JOHANNES HÜBNER GIESSEN

ideas and solutions

中文 | ENGLISH

安装空心轴编码器
扭矩支架，适配轴

Mounting encoders with hollow shaft
Torque brackets, adapter shafts

目录

任务和解决方案	3
扭矩支架结构	4
确定扭矩支架所需的杆长度	5
编码器 / 扭矩支架 / 安装底座概览表	6
安装带扭矩支架的空心轴编码器	8
绝缘/安全型安装	10
安装空心轴编码器的适配轴	11

Contents

Task and solution	3
Structure of a torque bracket	4
Determining the required lever length of the torque bracket	5
Overview tables of encoders / torque brackets / mounting plates	6
Mounting hollow shaft encoders with a torque bracket	8
Isolation / Safety installations	10
Adapter shafts for mounting hollow shaft encoders	11

精确度、优势、以客户为中心
我们专注于技术 – 我们理解我们的客户。我们以卓越的理念和量身定制的解决方案坚定的站在您的身边，并通过为客户提供强大的编码器系统、强大的驱动技术和全球化服务来支持我们的客户。这就是我们如何与客户共同努力，克服重型工业和其他恶劣条件下的领域的巨大挑战，并可持续地改善他们的业务，您希望我们应对哪些挑战？

我们的应用领域：
- 金属和轧机技术
- 港口和起重机技术
- 矿山工业
- 石油和天然气工业
- 造纸工业
- 运输
- 海洋工程
- 发电
- … 以及许多其他应用领域

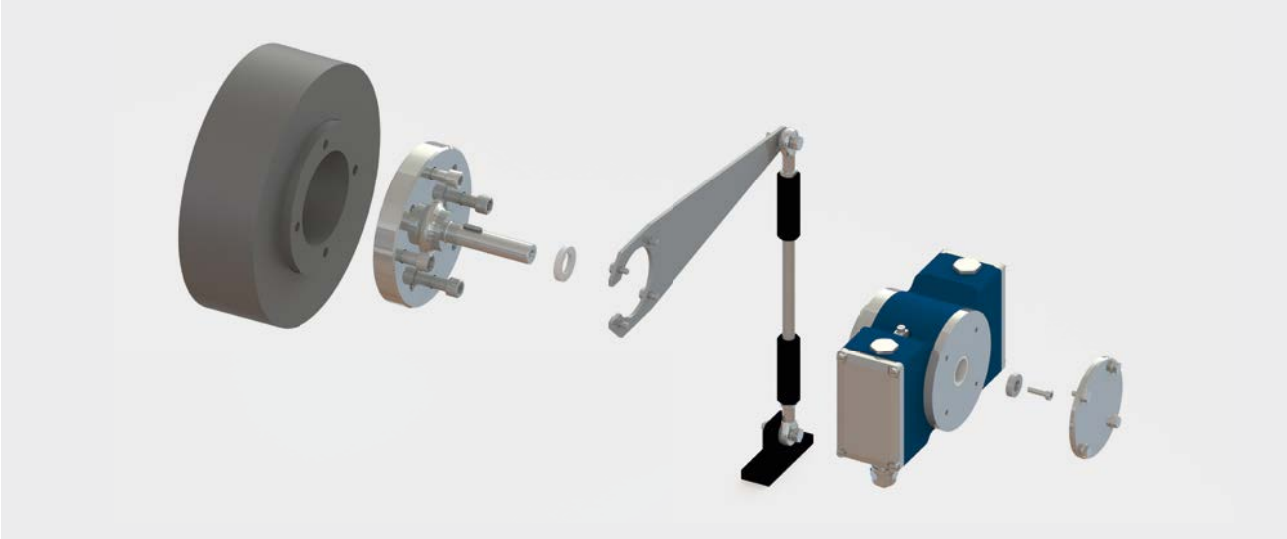
Precision. Strength. Customer focused.
We are fascinated by technology – and we understand our customers. We stand firmly at your side with exceptional ideas and tailor-made solutions and support our customers by offering them robust encoder systems, powerful drive technology and global service. This is how we work together with our customers to overcome the huge challenges in the heavy-duty industry and other fields subject to harsh conditions and to sustainably improve their business. What challenges do you want us to tackle?

Our fields of applications:
- Metal and rolling mill technology
- Harbour and crane technology
- Mining industry
- Oil and gas industry
- Paper industry
- Transport
- Marine engineering
- Power generation
- … and many other applications

任务和解决方案 Task and Solution

任务
重工业要求编码器解决方案能够多年可靠地提供过程控制所需的信号，即使在由于冲击、振动、温度、粉尘、污垢和液体造成的重负载的极端环境条件下也是如此。潜在爆炸性环境涉及更高的挑战性要求。每一次非计划性停机都会造成重大的生产损失。除了选择合适且坚固耐用的编码器外，机械安装的质量对信号质量有重要影响。安装空心轴编码器时，需要补偿传动轴的径向偏差和轴向窜动以及由于安装公差导致的径向跳动。

Task
The heavy-duty industry demands encoder solutions that reliably provide the required signals for process control over many years, even under extreme environmental conditions with heavy loads due to shock, vibration, temperature, dust, dirt and liquids. Potentially explosive environments involve further challenging requirements. Every unplanned down-time causes high production losses. In addition to selecting a suitable robust encoder, the mechanical mounting quality also significantly influences the signal quality. When mount-ing hollow shaft encoders, the radial eccentricity and axial motions of the drive shaft and the radial runout caused by the fitting tolerance have to be compensated.



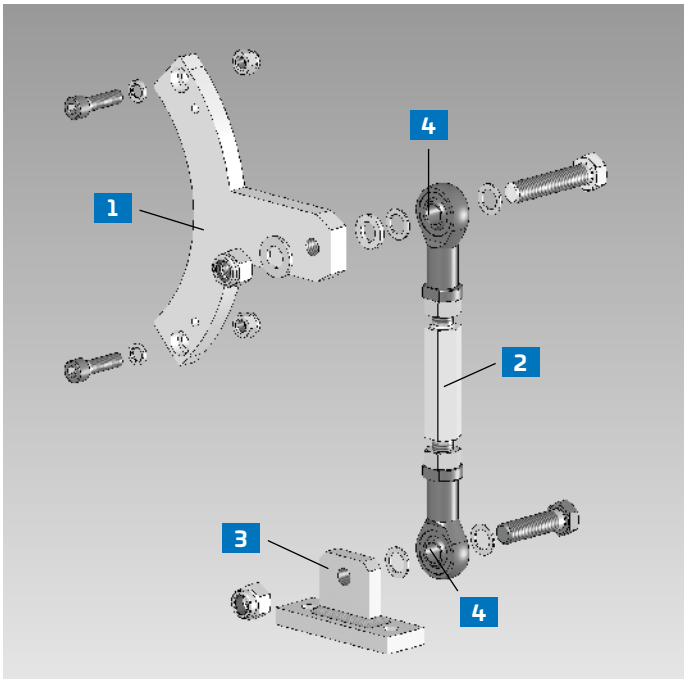
解决方案
Johannes Hübner Giessen，重工业中在全球范围内真正的重载编码器解决方案的专家提供合适的抗扭联轴器、适配器盘和中间法兰，用于在恶劣的环境条件下安装增量和绝对值编码器。

以下产品可用于安装空心轴编码器：
- 法兰式适配轴
- 拧入式适配轴
- 扭矩支架
- 不同长度、直径以及不同的紧固选项
- 多种带和不带定心螺纹的轴
- 选项：不锈钢连接头的扭矩支架
- 选项：防止轴承和轴电流的隔离
- 具有功能安全型（PL e）的编码器安装的特殊设计
- 按要求个性化设计

Solution
Johannes Hübner Giessen, the specialist for genuine heavy-duty encoder solutions in the heavy-duty industry worldwide, offers suitable individually designed adapter shafts and torque brackets for the hollow shaft mounting of incremental, absolute and further encoders under tough environmental conditions.

The following products are available for mounting encoders with a hollow shaft:
- Flange adapter shafts
- Screw-in adapter shafts
- Torque brackets
- Different lengths, diameters and fastening options
- Variants for shafts with and without a centering thread
- Optional: torque brackets with stainless steel link heads
- Optional: isolation of adaptershaft and torque bracket for protection against shaft currents
- Special designs for encoder installations with functional safety (PL e)
- Individual designs on request

扭矩支架结构
Structure of a torque bracket



1 各种长度的支架臂

2 各种长度的扭矩支架杆

3 个性化设计的底座

4 免维护，抗腐蚀的连接头

1 Bracket arm with a variable length

2 Torque bracket rod with a variable length

3 Base plate with an individual design

4 Maintenance-free, corrosion-resistant link heads

由抗腐蚀性材料制成的连接头可选择，适用于露天采矿、近海（例如港口起重机）或恶劣环境条件下的应用。

Link heads made of stainless steel are optionally available for applications in open-pit mining, close to the sea (e.g. port cranes) or under aggressive environmental conditions.

安装空心轴编码器时的不准确是由以下原因引起的：
- 驱动轴的径向偏差 α_1
- 由配合公差 α_2 引起的径向偏差
- 驱动轴的轴向窜动 α_3

由这些不准确性导致的测量误差加在一起，总旋转角度误差为：
总体 $\alpha = \alpha_1+\alpha_2+\alpha_3$

旋转角度误差可以通过以下方式减少：
- 安装精度高
- 扭矩支架中的长杆臂长

Inaccuracies when mounting hollow shaft encoders are caused by:
- Radial eccentricity of the drive shaft α_1
- Radial eccentricity caused by the fitting tolerance α_2
- Axial motion of the drive shaft α_3

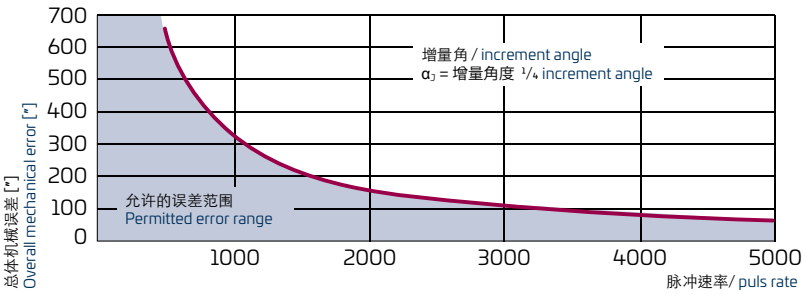
The measurement errors resulting from these inaccuracies add up to an overall rotation angle error of:

$\alpha_{Overall} = \alpha_1 + \alpha_2 + \alpha_3$

The rotation angle error can be reduced by means of:
- High mounting precision
- A long lever arm length in the torque bracket

确定扭矩支架所需的杆长度
Determining the required lever length of the torque bracket

确定增量编码器的最大允许总体误差 $\alpha_{Overall}$ 的选择表 取决于脉冲速率 / Selection table for determining the maximum permitted overall error, $\alpha_{Overall}$, for an incremental encoder depending on the pulse rate

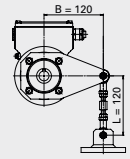
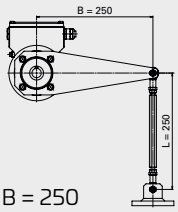
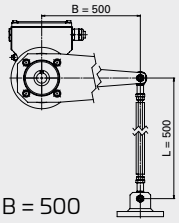


当安装单圈分辨率为12位或更高分辨率的绝对值编码器时，可以假定最大允许总误差为80″。

A maximum permitted overall error of 80″ can be assumed for mounting absolute encoders with a singleturn resolution of 12 bit or higher.

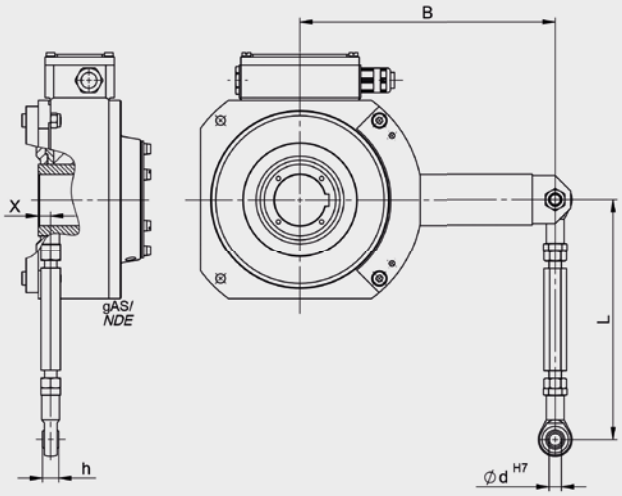
根据机械引起的总体误差，确定扭矩支架所需支架臂长度的选择表，“$\alpha_{Overall}$”($\alpha_{Overall} = \alpha_1 + \alpha_2 + \alpha_3$) / Selection table for determining the required lever arm length of the torque bracket depending on the mechanically caused overall error, “$\alpha_{Overall}$” ($\alpha_{Overall} = \alpha_1 + \alpha_2 + \alpha_3$)

$\alpha_{Overall} = \alpha_1 + \alpha_2 + \alpha_3$ / $\alpha_{Overall} = \alpha_1 + \alpha_2 + \alpha_3$

	旋转角度错误 α_1 [″] Rotational angle error α_1 [″]					旋转角度错误 α_2 [″] Rotational angle error α_2 [″]				旋转角度错误 α_3 [″] Rotational angle error α_3 [″]				
	轴的径向偏差 [mm] Radial eccentricity of shaft [mm]					装配误差引起的径向偏差 [mm] / Radial eccentricity caused by fitting tolerance [mm]				轴向串动 [mm] Axial motion [mm]				
	0,02	0,04	0,06	0,08	0,10	0,02	0,04	0,06	0,08	1	2	4	6	10
 B = 120	35″	69″	103″	138″	172″	35″	69″	103″	138″	8″	29″	115″	260″	718″
 B = 250	17″	33″	50″	66″	83″	17″	33″	50″	66″	2″	7″	27″	60″	166″
 B = 500	9″	17″	25″	33″	42″	9″	17″	25″	33″	1″	2″	7″	11″	45″
B = 1000	5″	9″	13″	17″	21″	5″	9″	13″	17″	0,1″	0,5″	2″	4″	11″

扭矩支架的长度（L）仅在轴向行程的情况下有主要影响，此时应选择最大可能的长度。/ The length (L) of the torque bracket only has a major influence in the case of axial stroke, when the maximum possible length should be selected.

编码器 / 扭矩支架 / 安装底座概览表
Overview tables of encoders / torque brackets / mounting plates

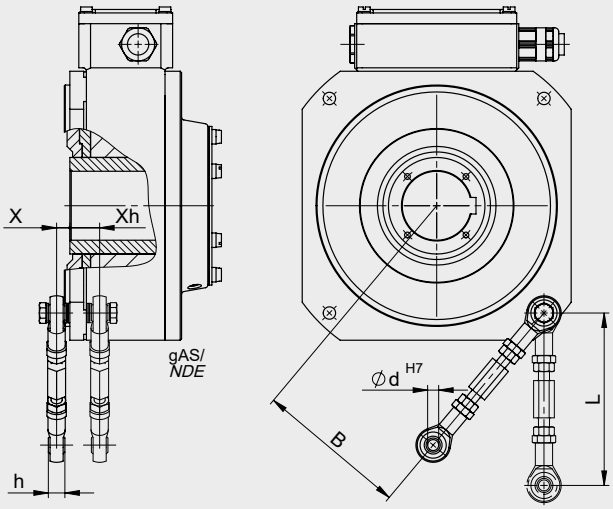


1. 带支架臂的扭矩支架 / Torque bracket with a bracket arm

型号 / Type	图纸 / Drawing	可获得绝缘的变形体 / Isolated variants available	d H7	h	X	B	L
FGHJ 2	HM 11 M 1042 10b	no	6	9	20,5	69,5	变量/ variable
FGH 40, FGH 4, A...H 40, A...H 4, UOMH(J) 4L, UOMH(J) 41, USLH 42	HM 09 M 102 203a	yes	8	12,2 / 15,2 iso	15,7	120 – 500	
FGH 6	HM 03 M 55 771	yes	12	16	12	150 – 750	
A...H 60	HM 19 M 114 729	yes	8 / 12	12	12,2	175 – 750	
FGH 8	HM 03 M 55 764	no	12	16	12	350 – 750	
FGH 14	HM 02 M 55 597	yes	12	16	35	200 – 565	

其它尺寸按要求提供 / *other dimensions on request*

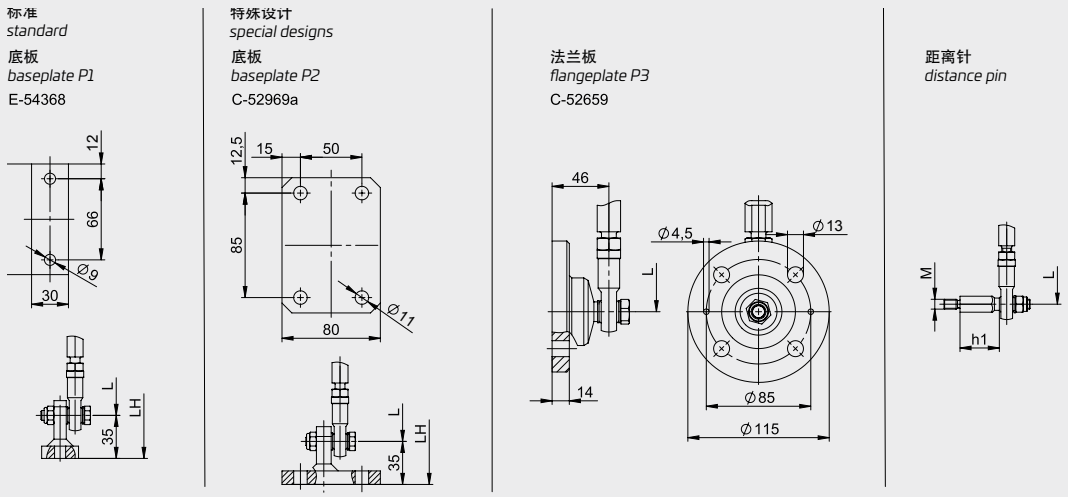
编码器 / 扭矩支架 / 安装底座概览表
Overview tables of encoders / torque brackets / mounting plates



2. 直接安装在外壳上的扭矩支架 / Torque bracket mounted directly on the housing

型号 / Type	图纸 / Drawing	可获得绝缘的变形体 / Isolated variants available	d H7	h	X	Xh	B	L
FGH 6	HM 03 M 55 770	yes	8	12	10	-	110	变量/ variable
FGH 8	HM 02 M 55 627	yes	8	12	8	27,7	140	
FGH 14	HM 02 M 55 587	yes	14	19	-	-	200	
FGH 40	HM 10 M 101 771a	yes	6	9	4	-	42,5	

其它尺寸按要求提供 / *other dimensions on request*



扭矩支架的底座/法兰盘 / Base - and Flange plates for torque brackets

安装螺栓可按照用户的要求设计

Mounting bolts can be designed to meet individual customer requirements.

安装带扭矩支架的空心轴编码器
Mounting hollow shaft encoders with a torque bracket

选择扭矩支架

- 扭矩支架臂与扭矩支架杆的理想安装角度为90°角。
- 考虑到脉冲速率和/或编码器的分辨率，根据相应安装点的最大允许总体误差确定所需的宽度尺寸B。
- 根据预设支撑/基点确定长度尺寸L。
- 选择支撑点：轴和支撑点之间应该有一个没有相对运动（例如由振动引起）的区域
- 扭矩支架的理想安装点：底座固定于静止的表面上或者电机上的紧固螺栓
- 按需要选择：隔离、不锈钢、安全为主（排除故障）

Selecting the torque bracket

- The ideal mounting line from the bracket arm to the bracket rod of the torque bracket is at an angle of 90°.
- Determine the required width dimension B based on the maximum permitted overall error of the respective mounting point in consideration of the pulse rate and / or the resolution of the encoder.
- Determine the length dimension L based on the intended support / base point.
- Select the support point: an area without relative motion (e.g. caused by vibration) should be located between the shaft and the support point
- Ideal mounting points for the torque bracket: base plate on an immovable surface, fastening bolt on the motor
- Select options where required: isolation, stainless steel, safety-oriented (with fault exclusion)

安装空心轴编码器

1. 准备安装点：清洁（电机）轴、止口、紧固表面和紧固螺纹，并检查是否损坏。
2. 安装适配器轴，并使用百分表对其校准。适配轴末端的径向跳动不应超过0.05 mm。如有需要，使用球头顶丝将适配轴对正，然后用螺纹紧固胶（如Loctite®243）将其固定。
3. 使用随机提供的螺丝固定将支架臂固定在编码器上。
4. 将空心轴编码器安装在适配轴上。空心轴编码器必须能够平稳地滑动到适配轴上——在任何情况下都不能用增加的力滑到适配轴上。不要使用锤子，因为这可能会损坏轴承。
5. 将扭矩支架固定到支撑点上。转动扭矩支架杆进行的微调。
6. 使用随机提供的轴向张力环和相应的内六角螺丝固定空心轴编码器。
7. 使用端盖和螺丝封闭空心轴编码器。
8. 不要在扭矩支架的连杆头上涂漆

Mounting hollow shaft encoders

1. Prepare the mounting point: clean the (motor) shaft, centering, fastening surfaces and fastening thread and check for damage.
2. Mount the adapter shaft and use a gauge to align it. The radial runout at the end of the adapter shaft should be no more than 0.05 mm. If required, use the ball thrust alignment screws to align the adapter shaft, then secure it with screw retention (e.g Loctite® 243).
3. Use the supplied screws to fasten the bracket arm of the torque bracket to the hollow shaft encoder.
4. Mount the hollow shaft encoder on the adapter shaft. The hollow shaft unit must slide smoothly onto the adapter shaft – under no circumstances should it be slid on with increased force. Do not use a hammer because this may damage the bearings.
5. Fasten the torque bracket to the support point. Carry out fine alignment of by turning the torque bracket rod.
6. Use the supplied axial tensioning disc and corresponding cylinder head screw to secure the hollow shaft unit.
7. Use the cover and screws to close the hollow shaft unit.
8. Do not paint the link heads of the torque bracket

安装带扭矩支架的空心轴编码器
Mounting hollow shaft encoders with a torque bracket

检查安装的扭矩支架
- 安装后，扭矩支架杆应在连杆头内易于用手拧转。
- 每年至少检查一次连杆头的平滑度。
- 如果连杆头被卡住，用特氟隆喷雾或稍微润滑一下。

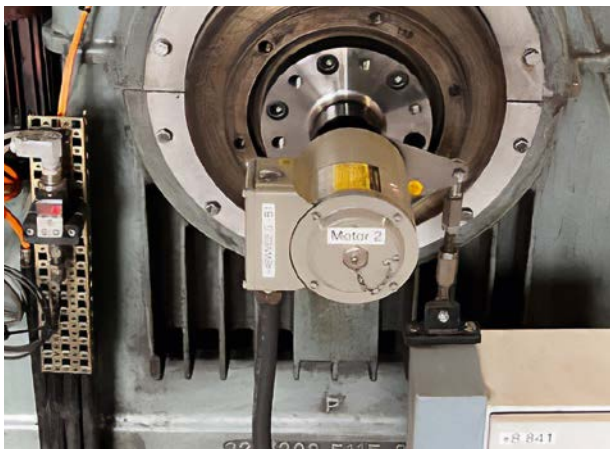
Checking the mounted torque bracket
- After mounting, the torque bracket rod should be easy to twist by hand within the link head.
- Check the smoothness of the link heads at least once a year.
- If the link heads are jammed, treat them with Teflon spray or lubricate them slightly.

使用法兰式适配轴和带有底板的扭矩支架将FGH 6与EGS 4安装在混凝土表面上。

Mounting the FGH 6 with EGS 4 using a flange adapter shaft and a torque bracket with a base plate on a concrete surface.

使用法兰式适配轴和扭矩支架将FGH6与EGS41 安装在一起。

Mounting the FGH 6 with EGSH 41 using a flange adapter shaft and torque brackets.



使用法兰式适配轴和带有底板和底座的扭矩支架将U-ONE基本单元安装在混凝土表面上

Mounting the U-ONE basic unit using a flange adapter shaft and a torque bracket with a base plate and pedestal on a concrete base

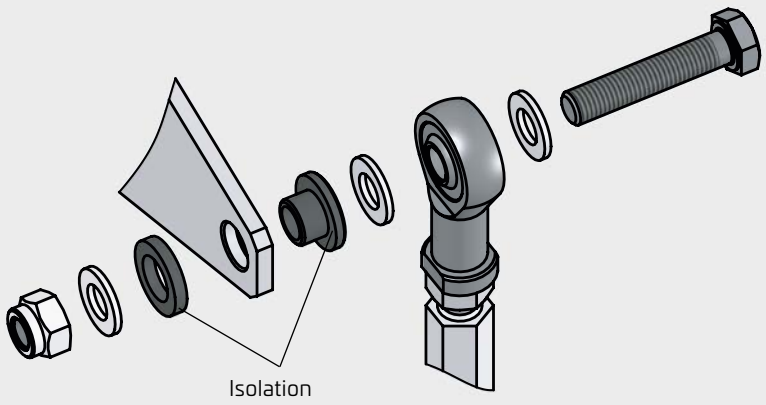
绝缘/安全型安装
Isolation / Safety installations

绝缘以避免轴电流
使用绝缘适配法兰可防止轴电流的潜在流动。绝缘扭矩支架可作为替代方案或附加方案。

应使用塑料制成的隔离衬套和隔离螺钉来隔离扭矩支架。

Isolation to avoid shaft currents
Using isolated adapter shafts prevents the potential flow of shaft currents. Isolated torque brackets can also be used as an alternative or in addition.

Isolated bushes made of plastic and isolating screws should be used to isolate the torque brackets.



安全系统解决方案：安全编码器与故障排除装置
带有符合性声明的扭矩支架和适配器轴可作为安全组件提供，特别是用于安全安装安全认证的编码器（SIL/PL）。这大大简化了客户的风险评估和验收流程。

每一个系统解决方案都是根据安全性单独计算，并根据用户的应用量身定制；

1. 机械部件，如：适配轴、扭矩支架和与应用轴的螺纹连接，其设计符合IEC 61800-5-2 标准，可实现最大的抗疲劳性和承载能力。
2. 所有配件的材料采购都有可追溯性（3.1检验证书）
3. 生产机械附件，包括使用经过校准的三维测量机测量所有形状和位置公差。
4. 安全文件：安全计算结果报告、操作和装配说明，包括安装协议以及符合DIN EN ISO 13849标准的声明。

Johannes Hübner 工程支持团队也可以选择在现场进行测量和安装。

用于潜在爆炸性环境的编码器附件 适用的适配法兰和扭矩支架可用于带有 Ex保护的编码器。

Safe system solution: safety encoder with fault exclusion mounting
Torque brackets and adapter shafts with a declaration of conformity are available as safety components, especially for safely mounting safety-certified encoders (SIL/PL). These significantly simplify the risk assessment and acceptance processes for the customer.

Each system solution is individually calculated in terms of safety and tailor-made to suit the customer's application:

1. The mechanical components such as adapter shafts, torque brackets and screw connections to the application shaft are designed to achieve maximum fatigue resistance and load-bearing capacity in accordance with IEC 61800-5-2.
2. Material procurement for all accessories, including traceability (3.1 inspection certificate)
3. Production of mechanical accessories, including measurement of all shape and position tolerances, with a calibrated 3D measuring machine
4. Safety documentation: Result report of safety calculations, operating and assembly instructions, including a mounting protocol, and a declaration of conformity according to DIN EN ISO 13849

The Johannes Hübner Engineering Support team can also optionally handle the measurements and mounting on site.

Accessories for encoders for potentially explosive atmospheres
Suitable adapter flanges and torque brackets are available for encoders with Ex protection.

安装空心轴编码器的适配轴
Adapter shafts for mounting hollow shaft encoders

拧入式适配轴 / Screw-in adapter shafts

- 适用于带或不带定心螺纹的轴
- 针对客户的设计
- 改造和更换的理想选择
- 使用滚珠推力螺丝轻松对齐适配轴
- 选项：绝缘设计，符合DIN EN ISO 13849-2认证的安全部件

法兰式适配轴 / Flange adapter shafts

- For shafts with or without a centering thread
- Customer-specific design
- Ideal for retrofitting and replacement campaigns
- Easy alignment of the adapter shaft with ball thrust screws
- Options: isolated design, certified safety component according to DIN EN ISO 13849-2

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