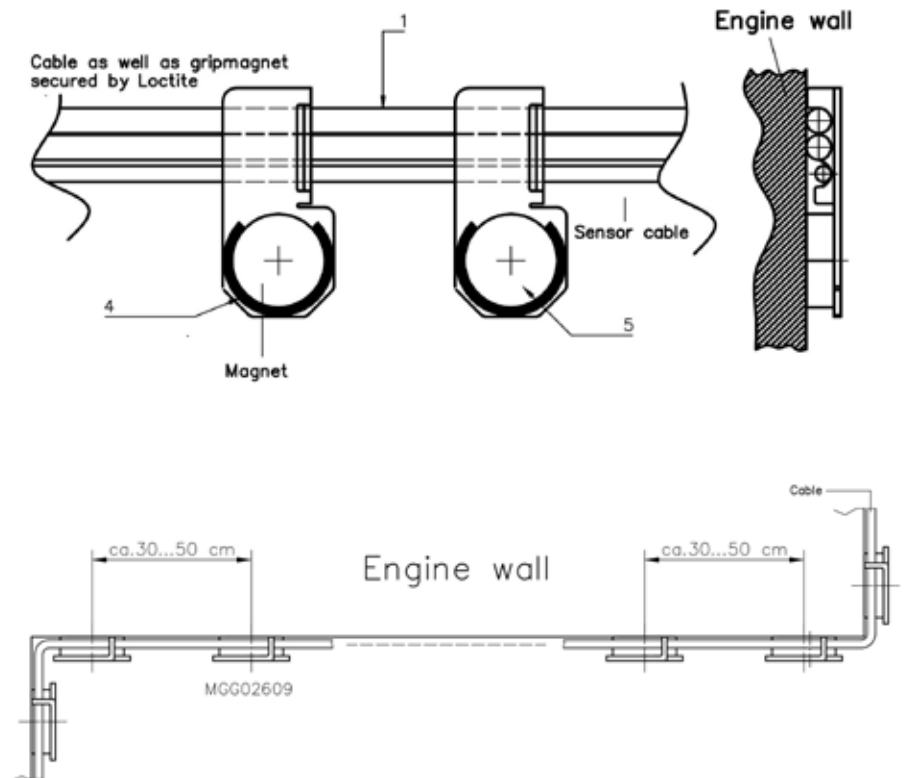
1 Sensor Cable

4 Loctite®

5 Magnetic clip sufficient for 1...3 sensor cables

How to fix the magnetic clips:

- The surface should be as smooth as possible
- Clean the foreseen area of the bedplate with a suitable cleaner (acetone or similar)
- The surface must be 100% free of oil, grease, lubricant
- The surface of the magnet must 100% rest on the bedplate surface and also free of oil, grease etc.
- Lead cables without twisting from one to the next magnetic clip
- The distance between the magnetic clips should be between 30... 50 cm
- Before and after a corner use one magnet clip each
- Secure the magnets against slipping by the provided glue (part of the delivery)
- Apply the glue around the magnet according the above drawing



NOTE!

There must be under no circumstances glue between the magnet surface and the bedplate surface! The glue is to secure the magnet clips against slipping while engine vibration.



Installation, fixing and commissioning

cable installation inside the engine by means of screwable holder

1 Cable

6 Screwable cable holder

- Sufficient for 1 – 3 cables

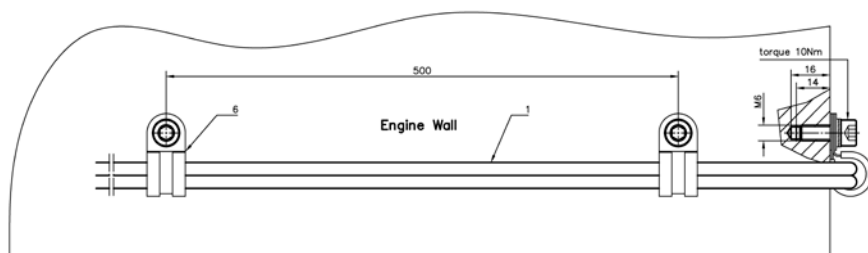


Fig.59: Schematic for placing the screwable holder inside the engine



NOTE!

Start the cabling from the inside out (from the sensor to the cable glands out of the engines) to avoid the form of the cable loops inside the engine!

How to fix the screwable cable holder:

- Lead the cables from sensors to the cable glands out of the engine to avoid the form of any cable loops inside the engine
- Lead cables without twisting from one to the next cable holder
- The distance between the cable holders should be approx. 500 mm
- Before and after a corner use one cable holder each



Fig.60: application of screwable cable holder in the engine

1 Cable

2 Screwable cable holder



Installation, fixing and commissioning

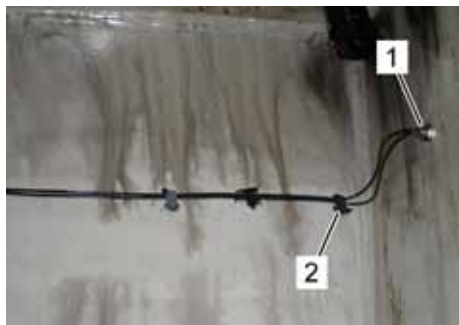


Fig. 60: Cable gland inside the engine

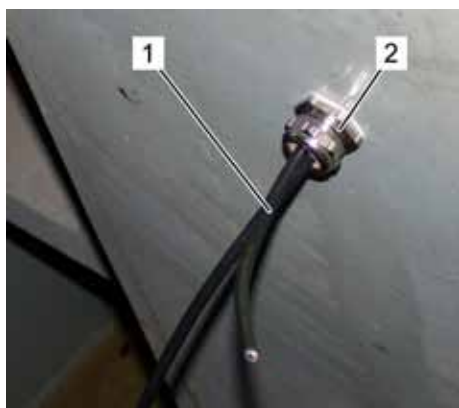


Fig.61: Cable gland outside the engine

4. Lead cables (Fig. 60/2) through cable glands (Fig. 60/1) from the inside (Fig. 60) to the outside (Fig.61) of the engine.
2. Tighten the cable glands inside the engine.
1 cable gland inside the engine
2 cables inside the engine
3. Tighten the cable glands outside the engine after all sensors have been mounted.
1 cables outside the engine
2 cable gland outside the engine



NOTE!

The number of cables that have to be led through the cable glands depends on the type of engine and whether there is a main bearing temperature sensor installed or not.

6.3.5.2 Placing and fixing of cables for retrofit installation



NOTE!

The cables of the sensors inside the engine have to be placed according to the same instructions and drawings as for new engines under construction (chapter 6.3.4.1) . **Both, the installation with magnetic clips (grip magnets) and with screwable cable holder can be used.** However, the **preferred method should be the installation by means of the magnetic clips** to avoid unnecessary drilling (metal cuttings) in the engine compartment.



Installation, fixing and commissioning

6.3.6 Mounting a Terminal box

**NOTE!**

One Terminal box can take up to 16 sensors max. In case of a BDMS/BTMS with a 7-cylinder engine 14 distance sensors and one water-in-oil sensor can be connected to one Terminal box. If more than 16 sensors should be installed (8 cylinders or more) a second Terminal box is needed.

The following table provides an overview taking into account the number of cylinders of the engine, the respective number of installed distance sensors and the required quantity of Terminal boxes.

Cylinders	Distance sensors	Terminal boxes
4-7	8-14	1
8-14	15-28	2

The respective schematic drawings are enclosed in the Appendix, chapter 10.3.

**NOTE!**

The distance between the Terminal box(es) and the Line Converter box must not exceed a distance of 5 m to avoid malfunctions.

Mounting

The Terminal boxes have to be mounted outside of the engine bedplate on its surface.

Take into account the length of the cables which have to be connected to the Terminal box when selecting a place for mounting:

- n Distance sensor cables: 15 m
- n Water-in-oil sensor cables: 15 m

**NOTE!**

The Terminal box(es) should be mounted near the cable glands on the manoeuvre side of the engine.



Installation, fixing and commissioning

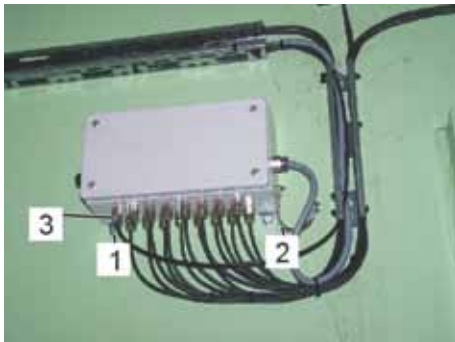


Fig. 54: Connection box

1. Attach the Terminal boxes to the engine block either by four bolts (Fig. 54/1) or by electrical welding.
 | Bolts M8 and NordLock® discs are included in delivery.

The cable glands have to be on the bottom side of the box (Fig. 54/3) because otherwise the text inside of the box will be upside down.



NOTE!

The Terminal box in Fig. 54 is different from this one in the scope of today's supply.

2. Remove possible colour on the engine block to guarantee a metallic bright surface for assembling the GND strap.
3. Screw the GND strap (Fig. 54/2) with a 6 mm hexagonal bolt onto the engine block.
 | M6: 6 Nm

6.3.7 Connecting the Terminal box

- n Make sure the Terminal box is mounted correctly.



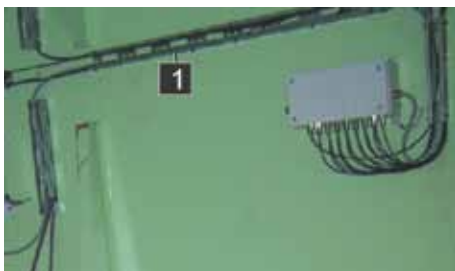
CAUTION!

Damage to cables in case of improper leading!

The cables of the sensors might get damaged if they are not led through the cable trays.

Therefore:

- Always use the provided cable trays to lead cables.
- Mount additional cable trays if necessary.



1. Lay cables of all sensors that have to be attached through cable trays (Fig. 55/1) to the Terminal box.



NOTE!

Cables that are too long may be shortened or coiled up and fastened on the cable tray or Terminal box.



Installation, fixing and commissioning

Fig. 55: Cable trays on engine block

Leading cables into the box

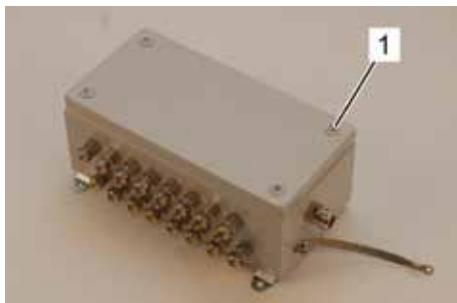


Fig. 56: Screws on the Terminal box

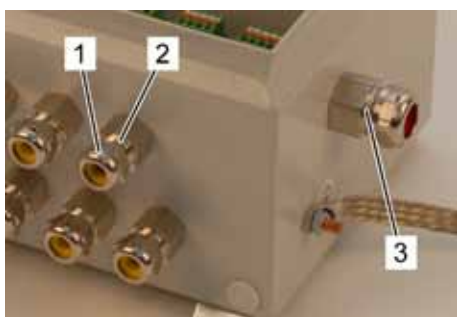


Fig. 57: Types of cable glands

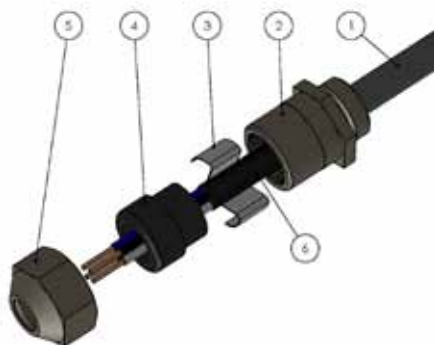


Fig. 58: Spring on naked screen

2. Prepare all cables according to the description
3. Loosen the screws on the Terminal box (Fig. 56/1) and open it.
4. Loosen the pressure screw of the cable glands (Fig. 57/1).
5. Guide the cables from the sensors through the smaller cables glands (Fig. 57/2) into the Terminal box.
6. Guide the bus cables (LT2004F0) through the bigger cable glands on the side (Fig. 57/3) into the Terminal box.
7. Make sure all cables (Fig. 58/1) are placed correctly and the spring (Fig. 58/3) is in contact with the naked screen (Fig. 58/6).
8. Connect the conductors to the respective connector according to chapters 6.3.7.1 to 6.3.7.2.
9. Close the Terminal box and tighten the screws.



Installation, fixing and commissioning

6.3.7.1 Connecting sensors



NOTE!

Inside the Terminal box the distance sensors can be connected to any available connector without following a routine.

Distance sensors, water-in-oil sensor and main bearing temperature sensor get connected similarly.

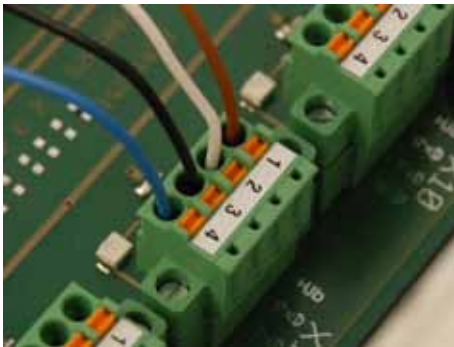


Fig. 59: Connecting a sensor

1. Connect the conductors of the sensors according to Fig. 59. For details refer to the respective terminal diagrams.

Slot	Marking	Conductor colour
1	+U _b	brown
2	RxD	white
3	TxD	black
4	GND	blue

6.3.7.2 Connecting the bus cable

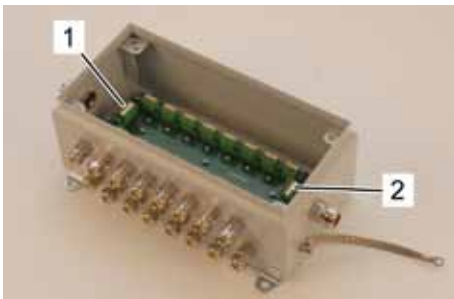


Fig. 60: Connectors for bus cable

The Terminal box has two connectors for a bus cable. They are identified as X17 (Fig. 60/1) and X18 (Fig. 60/2).

1. Choose a connector taking into account the position of the Line Converter box.
 - | X17: Line Converter box left of Terminal box
 - | X18: Line Converter box right of Terminal box



Fig. 61: Connecting the bus cable

2. Connect the conductors of the bus cable according to Fig. 61. For details refer to the respective terminal diagrams.

Slot	Marking	Conductor colour
1	+U _b	green
2	RxD	brown
3	TxD	yellow
4	GND	white



6.3.8 Mounting the Line Converter box



NOTE!

The distance between the Terminal box(es) and the Line Converter box must not exceed a distance of 5 m to avoid malfunctions.

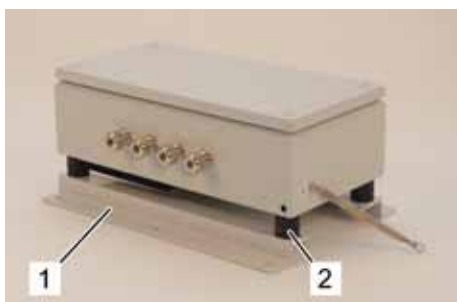


Fig. 62: Z-profile

The Line Converter box may optionally have Z-profiles (Fig. 62/1) with vibration dampers (Fig. 62/2).



Fig. 63: Mounting Line Converter box

1. Attach the Line Converter box to the engine block by six bolts (Fig. 63/1).
The cable glands should be on the bottom side of the box (Fig. 63/2).
 - | Bolts M8 and NordLock® discs are included in delivery.



Fig. 64: Connecting earthing strap

2. Remove possible colour on the engine block to guarantee a metallic bright surface (Fig. 64/1) for assembling the GND strap.
3. Screw the GND strap (Fig. 64/2) with a 6 mm hexagonal bolt onto the engine block.
 - | M6: 6 Nm



Installation, fixing and commissioning



4. Mounting bracket BLG00402 for one Terminal box GHG02621-3, or BLG00403 for two Terminal boxes GHG02621-3.

*Fig. 65: Mounting bracket BLG00402 with
the terminal box GHG002621... and one
lineconverter box GHG002611...*



Installation, fixing and commissioning

6.3.9 Connecting the Line Converter box

- n Make sure the Line Converter box is mounted correctly.



CAUTION!

Damage to cables in case of improper leading!

The cables might get damaged if they are not led through the cable trays.

Therefore:

- Always use the provided cable trays to lead cables.
- Mount additional cable trays if necessary.

There are two types of Line Converter boxes available:

- n GHG02611-4 for 24 V DC
- n GHG02611-5 for 115-230 V AC

These types have different ship voltage supply connections for AC and DC types.

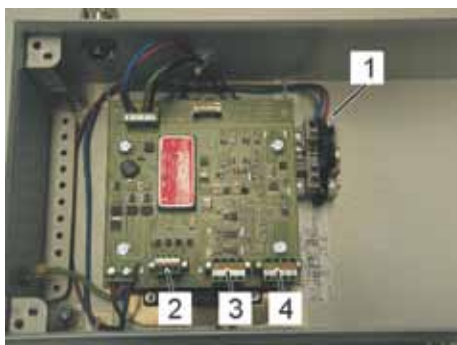


Fig. 66: Connectors

The Line Converter box has four connectors:

- n X1: Power supply for the board (Fig. 66/1)
- n X2: Bus cable to indication unit (Fig. 66/2)
- n X3: Bus cable from Terminal box on the left of the Line Converter box (Fig. 66/3)
- n X4: Bus cable from Terminal box on the right of the Line Converter box (Fig. 66/4)



Fig. 67: Cable glands

The Line Converter box has four cable glands, one for each cable (Fig. 67/1). The bus cables from the Terminal boxes are thinner than the others. So they have to be led through both the right cable glands.



NOTE!

If only one Terminal box is installed it has to be connected to connector X3.



Installation, fixing and commissioning



Fig. 68: Cable trays on engine block

1. Lay cables through cable trays (Fig. 68/1) to the Line Converter box.



NOTE!

Cables that are too long may be shortened or coiled up and fastened on the cable tray or Line Converter box.

Leading cables into the box



Fig. 69: Screws on the Line Converter box

2. Prepare all cables according to the description in "Preface".
3. Loosen the screws on the Line Converter box (Fig. 69/1) and open it.

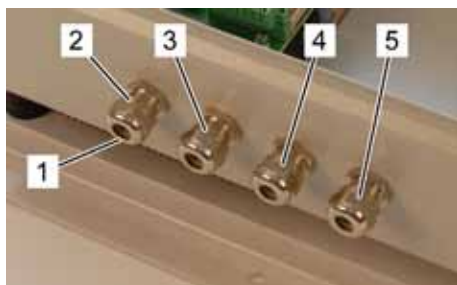


Fig. 70: Types of cable glands

4. Loosen the pressure screw of the cable glands (Fig. 70/1).
5. Guide the bus cables from the Terminal boxes through both the cable glands in the middle (Fig. 70/3+4) into the Line Converter box.
6. Guide the bus cable to the Indication unit (LT2004D0) through the cable gland on the left (Fig. 70/2) and the power supply through the cable gland on the right (Fig. 70/5) into the Line Converter box.

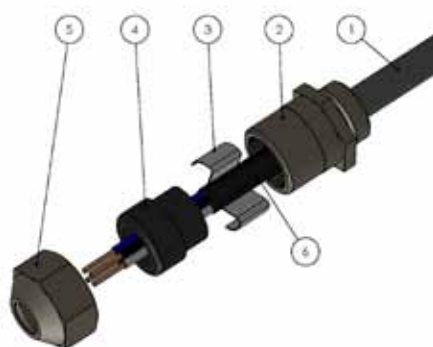


Fig. 71: Spring on naked screen

7. Make sure all cables (Fig. 71/1) are placed correctly and the spring (Fig. 71/3) is in full contact with the naked screen (Fig. 71/6).
8. Tighten the pressure screw (Fig. 70/1) of each cable gland so that the cable is fixed.
9. Connect the conductors to the respective connector according to chapters 6.3.9.1 till 6.3.9.3.
10. Close the Line Converter box and tighten the screws.



Installation, fixing and commissioning

6.3.9.1 Connecting the bus cables from the Terminal boxes

- n Type of cable: LT2004F0

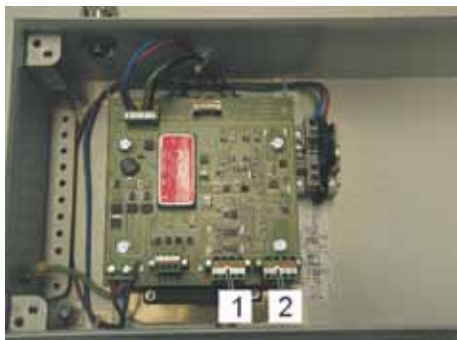


Fig. 72: Connectors X3 and X4

The bus cables of the Terminal boxes have to be connected to the connectors X3 and X4.

- 1 Connector X3
- 2 Connector X4

- n Bus cable from Terminal box on the left to X3 (Fig. 72/1)
- n Bus cable from Terminal box on the right to X4 (Fig. 72/2)



Fig. 73: Connecting the bus cables

1. Connect the conductors of the bus cables according to Fig. 73. For details refer to the respective terminal diagrams.

Slot	Marking	Conductor colour
1	+u _b	green
2	RxD	brown
3	TxD	yellow
4	GND	white

6.3.9.2 Connecting to the ship's/plant's power supply



Fig. 74: Board power supply

All cabling inside the Line Converter Box except the bus connections at X2, X3 and X4 are factory-made.

So the board power supply at X1 looks as shown in Fig. 74.

Position	Marking	Conductor colour
1	+24 V	red
2	0 V	blue



Installation, fixing and commissioning

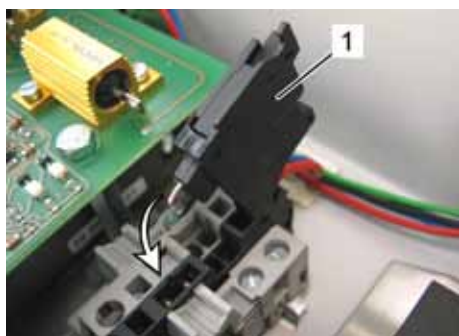


Fig. 75: Power switch

The centralized power supply from the ship is carried out via the power switch (Fig. 75/1). It can be closed to switch on and opened to switch off the power supply from the ship.

Connecting to Line Converter box type GHG02611-4

n 24 V DC from ship net

1. Connect the conductors of the power supply according to Fig. 76. For details refer to the respective terminal diagrams.
2. Use the screws to tighten the conductors.

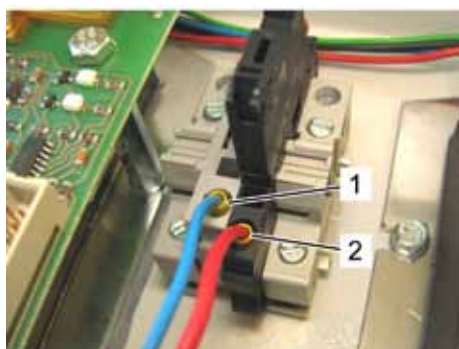


Fig. 76: Connection with 24 V DC

Position	Marking	Conductor colour
1	–	blue
2	+	red

Connecting to Line Converter box type GHG02611-5

n 115/230 V AC from ship net

1. Connect the conductors of the power supply according to Fig. 77. For details refer to the respective terminal diagrams.
2. Use the screws to tighten the conductors.

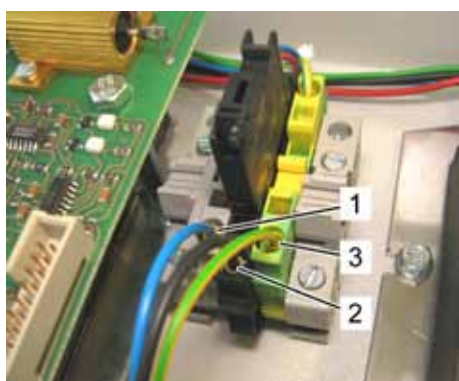


Fig. 77: Connection with 115/230 V AC

Position	Marking	Conductor colour
1	–	blue
2	+	black
3	GND	yellow/green



Installation, fixing and commissioning

6.3.9.3 Connecting the bus cable of the Indication unit

n Type of cable: LT2004D0

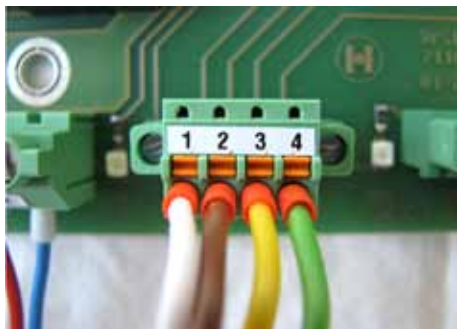


Fig. 78: Connecting the bus cable

1. Connect the conductors of the bus cable according to Fig. 78. For details refer to the respective terminal diagrams.

Slot	Marking	Conductor colour
1	RxD\	white
2	RxD	brown
3	TxD\	yellow
4	TxD	green

6.3.10 Mounting the Indication unit

The Indication unit can be installed in two different ways:

- n Inside of the optionally available field housing inside the engine room (MDA312... in field housing GHG02631)
- n Into a switchboard or control console panel in the control room of the ship (MDA312...)



NOTE!

The indication unit may be theoretically mounted in a distance up to 1000 m to the Line Converter box. However, please consider the agreed cable length.

Mounting inside the engine room



Fig. 79: Indication unit with cable glands

1. Connect the Indication unit (Fig. 79/1) to the housing (Fig. 79/2).
2. Attach the Indication unit to the bulkhead either by bolts or by electrical welding. The cable glands (Fig. 79/3) have to be on the bottom side of the box.
 - └ Bolts and NordLock® discs are included in delivery.
3. Remove possible colour on the engine block to guarantee a metallic bright surface for assembling the GND strap.
4. Screw the GND strap onto the bulkhead.



Installation, fixing and commissioning

Mounting inside the control room

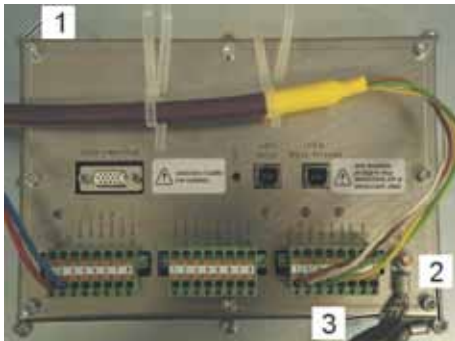


Fig. 80: Indication unit in control room

1. Fix the Indication unit on the control panel in a suitable position with screws on its back (Fig. 80/1).
2. Remove possible colour on the back of the control panel to guarantee a metallic bright surface for assembling the GND strap (Fig. 80/2).
3. Screw the GND strap (Fig. 80/3) onto the back of the control panel.

6.3.11 Connecting the Indication unit

- n Make sure the Indication unit is mounted correctly.



CAUTION!

Damage to cables in case of improper leading!

The cables might get damaged if they are not led through the cable trays.

Therefore:

- Always use the provided cable trays to lead cables.
- Mount additional cable trays if necessary.

The connecting has to be made via the cable glands or directly to the connectors depending on the type of Indication unit.

- n MDA312...: Connecting through cable glands
- n MDA312...: Direct connection to connectors

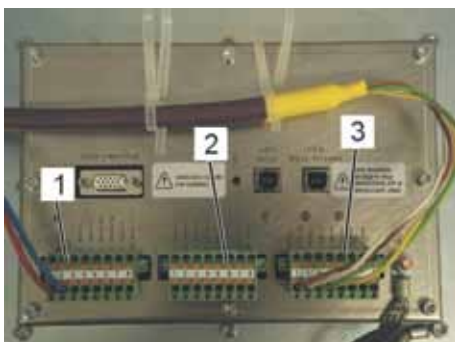


Fig. 81: Connectors

The Indication unit has among others three connectors:

- n X11: Power supply and alarm contacts (Fig. 81/1)
- n X12: Alarm contacts (Fig. 81/2)
- n X13: Bus cable from Line Converter box (Fig. 81/3)



Installation, fixing and commissioning



Fig. 82: Cable trays on engine block

1. Lay cables through cable trays (Fig. 82/1) to the Indication unit.



NOTE!

Cables that are too long may be shortened or coiled up and fastened on the cable tray or the Indication unit.

The violet cable from the Line Converter Box has to be laid on the best way in the vessel on existing cable rails.

Avoid parallel running with power cables and too close distances to generator sets.

Leading cables into Indication unit MDA312...



Fig. 83: Indication unit

When using the Indication unit type MDA 312... it is necessary to lead the cables into the unit via cable glands.

2. Prepare all cables according to the description in "Preface".
3. Loosen the screws on the Indication unit (Fig. 83/1) and open it.
4. Loosen the pressure screw of the cable glands.
5. Guide the cables through the cables glands (Fig. 83/2) into the Indication unit.

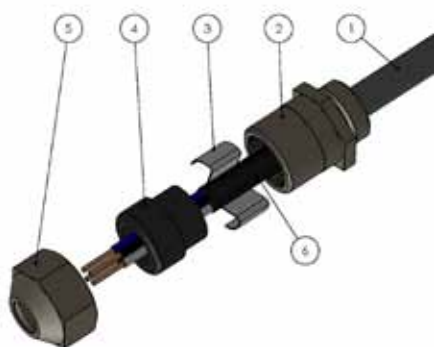


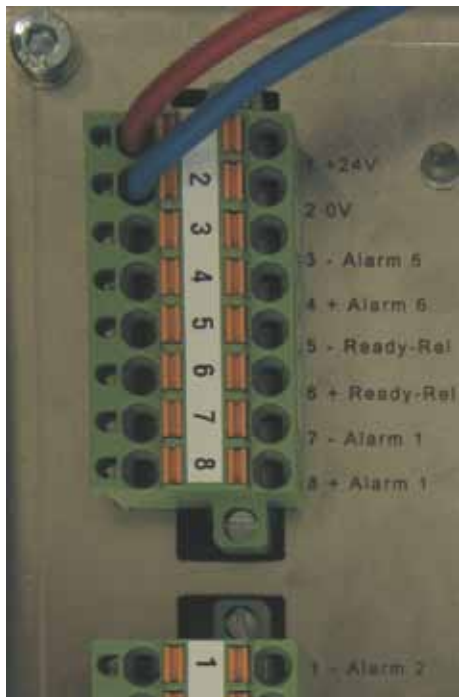
Fig. 84: Spring on naked screen

6. Make sure all cables (Fig. 84/1) are placed correctly and the spring (Fig. 84/3) is in contact with the naked screen (Fig. 84/6).
7. Connect the conductors to the respective connector according to chapters 6.3.11.1 to 6.3.11.2.
8. Close the Indication unit and tighten the screws (Fig. 83/1).



Installation, fixing and commissioning

6.3.11.1 Connecting the power supply



The power supply is connected to the connector X11 (Fig. 81/1).

1. Connect the conductors of the power supply according to Fig. 85. For details refer to the respective terminal diagrams.

Slot	Marking	Conductor colour
1	+24 V	depends on yard connection
2	0 V	depends on yard connection

Fig. 85: Connecting power supply



6.3.11.2 Connecting the bus cable from the Line Converter box

n Type of cable: LT2004D0

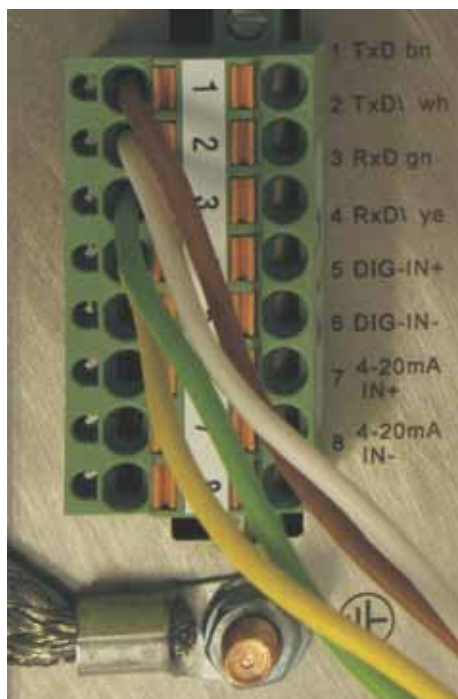


Fig. 86: Connecting bus cable

1. Connect the conductors of the bus cable according to Fig. 86. For details refer to the respective terminal diagrams.

Slot	Marking	Conductor colour
1	TxD	brown
2	TxD\	white
3	RxD	green
4	RxD\	yellow



Installation, fixing and commissioning

6.3.11.3 Connecting the engine alarm and engine safety system

The Indication unit delivers the alarm contacts potentially free.

Connect the respective conductors according to the following table and Fig. 87.



Fig. 87: View about the connectors

Slot	Marking	Connection
X11/3	– Alarm 6	– Relay 6/H ₂ O main-alarm**/N. O.
X11/4	+ Alarm 6	+ Relay 6/H ₂ O main-alarm**/N. O.
X11/5	– Ready-Rel	– Ready Relay*/N. C.
X11/6	+ Ready-Rel	+ Ready Relay*/N. C.
X11/7	– Alarm 1	– Relay 1/bearing wear alarm*/N. O.
X11/8	+ Alarm 1	+ Relay 1/bearing wear alarm*/N. O.
X12/1	– Alarm 2	– Relay 2/bearing wear slow down**/N. O.
X12/2	+ Alarm 2	+ Relay 2/bearing wear slow down**/N. O.
X12/3	– Alarm 3	– Relay 3/Main bearing temperature alarm*/N. O.
X12/4	+ Alarm 3	+ Relay 3/Main bearing temperature alarm*/N. O.
X12/5	– Alarm 4	– Relay 4/ Main bearing temperature slow down **/N. O.
X12/6	+ Alarm 4	+ Relay 4/ Main bearing temperature slow down **/N. O.
X12/7	– Alarm 5	– Relay 5/ H ₂ O pre-alarm */N. O.
X12/8	+ Alarm 5	+ Relay 5/ H ₂ O pre-alarm */N. O.

- connection to engine alarm system

** connection to engine safety system



NOTE!

Wirebreak resistors to be mounted in parallel with relay contacts at X11, X12 according to suppliers requirements for alarm and safety system.



Installation, fixing and commissioning

6.3.11.4 Other connectors

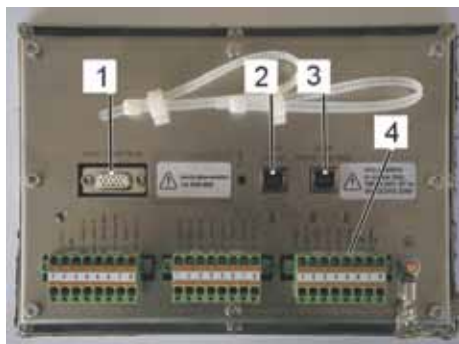


Fig. 88: View about the connectors

1. User – Interface

special service connector for temporary connecting the handheld terminal.

2. USB Serial

USB-interface for connection of any PC (PC not included in scope of supply)



NOTE!

Only windows 2000 or XP operating system.

At connection the WINDOWS-device manager creates a COM-port. Please insert 115200 bps/8/N/1

real time output of sensor measuring data.

reception is possible with software like hyper-terminal direct from the WINDOWS operating system or with software LagMon from Dr. E. Horn

3. USB Mass Storage

USB-interface for connection of any PC (PC not included in scope of supply)



NOTE!

Only windows 2000 or XP operating system.

access to the internal memory card with WINDOWS-EXPLORER. It is possible to record the data of the memory card at any PC (PC not included in scope of supply)



NOTE!

Access to the internal memory card only at engine standstill!



Installation, fixing and commissioning

4. X 13 pin 5 ... 8

- X13-5 - 24 VDC for binary contactor "Diesel engine rotation backwards" (maneuvering)
- X13-6 - binary input for "backwards-signal" from contactor or 24 V-logic
- X13-7 - analogue input 4 – 20 mA (+) for engine load signal
- X13-8 - analogue input 4 – 20 mA (-) for engine load signal



6.4 Checks

There are a few checks that have to be carried out before commissioning.

Checking connections

- n Make sure that all sensors are connected correctly inside the engine in line with the ID numbers for 4 to 14 cylinder engines mentioned in the Annex.
- n Recheck all power connections between Terminal box(es) and Line Converter box for correct connection. Obey the colour code.
- n Recheck the bus connections between Terminal box(es) and Line Converter box for correct connection. Obey the colour code.
- n Recheck the bus connections between Line Converter box and Indication unit in the engine control room for correct connection. Obey the colour code.
- n Check if all GND connections at Terminal box(es), Line Converter box and Indication unit are mounted with the copper mash bands to the units.
- n Measure the voltage foreseen to be used to make sure that 24 V DC are not mixed up with 115/230 V AC or vice versa.
- n Recheck polarity.

Checking function

1. Open the Line Converter box and switch on power supply by closing the power switch.
2. Open the Terminal box(es) and check if the green LED is lit at all busy connectors.

Checking relays

It is possible to release the ready-relay and the alarm-relays with the push button "TEST" at the backside of the MDA312-2 (see 1 at Fig. 89)

After pressing the push button "TEST" at the backside of the MDA312... for min. 5 seconds the following action starts:

- 1.) all pre-alarms are activated for some seconds (i.e. the relays 1, 3, 5 are set)
- 2.) the pre-alarm relays are deactivated (i.e. the relays 1, 3, 5 are cleared) and the main-alarms are activated for approx. some seconds (i.e. the relays 2, 4, 6 are set).
- 3.) Main-alarms are deactivated (i.e. the relays 2, 4, 6 are cleared) and the system error-alarm is activated (i.e. the ready-relay is set) for approx. some seconds
- 4.) system error-alarm is deactivated (i.e. the ready-relay is cleared)



Installation, fixing and commissioning



Fig. 89: Test button MDA312-2



NOTICE!

Malfunction through dirty sensors!

When a cable is displaced from a sensor it might get polluted by dirt and particles.

Therefore:

- Always place the foreseen cap onto the sensor cable and the sensor itself.

Preparing transport of an incomplete delivered engine

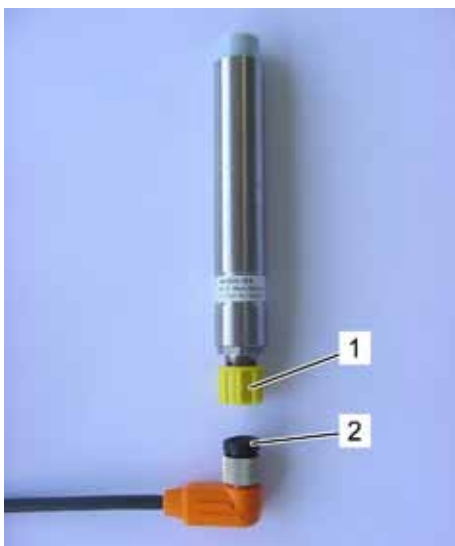


Fig. 90: Caps

When an engine is delivered in parts and not as a whole to the shipyard, the following works have to be carried out:

1. Open the Line Converter box and switch off the power supply.
2. Mark the sensor cable allowing a clear identification at reassembling which cable belongs to which sensor, left or right hand side.
3. Loosen the sensor cable from the sensor and place a cap on the sensor cable (Fig. 90/2) as well as another one on the sensor (Fig. 90/1) itself.



NOTE!

The caps are part of Dr. E. Horn's delivery.

4. Coil up the sensor cables and secure them in the engine bed plate.

After transport of an incomplete

1. Remove the caps from sensor and sensor cable and connect



Installation, fixing and commissioning

delivered engine

them according to the marking.

2. Check the sensor brackets for damages. Replace them if necessary.
3. Open the Terminal box(es) and the Line Converter box.
4. When all sensors are connected switch on the power supply at the power switch.
5. Open the crankcase doors.
6. Check all LED in Terminal and Line Converter box for lighting.
7. If all LED are on close the crankcase door, the Terminal box(es) and the Line Converter box.

6.5 Commissioning

The crossheads are closing down nearer to the distance sensors at the moment of inertia with increasing speed. This has to be compensated by differed values that have to be stored in the system.

Please use only chapter 4 of document "User Interface Manual" DK0002208 to carry out the required procedure.

The systems alarms are active, after the first speed point is covered. After completion of all three speeds, the system will proceed into self learning mode for the next 500 engine running hours. During this period the fine calibration curve will be built.



NOTE!

The commissioning of the BDMS/BTMS is so far always necessary to start up the system. Although the system protects the engine already after the first speed point is covered, it is necessary to record 3 interpolation values to start the so called "learning phase".

The proof for the start of the 500 hours learning phase must be provided to the Dr. E. Horn GmbH!



Operation

7 Operation

7.1 Safety

Personal protective equipment

During operation no special protective equipment has to be worn.

Improper operation



WARNING!

Risk of injury due to improper operation!

Improper operation can result in severe personal injuries or material damage.

Therefore:

- Perform all the operating steps in accordance with the information in this operator's manual.
- Ensure that all covers and safety devices are installed and in proper working condition before starting work.
- Never deactivate safety equipment during operation.
- Ensure tidiness and cleanliness in the working area. Loose components and tools lying around or on top of each other are sources of accidents.

7.2 Operating the Indication unit

If the system has been installed correctly all respective values subject to installed components can be monitored. All values are displayed on the Indication unit (Fig. 91).

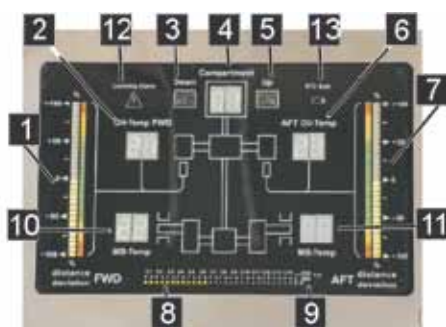


Fig. 91: Indication unit, full configuration

- 1 Distance deviation measured by FWD distance sensor
 - 2 splash oil temperature at FWD distance sensor
 - 3 Optical button "Down"
 - 4 Compartment number
 - 5 Optical button "Up"
 - 6 splash oil temperature at AFT distance sensor
 - 7 Distance deviation measured by AFT distance sensor
 - 8 LED indicating the number of installed distance sensors
 - 9 LED indicating installed H₂O sensor
 - 10 Main bearing splash temperature
 - 11 Main bearing splash temperature
 - 12 Learning alarm
 - 13 Real-Time-clock battery level low
1. Use the optical buttons "Up" (Fig. 91/2) and "Down" (Fig. 91/4) to scroll through the different compartments.
 2. Check all values with regard to what is expected.

Distance deviation

The distance measured by the distance sensors is displayed with respect to the value that was built during learning mode just after



system installation.

Oil temperature

The splash oil temperature is measured by the distance sensors as well. The respective temperature is presented as absolute value for each side of a compartment (Fig. 91/1 and Fig. 91/5).



NOTE!

The temperature of the splash oil near a distance sensor is measured with a tolerance of ± 2 °C.

Main bearing temperature (optional)

The temperature of the main bearings (Fig. 91/7 and Fig. 91/10) will be displayed when the engine has been started and the load increases.



NOTE!

When operating normally the temperature has to rise up close to or above the lube oil temperature.

Sensor status

The LED row Fig. 91/8 indicate installed distance sensors for every compartment:

green – normal, no alarm

red – alarm limit exceeded

dark – sensor not installed or sensor not working or sensor connection not working.

The two LEDs Fig. 91/9 show the installed water-in-oil sensor:

both LEDs green – normal, no alarm

PAV-LED red – Pre-alarm

both LEDs red – Main-alarm

both LEDs dark – sensor not installed or sensor not working or sensor connection not working.

Learning alarm

In learning mode the system first is sampling 1000 sensor measurement values at each speed point, corresponding to 1000 engine revolutions. An average – so called reference value – is calculated from the 1000 samples. The sampling of such reference values will, however, be continued for totally 500 hours of engine operation. In this period, the average at each speed point is recalculated every 50 hours based on available samples. If any further reference value at any speed point is changing by 0.2mm or more (compared to the first obtained valid value based on 1000 samples) the “Learning Alarm” is indicated.



Operation



CAUTION!

Risk of bearing damage

If "Learning Alarm" is indicated, possibly bearing wear is going on. The system cannot release "normal alarm" in every case, because it is adjusting in some way to the changing distance measurement values during learning mode

RTC Batt.

Battery lifetime is 10 years minimum. Red light indicates low level. Then the battery has to be changed to avoid loss of Real-Time-Clock, if system power will be switched off. A new battery has to be ordered from the supplier. For changing the MDA312 has to be opened at the backside. Setting of Real-Time-Clock is described in Chapter 7 of document "User Interface Manual" DK002208.



7.3 Testing a water-in-oil-sensor

Personal

- n Sensor must only be tested by qualified personnel.

Personal protective equipment

Wear the following personal protective equipment when entering the compartment:

- n Protective clothing
- n Safety boots
- n Safety gloves
- n Hard hat
- n Safety belt if it is necessary to bridge big heights



WARNING!

Danger of injury caused by oil under pressure!

In case of defective lines or machine parts oil may escape under pressure. This can cause severe injuries.

Therefore:

- Do not open pipelines under pressure.
- Depressurize pipelines before starting any work.
- Have defective parts repaired.



Fig. 92: Alarm indication on sensor cap

1. Depressurize the oil pipe.
2. Disconnect the sensor and remove it from the pipe.
3. Connect the sensor to the plug again.
4. Press and hold the black button (Fig. 92/1) on the sensor cap.
 - Ä An alarm should be indicated on the sensor cap (Fig. 92/2) and on the Indication unit (Fig. 93/1) within the next ten seconds.

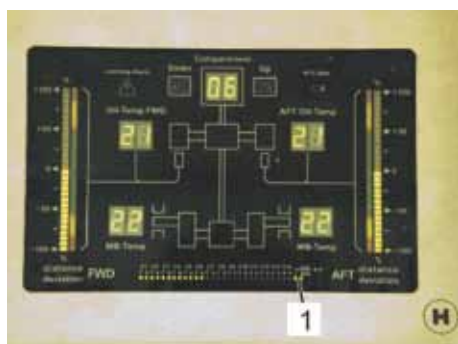


Fig. 93: Alarm indication on Indication unit



Maintenance

8 Maintenance

8.1 Safety

Personnel

- n The maintenance work described here cannot be executed by the operator unless otherwise indicated.
- n Some maintenance tasks can only be executed by trained qualified personnel, or only by the manufacturer. In these cases this is separately indicated in the description of the specific maintenance tasks.
- n All work on the electrical equipment should only be executed by a qualified electrician.

Personal protective equipment

Wear the following personal protective equipment at all maintenance work:

- n Protective clothing
- n Safety boots
- n Hard hat
- n Safety belt if it is necessary to bridge big heights



NOTE!

Other personal protective equipment that has to be worn at particular work will be mentioned in the warning notices in this chapter.

Electrical system



DANGER!

Electric power poses a fatal risk!

Contact with live parts may prove fatal. When switched on, electric components may be subject to uncontrolled movements and may cause very serious injury.

Therefore:

- Switch off the power supply before starting maintenance work, and make sure that it cannot be switched on accidentally.



Engine



WARNING!

Danger to life caused by engine in progress!

Starting the engine while working on or inside of it may cause very serious injury or even lead to death.

Therefore:

- Switch off the engine before performing any maintenance work and make sure that it cannot be switched on accidentally.

Securing against switching on



DANGER!

Danger to life caused by uncontrolled switching on again!

There is a risk of the electric power supply or the engine being switched on again when performing maintenance work. This imposes danger to the life of persons in the danger zone.

Therefore:

- Before starting work, switch off all power supplies and secure against switching on again.



WARNING!

Injury hazard posed by improperly executed maintenance work!

Improper maintenance can cause severe injury or property damage.

Therefore:

- Prior to starting work ensure that there is sufficient assembly space.
- Ensure order and cleanliness at the assembly site! Loose parts and tools, parts and tools placed on top of each other are hazard sources.
- If components have been removed, ensure that they are properly mounted; re-install all mounting elements and comply with all screw tightening torque specifications.

Environmental Protection

Comply with the following environmental protection instructions when performing maintenance work:

- n Wipe any emerging, used or excessive grease off all lubrication points that need to be manually supplied with lubricant, and dispose of in compliance with local regulations.



Maintenance

- n Catch exchanged oil in suitable containers and dispose of in compliance with locally valid regulations.

8.2 Maintenance schedule

Maintenance tasks that are required for optimum and trouble-free operation are described in the sections below.

If increased wear is detected at regular inspections then the required maintenance intervals must be shortened by the customer to correspond with the actual signs of wear.

Contact the manufacturer for questions on maintenance work, see the service address on page 2.

Interval	Maintenance work	Proceeded by
At every opening of the crankcase door	Visually check the distance sensors and the cabling for damages. The LED must be lit.	Qualified personnel
	Visually check the main bearing sensors (if installed) and the cabling concerning being glued.	Qualified personnel
	Visually check the water-in-oil sensor (if installed). LED must be flashing.	Qualified personnel
Annually	Check all the cabling being laid for damages. Have them repaired or replaced immediately.	Professional electrician



8.3 Maintenance tasks

8.3.1 Changing distance sensors

- n Maintenance work must only be carried out by qualified personnel.
- n Also use chapter 5 and 6 of document "User Interface Manual" DK002208.
- n Additionally required protective equipment:
 - | Hard hat
 - | Safety belt
 - | Safety boots
 - | Protective gloves

**NOTE!**

When a distance sensor is defective, the respective LED on the Indication unit will not be lit anymore. Distance sensors cannot be repaired, they have to be changed.

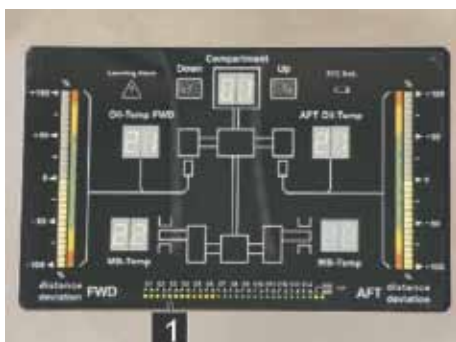


Fig. 94: Indicating a defective sensor

The LED C3 (Fig. 94/1) in the lower range of the Indication unit is off. The respective sensor is defective and has to be changed.

1. Order a new sensor from Dr. E. Horn.

**NOTE!**

We recommend taking our special tools for changing sensors (Fig. 95/1) to have fewer complications with the exchange. The tools will be part of the hardware delivery.



Fig. 95: Special tool for all sensor brackets

- n Required tools:
 - | Special tools for changing defective sensors:
- 1. Special tool for changing a distance sensor for all sensor bracket

**NOTE!**

Before changing a sensor, the spare sensor has to provide with the cylinder-dependent ID. Please see the pages 9 – 12 in Handheld User Manual (DK002208) for changing the sensor ID.



Maintenance

Changing a sensor in a tube type sensor bracket

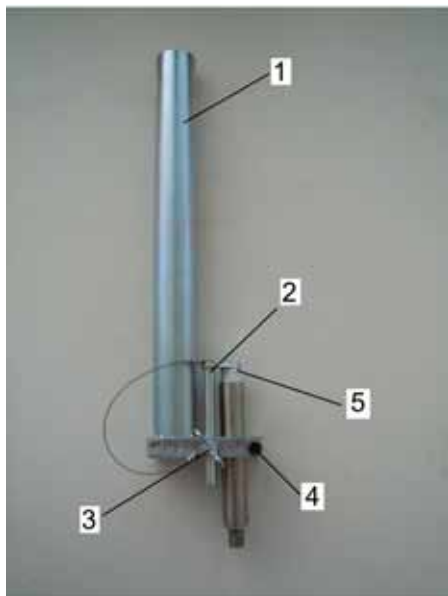


Fig. 96: Tube type sensor bracket with tool

1. Stop engine and secure it against accidental restart (ð see Operating Instructions of the engine manufacturer).
2. Turn engine, so that the crosshead is away from the sensor which has to be change and working under the crosshead is possible (ð see Operating Instructions of the engine manufacturer).
3. Place the tool (Fig. 96/2 ,101/2) into the foreseen hole of the sensor bracket (Fig. 96/1,101/1).
4. Slide down the tool, until it rests on the sensor tip (Fig. 96/5, 101/5).
5. Fix the tool by using the thumbscrew (Fig. 96/3,101/3).
6. Make sure that the tool is still in contact with the sensor (Fig. 96/5, 101/5).
7. Disconnect the cable of the sensor.
8. Loosen the clamping bolt of the sensor (Fig. 96/4,101/4) and remove the sensor.
9. Insert a new sensor and make sure that it is in contact with the contact plate of the tool (Fig. 96/5,101/5).
10. Check the connector of the new sensor for correct placement.
11. Tighten the clamping bolt (Fig.100/4,101/4) with a torque moment of 16 Nm.
12. Connect the sensor cable.
13. Remove the clamping bolt (Fig. 96/3,101/3) and remove the tool (Fig. 96/2,101/2).



NOTE!

Further adjustments are not necessary.

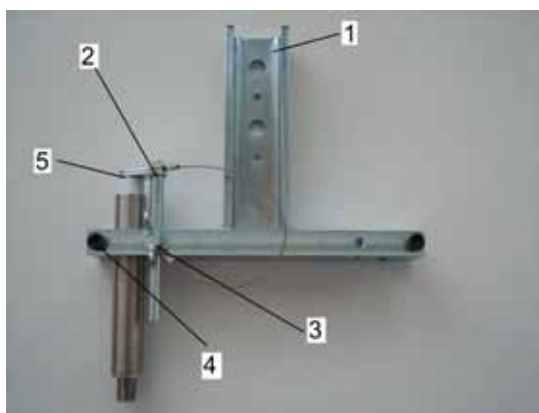


Fig. 97: Profile type sensor bracket with tool



8.3.2 Inspecting a main bearing after production test run

- n Maintenance work must only be carried out by qualified personnel.
- n Additionally required protective equipment:
 - | Hard hat
 - | Safety belt
 - | Safety boots
 - | Protective gloves

If a main bearing has to be inspected because of classification request it has to be opened. Follow this routine:

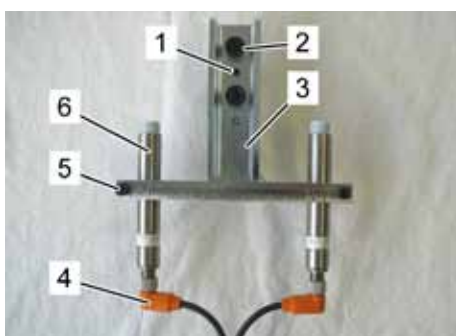


Fig. 98: Sensor bracket with sensors

1. Disconnect the sensor cables (Fig. 98/4) in the compartment where the inspection has to be made.
2. Leave sensors (Fig. 98/6) in their position and do not open the clamping bolts (Fig. 98/5).



NOTE!

When the clamping bolts get opened the sensors have to be arranged anew.

3. Remove the fastening bolts (Fig. 98/2) of the sensor brackets.
4. Use on small brackets a large screwdriver and place it between the A-frame and the sensor bracket to separate the sensor brackets from the alignment pins (Fig. 98/1). On larger brackets please use the threaded hole, insert a threaded bolt and press the bracket from the A-frame screwing the bolt down.
5. Remove the threaded bolt and place the sensor brackets with the sensors in a secure place.
6. Inspect the main bearing and reassemble it.
7. Place the sensor bracket (Fig. 98/3) onto the alignment pins (Fig. 98/1).
8. Insert the fastening bolts (Fig. 98/2) with new NordLock® discs and tighten them with the correct torque moment (ð see chapter 8.4).



NOTE!

According to the engine manufacturer MAN B&W never more than just one sensor per cylinder compartment should be removed.



Maintenance

8.4 Screw tightening torques

Component	Dimension	Value	Unit
Single sensor bracket, tube type	M10	70	Nm
	M12	120	Nm
Double sensor type, profile type	M8	35	Nm
	M10	50	Nm
Sensor clamping screw, all brackets	M6	16	Nm
Bolts for Terminal and Line Converter box	M8	16	Nm
Ground screw	M6	6	Nm

8.5 Measures after maintenance

Perform the following steps after completing maintenance and before switching on the machine:

1. Check all previously loosened screw connections for a tight fit.
2. Check whether all previously removed protective devices and covers are properly installed again.
3. Make sure that all tools, materials and other equipment used were removed again from the work area.
4. Clean up work area and remove any substances left over, such as fluids, processing material or the like.
5. Make sure that all safety features on the machine are fully functional.



9 Troubleshooting

The following chapter describes possible causes of faults and the steps required to eliminate them.

In the event of frequent faults, reduce the maintenance intervals to correspond to the actual working load.

In the event of faults that cannot be eliminated through the following instructions, please contact the manufacturer (service address on page 2).

9.1 Safety

Personnel

- n All troubleshooting work on the electrical system must be performed by a qualified electrician.

Personal protective equipment

Wear the following personal protective equipment at all troubleshooting work:

- n Protective clothing
- n Safety boots
- n Protective gloves
- n Hard hat
- n Safety belt if it is necessary to bridge big heights



NOTE!

Other personal protective equipment that has to be worn at particular work will be mentioned in the warning notices in this chapter.

Electrical System



DANGER! Electrocution hazard!

An electrocution hazard is posed by contact with live components. Switched on electrical components can execute uncontrolled movements and cause serious injuries.

Consequently:

- Prior to starting work, switch off the supply of electricity and ensure that it cannot be switched on again.



Troubleshooting

Engine



WARNING!

Danger to life caused by engine in progress!

Starting the engine while working on or inside of it may cause very serious injury or even lead to death.

Therefore:

- Switch off the engine before performing any maintenance work and make sure that it cannot be switched on accidentally.

Securing against switching on



DANGER!

Danger to life caused by uncontrolled switching on again!

There is a risk of the electric power supply or the engine being switched on again when performing maintenance work. This imposes danger to the life of persons in the danger zone.

Therefore:

- Before starting work, switch off all power supplies and secure against switching on again.



WARNING!

Unauthorized troubleshooting procedures can result in injury!

Improper troubleshooting procedures can result in severe personal injury or material damage.

Therefore:

- Prior to beginning installation, ensure that there is sufficient space to work.
- Make sure that the assembly location is clean and well organized. Components that are loosely stacked or lying around can cause accidents.
- If components have been removed, ensure proper assembly, install all mounting elements and comply with screw tightening torques.



In case of faults:

The following general rules apply:

1. In the event of faults that pose immediate danger to man or machine, activate the emergency shutoff function immediately.
2. Determine cause of fault.
3. If elimination of the fault requires working in the danger zone, switch off unit and secure against being switched on again.
4. Immediately inform the person in charge at the equipment location of the fault.
5. Depending on the type of fault, eliminate the fault or have it eliminated by an authorized specialist.



NOTE!

The chapter "Troubleshooting" below provides information on who is authorised to eliminate the fault.



Troubleshooting

9.2 Troubleshooting chart


NOTE!

If the display unit MDA312... does not start, switch of the power supply (24V) for at least 1 minute. Then switch on the power supply (24V) again.

Trouble	Possible reason	Troubleshooting	Chapter
Indication unit is connected but not illuminated.	No electrical connection existing.	Check the status of the LED on the back.	9.3.1
		Check the fuse.	9.3.2
Indication unit is illuminated but bargraphs or temperature windows are flashing.	Bus cable is not connected.	Check the bus cable.	9.3.2
	Power switch in the Line Converter box is open.	Close power switch in the Line Converter box.	9.3.2
Distance sensor in the lower row of the display is missing.	Distance sensor is not connected.	Check connection of the sensor in Terminal box.	9.3.3
Main bearing temperature for one sensor is missing when scrolling through the compartments.	Main bearing temperature sensor is not connected.	Check connection of the sensor in Terminal box.	9.3.4
A water-in-oil sensor is not indicated in the display.	Water-in-oil sensor is not connected.	Check connection of the sensor in Terminal box.	9.3.5
No function of the Terminal box.	Terminal box is not connected.	Check if Terminal box is connected.	9.3.6



9.3 Troubleshooting

9.3.1 Checking the electrical connection of the Indication unit

n Execution only by a qualified electrician.

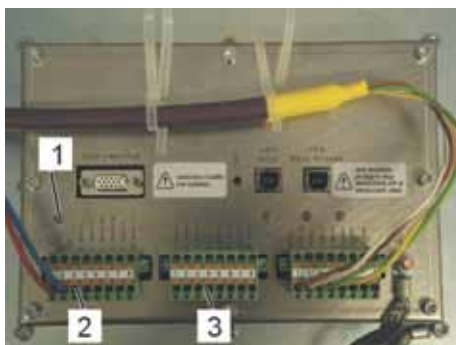


Fig. 99: Indication unit

1. Check if the LED (Fig. 99/1) on the back of the Indication unit is lighting.
2. If the LED is off measure the voltage at the connectors X11 (Fig. 99/2) and X12 (Fig. 99/3).



NOTE!

A voltage of 24 V DC is required.

9.3.2 Checking the bus cables of the Indication unit and power supply

n Execution only by a qualified electrician.

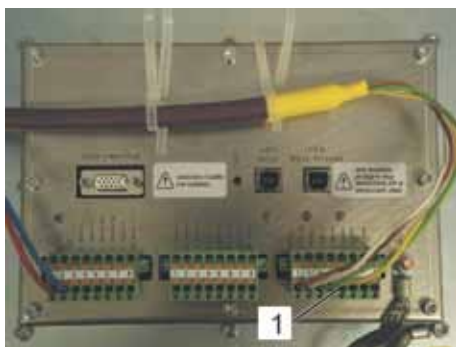


Fig. 100: Indication unit

1. Check the connection of the bus cables (Fig. 100/1) from X13/1 to X13/4 on the back of the Indication unit.

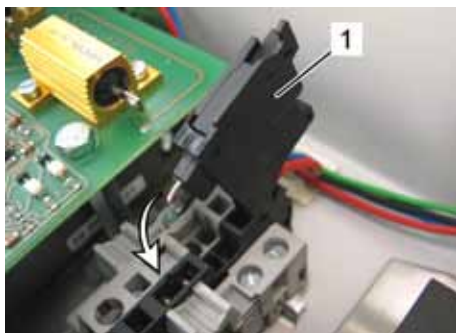


Fig. 101: Power switch

2. If the bus cables are connected correctly open the Line Converter box and check whether the power switch is closed or not.
3. If not so close the power switch (Fig. 101/1).
Ä The LED at the connectors X1, X2 and X3 (Fig. 102/1+2) must be on.



Troubleshooting

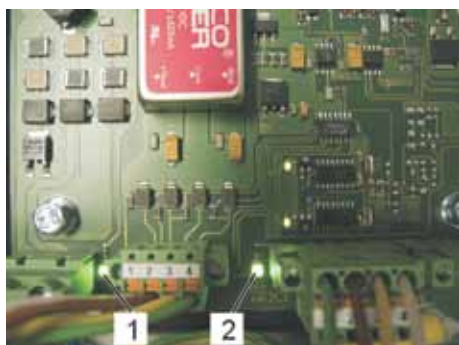


Fig. 102: LED on

4. If the LED are off check the voltage at the power switch. It must be 24 V DC.

If there is no voltage measurable:

5. Check the power supply at the next connection in ship's supply system.

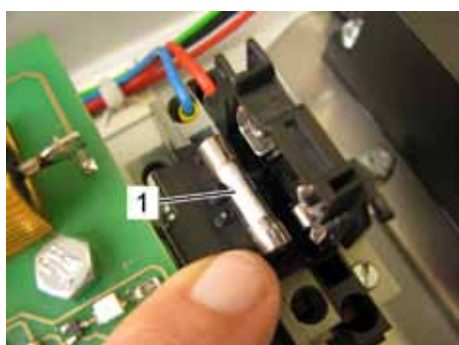


Fig. 103: Fuse

If there is voltage measurable:

6. Remove the fuse (Fig. 103/1) of the power switch handle and replace it by a new one.
 - └ AC supply voltage: 3.15 amperes delayed action, sand filled, size 5x20 mm
 - └ DC supply voltage: 6.3 amperes delayed action, sand filled, size 5x20 mm
 - Ä The LED must be on.

If there is still no power (green LED in Fig. 102 off) and there is no voltage measurable at the main supply inlet:

7. Check the main supply the BDMS/BTMS system in the ship supply distribution system.



Fig. 104: Bus LED

If there is power and the LED are on:

8. Check the bus connection at connector X2 inside the Line Converter box.
9. Remove the connector and replace it after 30 seconds.
 - Ä The two bus LED (Fig. 104/1+2) must flicker indicating bus operation.
10. If the two bus LED are constant on check the bus connection from Line Converter box to Indication unit for damages.
11. Have defective cables replaced by new one of the same type.



9.3.3 Checking distance sensors

n Execution only by a qualified electrician.

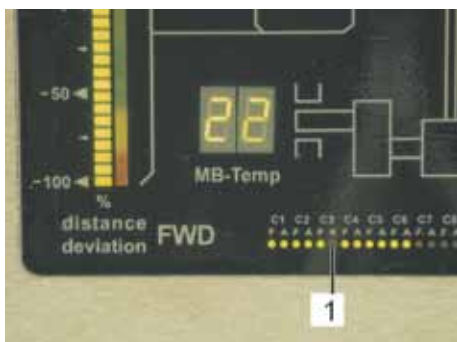


Fig. 105: Distance sensor missing

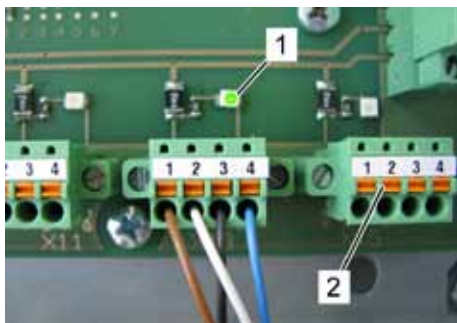


Fig. 106: Terminal box

1. Note: if the number of the distance sensor is not illustrated on the Indication unit (Fig. 105/1 means AFT sensor compartment 3)...

2. ...please open the Terminal box and check all connected terminals for the respective LED (Fig. 106/1) being on.
3. If a LED is off remove the respective connector (Fig. 106/2).
4. Replace the connector after 30 seconds.
Ä The LED (Fig. 106/1) must be on.

If the LED just lights up shortly:

5. Open the respective crank house door and disconnect the connector from the sensor.
6. Check the connector for damages.
7. Replace the connector if defective.
8. Connect the connector to the sensor.
9. Check the LED for lighting.
Ä If the LED is on the sensor works.
Ä If the LED just lights up shortly the sensor is defective and has to be replaced (see chapter 8.3.1).



Troubleshooting

9.3.4 Checking main bearing temperature sensor



NOTE!

Except at the coupling or coupling counter side (depending on the mode of installation of the main bearing temperature sensors) the main bearing temperature will be indicated only one time per main bearing. In the coupling or coupling counter side compartment only the main bearing temperature of the first and second respectively the last and the penultimate bearing will be indicated.

n Execution only by a qualified electrician.

1. Note the number of the cylinder (Fig. 107/1) and the position FWD (Fig. 107/3) and AFT (Fig. 107/2) respectively.

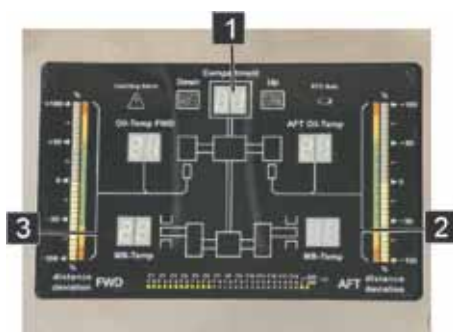


Fig. 107: Indication unit

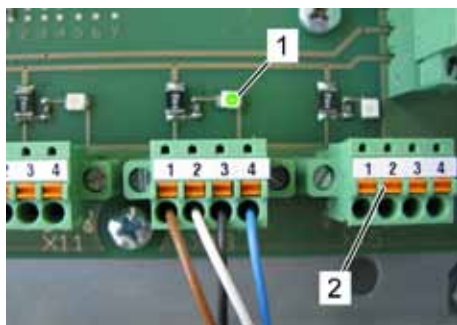


Fig. 108: Terminal box

2. Open the Terminal box and check all connected terminals for the respective LED (Fig. 108/1) being on.
3. If an LED is off remove the respective connector (Fig. 108/2).
4. Replace the connector after 30 seconds.
Ä The LED (Fig. 108/1) must be on.

If the LED just shortly lights up the cabling or the main bearing temperature sensor itself is defective.

5. Have the cabling repaired or the sensor changed.



9.3.5 Checking water-in-oil sensor

n Execution only by a qualified electrician.



Fig. 109: Water-in-oil sensor

1. Check on the sensor itself if the LED is flashing.
2. If the LED are off remove the connector and replace it again.
Ä LED must be flashing.

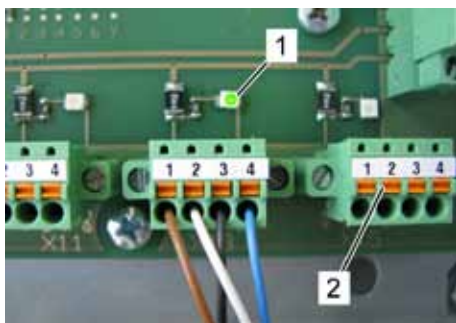


Fig. 110: Terminal box

If the LED are still off:

1. Open the Terminal box and check all connected terminals for the respective LED (Fig. 110/1) being on.
2. If a LED is off remove the respective connector (Fig. 110/2).
3. Replace the connector after 30 seconds.
Ä The LED (Fig. 110/1) must be on.

If the LED just lights up shortly:

4. Check the cabling of the water-in-oil sensor completely.
5. If the cabling is not defective replace the sensor.



Troubleshooting

9.3.6 Checking function of the Terminal box

n Execution only by a qualified electrician.

1. Open the Terminal box.
2. Check if the LED of all connected sensors are on (Fig. 111/1).

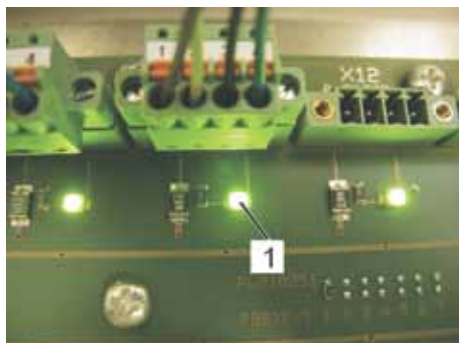


Fig. 111: Terminal box

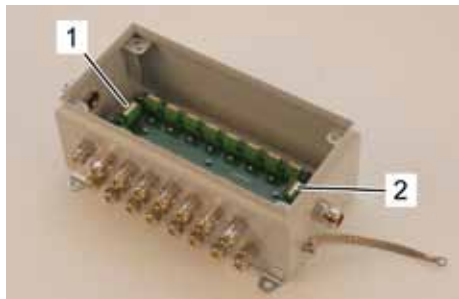


Fig. 112: Bus connection in Terminal box

If no LED is on:

3. Check X17 (Fig. 112/1) and X18 (Fig. 112/2) respectively for correct cabling and insertion of the leads.
4. Measure the voltage at the connectors X17/1, X17/4 and X18/1, X18/4 respectively.
 - Ä The voltage is 24 V DC.

If the voltage differs:

5. Open the Line Converter box.
6. Check if the LED is on (Fig. 113/1+2).
7. Check the connections at X3 and X4.
8. Measure the voltage at the connectors X3/1, X3/4 and X4/1, X4/4 respectively.

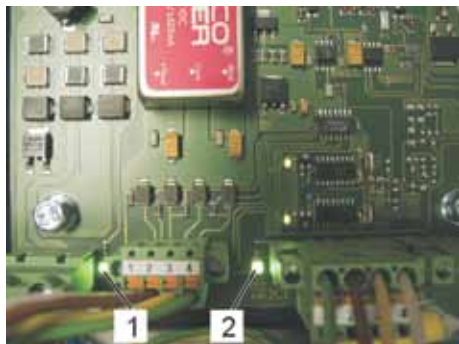


Fig. 113: Line Converter box

If voltage is present and LED are on:

9. Check the cabling between Line Converter box and Terminal box for damages.
10. Have defective cables replaced by identical cable types.



9.4 Startup after eliminating fault

After remedying the fault, the following steps should be taken to re-start the system:

1. Ensure that no one is in the danger zone.
2. Start up in accordance with the instructions in the “Installation” and “Operating” chapter.



Appendix

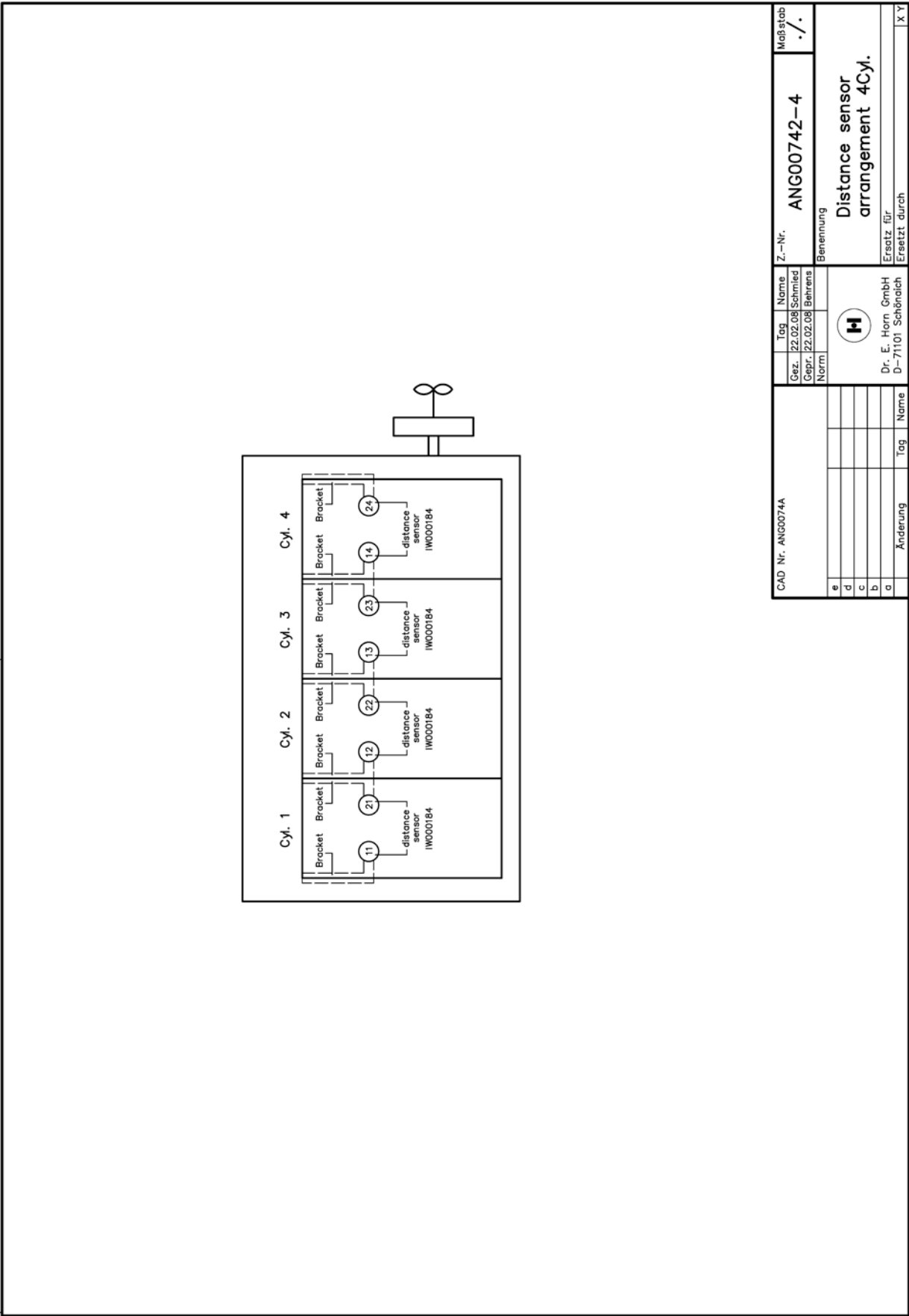
10 Appendix

10.1 Installation schemata for the distance sensors

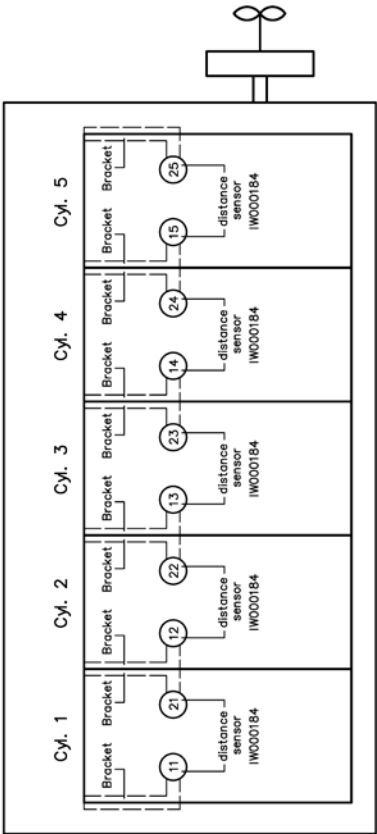
The following drawings show the installation schematics of distance sensors for engines with

- n 4 cylinders (ANG00742-4)
- n 5 cylinders (ANG00742-5)
- n 6 cylinders (ANG00742-6)
- n 7 cylinders (ANG00742-7)
- n 8 cylinders (ANG00742-8)
- n 9 cylinders (ANG00742-9)
- n 10 cylinders (ANG00742-10)
- n 11 cylinders (ANG00742-11)
- n 12 cylinders (ANG00742-12)
- n 14 cylinders (ANG00742-14)

Note: Cylinder counting is shown for MAN B&W engines only!



Appendix

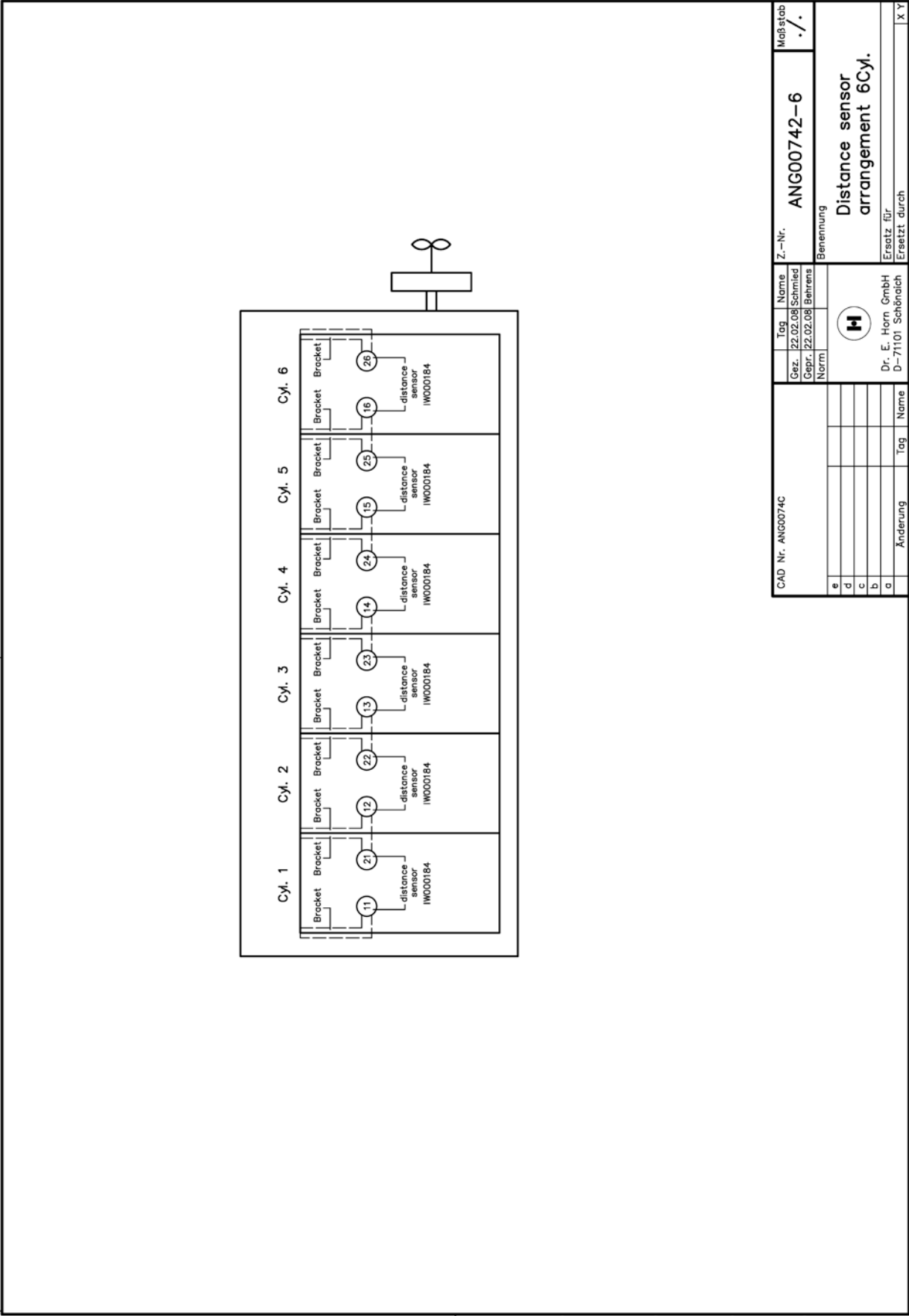


CAD Nr. ANG0074B		Tag	Name	Z.-Nr.	Maßstab
Gez.	22.02.08	Schmid		ANG00742-5	1:1
Gepr.	22.02.08	Behrens			
Norm					
		Benennung		Distance sensor arrangement 5Cyl.	
		Dr. E. Horn GmbH		Ersatz für	
		D-71101 Schönlach		Ersetzt durch	
		Änderung	Tag	Name	X Y
		a			
		b			
		c			
		d			
		e			

Diese Zeichnung ist unser Eigentum. Weitergabe ist unzulässig.

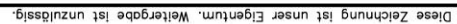


Appendix



Diese Zeichnung ist unser Eigentum. Weitergabe ist unzulässig.

22

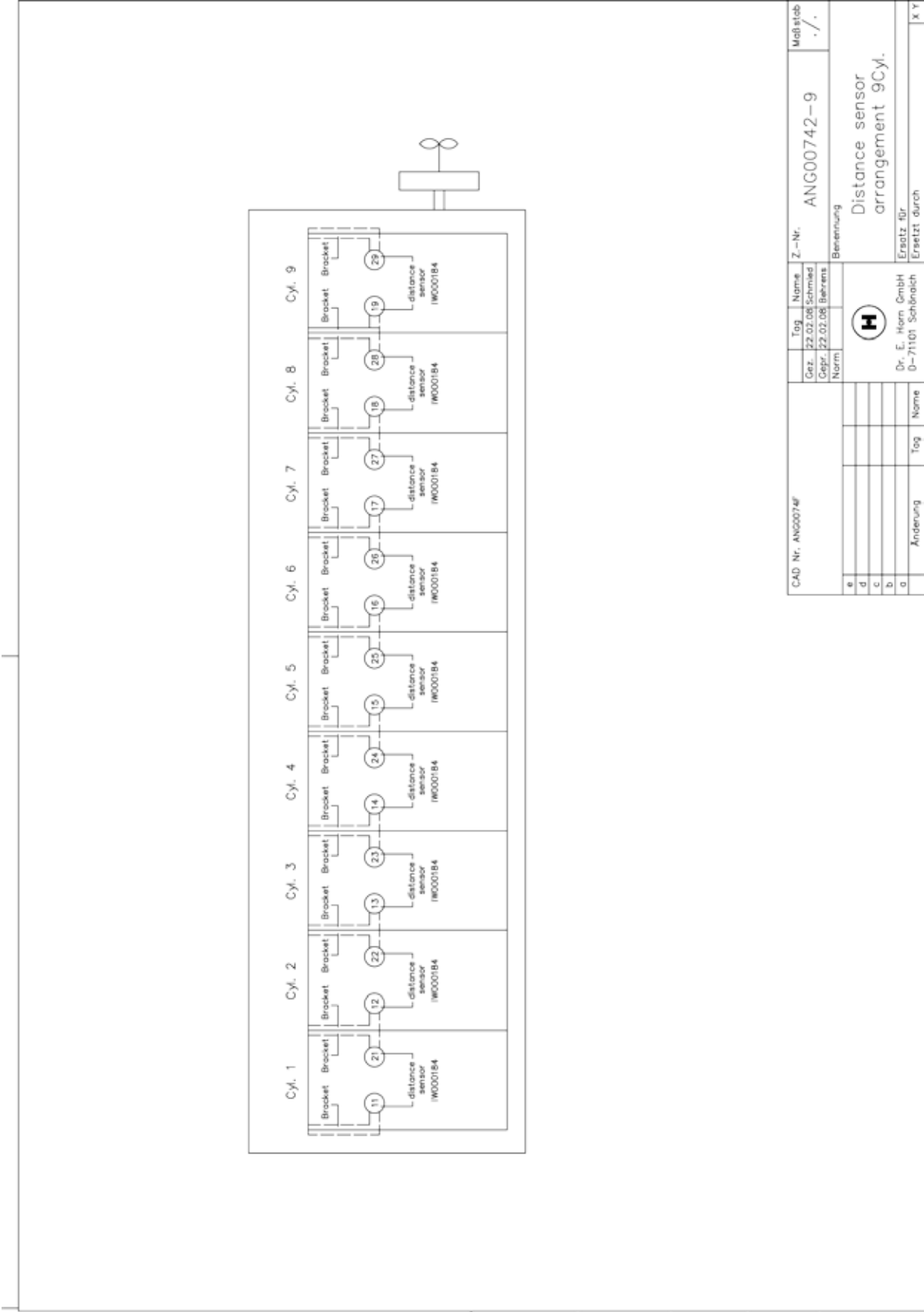
DK002262-Rev.9



DK002262-Rev.9



Appendix

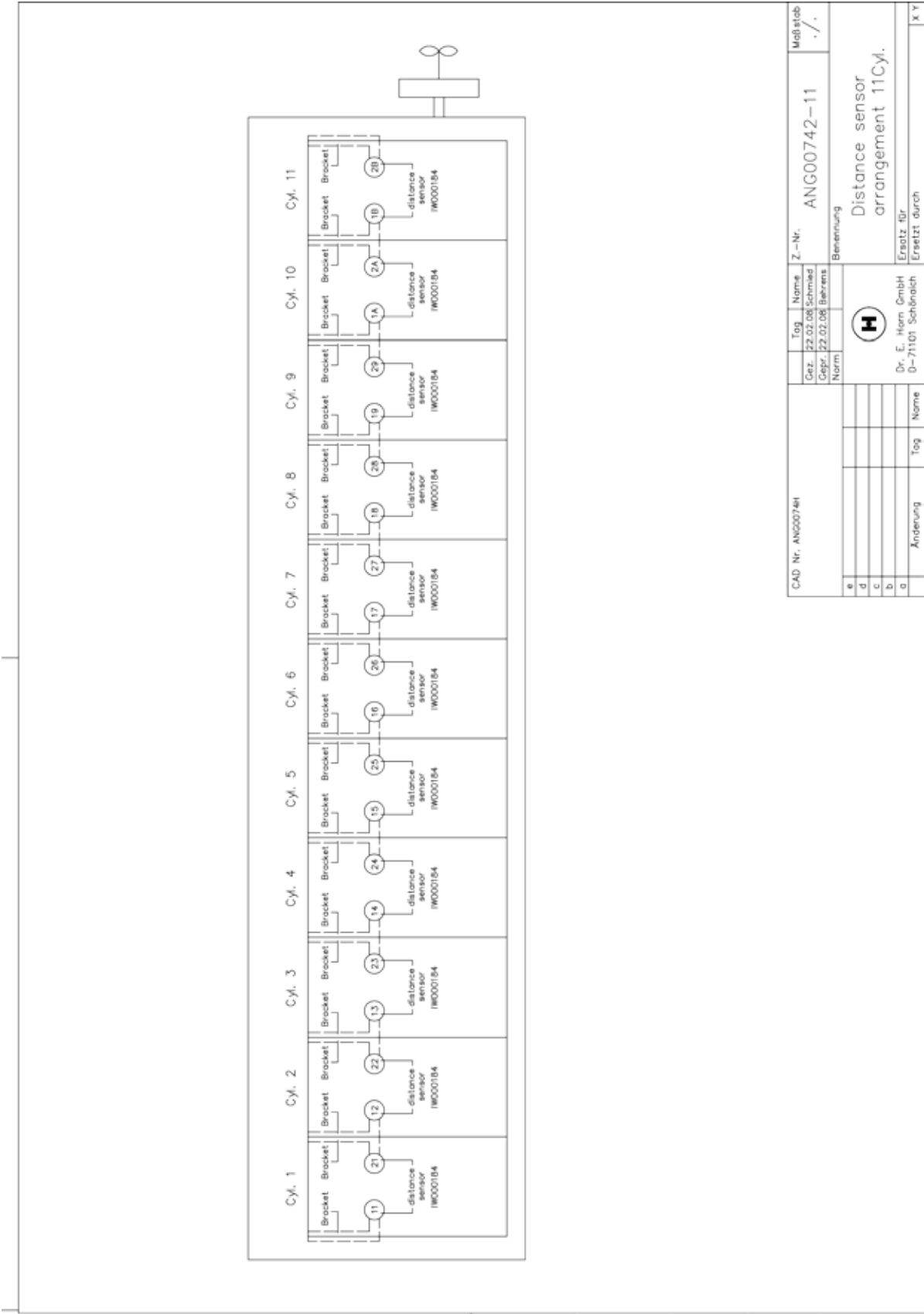




DK002262-Rev.9

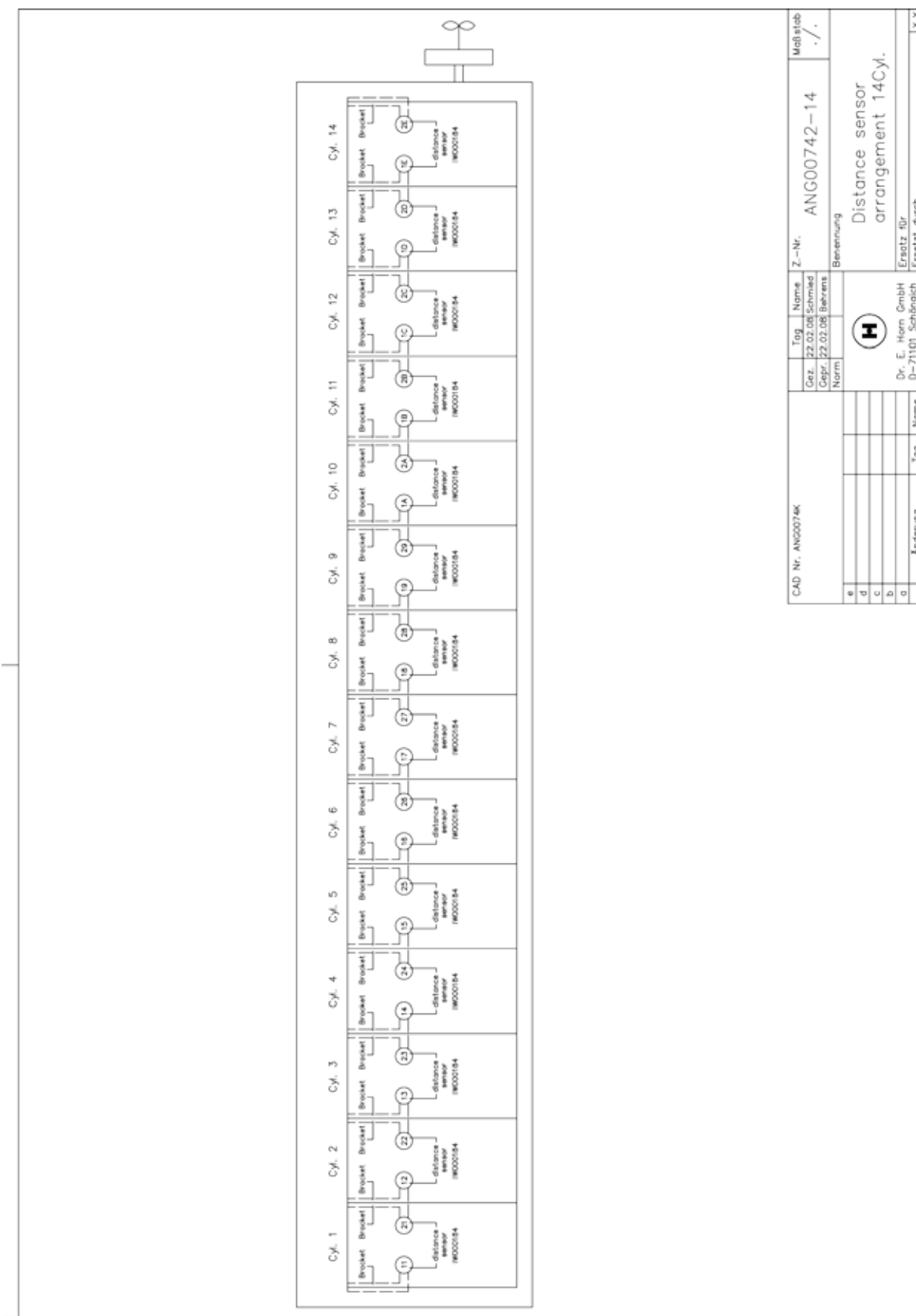


Appendix





DK002262-Rev.9



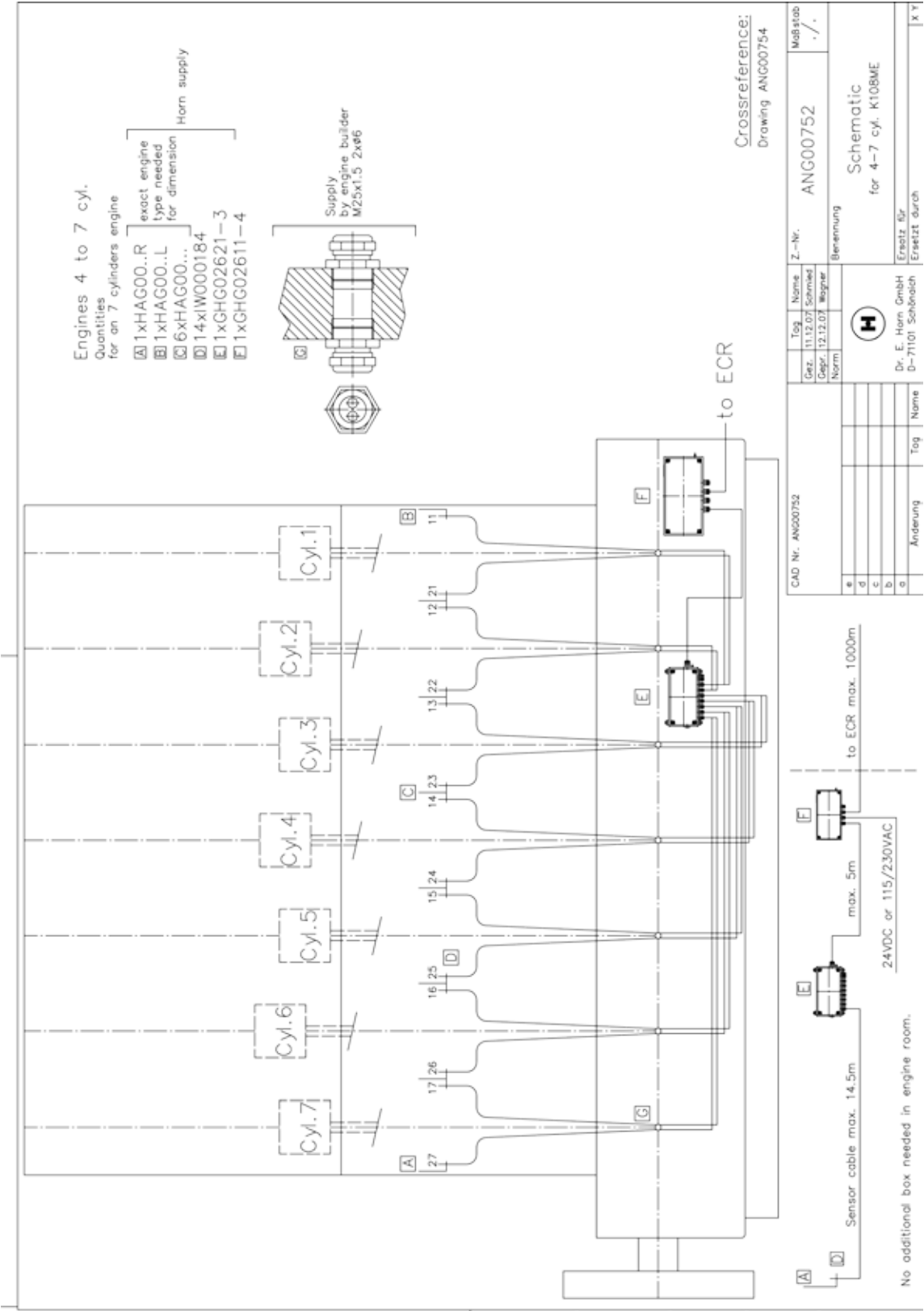
10.2 Counting of sensors

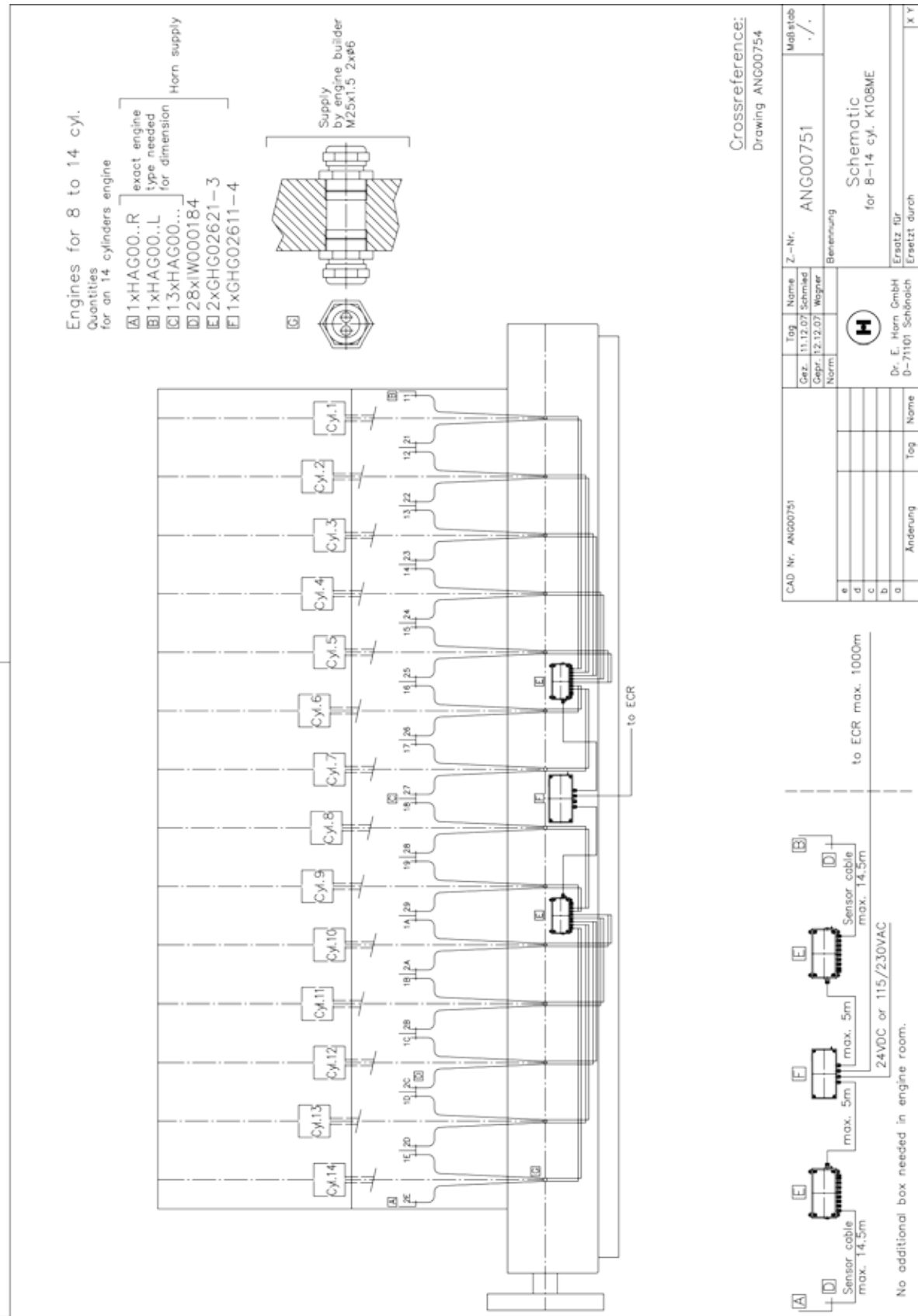
[illegible]



Appendix

10.3 System installation schemata







Index

11 Index

A	
Accident	21
Adhesive	19
Appendix	121
Assemblies.....	31
B	
Brackets	34
Brief description	30
C	
Cables.....	70
Checks	93
Commissioning	49, 96
Connection.....	41
Contact.....	10
Copyright.....	9
Customer Service	10
D	
Danger zones.....	21, 43
Distance sensor	31
Checking	116
E	
Ear defenders	16
Electric Current	16
Emissions.....	28
Environmental protection	22
F	
Fire	21
First Aid.....	21
H	
Hard hat	15
I	
Indication unit.....	39
Checking electrical connection.....	114
Connecting	85
Installation	84
Installation	49, 53
Preface	53
Schemata	121
schemata system	133
L	
Liability	9, 14
Lifting eyes	46
Line Converter box.....	38
Connecting	80
Installation	78
Lubricants.....	22
M	
Main bearing	
Inspection	108
Main bearing temperature sensor	33
Checking.....	117
Maintenance.....	102
Maintenance schedule	104
Maintenance tasks	105
N	
Noise	19
O	
Oil pressure.....	17
Operating elements.....	44
Operating materials.....	18
Operation	97
Overview	29
Owner.....	11
P	
Packing	45, 47
Personal protective equipment	15
Personnel	12
commissioning.....	49, 110
installation.....	49, 109
maintenance	101
Pneumatics	17



Preface	53	Tube type	34
Professional electrician.....	12	Sensors.....	31
Protective clothing	15	Testing	99
Protective equipment		Spare parts	10
Installation, fixing and commissioning	49	Storage	45, 48
Maintenance	102	Surfaces	
Operation	97	hot	20
Troubleshooting	110	Symbols	
Protective gloves	15	in this manual	8
Purpose	14	T	
Q		Technical data	23
Qualified personnel.....	12	Terminal box	37
R		Checking	118
Risk of fire.....	18	Connecting	74
S		Installation	73
Safety		Transport.....	45, 46
general	11	Crane.....	46, 47
Safety belt.....	15	Forklift truck.....	47
Safety boots.....	15	Inspection	46
Screw tightening torques.....	109	Troubleshooting.....	110, 114
Sensor		Chart.....	113
Changing.....	105	U	
Connecting.....	77	Use.....	14
Counting.....	132	V	
Distance	31	Vibrations	18
Main bearing temperature	33	W	
Water-in-oil.....	32	Warranty	10
Sensor brackets.....	34	Water-in-oil sensor.....	32
Installation.....	55	Checking	118
Profile type	35	Work zones	43

文件说明 Document Remarks		机 型 Eng. Type		CMD-MAN-B&W 6G60ME-C9.5		
		台 份 Set No.				
		工程编号 Engine No.				
		船 厂 Shipyard		NTS		
		船 号 Hull No.		0311113/14/15/16/17/18/19/20		
		船级社 Classification Society		ABS		
CMD-MAN B&W 6G60ME-C MK9.5 BEARING WEAR MONITOR + MAIN BEARING TEMPERATURE+ WIO E-14 轴承磨损+主轴承温度+油中水						
						5
						4
						3
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修 改 说 明 Corrected Description						
						5
						4
						3
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						1
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 上海中船三井造船柴油机有限公司 CSSC-MES Diesel Co., Ltd.				文件编号 Document No.	D6519912-9.	

Bearing Monitoring System

BDTMS

– APPROVAL DRAWING – DK005659

Revision: 00, 14.03.2017

Project name:

POR NO.:

Shipyard: CMD

Ship owner:

Engine no:

Hull no:

Propeller type: FPP

Engine type: 6G60ME-C9.5

Horn Part no.:

Order confirmation:

© Dr. E. Horn GmbH & Co. KG
Sensors - Monitoring – Systems
Im Vogelsang 1
D- 71101 Schoenaich

Tel: +49 (0)7031 6302-0
Fax: +49 (0)7031 6302-99
Email: info@dr-horn.org
Internet: www.dr-horn.org

Content:

1.	General	3
2.	Scope of supply	4
3.	Spare parts	8
4.	Tools	10
5.	Drawings of engine mounted equipment - Inside of engine.....	11
5.1	Distance sensor IW000184.....	11
5.2	Temperature sensor TGL00921	11
5.3	Schematics for fixing grip magnets	12
5.4	Cable glands	12
5.5	EMC Cable gland assembly for connection at Terminal box GHG02621-3	13
6.	Drawings of engine mounted equipment - Outside of engine.....	14
6.1	Terminal box GHG02621-3 and connection plan	14
6.2	Water in Oil sensor FRG00032-6_AW	16
6.3	Installation of Water in Oil sensor.....	16
6.4	Mounting bracket with boxes BLG00403	17
6.5	Line converter box GHG02611-4	18
6.6	Connection plan for line converter box GHG002611-4.....	19
6.7	Connection wiring diagram	21
6.8	Principle installation drawing	22
6.9	Position of GHG02611-4, GHG02621-3 incl. mounting bracket.....	23
6.10	Distance and temperature sensor arrangement.....	24
6.11	Mounting of temperature sensor TGL00921	25
7.	ECR – Engine control room equipment	26
7.1	Indication unit MDA3123013-2 – BDTMS	26
7.2	Connection plan for indication unit MDA 312.....	27
7.3	Connection User Interface to indication unit MDA 312... ..	29
8.	Wiring diagram	30
8.1	System BDTMS.....	30
9.	Appendix for brackets	

1. General

Engine Mounted Equipment (inside of engine)

1. Distance sensors type IW000184 with flying cables type KSG03252-15 including connectors.
2. Brackets type HAG00... suitable for above specified engine, incl. mounting material.
3. Temperature sensor TGL00921 with cable.
4. Cable fixing by use of magnetic cable clips type ZUG00441 (see drwg. ANG00834)
5. Cable glands.

Engine Mounted Equipment (outside of engine)

1. Connection box type GHG02621-3. line converter box type GHG02611-4 mounted on BLG00403 including cables and cable glands to connect sensors and cable glands to line converter box with indication unit type MDA312.... in the engine control room (ECR).
2. Water in oil sensor type FRG00032-6_AW including 15m cable, shall be mounted behind the lube oil pump. (see drwg. ANG00508 and ANG00662).

ECR-Engine Control Room Equipment

1. 1 pc. Indication unit MDA 312... for installation in control panel.
2. 1 pc. User interface type EV314013 with connection cable.

Wiring Diagram

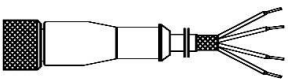
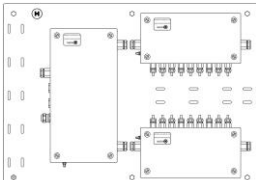
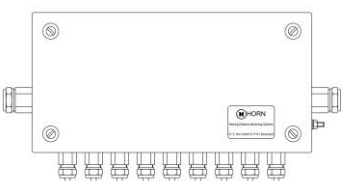
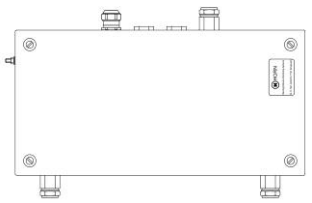
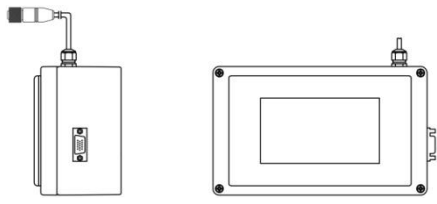
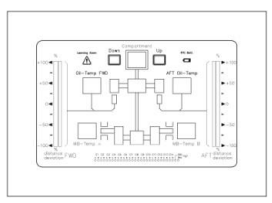
1. Wiring diagram for terminal box and line converter box (ANG0075B).
2. Wiring diagram for terminal box, line converter box and indication unit in the ECR (see drwg. ANG00508).
3. Example schematic of distance and temperatur sensor arrangement for 6 cylinders on engine (see drwg. ANG01301) and sensor placement in the engine (see drwg. ANG00742-6).

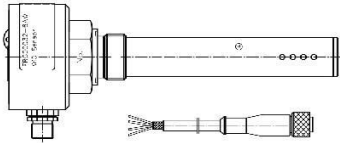
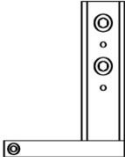
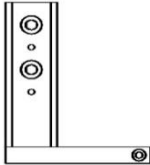
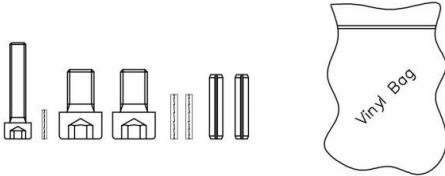
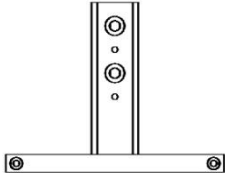
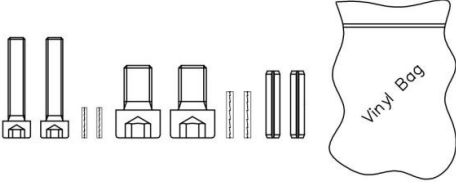
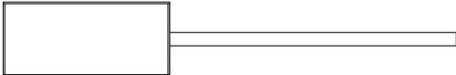
Cable

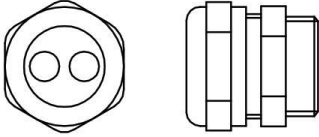
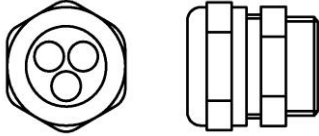
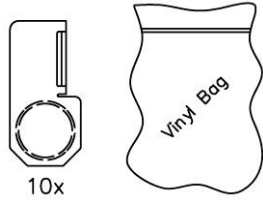
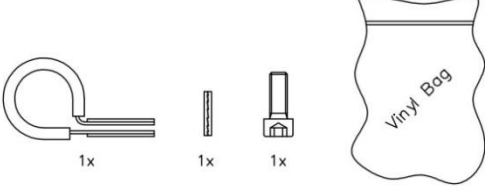
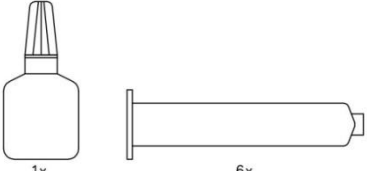
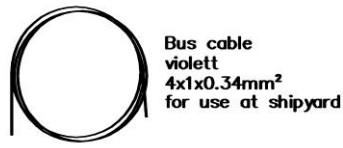
100m bus cable type LT2004D0 for connection of Line converter box and Indication unit MDA312... .

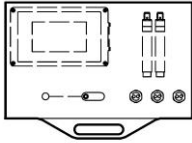
Modifications with similar function are subject to change.

2. Scope of supply

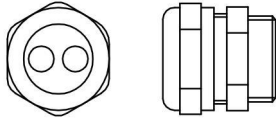
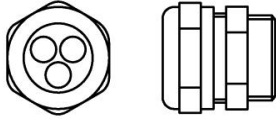
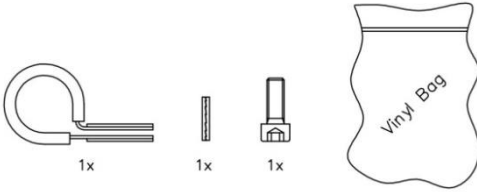
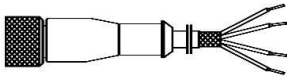
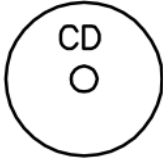
01	Distance sensor		IW000184	12	Engine side
02	Connector with cable 15m		KSG03252-15	12	Needed for IW000184 Engine side
03	Mounting bracket with boxes		BLG00403	01	Engine side
04	Terminal box		GHG02621-3	02	Mounted on BLG0040. Engine side
05	Line converter box		GHG02611-4 24VDC	01	Mounted on BLG0040. Engine side
06	User interface with cable		EV314013	01	ECR
07	Indication unit BDTMS		MDA 3123013-2	01	ECR
No	Name	Sketch	Order No.	Qty	Remark

08	Water in Oil sensor cable 15m		FRG00032-6_AW	01	Engine side
09	Bracket angled, left side	 fly wheel side	HAG00581-L	01	Engine side
10	Bracket angled, right side	 counter side	HAG00581-R	01	Engine side
11	Accessory (Brackets angled)		ZUG00422	02	Need for HAG00...-L HAG00...-R Engine side
12	Bracket middle position		HAG00581	05	Engine side
13	Accessory (Brackets angled)		ZUG00421	05	Need for HAG00... Engine side
14	Temperature sensor		TGL00921	07	Engine side
No	Name	Sketch	Order No.	Qty	Remark

15	Cable gland		KV000481	04	Engine side
16	Cable gland		KV000483	10	Engine side
17	Grip Magnet		ZUG00441	10	Engine side
18	Gland plate with screw		ZUG00425	07	Engine side
19	Fixation glue for ZUG000441 TGL00921		ZUG00451	02	Engine side
20	Bus cable, violet, 4x1x0.34mm ²		LT2004D0	100 m	Engine side; For use at shipyard
21	Cable, grey, multi core, 6x2x0.5mm ²		LT2012D0	10 m	ECR; for connection to AMS / safety system
22	Cable tie		CL000024	70	Engine side
No	Name	Sketch	Order No.	Qty	Remark

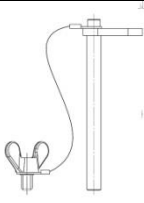
23	Spare part case		TAG00071-1	01	Spare part
24					
25					
26					
27					
28					
29					
No	Name	Sketch	Order No.	Qty	Remark

3. Spare parts

01	Cable gland M20x1,5		KV000481	02	Spare part
02	Cable gland M20x1,5		KV000483	02	Spare part
03	Gland plate with screw		ZUG00425	02	Spare part
04	Temperature sensor		TGL00921	01	Spare part
05	Distance sensor		IW000184	02	Spare part
06	Connector with cable 15m		KSG03252-15	02	Spare part need for IW000184
07	Document- ation		DK002262	01	ECR
No	Name	Sketch	Order No.	qty	Remark

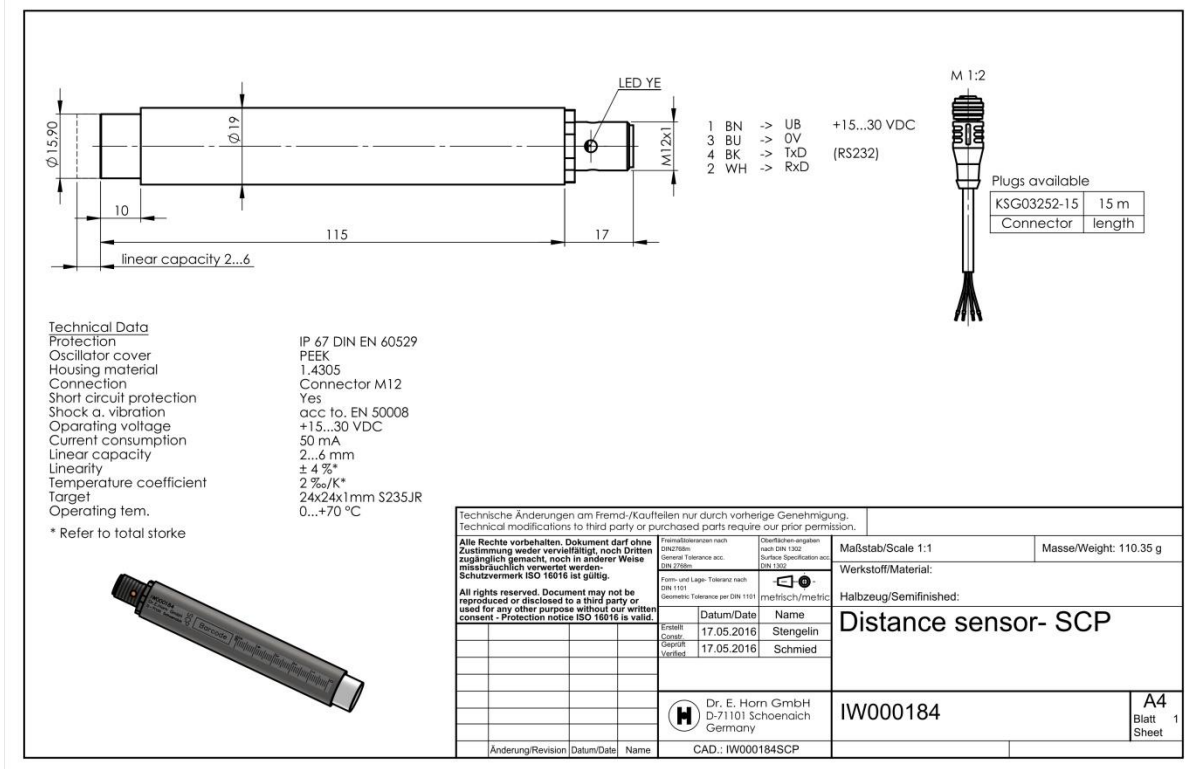
08	Glass fuse 3.15A, slow	 	ZUG00453	01	Spare part
09					
10					
11					
12					
13					
14					
No	Name	Sketch	Order No.	Qty	Remarks

4. Tools

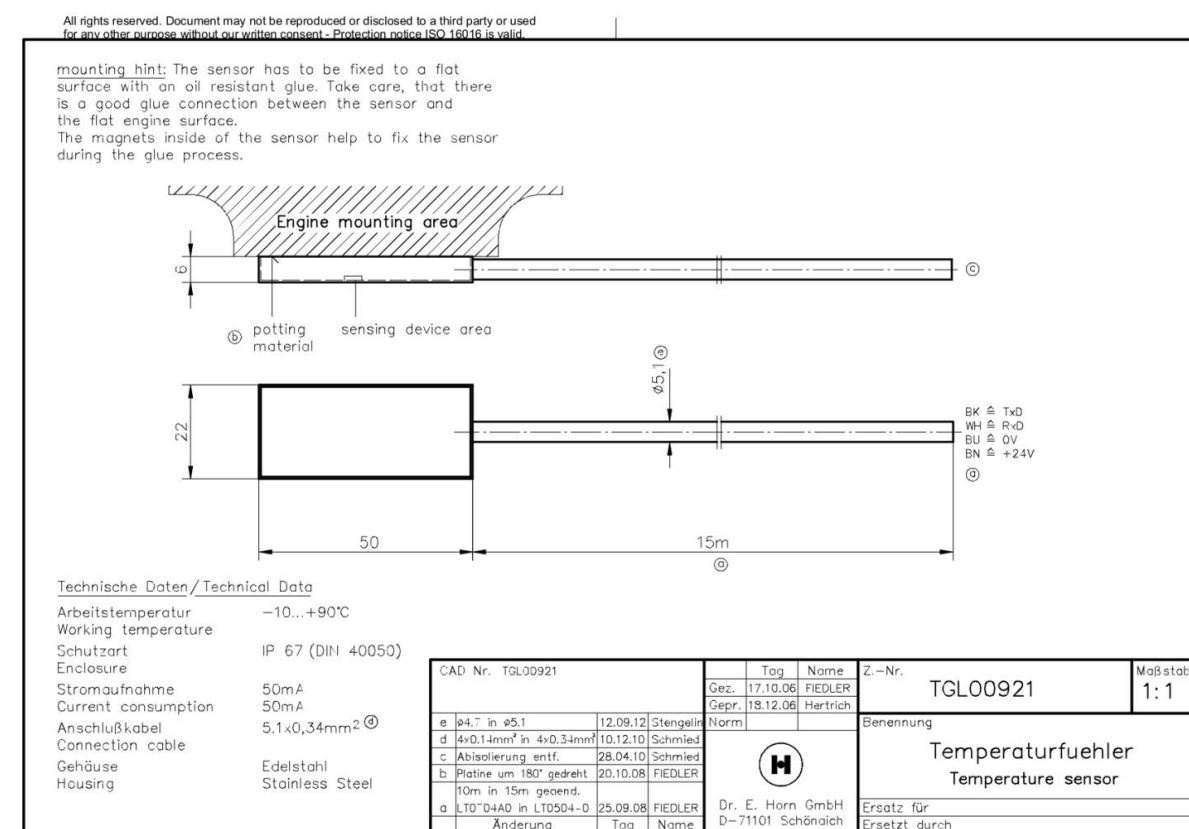
01	Distance tool		EM001040	01	
02	Sensor removal tool		SRT00103	01	
03					
04					
05					
06					
07					
No	Name	Sketch	Order No.	Qty	Remarks

5. Drawings of engine mounted equipment - Inside of engine

5.1 Distance sensor IW000184

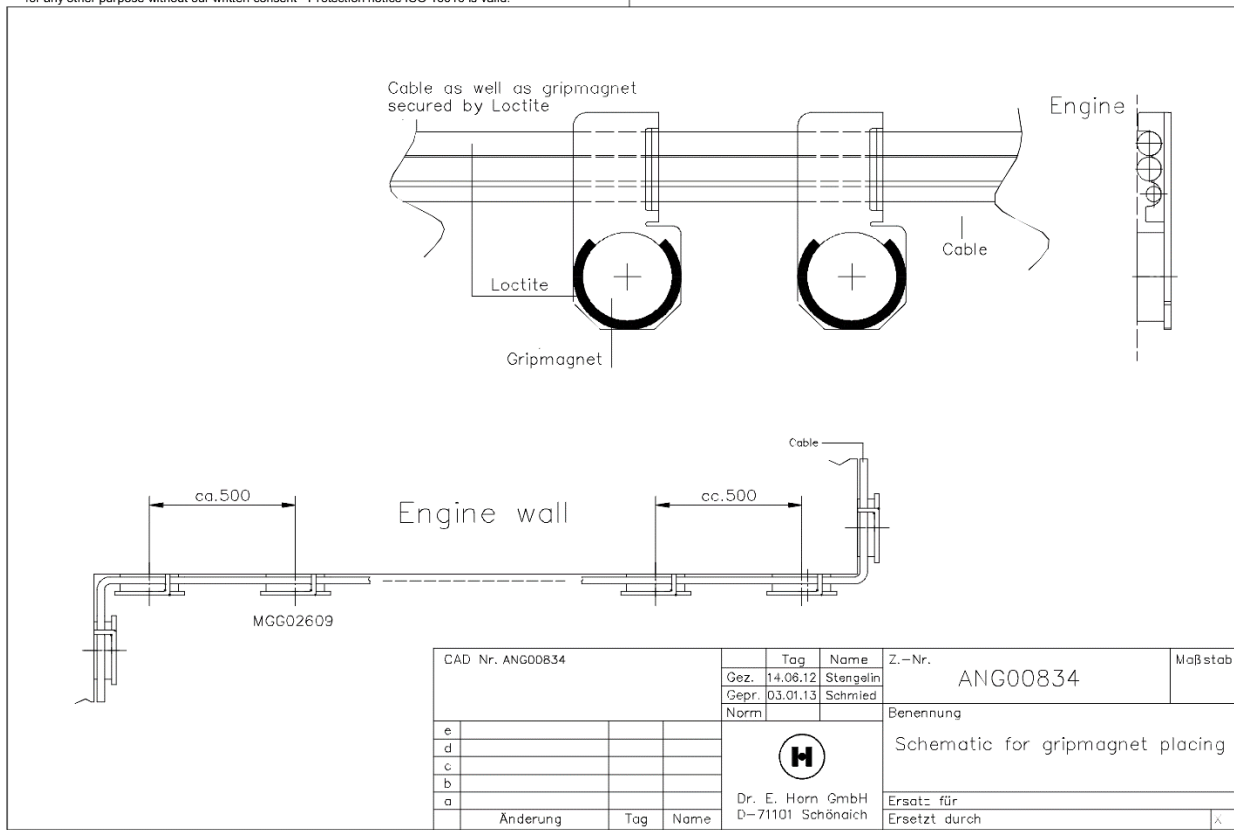


5.2 Temperature sensor TGL00921



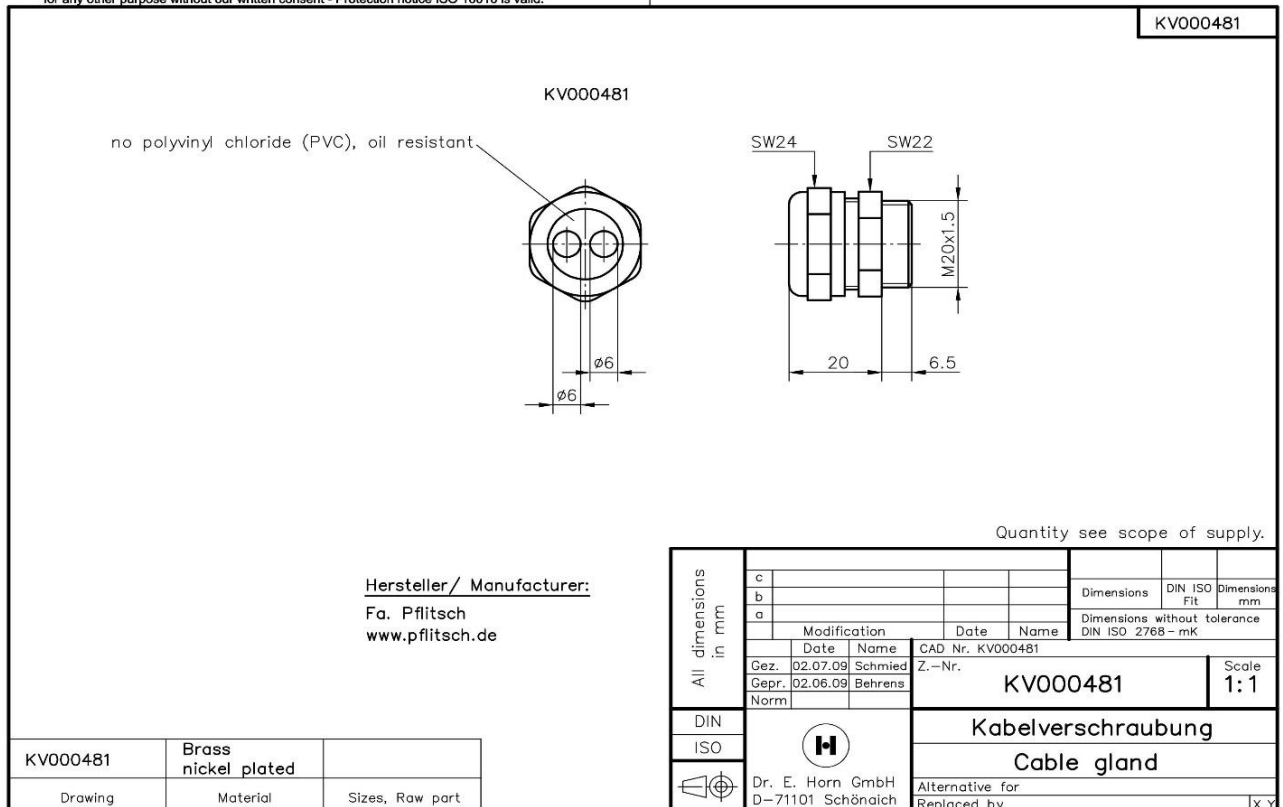
5.3 Schematics for fixing grip magnets

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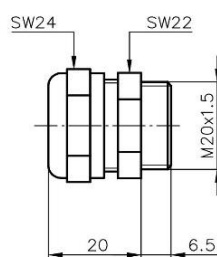


5.4 Cable glands

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no polyvinyl chloride (PVC), oil resistant.

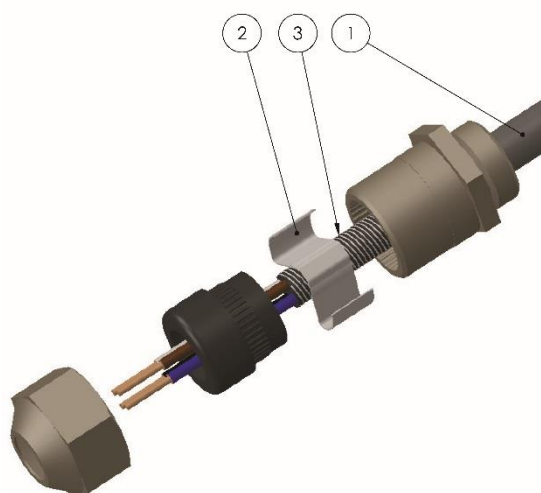


core drill diameter 18.5
Quantity see scope of supply.

KV000483	Brass nickel plated	
Drawing	Material	Sizes, Row part

All dimensions in mm										
	c						Dimensions	DIN ISO Fit	Dimension mm	
	b									
	a						Dimensions without tolerance DIN ISO 2768 - mK			
		Modification		Date	Name					
	Date	Name		CAD Nr. KV000483						
	Gez.	10.12.10	Schmied	Z.-Nr.					KV000483	Scale 1:1
	Gep.r.	10.12.10	Dr.Bernier							
	Norm									
DIN				Kabelverschraubung						
ISO				Cable gland						
				Alternative for						
					Replaced by					x
Dr. E. Horn GmbH D-71101 Schönaich										

5.5 EMC Cable gland assembly for connection at Terminal box GHG02621-3



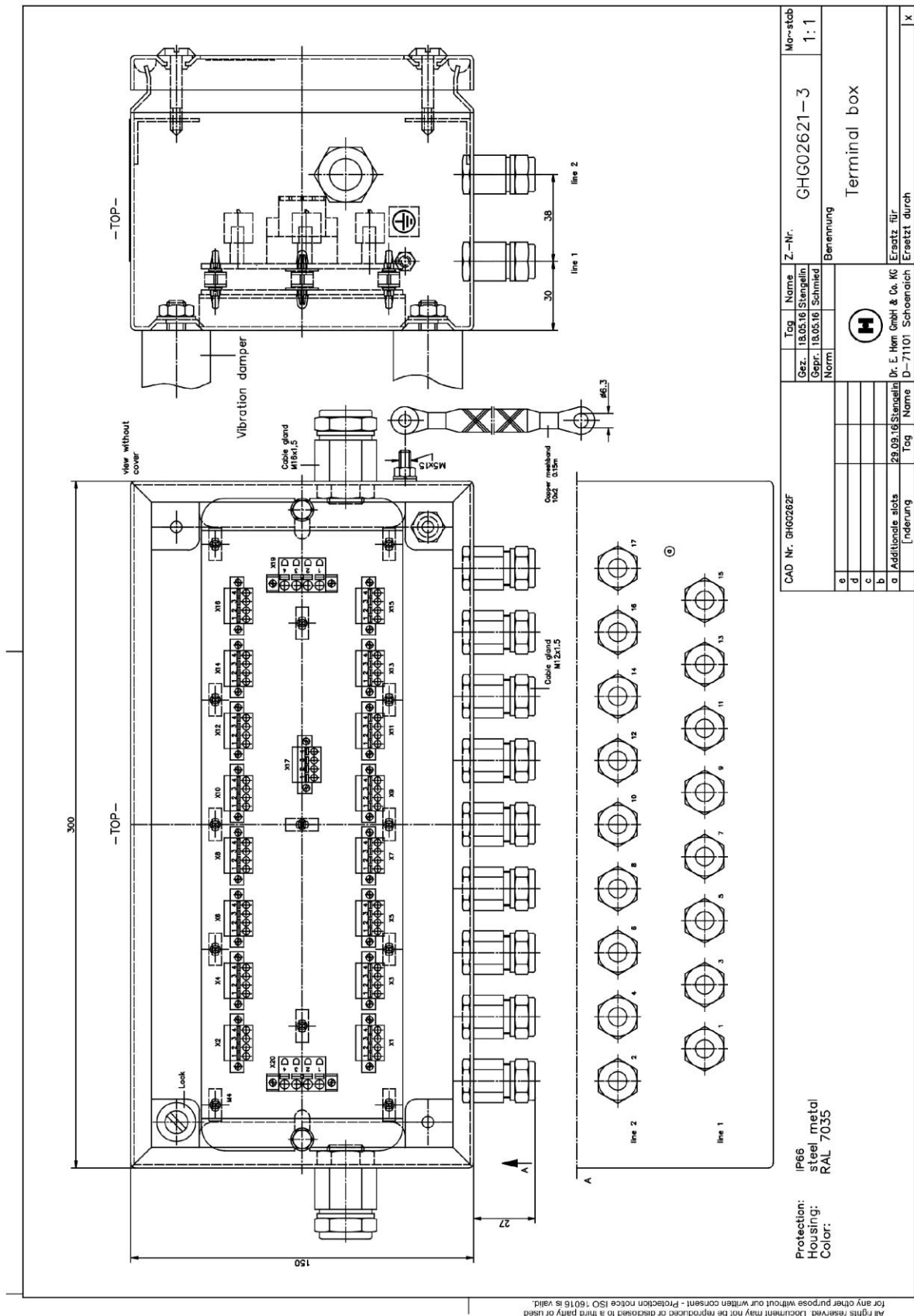
EMC shield should contact the dismantled cable screen:

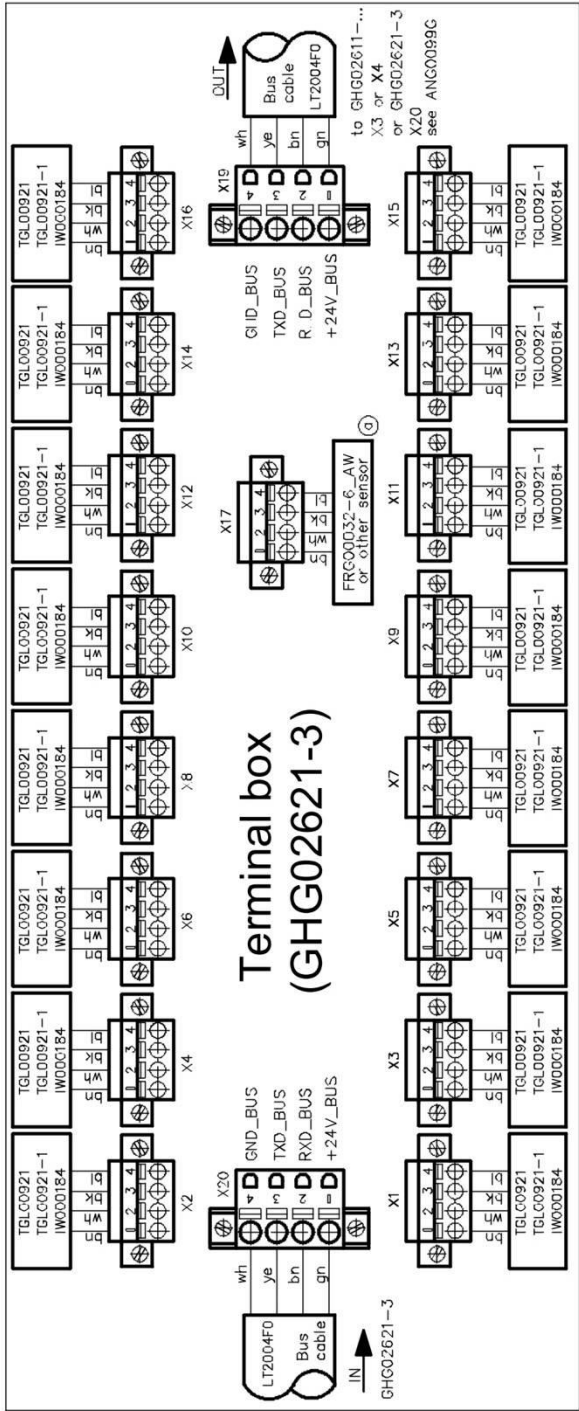
- 1.** Make sure all cables (1) are placed correctly and the spring (2) is in contact with the dismantled screen (3).
- 2.** For assembly compress the spring (2) slightly to insert it into the cable gland housing.
- 3.** Turn the front cap/screw of each cable gland on the cable gland housing to tighten and fix the cable.

Note:

! This type of cable gland should be used by engine manufacturer !

61 Terminal box GHG02621-3 and connection plan





Attention:

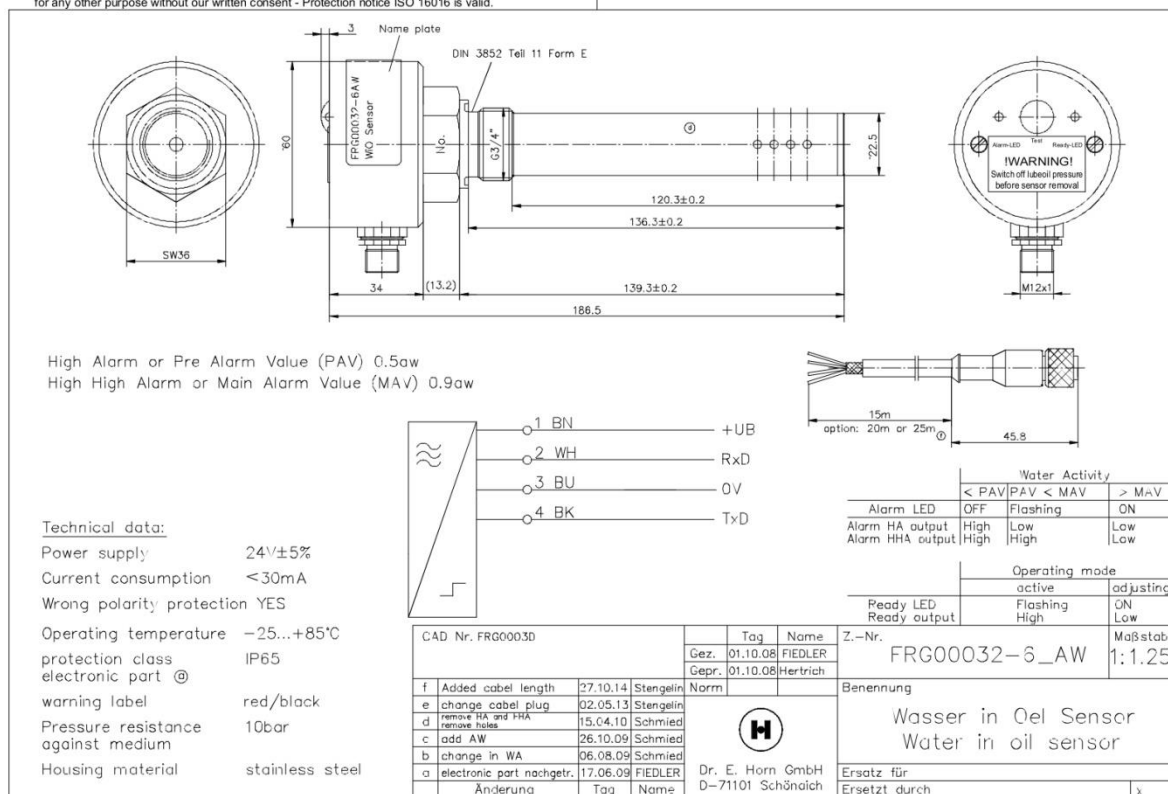
Each distance sensor IW000184 or splash oil temperature sensor TGL00921 can be connected to any one of the connection point X1 to X16. Use for the Water in oil sensor, only the connection point X17.

wh ≡ white
bn ≡ brown
ye ≡ yellow
gn ≡ green
bk ≡ black
bl ≡ blue

c				Maße	DIN ISO	Abmaße
b				Passung		mm
a	exchange text.	18.05.16	Stengelin	Maße ohne Toleranz		
	Änderung	Tag	Name	DIN ISO 2768 - mk		
	Tag	Name	CAD Nr.	ANG01528		
Gez.	02.05.16	Stengelin	Z.-Nr.			Maßstab
Gepr.	02.05.16	Schmied				
Norm						
Benennung						
Connection plan						
Terminal box						
Dr. E. Horn GmbH						
D-71101 Schöndach						
Ersatz für						
Ersetzt durch						
X						

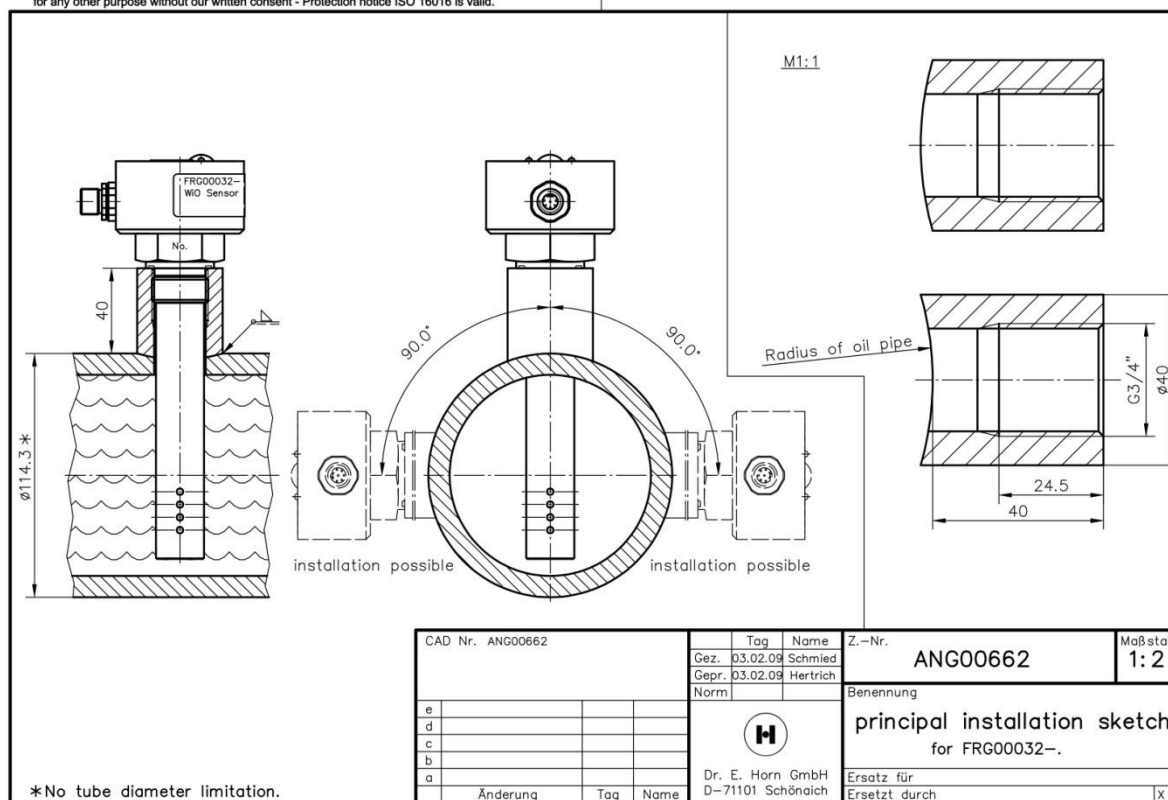
6.2 Water in Oil sensor FRG00032-6_AW

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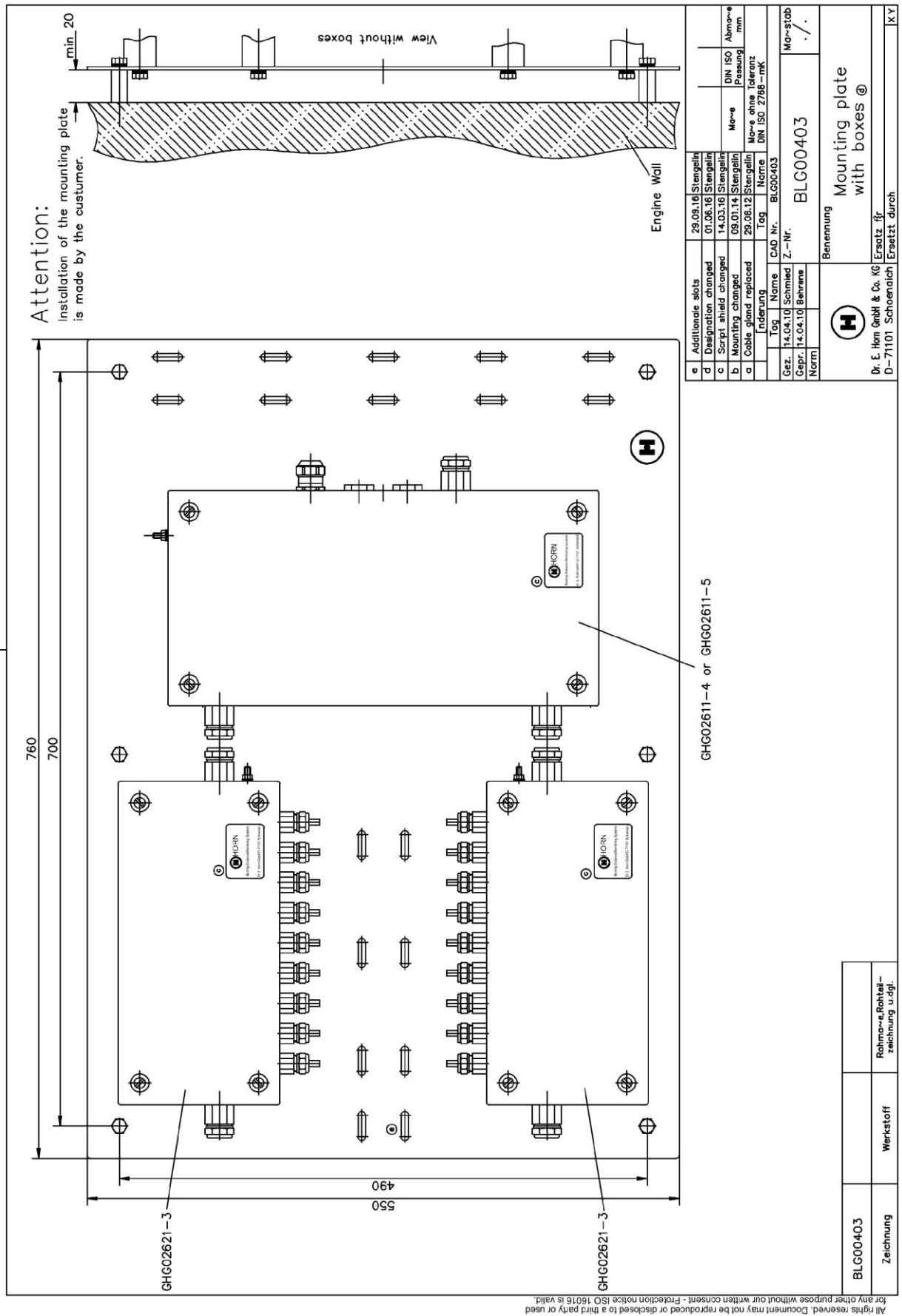


6.3 Installation of Water in Oil sensor

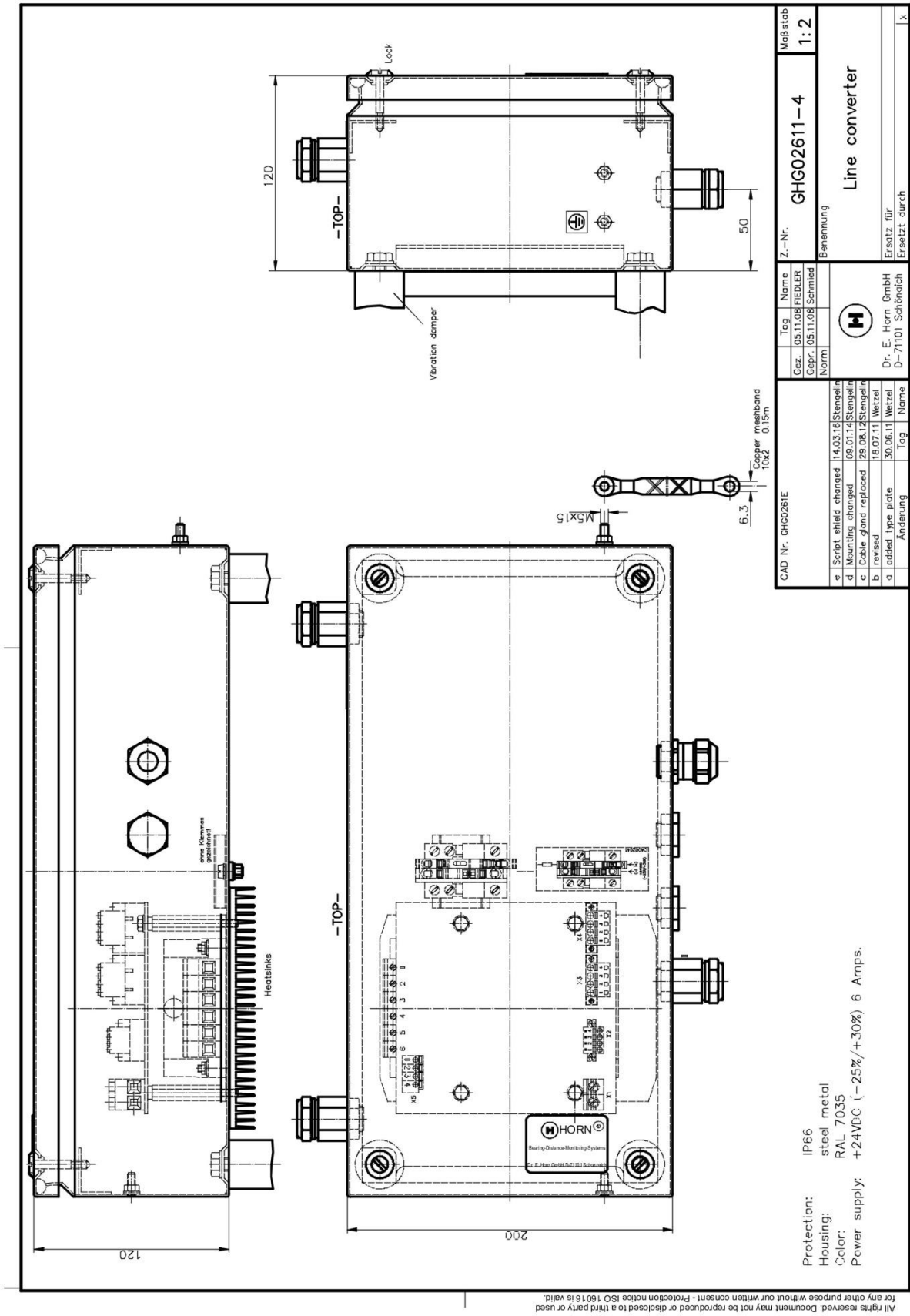
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6.4 Mounting bracket with boxes BLG00403

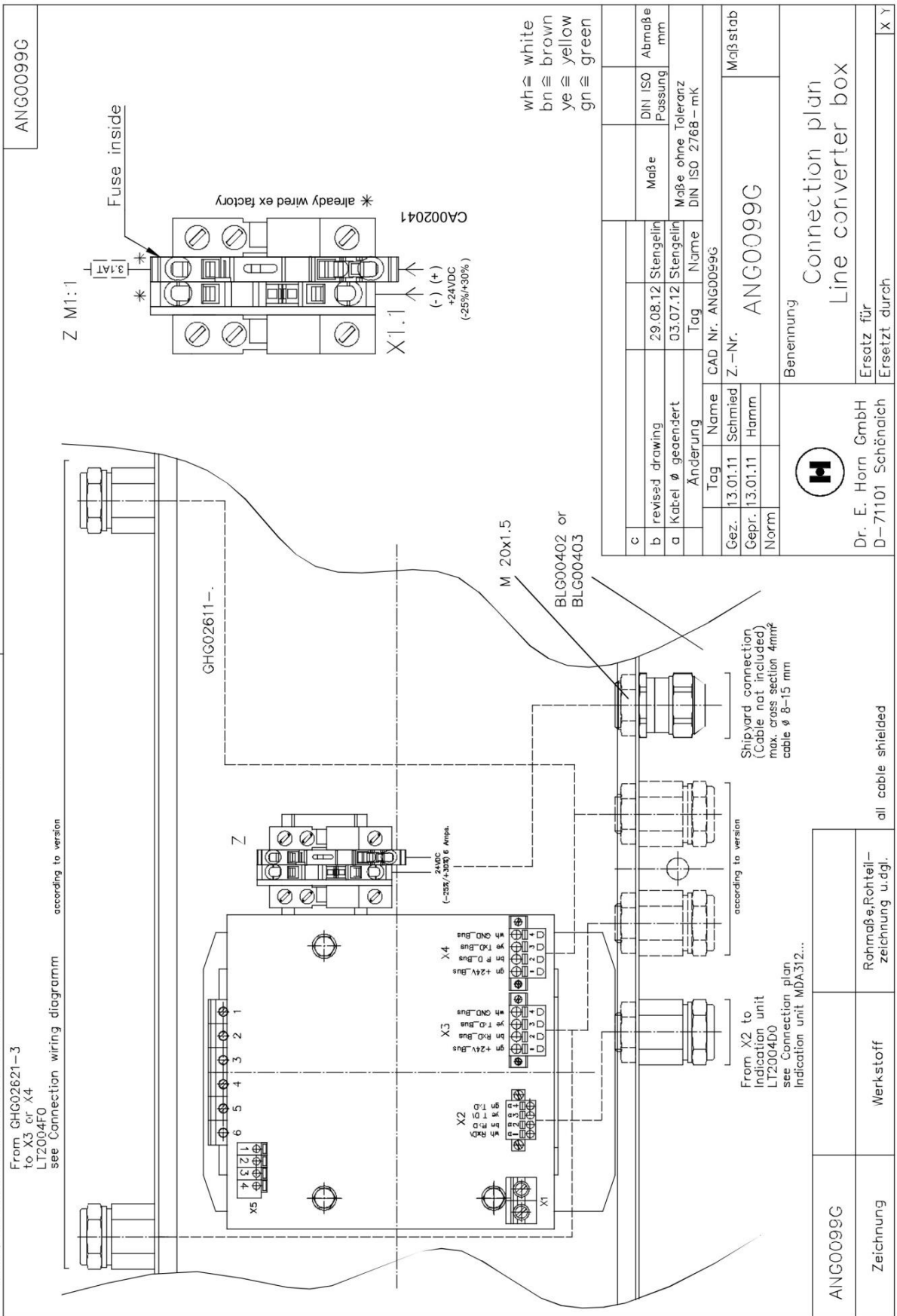


6.5Line converter box GHG02611-4



[illegible]

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6.7 Connection wiring diagram

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Quantity of cable glands
see drawing GHG02611-4 and GHG02621-3

Outer dimensions of GHG box
see drawing GHG02611-4 and GHG02621-3

GHG02621-3

X19

X4/X3

supply and wired by Dr.E.Horn

X1.1

24VDC

Shipyard supply

X2

to ECR

LT2004D0

supply by Dr.E.Horn

GHG02611-4 24VDC 6Amps.

GHG02611-5 115-230 VAC 1Amps.

GHG02621-3

X19

X3/X4

supply and wired by Dr.E.Horn

19.06.16

Stengelin

15.12.15

Stengelin

13.01.14

Stengelin

CAD Nr. ANG0075B

Gez. 13.09.11

Gepr. 13.09.11

Norm

Tag 13.09.11

Name Schmied Hamm

Z.-Nr. ANG0075B

Ma~stab ./.

H

Benennung

Connection wiring diagram for BLG0040.

Dr. E. Horn GmbH & Co. KG

D-71101 Schoenaich

Ersatz ffr

Ersetzt durch

e

d

c

b

a

Revised

Revised

Mounting changed

19.06.16

15.12.15

13.01.14

Stengelin

Stengelin

Stengelin

Tag

Name

19.06.16

15.12.15

13.01.14

Stengelin

Stengelin

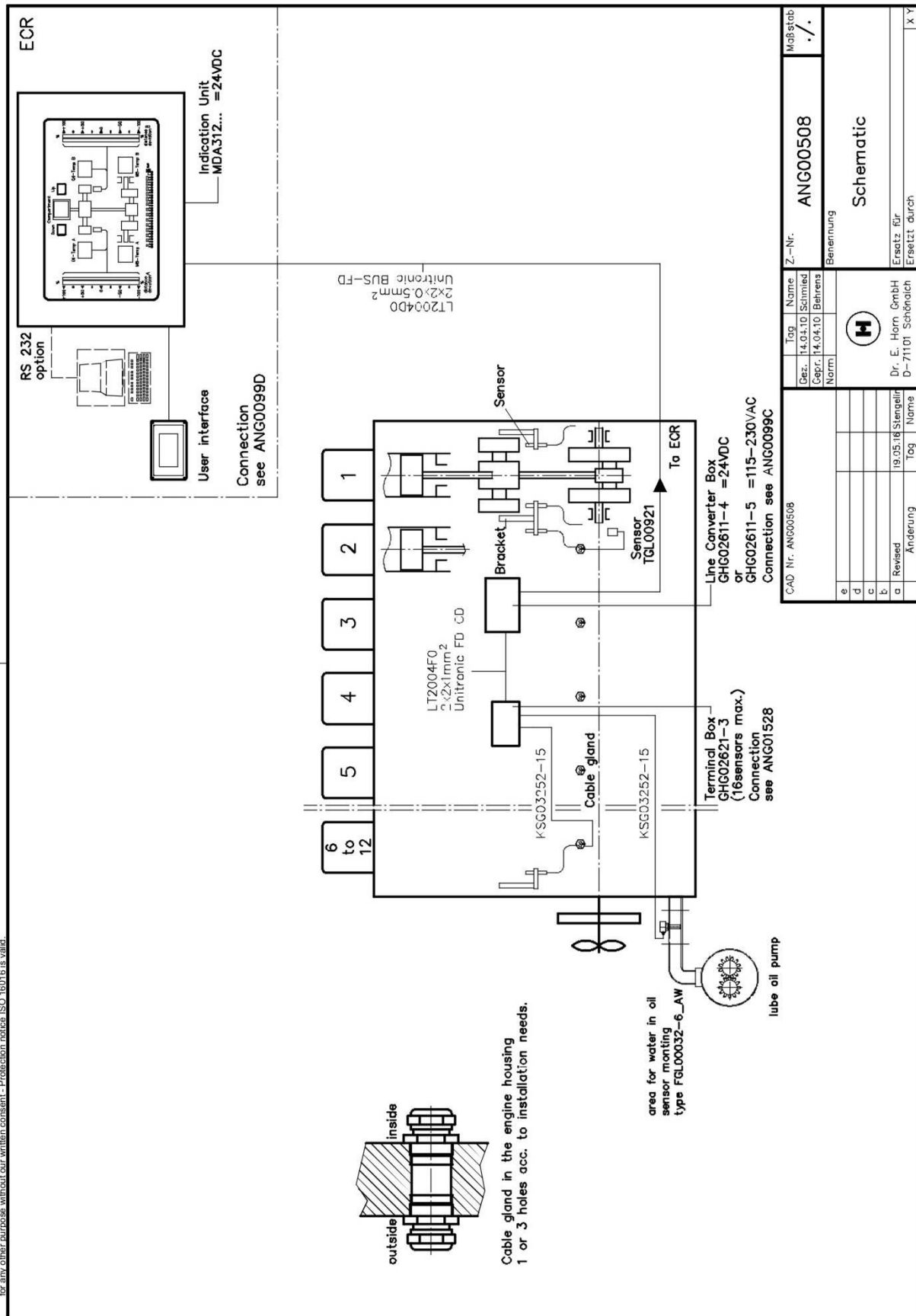
Stengelin

DK005659 .Rev.00, page 21

Sensors · Monitoring · Systems

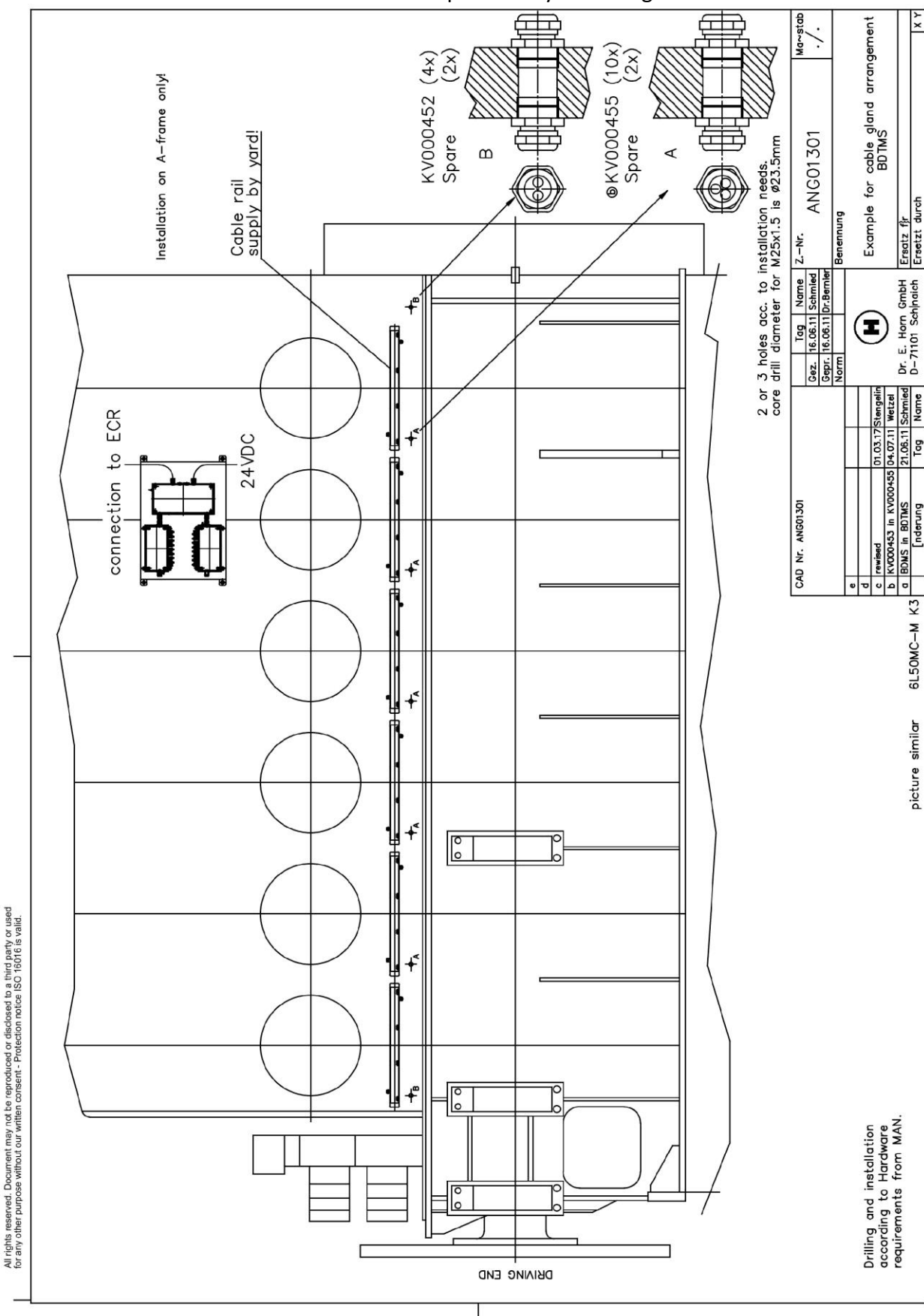
Dr. E. Horn GmbH & Co. KG · Im Vogelsang 1 · 71101 Schoenaich · Germany · Tel.: +49 7031 6302-0 · info@dr-horn.org

6.8 Principle installation drawing

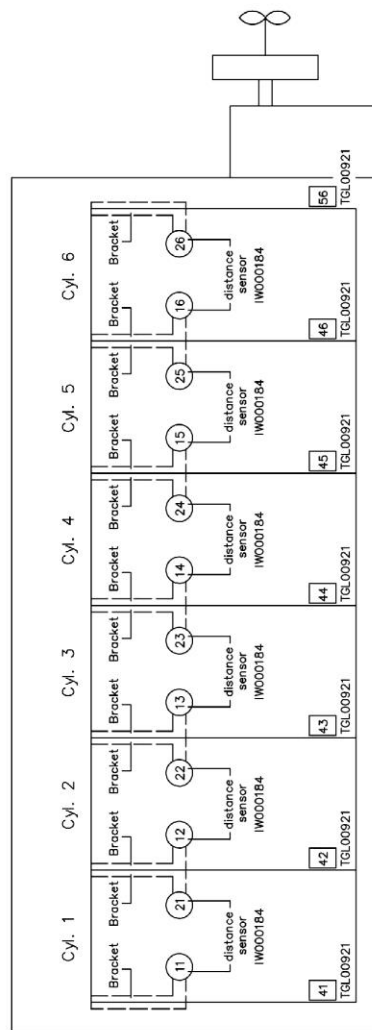


6.9 Position of GHG02611-4, GHG02621-3 incl. mounting bracket

– Example for 6 cylinder engine –

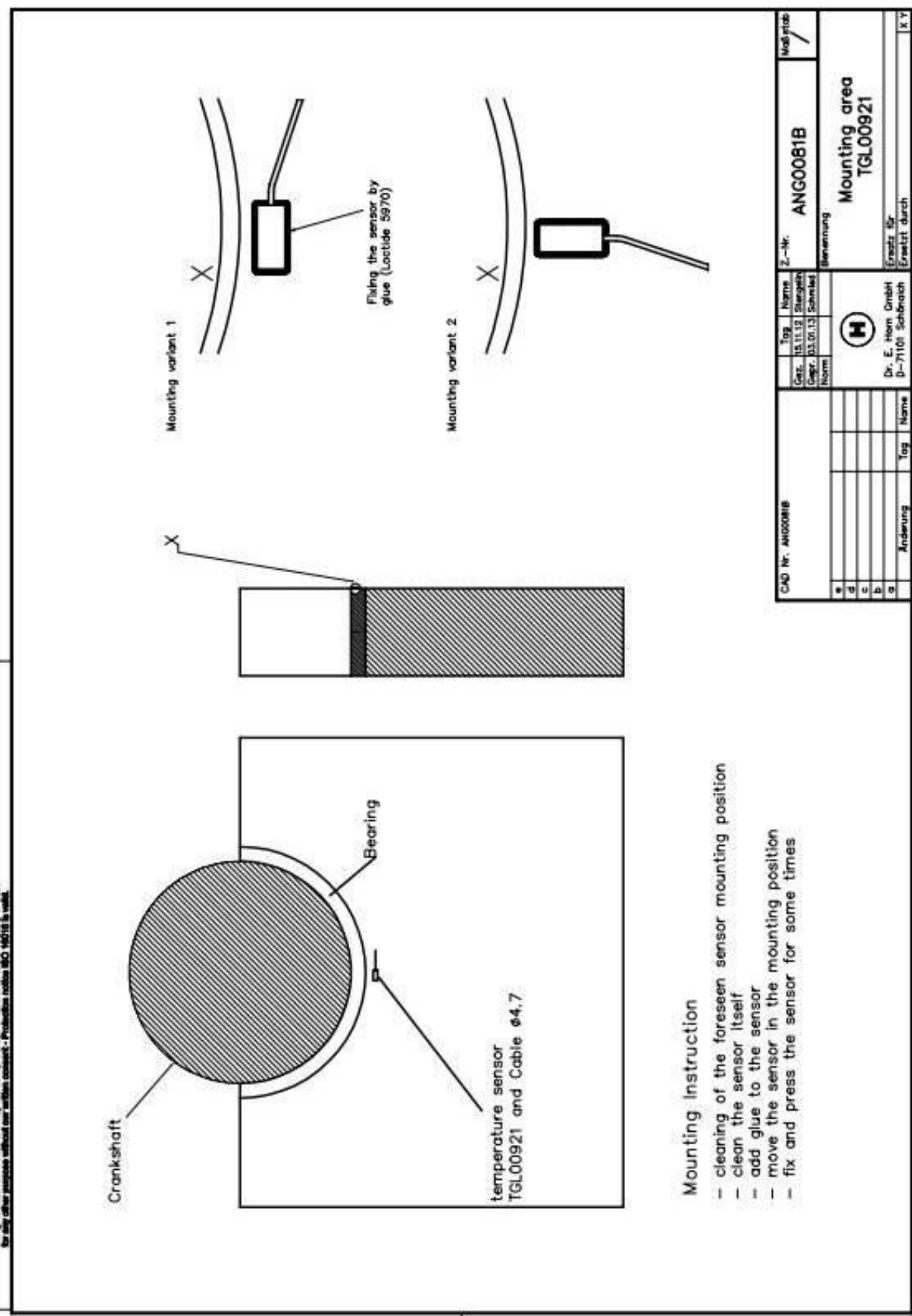


– Example for 6 cylinder engine –



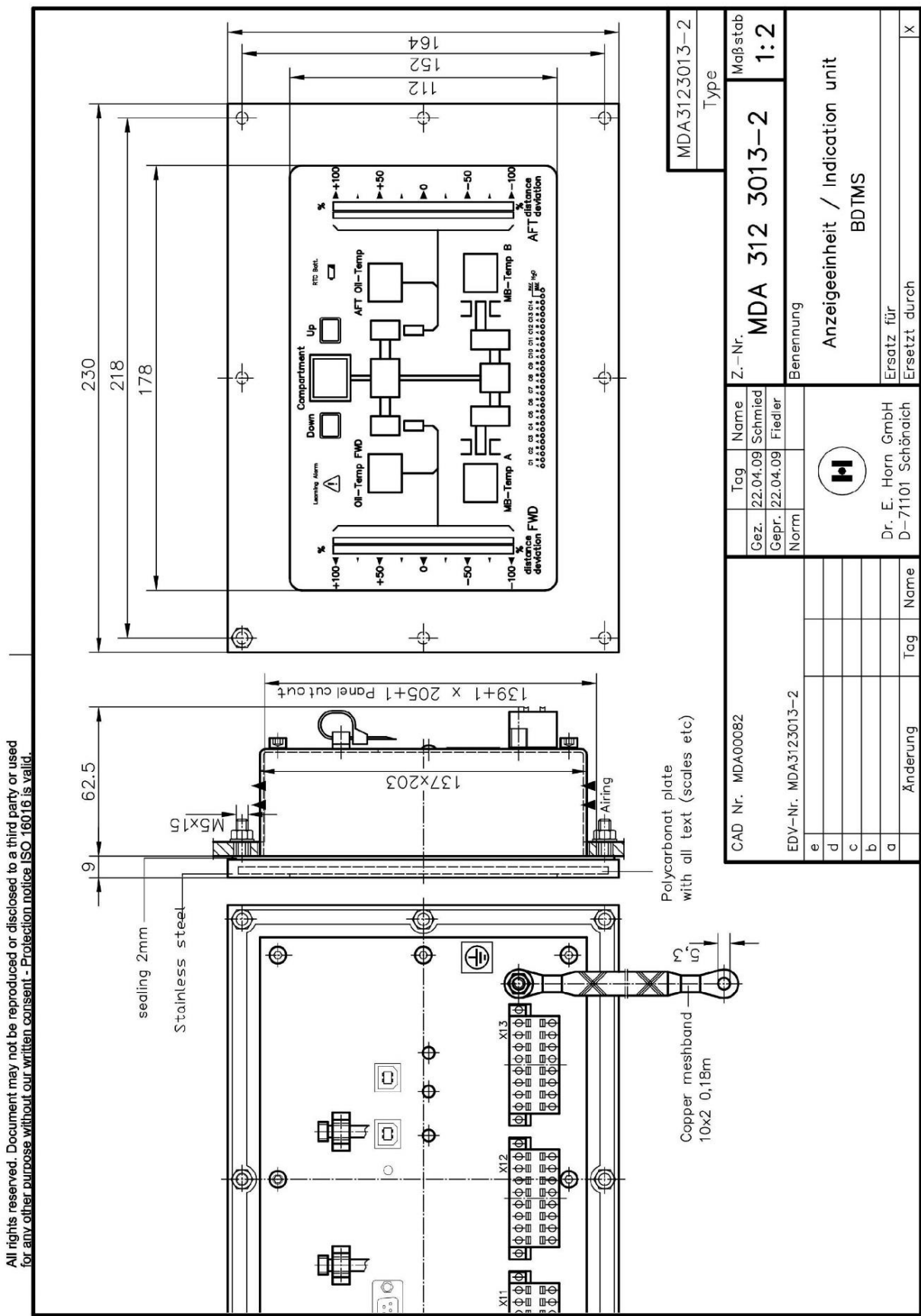
CAD Nr. AN600740		<table><tr><td>Gez.</td><td>26.04.12</td><td>Schmid</td></tr><tr><td>Gepr.</td><td>25.03.13</td><td>Stengelin</td></tr><tr><td colspan="3">Norm</td></tr></table>		Gez.	26.04.12	Schmid	Gepr.	25.03.13	Stengelin	Norm			<table><tr><td>Tag</td><td>Name</td><td>Z. Nr.</td><td>Vor-stab</td></tr><tr><td colspan="2" rowspan="2"></td><td>A\CO0742-6</td><td rowspan="2">/.</td></tr><tr><td>Benennung</td></tr><tr><td colspan="2">Dislance+ Temperature sensor arrangement 6Cyl.</td><td colspan="2"></td></tr><tr><td colspan="2">Ersatz für Ersetzt durch</td><td colspan="2"></td></tr></table>	Tag	Name	Z. Nr.	Vor-stab			A\CO0742-6	/.	Benennung	Dislance+ Temperature sensor arrangement 6Cyl.				Ersatz für Ersetzt durch			
Gez.	26.04.12	Schmid																												
Gepr.	25.03.13	Stengelin																												
Norm																														
Tag	Name	Z. Nr.	Vor-stab																											
		A\CO0742-6	/.																											
		Benennung																												
Dislance+ Temperature sensor arrangement 6Cyl.																														
Ersatz für Ersetzt durch																														
a																														
d																														
c																														
b																														
a	nderung	Tag	Name																											

6.11 Mounting of temperature sensor TGL00921



7. ECR – Engine control room equipment

7.1 Indication unit MDA3123013-2 – BDTMS



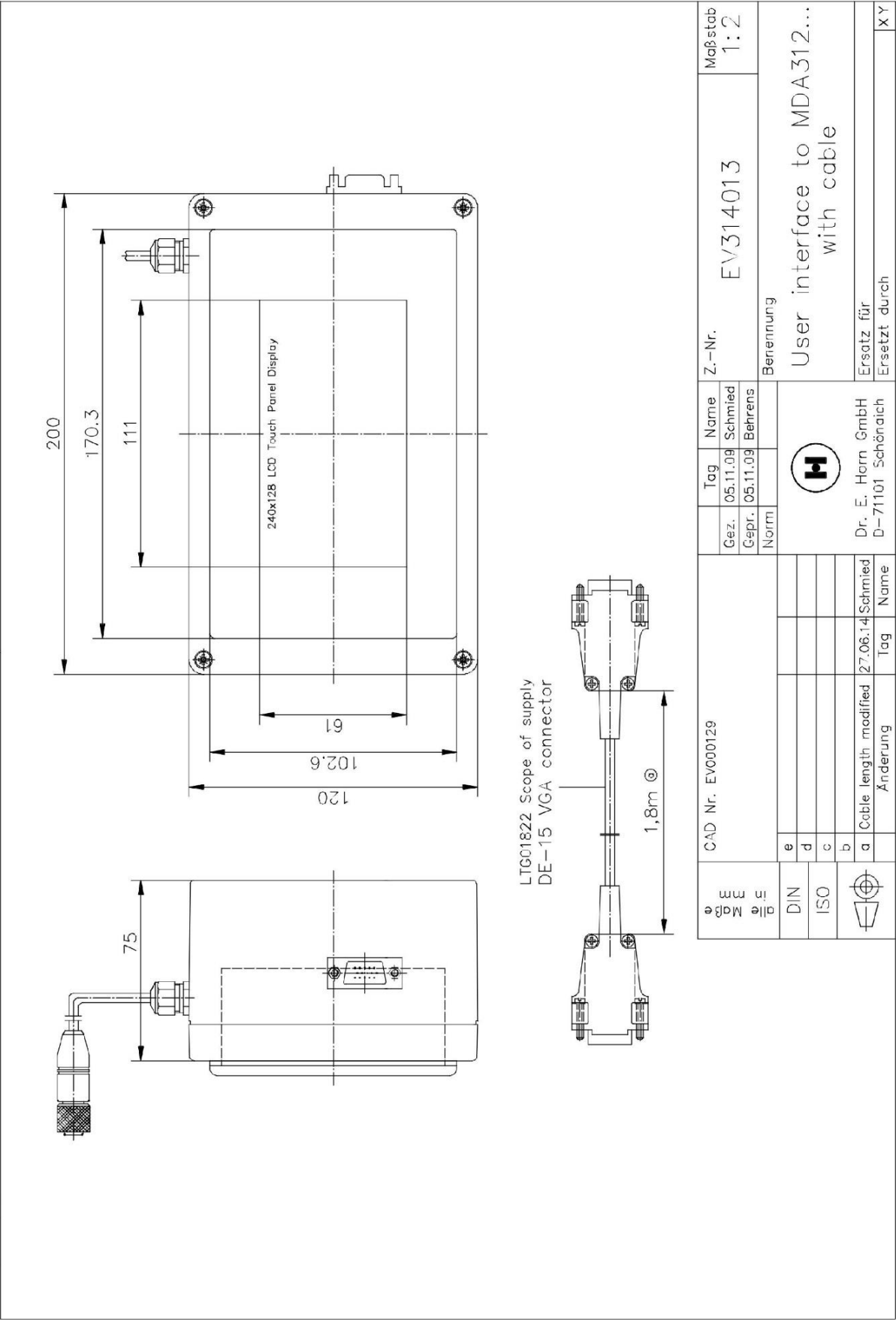
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Contact	Polarity ±	Relay Nr.	Connection to ship		Contact N.O./N.C.	Function/Alarm
			alarm system	safety system		
X11	X11/1	+				24V DC
	X11/2	-				0V DC
	X11/3	-		x	N.O.	H2O Main-Alarm
	X11/4	+		x	N.O.	H2O Main-Alarm
	X11/5	-			N.C.	MDA312 working/ready
	X11/6	+		x	N.C.	MDA312 working/ready
	X11/7	-		x	N.O.	bearing wear alarm
	X11/8	+		x	N.O.	bearing wear alarm
X12	X12/1	-		x	N.O.	bearing wear slow down
	X12/2	+		x	N.O.	bearing wear slow down
	X12/3	-		x	N.O.	Temperature alarm (Main bearing, splash oil and crosshead temperature)
	X12/4	+		x	N.O.	Temperature alarm (Main bearing, splash oil and crosshead temperature)
	X12/5	-		x	N.O.	Temperature slow down (Main bearing, splash oil and crosshead temperature)
	X12/6	+		x	N.O.	Temperature slow down (Main bearing, splash oil and crosshead temperature)
	X12/7	-		x	N.O.	H2O Pre-Alarm
	X12/8	+		x	N.O.	H2O Pre-Alarm
X13	X13/1					TxD (cable colour BR(own), from line converter connector X2/1)
	X13/2					TxD\ (cable colour WH(ite), from line converter connector X2/2)
	X13/3					RxD (cable colour G(ree)N, from line converter connector X2/3)
	X13/4					RxD\ (cable colour YE(llow), from line converter connector X2/4)
	X13/5	+				Astern-IN (binary signal)
	X13/6	-				Astern-IN (binary signal)
	X13/7	+				CPP-IN, 4-20mA (propeller signal)
	X13/8	-				CPP-IN, 4-20mA (propeller signal)

7.3 Connection User Interface to indication unit MDA 312...

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9. Appendix

for

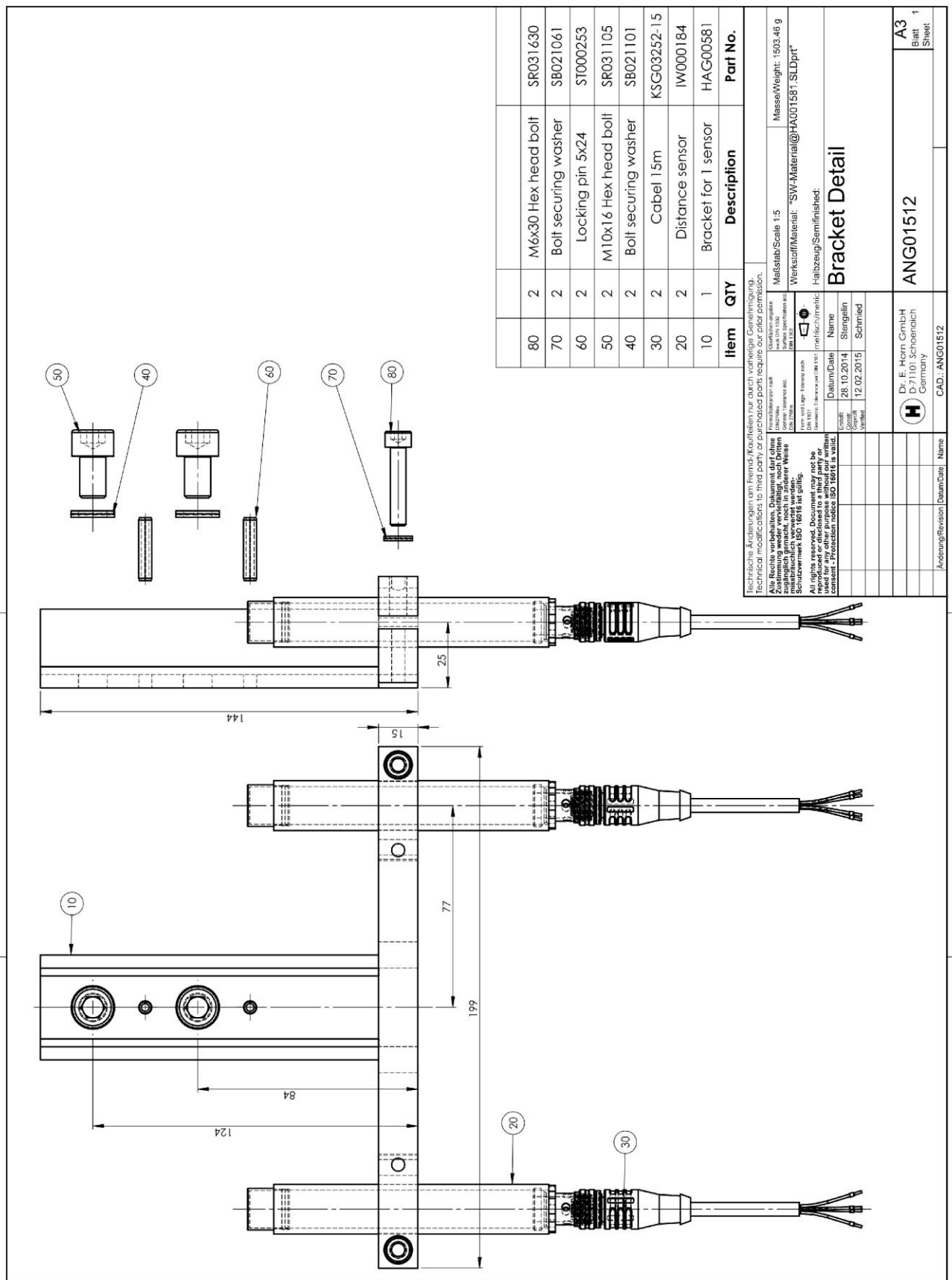
Bearing Monitoring System

DK005533

– Sensor Brackets Type HAG00581 –

(as advised by engine manufacturer)

Revision: 01, 12.07.2016



80	2	M6x30 Hex head bolt	SR031630
70	2	Bolt securing washer	SB021061
60	2	Locking pin 5x24	ST000253
50	2	M10x16 Hex head bolt	SR031105
40	2	Bolt securing washer	SB021101
30	2	Cabel 15m	KSG03252-15
20	2	Distance sensor	IW000184
10	1	Bracket for 1 sensor	HAG000581
Item	QTY	Description	Part No.

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Meßstab/Scale 1:5
 Werkstoff/Material: "SW-Material@HAG001581.SLDprt"
 Halbleitung/Semifinished:

Bracket Detail

Name: Stengelin
 Datum/Date: 28.10.2014
 Gezeichnet/Drawn: 12.02.2015
 Verifiziert/Verified: Schmid

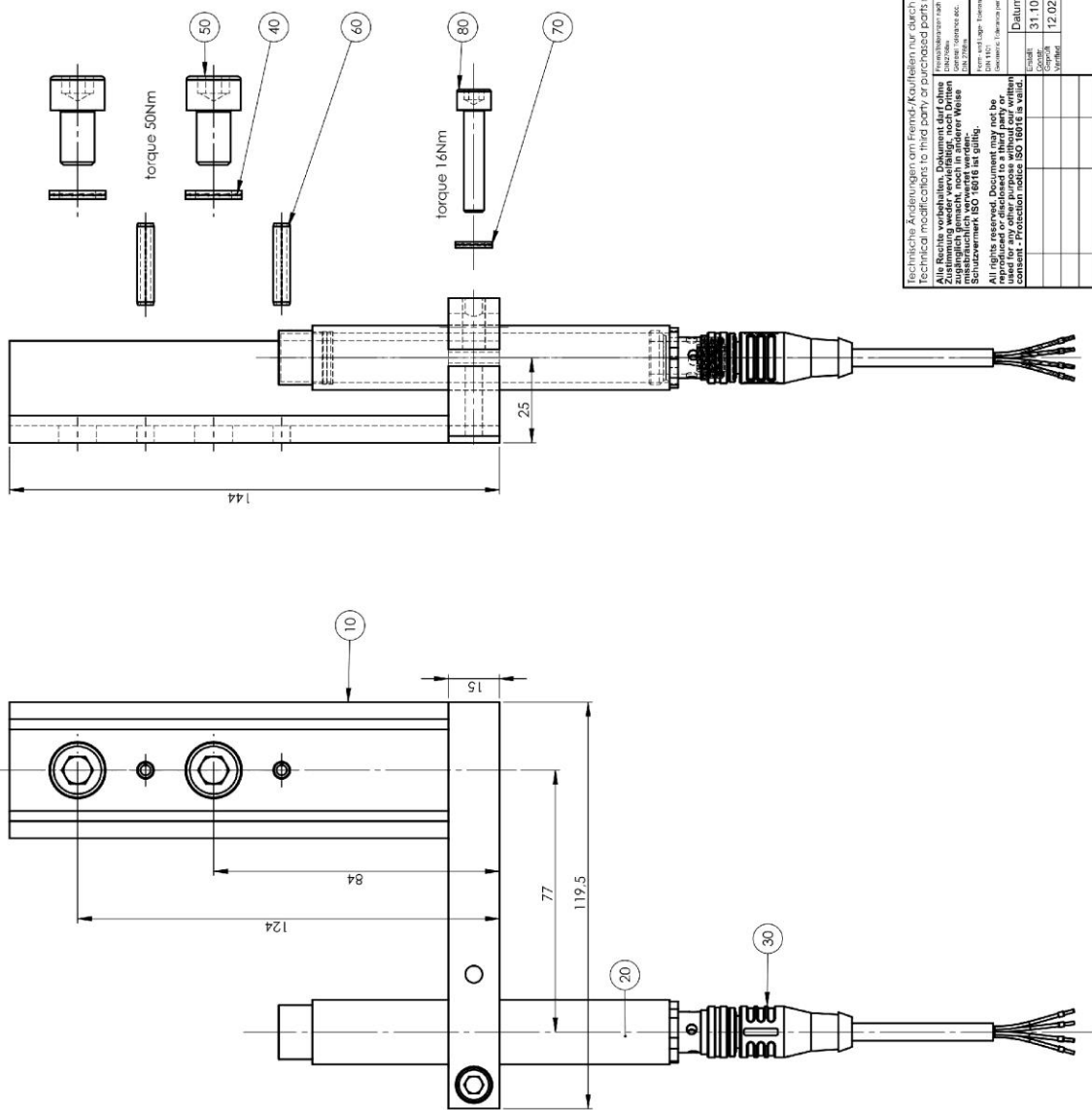
Dr. E. Horn GmbH
 D-71101 Schoenaich
 Germany

ANG01512

A3
 Blatt 1
 Sheet

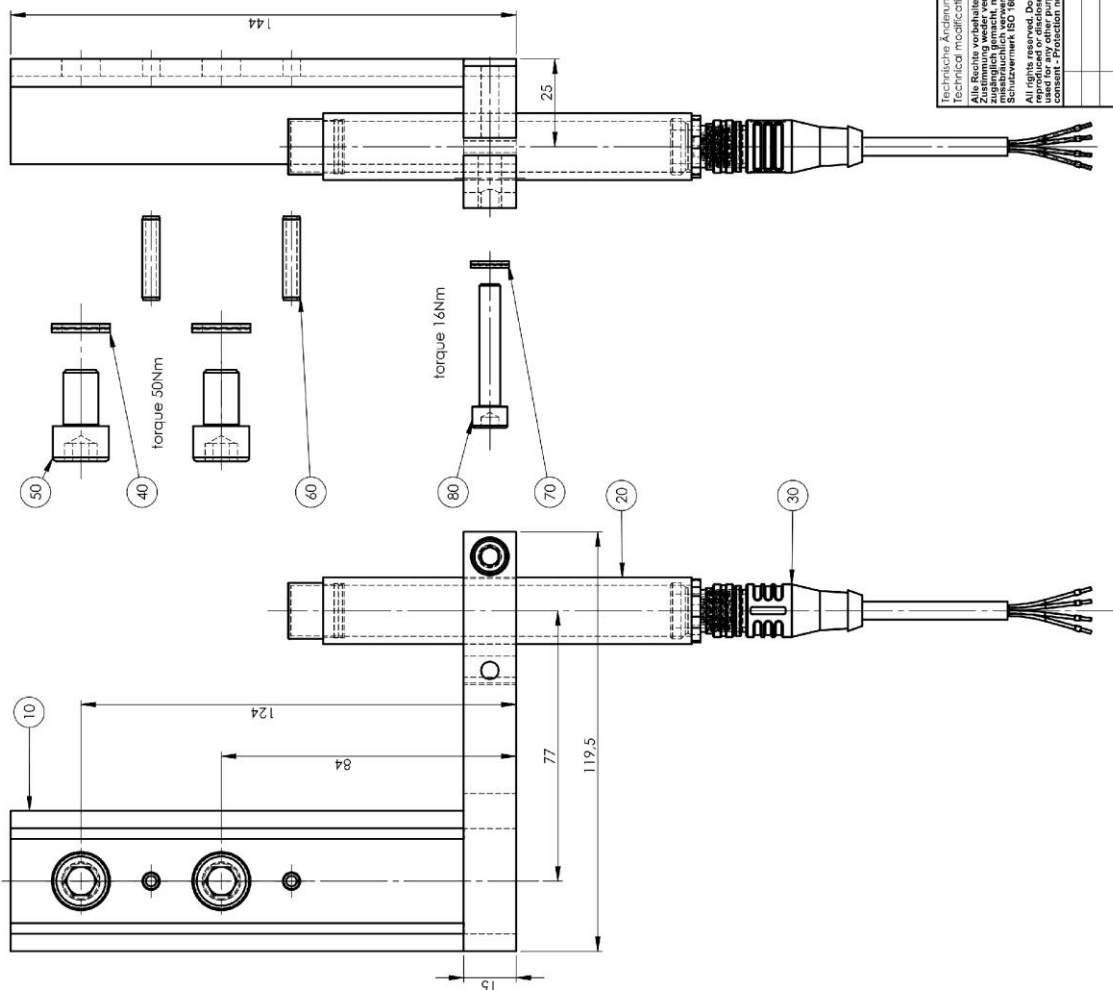
Änderung/Revision: Datum/Date: Name

CAD: ANG01512



Item	QTY	Description	Part No.
80	1	M6x30 Hex head bolt	SR031630
70	1	Bolt securing washer	SB021061
60	2	Locking pin 5x24	ST000253
50	2	M10x16 Hex head bolt	SR031105
40	2	Bolt securing washer	SB021101
30	1	Cabel 15m	KSG03252-15
20	1	Distance sensor	IW000184
10	1	Bracket for 1 sensor	HAG00581-L

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Dr. E. Horn GmbH D-71101 Schoenaich Germany		Bracket Detail	
ANG01513		A3 Blatt Sheet	
CAD: ANG01513			

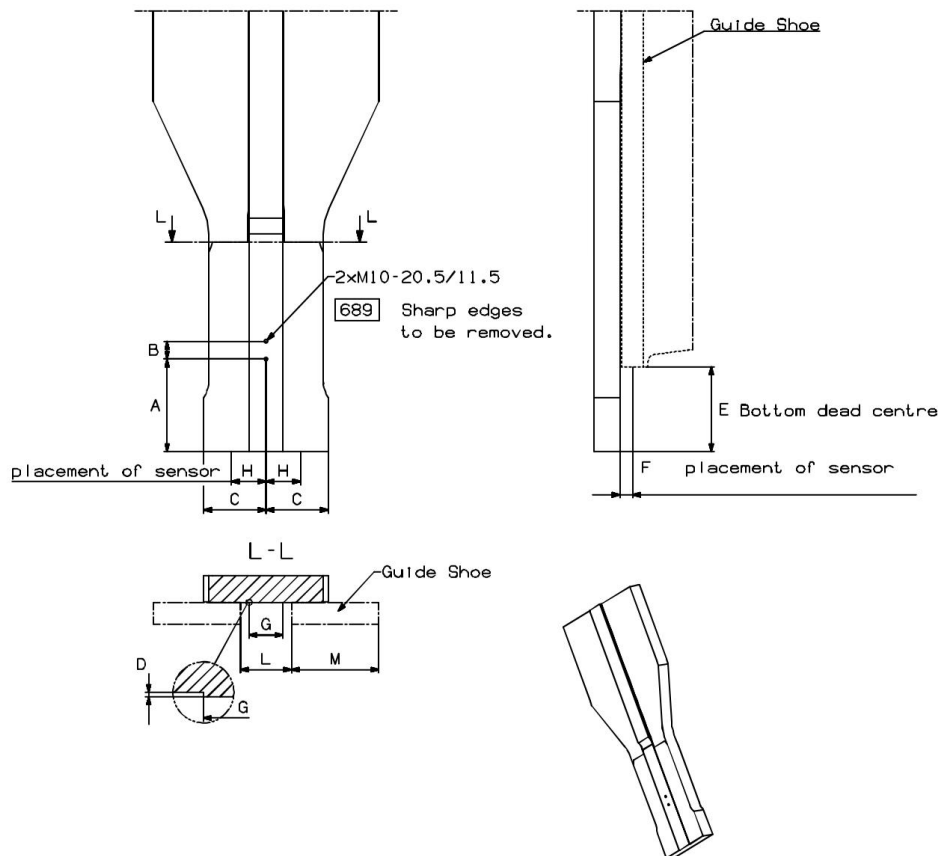


Item	QTY	Description	Part No.
80	1	M6x30 Hex head bolt	SR031630
70	1	Bolt securing washer	SB021061
60	2	Locking pin 5x24	ST000253
50	2	M10x16 Hex head bolt	SR031105
40	2	Bolt securing washer	SB021101
30	1	Cabel 15m	KSG03252-15
20	1	Distance sensor	IW000184
10	1	Bracket for 1 sensor	HAG00581-R

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Halbzeug/Semifinished:		Bracket Detail	
Erstellt/Drawn	Datum/Date	Name	
Geprüft/Checked	31.10.2014	Stangelin	
Verf. / Made	12.02.2015	Schmid	
Dr. E. Horn GmbH D-71101 Schoenaich Germany		ANG01514	
A3 Blatt 1 Sheet		CAD: ANG01514	

Table values is only valid on this page, and below views.

Engine	A [mm]	B [mm]	C [mm]	D [mm]	E [mm]	F [mm]	G [mm]	H [mm]	L [mm]	M [mm]
S30ME-B9.3/9.5	130	40±0.1	64	1	159	20±5	40	40±10		
S35MC-C/ME-B9.1/9.2/9.3/9.5	219	40±0.1	70	1	191	20±5	35	40±10		
S40MC-C/ME-B9.1/9.2/9.3/9.5	248	40±0.1	82	1	215	20±5	38	40±10		
G45ME-C9.5	346	40±0.1	84	1	313	20±5	48	40±10		
S46MC-C/ME-B7/8.1	30	40±0.1	102	1	9	20±5	38	55±10		
S46MC-C8.2	70	40±0.1	102	1	79	20±5	38	55±10		
S46ME-B8.2/8.3/8.5	70	40±0.1	102	1	79	20±5	38	55±10		
S50MC-C/ME-B/ME-C7/8.1	155	40±0.1	101	1.6	137.5	20±5	56	65±10		
S50MC-C/ME-C8.2/8.5	195	40±0.1	101	1.6	215	20±5	56	65±10		
S50ME-B8.2/8.3/8.5	195	40±0.1	101	1.6	215	20±5	56	65±10		
S50ME-B9.1/9.2/9.3/9.5	305	40±0.1	102.5	1	272	20±5	38	65±10		
G50ME-B9.3/9.5	328	40±0.1	102.5	1	295	20±5	38	65±10		
G50ME-C9.5	328	40±0.1	94	1	361	20±5	46	65±10		
S60MC-C/ME-C8.1	183	40±0.1	121	1	165	20±5	66	80±10	79	170
L60MC-C/ME-C	188	40±0.1	126	1	174	20±5	66	80±10	79	170
K60MC-S	329	40±0.1	126	1	315	20±5	66	80±10	79	170
S65ME-C8.1	191	40±0.1	115	1	177	20±5	70	82±10	80	177
S70MC-C/ME-C8.1	210	40±0.1	141	1	192	20±5	77	87±10	90	200
L70MC-C/ME-C	216	40±0.1	141	1	202	20±5	77	87±10	92	200



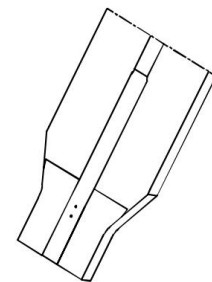
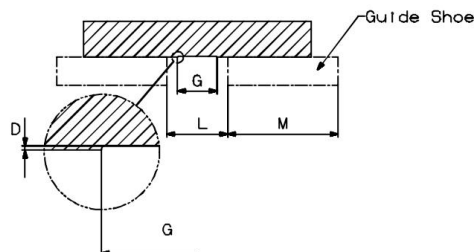
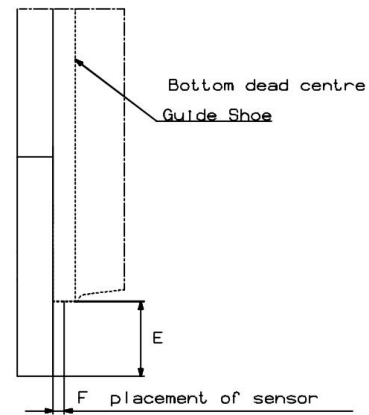
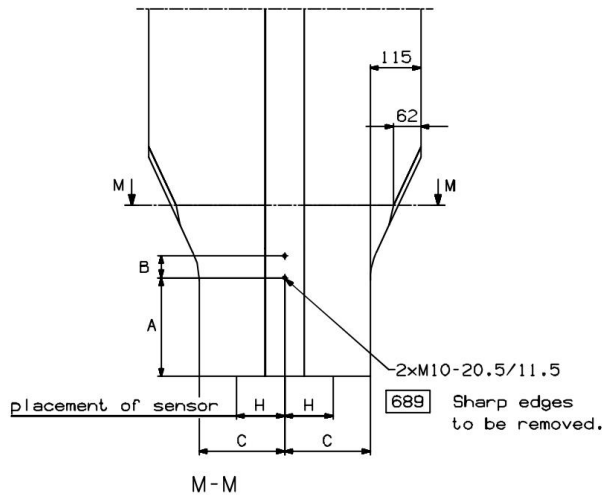
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Engine	A [mm]	B [mm]	C [mm]	D [mm]	E [mm]	F [mm]	G [mm]	H [mm]	L [mm]	M [mm]
S60MC-C/ME-C8.2-8.5	183	40±0.1	121	1	350	20±5	66	80±10	79	170
S65ME-C8.2-8.5	359	40±0.2	115	1	345	20±5	70	82±11	80	177
G60ME-C9/10	243	40±0.2	121	1	225	25±5	58	75±11	70	170
S70MC-C/ME-C8.2-8.5	210	40±0.1	141	1	375	20±5	77	87±10	90	200
L70MC-C/ME-C8.2-8.5	402	40±0.1	141	1	385	20±5	77	89±10	92	200
G70ME-C9/10	438	50±0.2	290	1	258	25±5	80	93±11	70	200
S80MC-C/ME-C8.1-8.5	390	50±0.1	150	1	210	17±5	90	89±10	104	220
K80ME-C9/10	389	40±0.1	145	1	375	17±5	90	88±10	94	215
S80ME-C9/10	374	40±0.1	145	1	360	17±5	90	88±10	94	215
G80ME-C9/10	374	40±0.1	153	1	360	17±5	80	88±10	84	220
S90MC-C/ME-C8.1-8.5	206	50±0.1	180	1	26	17±5	80	88±10	120	240
S90ME-C9/10	465	50±0.1	180	1	285	17±5	90	88±10	120	240
G95ME-C9/10	435	50±0.1	178	1	255	17±5	94	88±10	100	235
K98MC/ME/MC-C/ME-C	195	50±0.1	195	1	15	17±5	90	110±10	140	230

* Bracket turned 180° (see next page)



Frame-Box drilling (only this page).

M10 holes only to be added for engines prepared for Bearing Wear Monitoring systems.

Date	Des.	Ch.	A.C.	Revision change	Chg. No.	Rev.
20151104	NLM	JVM	Z3	Page 1: Value L+M added		27
20151104	NLM	JVM	Z4	Mark no updated		28
20150105	STRAS	B	Z3	->S35/S40MC-C/ME-B, S50ME-B9		25
20080507	NLM					00
Basic Standards ISO 9001				Suppl. Drawing No.1		
Material / Blank:				Final User Materials		
Scale 1: A0				Product Type: BMW		
Info. No.1 795717				Item Name: CABLE TRAY		
Final User Info. No.1				Final User Description: 5111013-2		
				Final User Ident. No.1		

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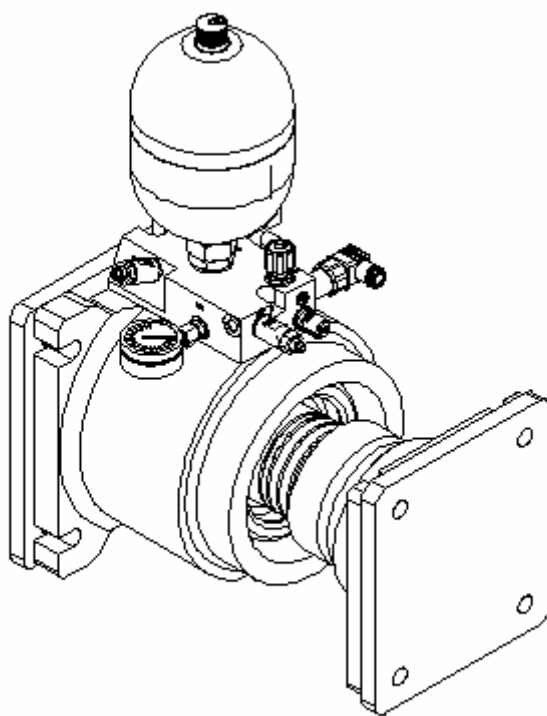
独立式主机液压顶推支撑装置

HYDRAULIC TOP BRACING STAND-ALONE TYPE OF M/E

DYDZ200

产品使用手册

Manual



南通航海机械集团有限公司

NANTONG NAVIGATION MACHINERY GROUP CO., LTD.

电话 TEL: +86 513 51008689 传真 FAX: +86 513 85540085



第一部分 Part 1



目 录 INDEX

1、简介 Introduction.....	4
2、技术参数 Technical description	5
3、系统组成 System parts	5
4、工作原理 Working principle.....	5
5、操作 Operation	7
6、安装 Installation	8
6.1 准备 Preparation	8
6.2 安装法兰的安装 Installation of mounting flanges	9
6.3 液压顶推支撑液压缸的安装 Installation of top bracing cylinders	10
6.4 液压控制单元包括蓄能器的安装 Installation of hydraulic unit including oil accumulator	10
6.5 电气控制系统的安装 Installation of electric control system.....	11
6.6 液压顶推支撑的充油、补油及调整 Filling, refilling and adjustment of top bracing.....	11
7、服务和维护 service and maintenance.....	13
7.1 备件 spare parts.....	13
7.2 服务检查 service inspection.....	13
7.3 油压的控制 control of oil pressure	13
7.4 调节绿色位置带 Adjusting green position band	14
7.5 推力杆对齐度 Distance rod alignment	14
7.6 更换密封件 Replacing sealing rings.....	15
7.7 更换蓄能器 Replacing oil accumulator	16
8、故障分析 Trouble shooting.....	17
Appendix 附录 A.....	19



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,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. the top bracing units are designed with a cylinder diameter of 200 mm and deliver in a low-pressure version (26bar) for engines with bore $\leq 600\text{mm}$, and a high-pressure version (40bar) for engines with bore $> 600\text{mm}$.

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 and 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，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 $\leq$ 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.

电磁阀控制是通过与转速信号相连的程序开关来控制的，开关由两个独立的延时开关组成，并可以设置程序（参照附录 A），原理见图 DYDZ200-DC

The solenoid valve is controlled by a programmable switch connected to the RPM signal. The switch is galvanic isolated and consist of two relays, which can be individually programmed (refer to the Appendix) . Shown in diagram DYDZ200-DC.

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程序开关来自动控制的，这也是常规模式，根据主机的转速，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 programmable switch. 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者控制开关失灵的情况下。

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 switch.

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 not 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 ≤ 2 mm。

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： $\leq 1^\circ$ (参照图 DYDZ200-AZ2)；

The parameters for the installation are: Installation tolerance : 475+1/+3mm(refer to the diagram DYDZ200-AZ); Installation parallelism $\leq 1^\circ$ (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):

$$H_{\max}-H_{\min}\leq 5\text{mm}$$

$$E_{\max}-E_{\min}\leq 5\text{mm}$$

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侧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 M20×65 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 × 65 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 DYDZ200-DK-YL、电气接线图参照 DYDZ200-DK-JX1/JX2）。

6.5.1 The electric control system should be installed and wired in accordance with the cabling overview and the electric principle diagrams and electric connection diagram in the supplying drawings (refer to the diagram DYDZ200-DK-YL、DYDZ200-DK-JX1/JX2).

6.5.2 当转速信号超过转速 10%以上，可编程开关被预置为激活顶推支撑。如果一个可选择的时间间隔被优先选择了，开关必须根据附录 A 中的指示重新编程。

6.5.2 The programmable switch is pre-set to activate the top bracing when the RPM signal gets above 10% of the engine speed. If an alternative interval is preferred, the switch should be re-programmed in accordance with the instructions in appendix A.

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 确保压力传感器已经和报警系统相连,且电磁阀已经连接到电气控制箱，且通电。

6.6.1 Make sure that the pressure transmitter is connected to the alarm system and that 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。

6.6.3.6 Continue 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。

6.6.3.7 Continue 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。

7.2.5 Remove 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 DYZZ200-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 DYZZ200-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 6.6.3.2 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。

7.6.3 Remove 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。

7.6.6 Lift 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 3.8bar，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 3.8 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

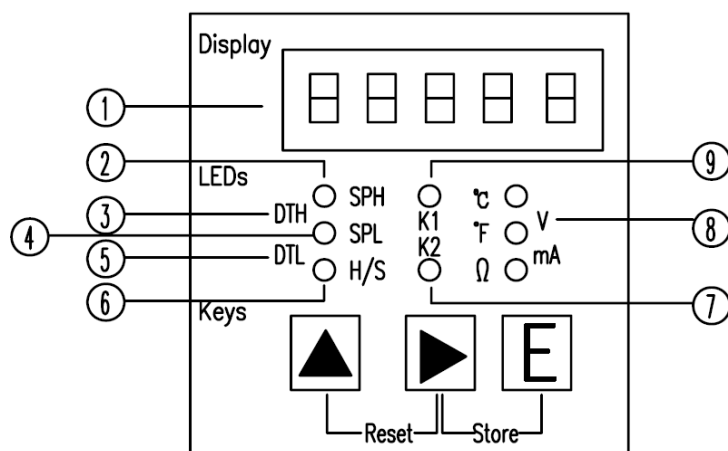


	oil-accumulator is less than the charging pressure, 4bar. Refill the accumulator with N2 as explained according to 7.7 and fill the hydraulic system hereafter as explained according to 6.6 .
Pressure gauge < 4 bar 压力表读数<4bar	如果压力表读数小于 4bar, 参见上面“报警信号”一栏。 If the pressure gauge is less than 4 bar, see ‘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 液压缸单元漏油	如果液压缸单元漏油, 说明密封圈受损或损坏。根据 7.6 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 5mm, 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 5mm, 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.
Switching range incorrect 开关范围不正确	如果液压顶推支撑被优先选择在另一个转速范围内, 开关应该被重新编程, 按照附表 A 中的指示操作。 If the top bracing is preferred active in another RPM range, the switch should be reprogrammed. Follow the instructions in appendix A.

Appendix 附录 A

Control panel

仪表面板:



- ① LED Diode light on display
- ② SPH Highest switching point for the relay
- ③ DTH Display SPH and SPL simultaneously
- ④ SPL Lowest switching point for the relay
- ⑤ DTL LED display SPL and H/S simultaneously
- ⑥ H/S Switching point behavior
- ⑦ K2 Relay controlling ASTERN
- ⑧ V LED displays °C and simultaneously
- ⑨ K1 Relay controlling AHEAD

- ① LED 面板显示屏
- ② SPH 继电器的高位开关点
- ③ DTH 灯 SPH 及 SPL 同时亮
- ④ SPL 继电器的低位开关点
- ⑤ DTL 灯 SPL 及 H/S 同时亮
- ⑥ H/S 开关点动作
- ⑦ K2 继电器控制后退
- ⑧ V 灯 °C 和 °F 同时亮
- ⑨ K1 继电器控制前进

Press “▲” “▶” “▲” successively Switch to edit mode

Press “▲” Select the various setting

Press “▶” Select the various setting

Press “E” Confirm setting and proceed to next parameter

Press “▲” “▶” simultaneously Reset; return to operating state without any change

Press “▶” “E” simultaneously Store; save changes and return to operating state

连续按 “▲” “▶” “▲” 进入编辑模式

按 “▲” 改变数值

按 “▶” 改变数值

按 “E” 确认设置，进入下一参数

同时按 “▲” “▶” 重新设置，不保存更改，返回至操作状态

同时按 “▶” “E” 储存，保存更改并返回至操作状态

Steps

Selecting the source signal:

1. Switch to edit mode by pressing the keys ▲▶▲ successively (within 1 sec. for each key), The display will show u 30 for voltage source signal (-30V, +30V). If the display shows

步骤:

选择电源信号:

1. 同时按 ▲▶▲ 进入编辑模式 (每个键少于 1S), 屏幕显示 u 30, 即电压信号 (-30V, +30V). 若显示另一数值, 按一次 ▶ 再按 ▲ 直至出现 u 30. 按 E 保存。



another value, press ► once and press ▲ until u 30 is shown. Press E to confirm.

2. When the programming by some reason should be cancelled, press the keys ▲► simultaneously and the switch returns to operation mode without storing any new values.

3. When the programming is done, press the keys ►E simultaneously. The new values are stored and the switch returns to operation mode.

Setting line break behavior:

1. When the source signal has been selected, LED K1 is on and the display will show  meaning that the relay energizes by line break. If this figure is not displayed, press ► once and press ▲ until it is corrected. Press E to confirm.

2. LED K2 is on and the display will show , if this figure is not displayed, repeat the procedure above. Press E to confirm.

Setting switching points, relay K1:

1. When the line break behavior is set, the LED for K1, SPL and V are on. Now the lowest switching point for K1 can be set.

2. Press ► to get to the position for the digital to be changed.

3. Press ▲ until the value is correct. In the example, the display should be 001.00. The lower switching point will thus be 1 Volt. If other digits are to be changed, repeat the process using ► and ▲. Press E to confirm.

4. The LED for K1, SPH and V are on. Now the highest switching point can be set.

5. Press ► to get to the position for the digit to be changed.

6. Press ▲ until the value is correct. The display should show 012.00. The higher switching point will be 12 Volt. If other digits are to be changed, repeat the process using ► and ▲.

7. Press E to confirm.

2. 当编程由于某些原因需取消时，同时按 ▲► 回到操作模式，新数值不保存。

3. 编程结束后，同时按 ►E，新数值存储，开关返回至操作模式

设定线性输出:

1. 电源信号选择完毕后，灯 K1 亮，屏幕显示 ，继电器线性激活。若无此显示，按 ► 一次，再按 ▲ 直至正确。按 E 保存

2. 灯 K2 亮，屏幕显示 ，若无此显示，重复上面的过程。按 E 保存

设定继电器 K1 的开关点:

1. 线性输出设置完毕后，K1，SPL 及 V 灯亮。现在可设置 K1 的最低开关点。

2. 按 ► 直至小数点移至要更改的数据的位置。

3. 按 ▲ 改变数值。例如，显示应为 001.00. 低开关点即为 1V。若需要更改，重复 ► 及 ▲。按 E 保存。

4. K1，SPH 及 V 灯亮。现在可设置 K1 的最高开关点。

5. 按 ► 直至小数点移至要更改的数据的位置。

6. 按 ▲ 改变数值。例如，显示应为 012.00. 高开关点即为 12V。若需要更改，重复 ► 及 ▲。

7. 按 E 保存。



Setting switching points, relay K2:

1. The LED for K2, SPL and V are on. The lowest switching point for K2 can be set.
2. Press ► until the blinking dot is in front.
3. Press ▲ until the sign is changed to -.
4. Press ► to get to the position for the digit to be changed.
5. Press ▲ until the value is correct. The display should show -12.00. The lower switching point will thus be -12 Volt. If other digits are to be changed, repeat the process using ► and ▲. Please note that -12V are lower than -1V.
6. Press E to confirm.
7. The LED for K2, SPH and V are on. Now the highest switching point for K2 can be set.
8. Press ► to get to the position for the digit to be changed.
9. Press ▲ until the value is correct, in this example -01.00. The higher switching point for RPM will be -1 Volt. If other digits are to be changed, repeat the process using ► and ▲.
10. Press E to confirm.

Setting switching point behavior K1:

1. LED for K1 and H/S (Hysteresis /Switching point behavior) are on. Switching point behavior will be set.
2. The figure  is displayed, showing that relay K1 is energized between the two setting points. If another figure is displayed, press ► until the figure  is displayed.
3. Press E to confirm.

Setting switching point behavior K2:

1. LED for K2 and H/S is on. Switching point behavior will be set.
 2. Repeat the setting procedure as for K1.
- Setting delay time lower K1:
1. K1 and DTH is on. The delay time for higher setting point is displayed.
 2. Repeat the setting procedure as for delay time lower K1.

设定继电器 K2 的开关点:

1. K2, SPL 及 V 灯亮。现在可设置 K2 的最低开关点。
2. 按►直至小数点移至最前面。
3. 按▲直至信号变为-。
4. 按►直至小数点移至要更改的数据的位置。
5. 按▲改变数值。例如, 显示应为-12.00. 低开关点即为-12V。若需要更改, 重复►及▲。按 E 保存(注意,-12V 低于-1V)。
6. 按 E 保存。
7. K2, SPH 及 V 灯亮。现在可设置 K2 的最高开关点。
8. 按►直至小数点移至要更改的数据的位置。
9. 按▲改变数值。例如, 显示应为-01.00. 高开关点即为-1V。若需要更改, 重复►及▲。
10. 按 E 保存。

设定 K1 输出:

1. K1, H/S 灯亮。现在可设置输出。
2. 屏幕显示 , 即继电器 K1 在两个设置点之间被激活。若无此显示, 按►直至  显示。
3. 按 E 保存。

设定 K2 输出:

1. K2, H/S 灯亮。现在可设置输出。
 2. 重复 K1 的设置过程。
- 设定 K1 低开关点的延迟时间:
1. K1 及 DTL 灯亮。现在可设置低开关点的延迟时间。
 2. 若延迟时间不正确, 按▲直至屏幕显示 1.0S, 即开关延迟 1S 运行。此数值可更改。



3. Press E to confirm.

Setting delay time higher K1:

1. K1 and DTH is on. The delay time for higher setting point is displayed.
2. Repeat the setting procedure as for delay time lower K1.

3. Press E to confirm.

Setting delay time lower K2:

1. K2 and DTL is on. The delay time for lower setting point is displayed.
2. Repeat the setting procedure as for delay time lower K1.

3. Press E to confirm.

Setting delay time higher K2:

1. K2 and DTH is on. The delay time for lower setting point is displayed.
2. Repeat the setting procedure as for delay time lower K1.

3 Press E to confirm.

Test

1. Display reads TEST.
2. By pressing ►, the display will run through a test. Ignore by pressing E.

Save changes :

Press ► E simultaneously to save changes and return to operating state. Signal V for voltage will be on.

In the programming state, the following errors could be displayed:

E.SPH1 K1 的高设置点过高

E.SPH2 K2 的高设置点过高

E.SPL1 Lower switch point for K1 is too low

E.SPL2 Lower switch point for K2 is too low

E.SP1 Lower switch point for K1 is higher than upper switch point

E.SP2 Lower switch point for K2 is higher than upper switch point

E.type Hardware fault

E.Unit Hardware fault

E.REL Hardware fault

3.按 E 保存。

设定 K1 高开关点的延迟时间:

- 1.K1 及 DTH 灯亮。现在可设置高开关点的延迟时间。
- 2.重复 K1 低开关点延迟时间的设置过程。

3.按 E 保存。

设定 K2 低开关点的延迟时间:

- 1.K2 及 DTL 灯亮。现在可设置低开关点的延迟时间。
- 2.重复 K1 低开关点延迟时间的设置过程。

3.按 E 保存。

设定 K2 高开关点的延迟时间:

- 1.K2 及 DTH 灯亮。现在可设置高开关点的延迟时间。
- 2.重复 K1 低开关点延迟时间的设置过程。

3.按 E 保存。

测试:

- 1.屏幕显示 TEST.
- 2.按►, 屏幕将会运行一个测试, 若需跳过, 按 E

保存更改:

同时按下►及 E, 保存更改并返回至操作界面。电压信号 V 灯亮。

在编程状态, 可能有以下错误显示:

E.SPH1 Upper switch point for K1 is too high

E.SPH2 Upper switch point for K2 is too high

E.SPL1 K1 的低设置点过低

E.SPL2 K2 的低设置点过低

E.SP1 K1 的低设置点高于高设置点

E.SP2 K2 的低设置点高于高设置点

E.type 软件错误

E.Unit 软件错误

E.REL 软件错误



In the operating state, the following error could be displayed: 在操作状态，可能有以下错误显示：

E.LB Wire break; or input too large E.LB 电缆断开，或输入太大

Error corrections:

1. If the error message concerns switching points, press E one or more times to get to the switching point to be changed. Change the value of the switching point as explained in the programming description.
2. If the error message concerns hardware faults, switch the power supply on and off. If this is without result, the module should be replaced.
3. When the error concerns wire break or too large input, the electric connections should be checked and the input mode (V30) of the switch should be controlled.

错误纠正：

- 1.若错误信息与开关设置点有关，按 E 一次或多次至需更改的开关点。根据编程描述改变设定值。
- 2.若错误信息与软件错误有关，将电源重启。若仍有错误信息，更换模块。
- 3.当错误与电缆断开或输入过大有关，应检查电气连接点及开关的输入模式 (V30)



第二部分

Part 2



目 录

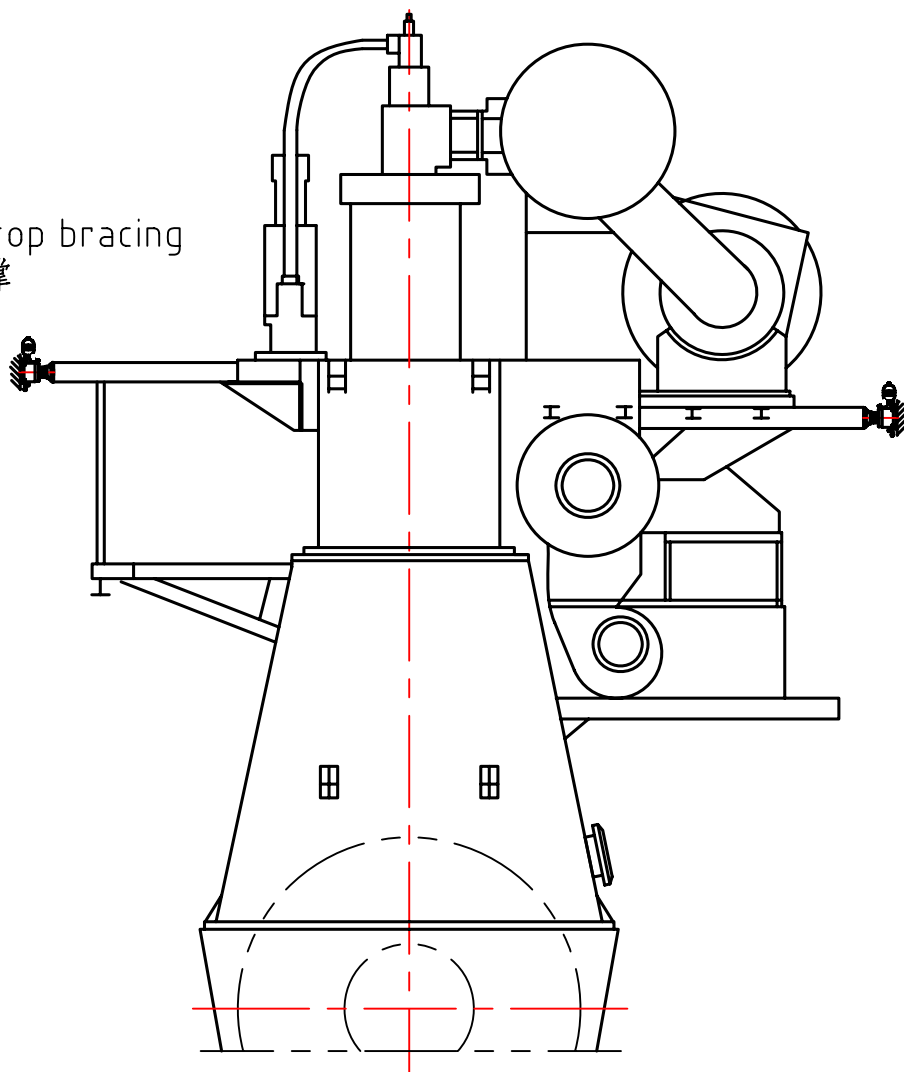
INDEX

1、液压顶推支撑布置图 (DYDZ200-BZ)	
The arrangement diagram of hydraulic top bracing.....	3
2、液压顶推支撑外形尺寸图 (DYDZ200-WX)	
Outline dimensions diagram of hydraulic top bracing.....	4
3、液压顶推支撑系统图(DYDZ200-XT)	
Hydraulic top bracing system diagram.....	5
4、运输用起吊工具 Lifting tools for transport (DYDZ200-QD)	6
5、安装工具 Fitting tool (DYDZ200-GJ)	7
6、液压手摇泵 Hydraulic hand pump (GYB6-WX)	8
7、液压顶推支撑单元图 (DYDZ200-ZC)	
Hydraulic top bracing' s unit diagram.....	9
8、液压顶推支撑工作原理图 (DYDZ200-GZ)	
Hydraulic top bracing' s working principle diagram	10
9、液压顶推支撑系统单元原理图 (DYDZ200-YL)	
Hydraulic top bracing system unit working principle diagram	11
10、程序开关原理图(DYDZ200-DC)	
programmable switch principle diagram	12
11、安装要求 Required of installation (DYDZ200-AZ1)	13
12、安装要求 Required of installation (DYDZ200-AZ2)	14
13、运行不重合度Service misalignment (DYDZ200-DT)	15
14、供货范围 scope of supply (DYDZ200-GH)	16
15、工具、附件清单 Stool and accessories list (DYDZ200-FJ)	17
16、电气控制箱 Electric control box (DYDZ200-DK-WX).....	18
17、电气原理图 Electric principle diagram (DYDZ200-DK-YL)	19
18、电气接线图 Electric connection diagram (DYDZ200-DK-JX1/JX2)	20
19、备件清单 Spare parts list (DYDZ200-BJ)	22
20、充气工具使用说明 Explanation of charge tool' s use (DYDZ200-CQ)	23

DYDZ200-BZ

Hydraulic top bracing
液压顶推支撑

Hull side
船体侧



Hull side
船体侧

借通用件登记

描 图

校 描

旧底图总号

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日 期

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					布置图 arrangement diagram		
					图样标记		
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工艺			日期				

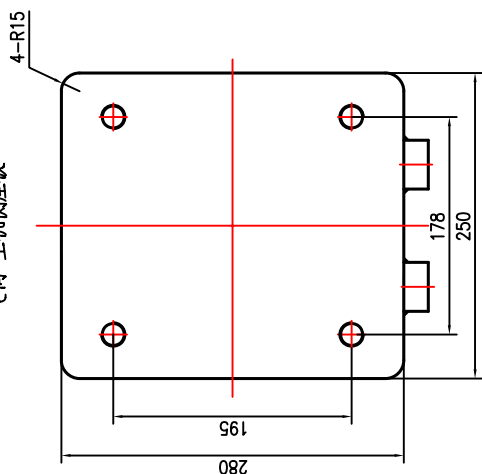
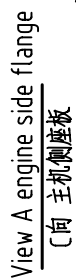


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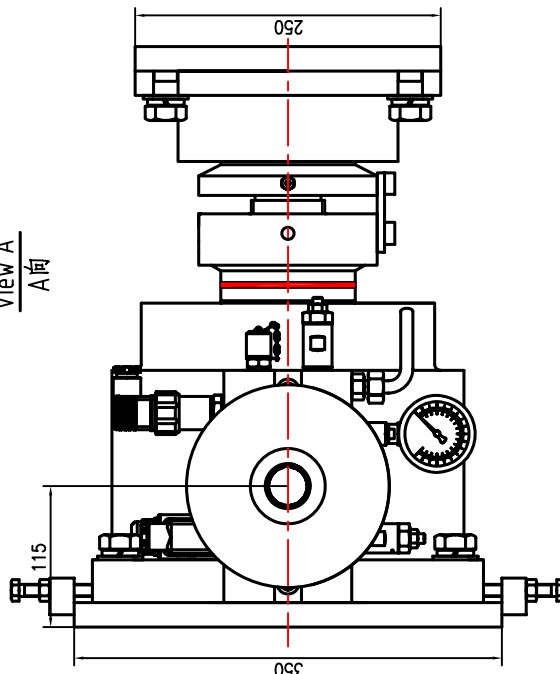
液压顶推支撑
hydraulic top bracing

DYDZ200-BZ

日



View A
A向



U

Engine side
主机側

Hull side 船体側

Oil accumulator
蓄能器

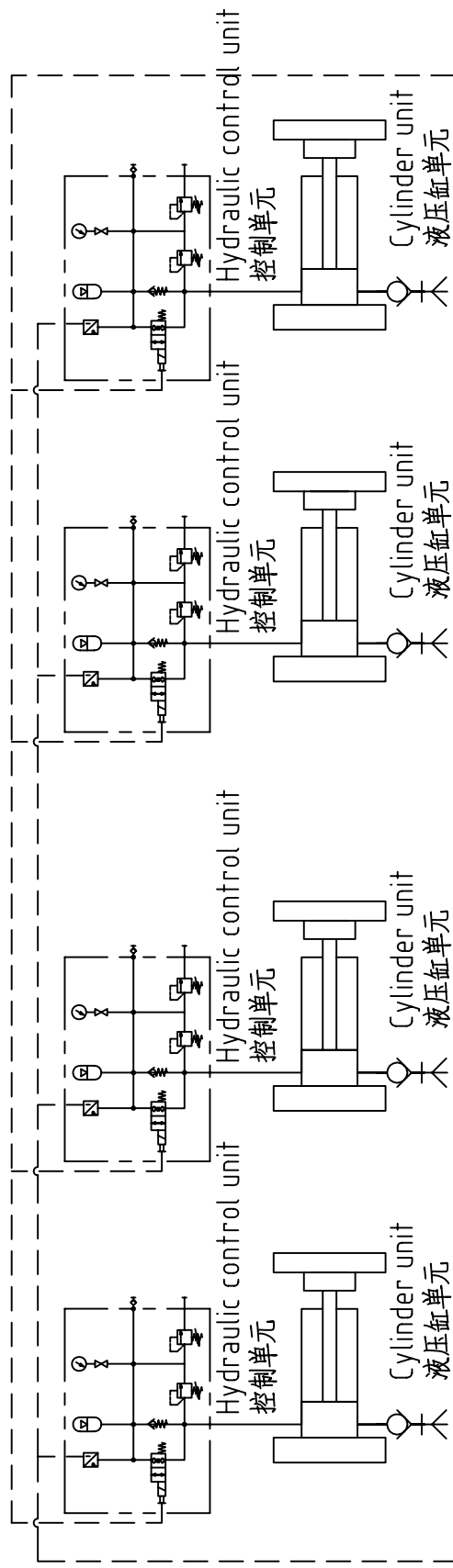
Control U
控制单元

Cylinder unit
液压缸单元

475

日

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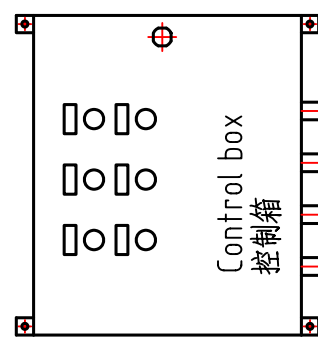


Connection point to AMS
与AMS连接

Oil low pressure alarm
低油压压力报警

— Electrical wire supplied by shipyard
电缆由船厂提供

- Power supply 电源
(Yard supply)(船厂提供)
- RPM Signal 转速信号
(Yard supply)(船厂提供)
- External Signal 其余信号
(Yard option)(船厂选择)

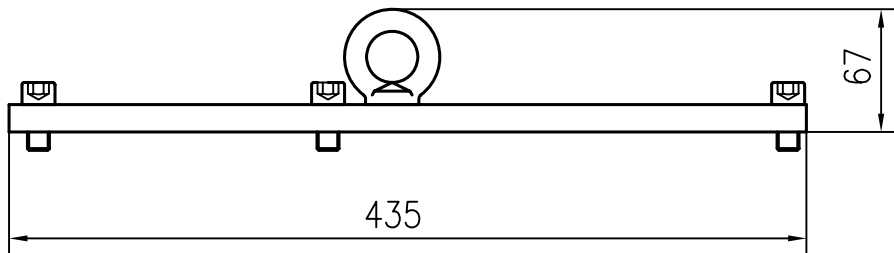


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				液压顶推支撑			
				Hydraulic top bracing			
				DYDZ200-XT			
				系统原理图			
				System Principle diagram			
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DYDZ200-QD



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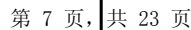


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运输用起吊工具
Lifting tool for tranport

DYDZ200-QD

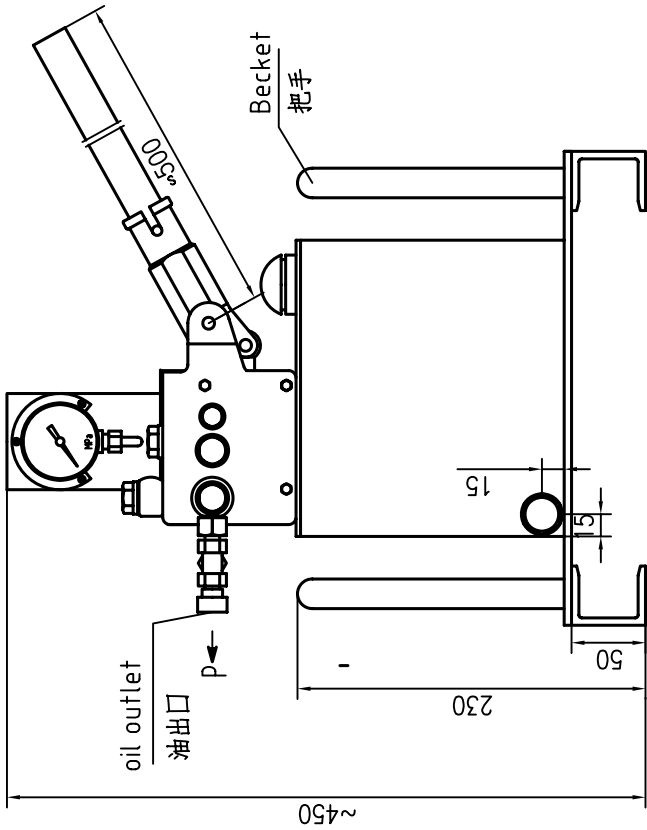
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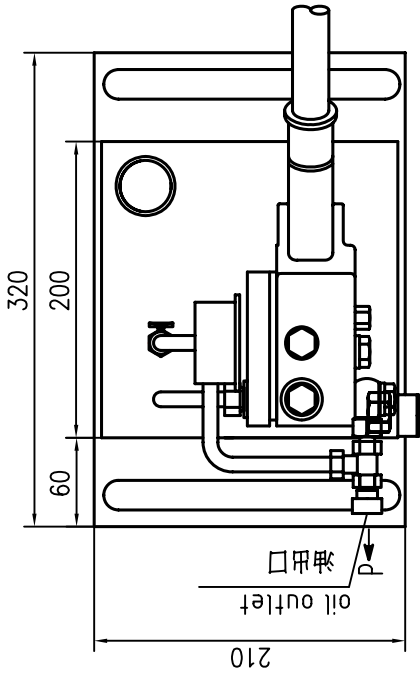
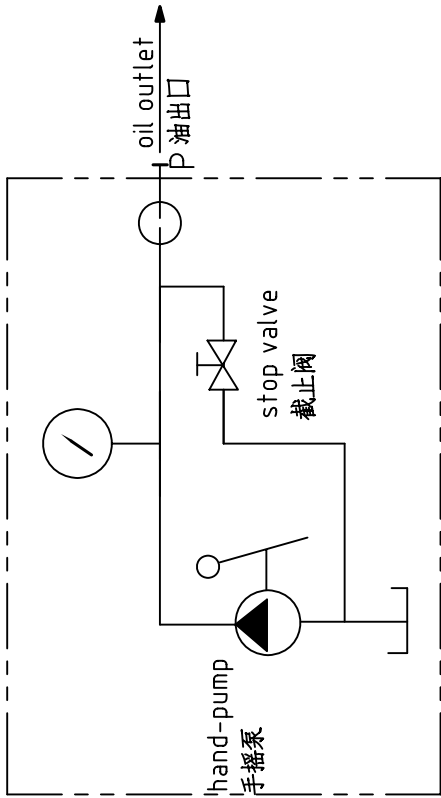
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pipe principle diagram
管系原理图



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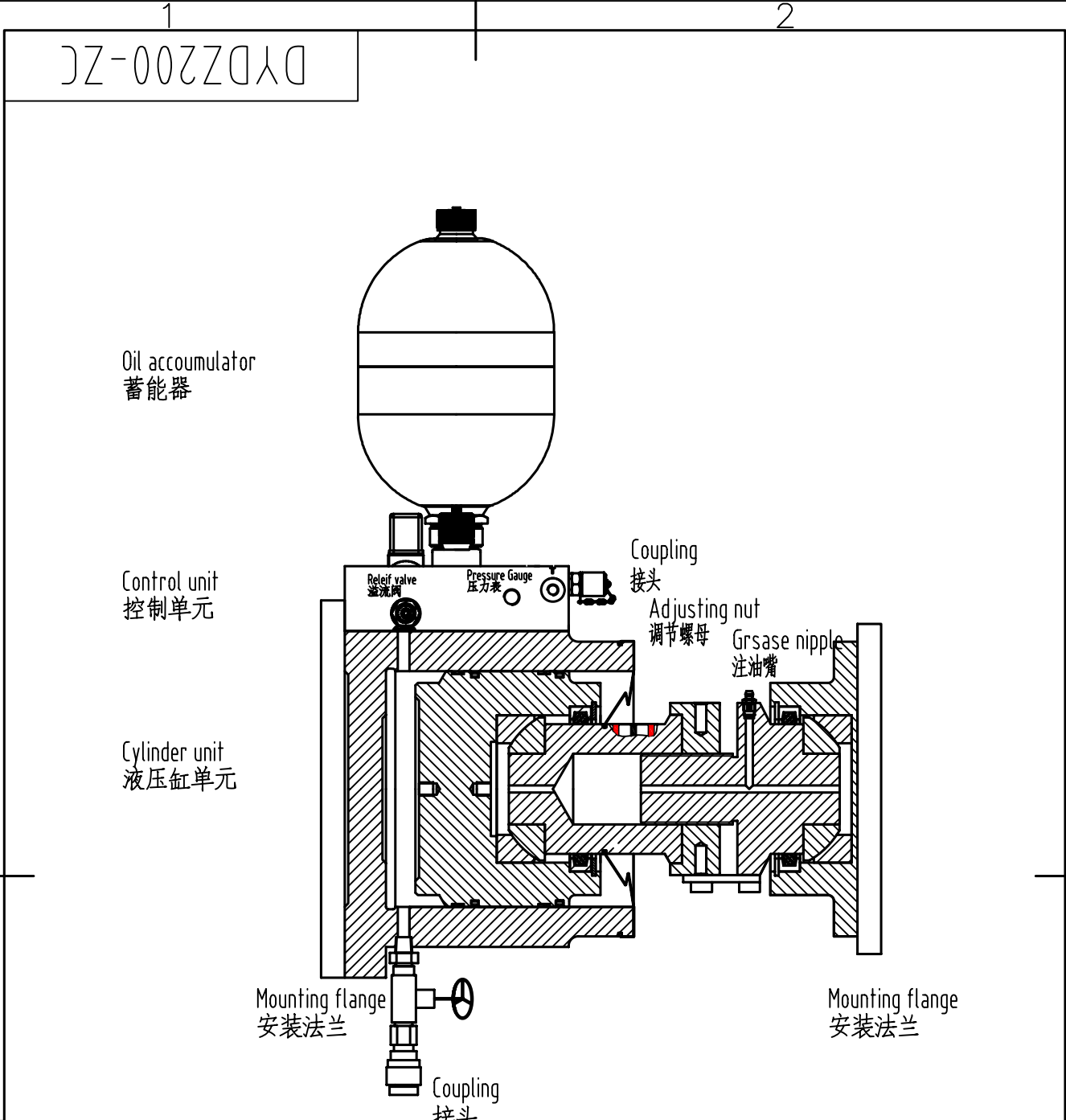
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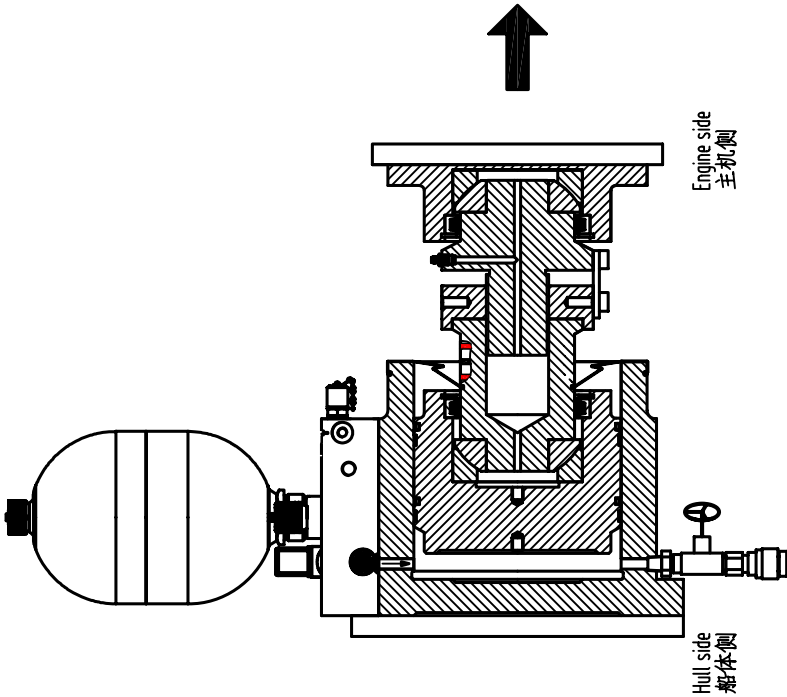
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南通航海机械集团有限公司				外形图				液压手摇泵			
				outline drawing				hydraulic hand pump			
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				1:3.5						GYB6-WX	

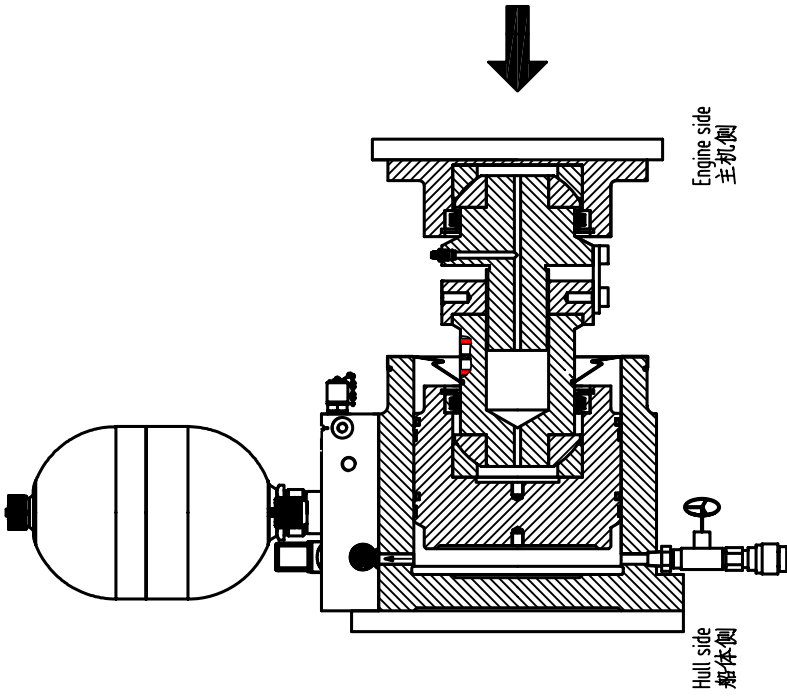
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	审核							1:5		
	工艺			日期						
第 9 页 共 23 页						共 页				



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 and engine increases, 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 and engine decreases, a non-return valve prevents the oil from 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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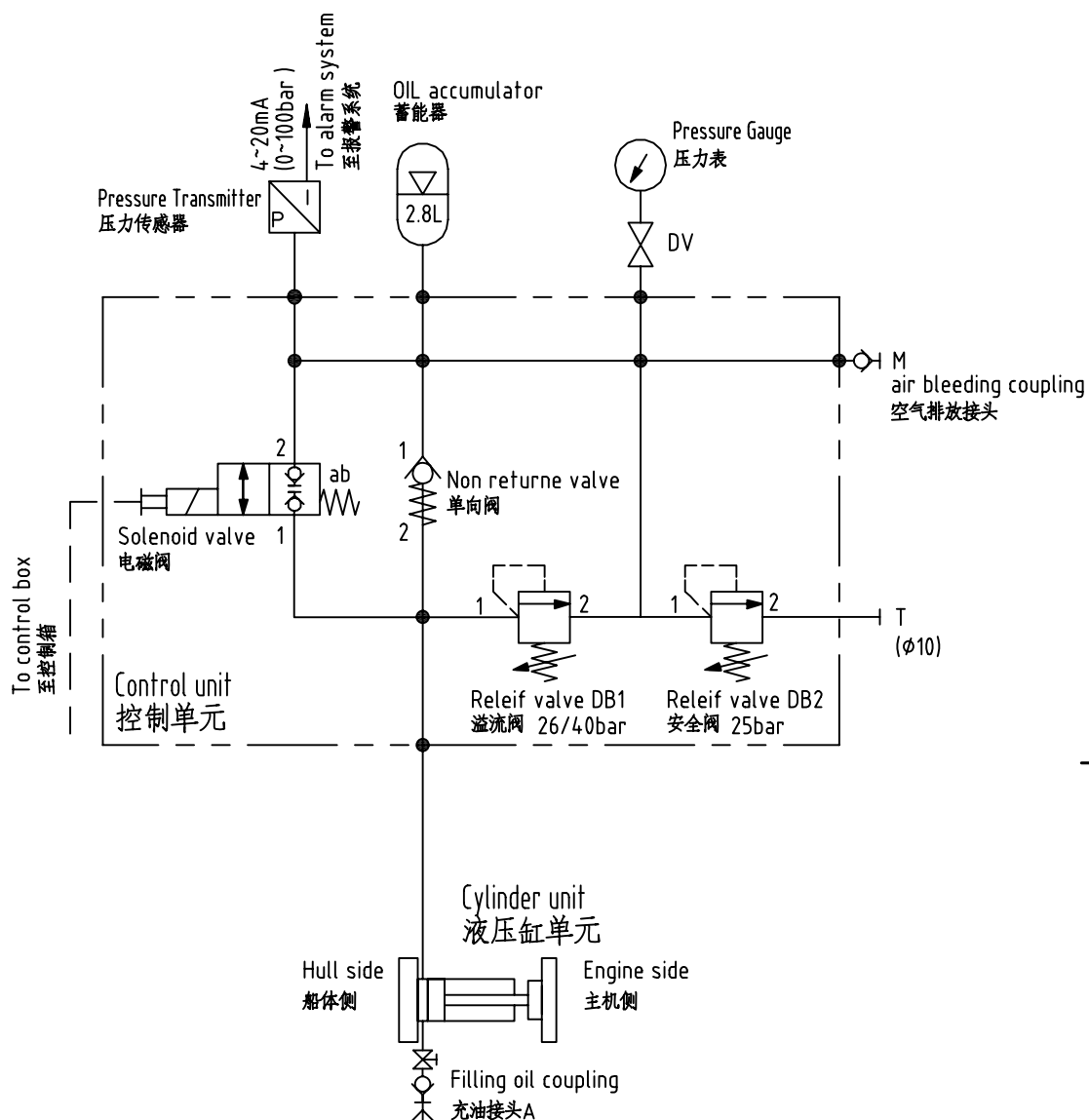
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校对						
审核						
工艺						
共				页	第	页
图样标记				重量	比例	
工作原理				1:5		
液压顶推支撑				hydraulic top bracing		
DYDZ200-GZ						



南通航海机械集团有限公司

DYDZ200-YL

Principle diagram
原理图



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系统单元原理图
system unit working principle



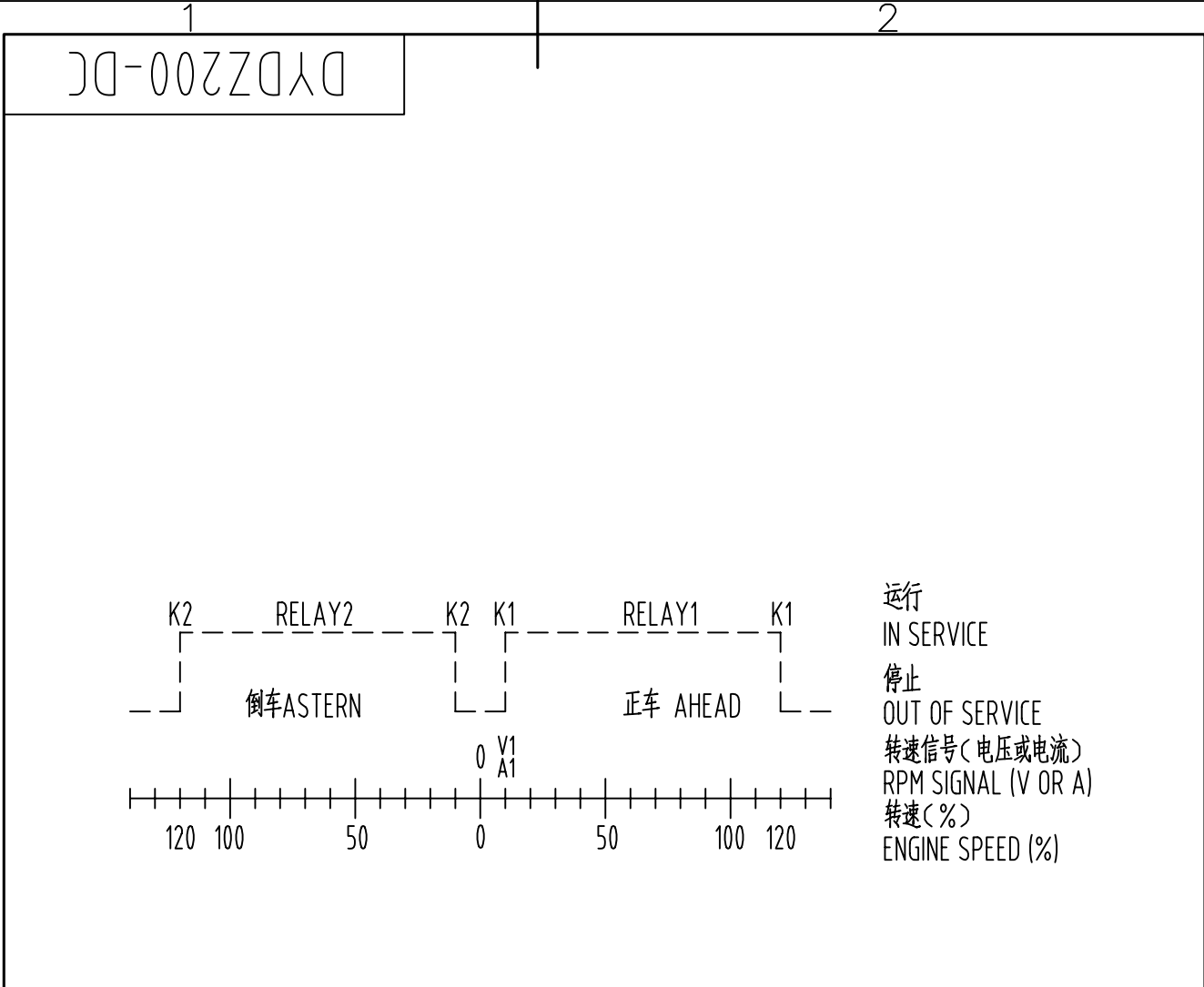
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液压顶推支撑
hydraulic top bracing

DYDZ200-YL

第11页 共23页

第 页

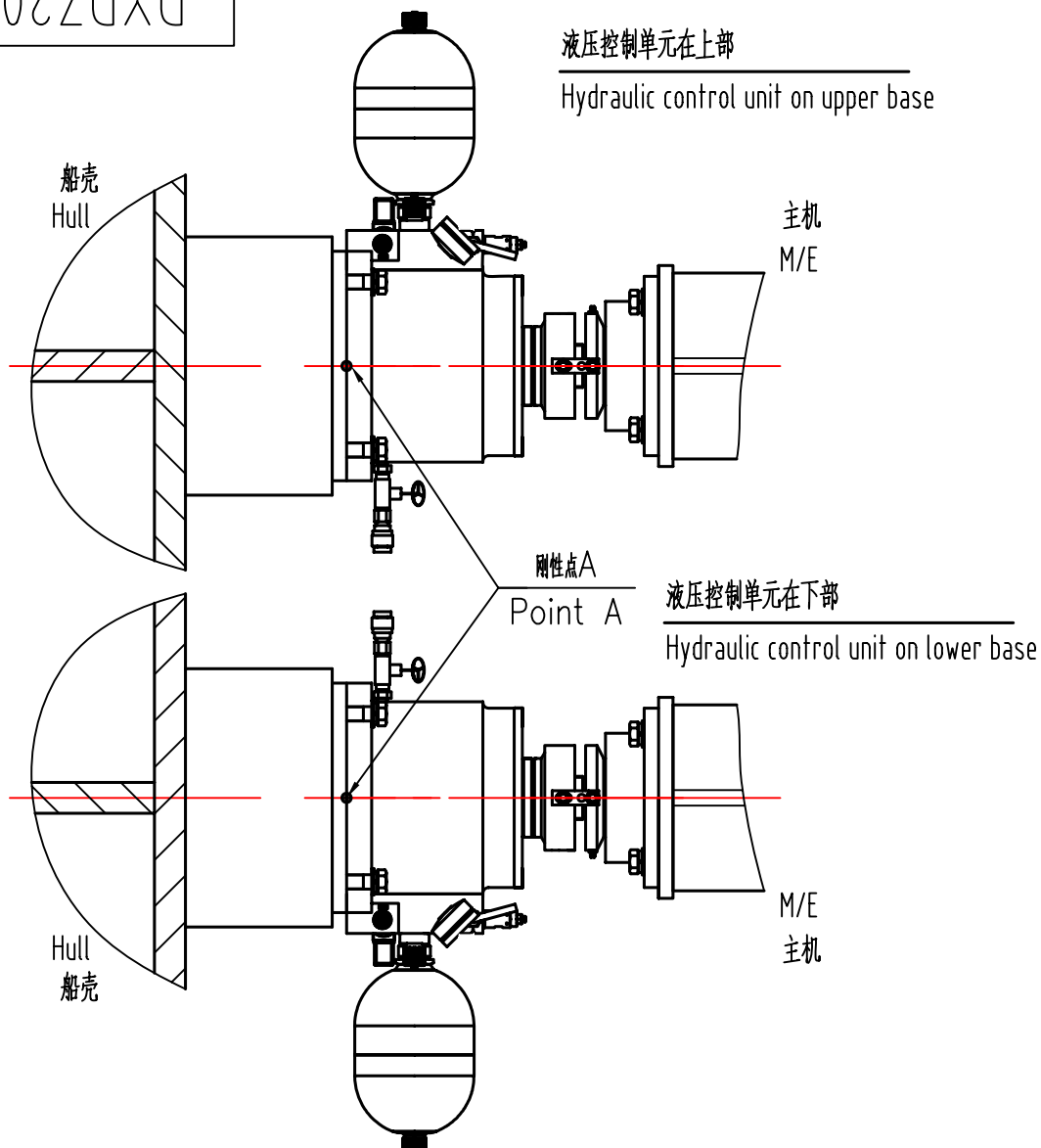


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	校对			审定						
	审核									
	工艺			日期		第12页共23页		第	页	

1

2

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. Corresponding deflation of casing side: 0.51mm

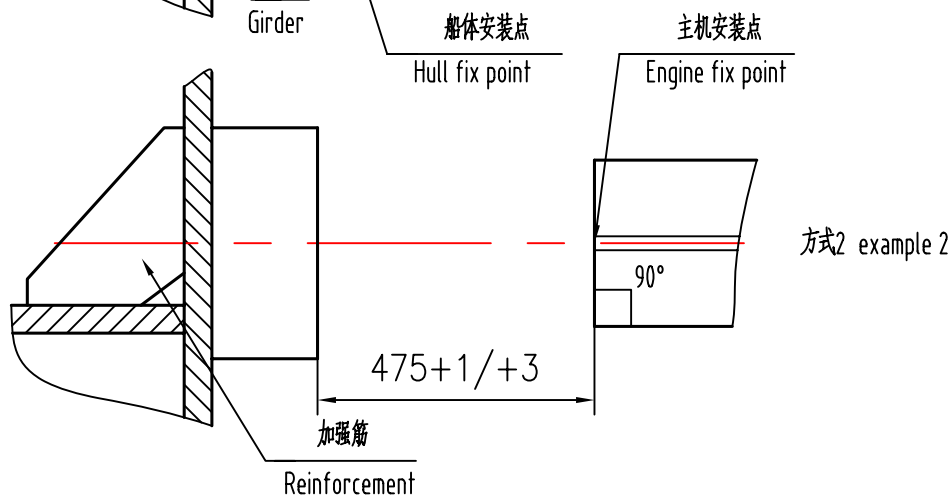
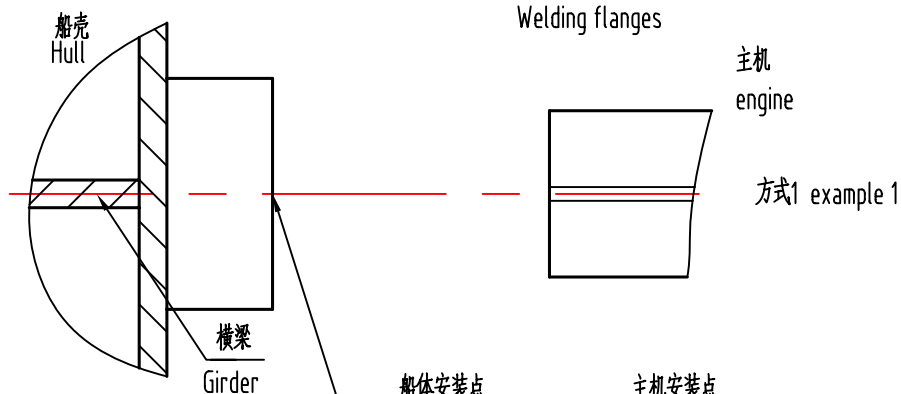
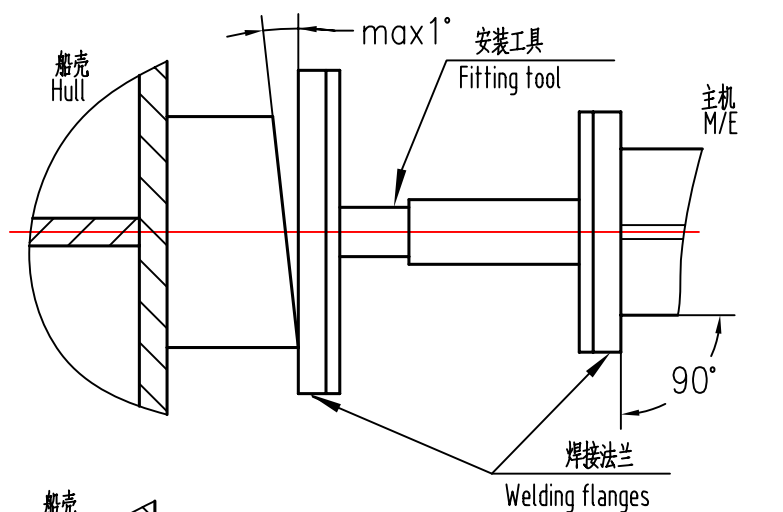
在安装点所在平面的水平和垂直方向施加 22KN 力时, 最大偏移 ≤ 2 mm.

In the horizontal and vertical direction of the top bracing cylinder,
force per bracing: 22KN, Max. corresponding deflation of casing side: 2mm

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												安装要求1 Required of installation					
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审核																	
工艺			日期														

DYDZ200-AZ2



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审核				
工艺				



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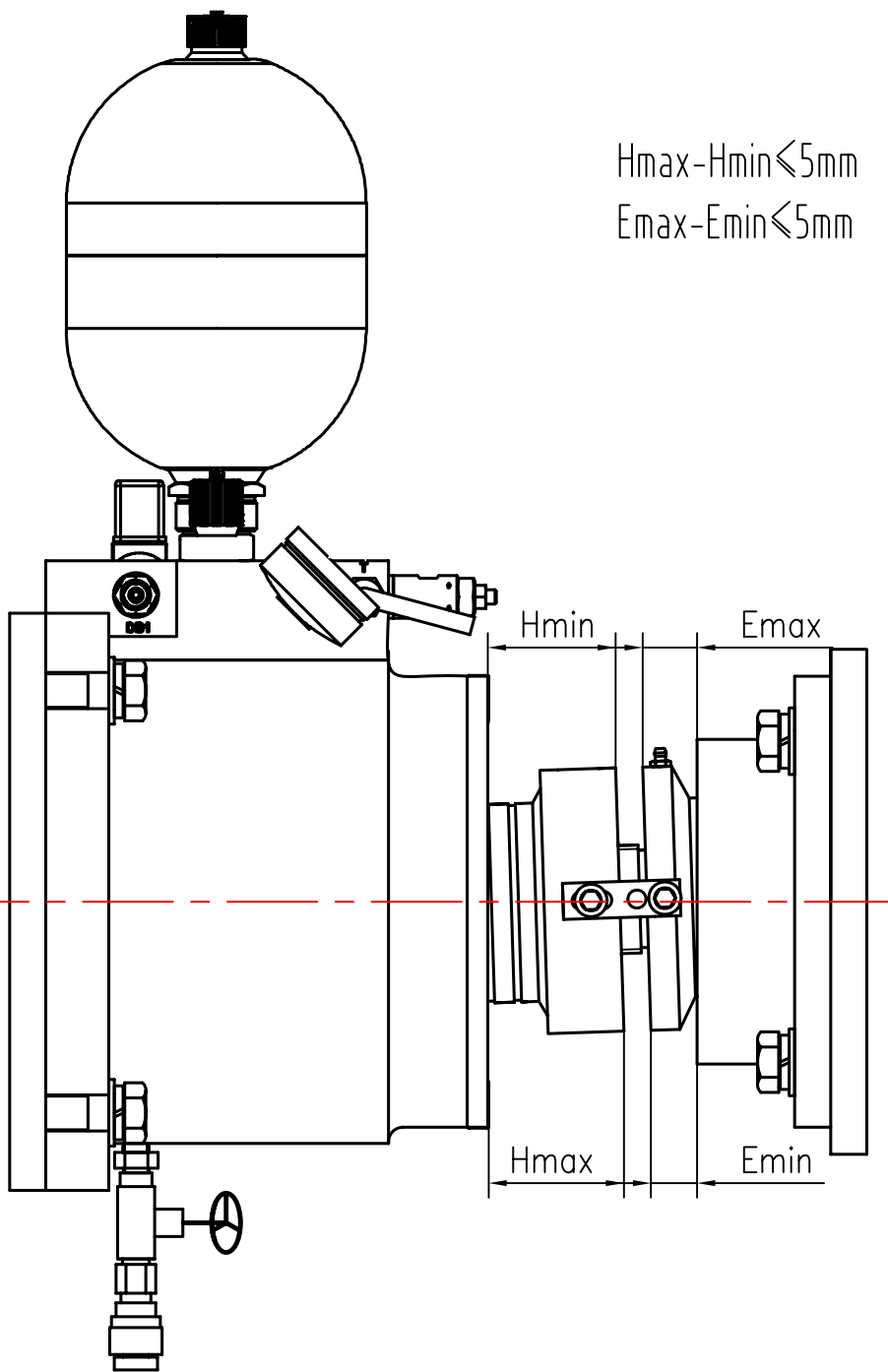
安装要求2
Required of installation 2

DYDZ200-AZ2

第14页共23页

第页

DYDZ200-DT



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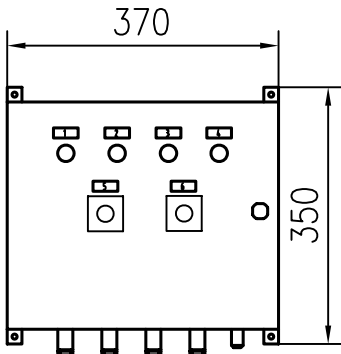
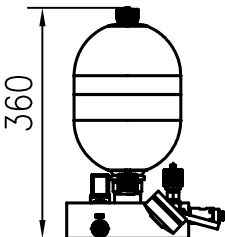
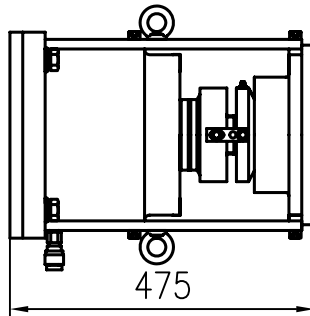


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运行不重合度

Service misalignment

DYDZ200-DT

		1		2					
		HG-00ZZ0A0							
	3	DYDZ200-DK	Electric control box 电气控制箱	component 组件	1				
	2	DYDZ200-FK	Control unit and accumulator include O ring seal 控制单元与蓄能器 含“O”型圈	component 组件	4				
	1	DYDZ200-YG	Cylinder unit 液压缸单元	component 组件	4				
借通用件登记									
描 图									
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		审核							
		工艺		日期			第 16 页 共 23 页 共 页 第 页		
		1				2			

DYDZ200-FJ

B

校 描

Remark
标记

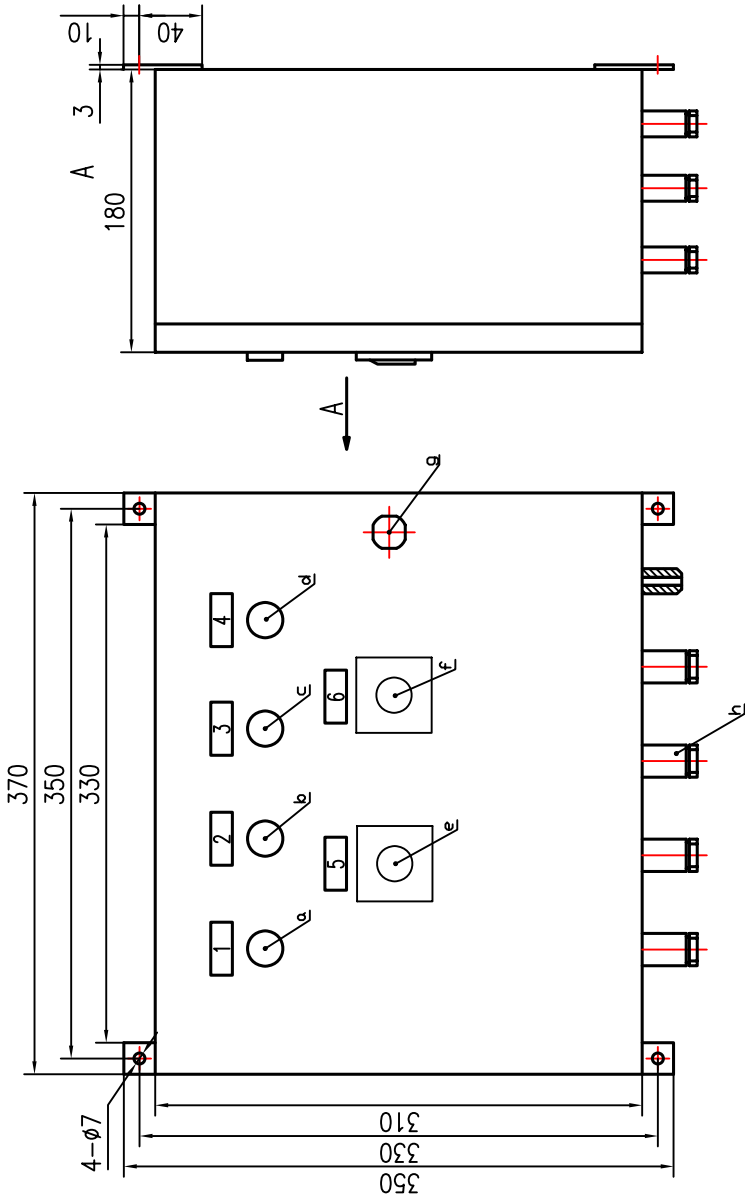
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簽字

日期

第	页
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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)

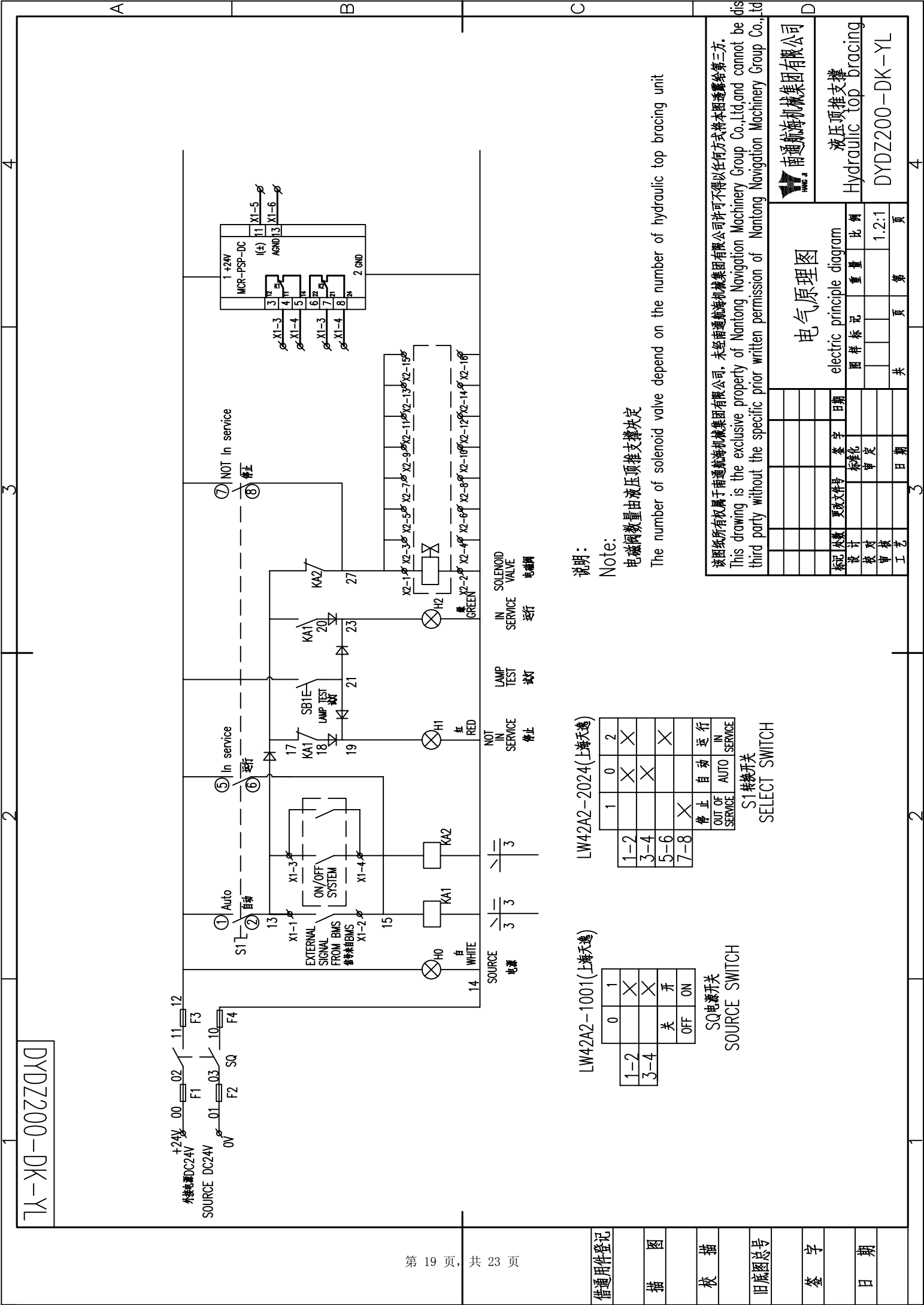
说明:电控箱防护等级为IP44

Note:The protection class of the control box is IP44

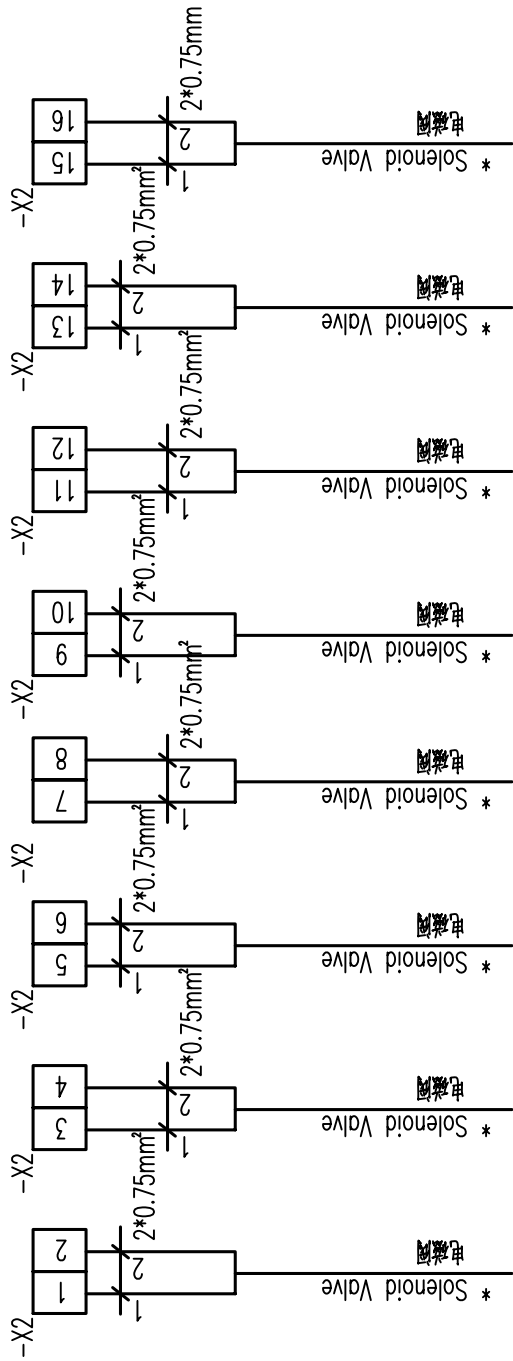
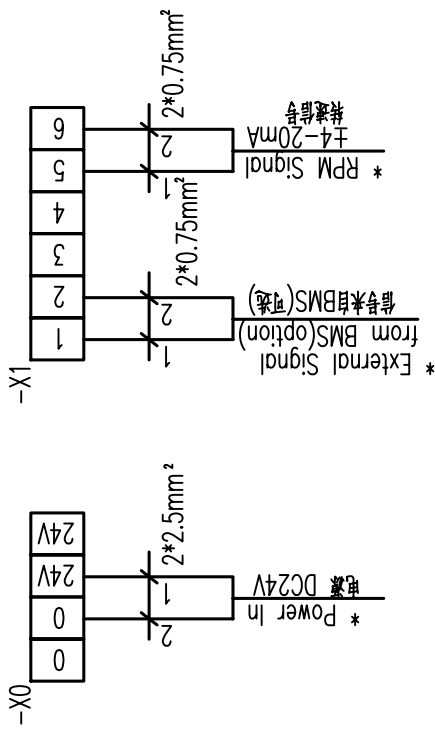
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电气控制箱				南通航海机械集团有限公司			
Electric control box				液压顶推支撑			
				hydraulic top bracing			
				DYDZ200-DK-WX			
标记 页数	更改文号	签字	日期	图 样 标 记	重 量	比 例	
设计		标准化				1:3.3	
技术							
审核							
工艺							
				共	页	第	页
				3			4



1	2	3	4
DYDZ200-DK-YL			
+24V 00 02 11 12 F1 F3 SOURCE DC24V 01 03 10 F2 F4 0V SQ			
1 2 3 4 12 11 10 9 8 7 6 5 4 3 2 1 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1			
1 +24V MCR-PSP-DC (+) 11 AGND 13 2 GND			
X1-3 X1-4 X1-3 X1-4 X2-1 X2-2 X2-3 X2-4 X2-5 X2-6 X2-7 X2-8 X2-9 X2-10 X2-11 X2-12 X2-13 X2-14 X2-15 X2-16			
NOT In service 修正			
In service 运行			
Auto 自动			
S1 转换开关			
EXTERNAL SIGNAL FROM BMS 来自BMS的信号			
ON/OFF SYSTEM ON/OFF系统			
X1-1 X1-2 X1-3 X1-4			
14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34			
H0 H1 H2 WHITE RED GREEN			
SOURCE IN NOT IN SOLENOID 电源 运行 停止 运行 电磁阀			
LW42A2-1001(上海天通)			
LW42A2-2024(上海天通)			
SQ电源开关 SOURCE SWITCH			
S1转换开关 SELECT SWITCH			
说明: Note: 电磁阀数量由液压顶推支撑决定 The number of solenoid valve depend on the number of hydraulic top bracing unit			
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南通航海机械集团有限公司 Hydraulic top bracing DYDZ200-DK-YL			
电气原理图 electric principle diagram 图样标记 重量 比例 1.2:1			
共 页 第 页			



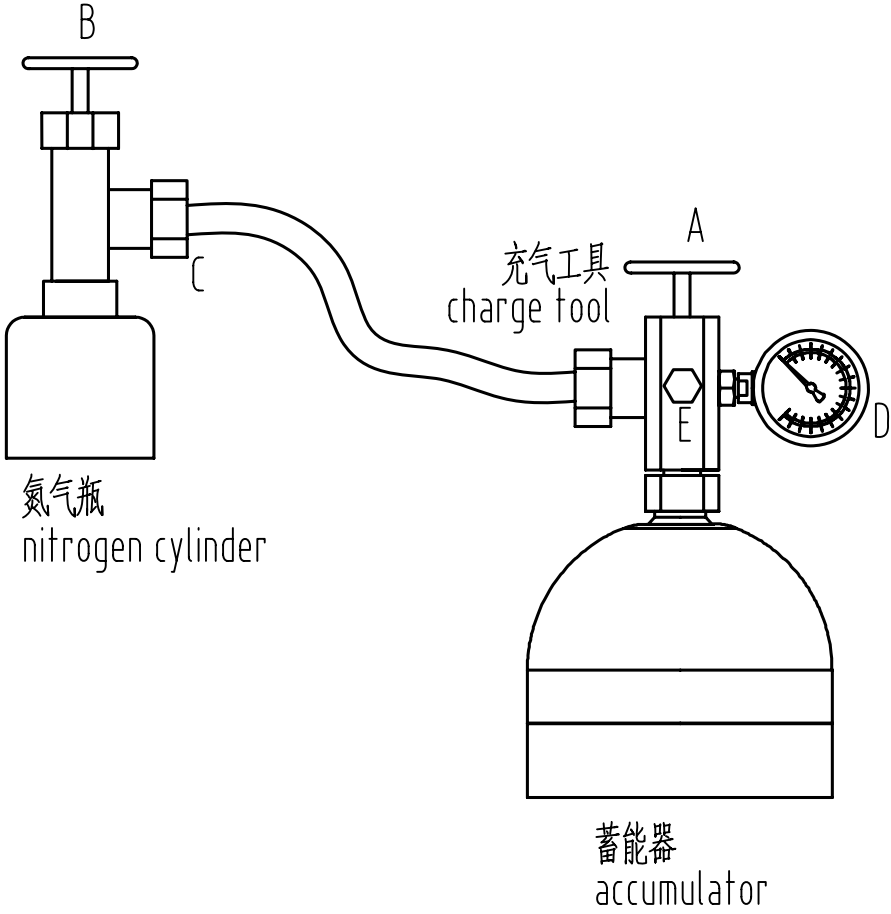
- 说明:
NOTE:
1 电磁阀数量取决于液压顶推支撑单元
The number of solenoid valve depend on no. of Hydr. Top Bracing Unit
2 “*” 部分由船厂接线
“*” part supply by shipyard

2 部分由船厂接线 part supply by shipyard										南通航海机械集团有限公司									
电气接线图 1										液压顶推支撑									
Electric connection diagram 1										Hydraulic top bracing									
										DYDZ200-DK-JX1									

A

B

第22 页 共 23 页



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签字						 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		
日期	标记	处数	更改文件号	签字	日期	图样标记	重量	比例
	设计			标准化				1:4
	校对			审定				
	审核							
	工艺			日期		第 23 页 共 23 页		第 页