柯普乐® 音叉物位开关

KSR KUEBLER® Tuning Fork Level Switch

安装和操作说明书

Mounting and operating instructions

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V1.2 TLS(C/E) 06.07.2022

1 工作原理

音叉物位开关是一种通用型的开关。核心部件是位于音叉内的振动驱动装置，驱动音叉达到其谐振频率，当音叉被介质浸没时，音叉的频率降低，此频率变化由电子线路检测出来并转换成一个开关量信号，达到液位报警或控制的目的。

图 1 结构图

2 应用

音叉物位开关的结构及原理，使其适用于所有液体，主要用于容器和管道中的溢出保护、干运行保护和泵运转保护，在石油、化工、水/废水、食品饮料、制药、冶金、轻工业等行业应用广泛。

3 安装

3.1 说明

请确认所有的零部件，尤其是传感器元件（音叉）、过程密封件和过程接口都满足安装条件，并再次确认过程压力、过程温度和介质特性，并与产品铭牌标示的参数对比。

3.2 开关点

音叉的侧面有标记（切口），作为垂直安装时的开关点标记，安装时要注意，该标记应处于所希望的开关点的高度。此开关点是按照介质“水”设置的，如果介质密度不同于水的密度，仪表的开关点会移动，可以通过灵敏度调节，详见调试章节。

3.3 罐体安装

3.3.1 螺纹安装

1）螺纹安装

说明：安装时叉体方向标记必须冲上。

L：确保罐壁上可能出现粘附的罐体和叉体间保留有足够的距离。

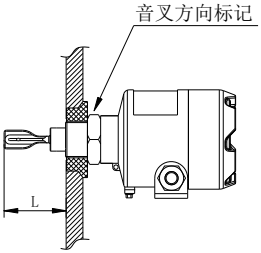

图 2 螺纹安装图

2）螺纹安装
说明：安装时叉体方向标记必须冲上。
粘度范围 0~2000mm^2/s，叉体末端与罐体壁面之间的距离≥25mm。

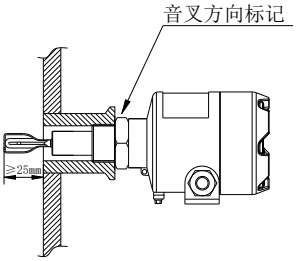

图 3 螺纹安装图

3.3.2 法兰安装

1）法兰安装
说明：按照图 4 标示的叉体方向安装。
L：确保罐壁上可能出现粘附的罐体和叉体间保留有足够的距离。

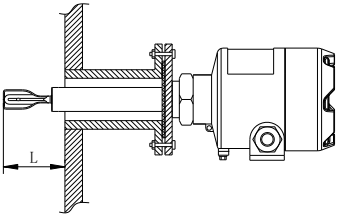

图 4 法兰安装图

2）法兰安装
说明：粘度范围 0~2000mm²/s，叉体缩进焊接管，焊接管的公称直径至少为 DN50。

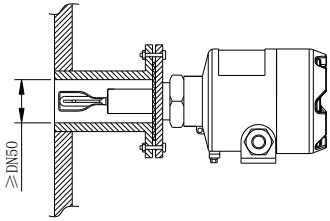

图 5 法兰安装图

3.3.3 管道安装

说明：在管道中安装时方向标记应与流体流向一致，图 7 所示安装方向会对测量造成影响。

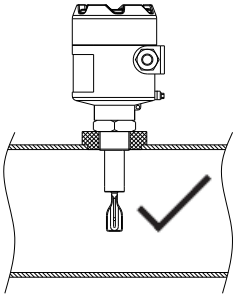

图 6 管道安装图（正确）

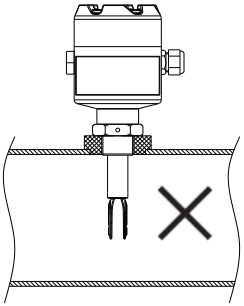

图 7 管道安装图（错误）

3.3.4 注意

1） 开关安装好后，在开关符合设备工况条件的情况下，开关所输出的通断切换信号就是设备内液体的位置信号；

2） 音叉作为振动检测部件，在安装过程中要注意，避免外力的碰撞和人为的损伤。

警告！当罐体内的液体是有压、有毒、易燃的危险性液体时，安装前应放空罐体内的液体，必要时应进行冲洗，待内部干净后再进行安装。

4 电气连接

4.1 说明

开关通断信号的工作点在产品出厂时已经完善。

开关安装好后才能接线，接线时先打开接线盒盒盖，连接电缆穿过电缆接口进入到接线盒内，按端子排列图进行接线。

注意：电缆敷设和电气连接必须按照设备适用的规则进行，并由具有资格的人员完成。

警告！电流脉冲信号可能因使用较长的电缆或线路与动力线路一并敷设而引发故障，所以必须使用屏蔽电缆并一端接地。

4.2 接线步骤

对于防爆型仪表，只有当不存在引爆的大气环境时才允许打开接线盒的盒盖。

操作步骤按照如下执行：

1） 拧开接线盒的盒盖；

2） 拧松电缆锁口上的锁紧螺母；

3） 去掉电缆大约 10cm 的外皮，去掉芯线末端大约 1cm 的绝缘层；

4） 将电缆穿过电缆锁口并插入接线盒内；

5） 用配套螺丝刀松开接线端子的压线螺栓；

6） 按照接线图将芯线末端插入接线端子的接线口；

7） 用螺丝刀拧紧接线端子的压线螺栓；

8） 可以通过用手轻拉芯线，检查端子接线是否牢固；

9） 拧紧电缆锁口的锁紧螺母；

10） 拧上接线盒盒盖；

11） 整个电气连接完成。

4.3 本安电路

本安电路时，必须在安全区安装本安认证的隔离安全栅，电气参数按照本安参数选定。

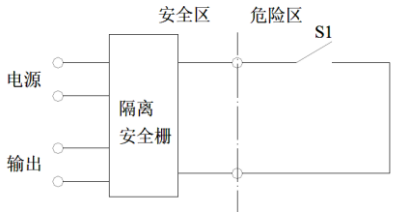

图 8 本安电路图

4.4 接线图

4.4.1 继电器 DPDT 输出

端子接线图在接线盒盒盖内侧，请按照端子接线图接线。
电源可以是 AC 220V 或 DC 24V，订货时请指定其中一种。

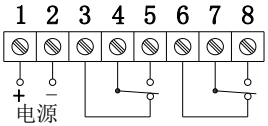

图 9 端子接线图（继电器 DPDT）

4.4.2 晶体管 PNP 输出

端子接线图在接线盒盒盖内侧，请按照端子接线图接线。
电源是 DC 24V。

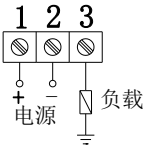

图 10 端子接线图（晶体管 PNP）

4.4.3 NAMUR 输出

端子接线图在接线盒盒盖内侧，请按照端子接线图接线。
电源是 8.2V。

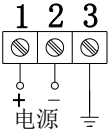

图 11 端子接线图（NAMUR 输出）

4.5 仪表面板

4.5.1 接线端子

端子 1 接电源正极，端子 2 接电源负极。
1） 继电器 DPDT 输出：
端子 4、7 为公共端，端子 3、6 为常闭触点，端子 5、8 为常开触点。
2） 晶体管 PNP 输出：
端子 3 为信号输出端。
3） NAMUR 输出：
端子 3 为接地端。

4.5.2 指示灯

正向面对仪表面板，左侧为电源和输出信号指示灯。

4.5.3 调节元件

两个码盘，分别有 0~9 共 10 级调节，在码盘中间有指示箭头，使用一字型螺丝刀进行不同级别的调节，正向面对仪表面板，左侧为延时设定，右侧为灵敏度调节。

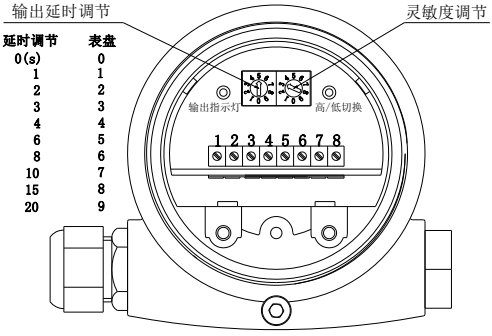

图 12 仪表面板说明

5 调试

5.1 说明

在仪表面板上可以看到指示灯和调节元件。

指示灯：电源和输出信号指示灯。

调节元件：用于设定输出延时和灵敏度调节的码盘。

5.2 功能指示

用于显示开关状态的指示灯。

电源指示：通电指示灯亮，断电指示灯关闭。

输出指示：开关状态改变，指示灯颜色变化，具体参看功能表。

5.3 功能调节

5.3.1 延时设定

出厂时动作延时设为零，如液面波动较大导致输出继电器抖动，可以将延时设定长一些直至消除抖动。

5.3.2 灵敏度调节

出厂时灵敏度设置为“3”，小于“3”灵敏度提高，大于“3”灵敏度降低。灵敏度“3”对应介质为水，如果介质的密度大于水，动作点会移向音叉方向，此时可以减小灵敏度，如果介质的密度小于水，动作点会移向接线盒方向，此时可以提高灵敏度，在灵敏度调节过程中，用户要在厂家指导下调整。

5.4 测试

上电后，将音叉提起后垂直插入水中，插入深度大于 13mm，此时输出指示灯亮继电器吸合，再将音叉提起离开水面，输出指示灯熄灭，继电器释放说明工作正常。

5.5 动作点

音叉液位开关可测量介质的最小密度可以达到 0.5g/cm3。

音叉物位开关的动作点是 13mm，音叉垂直向下安装。

音叉物位开关的动作点是 37mm，音叉垂直向上安装。

音叉物位开关的动作点是 4mm，音叉水平安装。
注意：动作点在出厂前设定，参考介质是水。

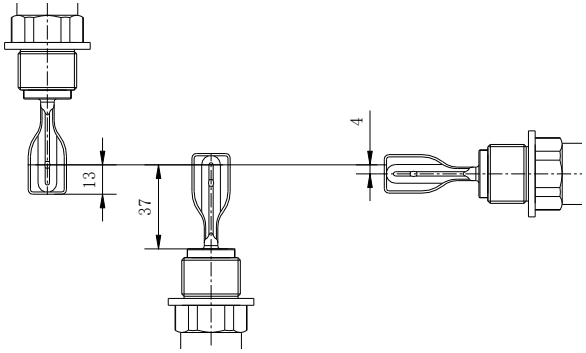

图 13 动作点位置

5.6 功能表

说明：下表显示与所设置的运行和物位相关的开关状态。

5.6.1 继电器 DPDT 输出

	液位	开关状态	指示灯
高限位			绿色 
高限位			红色 
低限位			红色 
低限位			绿色 
故障状态			红灯闪烁 

图 14 功能表（继电器 DPDT）

5.6.2 晶体管 PNP 输出

	液位	开关状态	指示灯
高限位			绿色
高限位			红色
低限位			红色
低限位			绿色
故障状态			红灯闪烁

图 15 功能表（晶体管 PNP）

5.6.3 NAMUR 输出

1）上升沿 L-H 触发

	液位	输出信号	指示灯
高限位		+ 0.6~1.0mA 2 ——► 1	○
高限位		+ 2.2~2.8mA 2 ——► 1	红色
低限位		+ 0.6~1.0mA 2 ——► 1	○
低限位		+ 2.2~2.8mA 2 ——► 1	红色
故障状态		＞2. 2mA	

图 16 功能表（NAMUR 输出）

2）下降沿 H-L 触发

	液位	输出信号	指示灯
高限位		+ 0.6~1.0mA 2 ——►1	○
高限位		+ 2.2~2.8mA 2 ——►1	红色 
低限位		+ 0.6~1.0mA 2 ——►1	○
低限位		+ 2.2~2.8mA 2 ——►1	红色 
故障状态		>2.2mA	

图 17 功能表（NAMUR 输出）

6 仪表维护

6.1 维护

按照本说明书使用，在正常情况下无需特别维护。

6.2 使用

1） 工作时的电气供电应该稳定，信号传输应考虑电气的屏蔽；
2） 安装的牢固和接线的可靠也是开关正常工作的首要保证；
3） 开关工作时应避免强烈的振动；
4） 开关不应在强磁场的环境和物体旁工作；
5） 对防爆型的开关在故障检查时应在安全场所进行，且故障排除后应仍确保其防爆性能；
6） 开关的电气结构应避免直接雨淋和日晒，应采取防护措施。

6.3 故障排除

本仪表具有最高的功能安全性，但是依然可能在运行期间存在故障，可能的原因：音叉；过程连接；供电；信号处理。

在排除故障时，首先检查输出信号，在多数情况下，可以通过这个方法检查到故障，并予以排除。

6.4 故障分析和处置

6.4.1 无介质覆盖有输出信号

原因：	处置：
工作电压太低	检查工作电压
电子部件损坏	更换电子部件
音叉上有附着物	检查叉体表面，如果有，则清除附着物
安装位置不对	安装在容器中不会形成死区或气泡的位置

6.4.2 介质覆盖动作点位置偏差过大

原因：	处置：
灵敏度设置不对	调整灵敏度码盘
音叉受损	检查音叉是否受损或严重腐蚀

6.4.3 介质完全覆盖音叉无输出信号

原因：	处置：
零敏度设置不对	调整灵敏度码盘
介质密度过低	确保被测介质密度在 0.5g/cm3 以上
仪表坏了	更换仪表

注意：

1） 电子部件更换，只有经过培训的专业技术人员才能完成，更换完成后，必须进行完整的调试；

2） 仪表经过上述检查和处置，依然不能正常工作，请与厂家联系。

7 拆卸

警告：

在拆卸前应注意危险操作条件，如：容器内高压、高温、腐蚀性或有毒介质等。

请参考“安装”和“电气连接”章节中的说明，以相反的顺序合理完成规定的操作步骤。

对于防爆型仪表，只有当不存在会引爆的大气环境时才允许打开接线盒盒盖。

8 防爆说明

8.1 隔爆产品的使用应严格遵循下列内容

隔爆产品经国家级仪器仪表防爆安全监督检验站（NEPSI）检验，符合标准 GB/T 3836.1-2021、GB/T 3836.2-2021 的有关要求，其防爆标志为 Ex db ⅡC T3…T6 Gb。

产品使用应遵循下列事项：

- 产品使用环境温度：-40℃～+60℃；
- 现场使用应遵守“严禁带电开盖”的原则；
- 电缆引入装置需外购，防爆标志为 Exdb IIC 并有防爆合格证，检查其使用环境温度是否符合要求，连接螺纹为 M20×1.5，安装时必须拧紧；
- 引入电缆护套外径应与外购的电缆引入装置密封圈内径允差±1mm；
- 产品使用时外壳应可靠接地；
- 温度组别与被测介质最高温度的关系如下：

温度组别	T3	T4	T5	T6
被测介质最高温度（℃）	190	130	95	80

- 安装现场应不存在对铝合金有腐蚀作用的有害气体；
- 维修必须在安全场所进行；当现场确认无可燃性气体存在时方可维修；
- 产品的安装、使用、维护、检查应同时遵守产品说明书、GB/T 3836.15-2017“爆炸性气体环境用电气设备 第 15 部分：危险场所电气安装（煤矿除外）”、GB50257-2014“电气装置安装工程爆炸和火灾危险环境电力装置施工及验收规范”、GB/T 3836.13-2021“爆炸性气体环境用电气设备 第 13 部分：爆炸性气体环境用电气设备的检修”和 GB/T 3836.16-2017“爆炸性气体环境用电气设备 第 16 部分：电气装置的检查和维护”的规定。

8.2 本安产品的使用应严格遵循下列内容

本安产品经国家级仪器仪表防爆安全监督检验站（NEPSI）检验，符合标准 GB/T 3836.1-2021、GB/T 3836.4-2021 的有关要求，其防爆标志为 Ex ia ⅡC T3…T6，产品必须与安全栅配套组成本安防爆系统。

- 产品使用环境温度：-40℃～+60℃；
- 温度组别与被测介质最高温度的关系如下：

温度组别	T3	T4	T5	T6
被测介质最高温度（℃）	190	130	95	80

- 本安参数为：Ui=16V，Ii=52mA，Pi=1.0W，Ci≈0.1uF，Li≈0mH；
- 安装现场不存在对产品外壳有腐蚀性作用的气体；
- 该产品与安全栅本安端之间的连接电缆为本安电缆（必须有绝缘护套），每根线芯截面积>0.5mm2，其接地线在安全场所接地。电缆布线应尽可能排除电磁干扰的影响；
- 用户不得自行更换该产品的零部件，应会同产品制造商共同解决运行中出现的故障，以杜绝损坏现象的发生；
- 产品的安装、使用和维护应同时遵守产品说明书、GB/T 3836.13-2021“爆炸性气体环境用电气设备 第 13 部分：爆炸性气体环境用电气设备的检修”、GB/T 3836.15-2017“爆炸性气体环境用电气设备 第 15 部分：危险场所电气安装（煤矿除外）”、GB/T 3836.16-2017“爆炸性气体环境用电气设备 第 16 部分：电气装置的检查和维护（煤矿除外）”和 GB50257-2014“电气装置安装工程爆炸和火灾危险环境 电气装置施工及验收规范”的有关规定。

9 型号说明

音叉物位开关的产品型号如下：

AaDbc-d-e/f-g

a 表示接线盒材质，可为空白；

D 为隔爆；

b 表示过程接口（与防爆性能无关），可为 NPT，R，G，MR，FC 或 F

c 表示叉体和接口材质，可为不锈钢 316L（V），哈氏合金（HC），不锈钢电抛光（VE），不锈钢外涂 PFA（VED），不锈钢外涂 ECTFE（VEC）

d 表示接口规格，可为英文代码或数字的组合（与防爆性能无关）；

e 表示输出信号（与隔爆性能无关），可为 JT，TR，NR（本安）或 TW；

f 表示特殊要求，可为空白或 HT；

g 表示插入深度，可为数值，最大为 3200mm。

10 质量保证

在用户按文件规定使用的前提下，从发货日起 12 个月的保证期内，产品因质量问题而不能正常工作或不符合文件的技术条件时将给予无偿修理或更换。

11 附件

装箱单；产品说明书；产品合格证；螺丝刀；用户附加定购的配件或附件。

特别声明：本手册以中文版本为标准，英文版本仅供参考

1. Principle

Tuning fork level switch is a universal level switch. The core component of the tuning fork level switch is the vibration drive device located in the fork body, which drives the fork body to reach its resonant frequency. When the fork body is immersed by the medium, the frequency of the fork body decreases, and the frequency change is detected by the electronic circuit and converted into a switching signal to achieve the purpose of liquid level alarm or control.

Fig. 1 Structure chart

2. Application

The structure and principle of the tuning fork type liquid level switch make it suitable for all liquids. The tuning fork level switch is mainly used for overflow protection in containers and pipelines, dry operation protection and pump operation protection, widely used in petroleum, chemical industry, water/waste water, food and beverage, pharmaceutical, metallurgy, light industry and other industries.

3. Installation

3.1 Information

Please confirm that all parts, especially the sensor components (tuning fork), process seals and process interfaces meet the installation conditions, and double confirm the process pressure, process temperature and media characteristics, and compare them with the parameters marked on the product nameplate.

3.2 Switch point

The side of the tuning fork is marked (notched) as the switch point mark in the vertical installation. It should be noted that the mark should be at the desired height of the switch point during installation. This switching point is set according to the "water" of the medium. If the density of the medium is different from that of water, the switching point of the instrument will move and can be adjusted by sensitivity, see the debugging section for details.

3.3 Tank installation

3.3.1 Thread mounting

1) Thread mounting

Note: The direction mark of the tuning fork must be upward when installing.

L: make sure there is enough space between the tank wall the tuning fork where adhesion may occur.

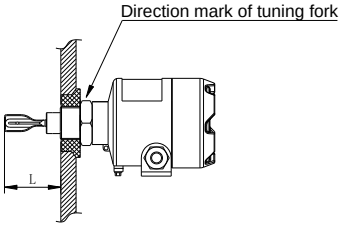

Fig. 2 Thread mounting

2) Thread mounting

Note: The direction mark of the tuning fork must be upward during installation. When the range of viscosity is 0~2000mm^2/S, the distance of tuning fork and tank wall should be at least 25mm.

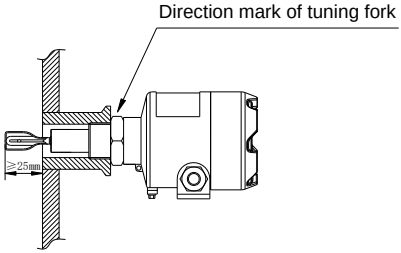

Fig. 3 Thread mounting

3.3.2 Flange mounting

1) Flange mounting

Note: make sure that the direction of tuning fork is correct.

L: make sure there is enough space between the tank wall.

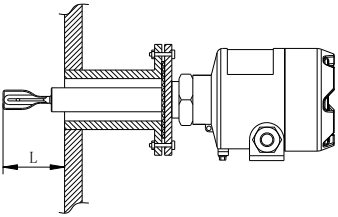

Fig. 4 Flange mounting

2) Flange mounting

Note: when the range of viscosity is 0~2000mm^2/S and the tuning fork is indented into the welding pipe, the nominal diameter of the welding pipe is at least DN50.

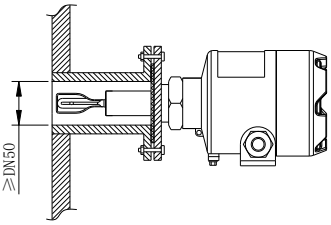

Fig. 5 Flange mounting

3.3.3 Pipe mounting

Note: for pipe mounting, the direction mark should be consistent with the flow direction of the fluid. The mounting direction shown in Fig. 7 will affect the measurement.

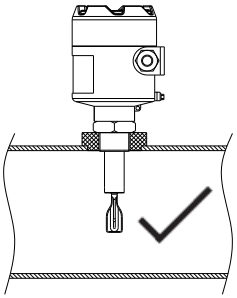

Fig. 6 Pipe mounting (Correct)

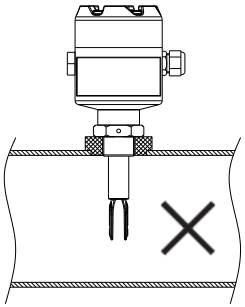

Fig. 7 Pipe mounting (Incorrect)

3.3.4 Note

1) After installation, the switch signal output by the switch is the position signal of the liquid in the device.

2) As a vibration detection component, the tuning fork should be paid attention to during installation to avoid collision of external forces and man-made damage.

Warning! When the liquid in the tank is a pressure, toxic, flammable and dangerous liquid, the liquid in the tank should be emptied before installation, and should be flushed when necessary, and then installed after the internal clean.

4.Electrical connection

4.1 Information

The working point of the switch has been improved when the product leaves the factory.

The connection can only be made after the switch is installed. When wiring, open the cover of the terminal box, connect the cable through the cable interface into the terminal box, and connect the cable according to the terminal arrangement diagram.

Note: cable laying and electrical connections must be carried out in accordance with applicable rules for equipment and by qualified personnel.

Warning! The current pulse signal may fail due to the use of a longer cable or line laid in conjunction with the power line, so it must be shielded and grounded at one end.

4.2 Wiring steps

For explosion-proof instruments, the cover of the terminal box is allowed to be opened only in the absence of a detonating atmosphere. The operation steps are as follows:

1) Unscrew the cover of the terminal box;

2) Unscrew the locking nut on the cable lock;

3) Remove the outer covering of the cable about 10cm, and remove the insulation layer at the end of the core wire about 1cm;

4) Pass the cable through the cable lock and insert it into the terminal box;

5) Loosen the bolt of the wiring terminal with the supporting screwdriver;

6) Insert the end of the core wire into the wiring port of the wiring terminal according to the wiring diagram;

7) Tighten the bolt of the wiring terminal with the supporting screwdriver;

8) Check whether the terminal wiring is firm by gently pulling the core wire;

9) Tighten the locking nut of the cable lock;

10) Screw on the terminal box cover;

11) The electrical connection is completed.

4.3 Intrinsically-safe circuit

When the intrinsically safe circuit is installed, the intrinsically safe isolated safety gate must be installed in the safety zone, and the electrical parameters must be selected according to the intrinsically safe parameters.

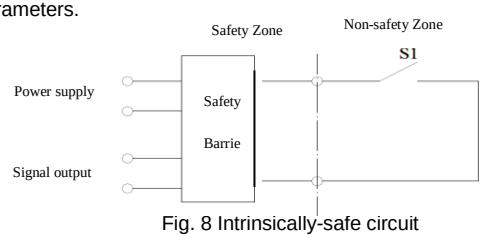

Fig. 8 Intrinsically-safe circuit

4.4 Wiring diagram

The wiring diagram is on the inside of the terminal box cover, please follow the wiring diagram.

4.4.1 Signal output Relay DPDT

The power supply can be AC 220V or DC 24V, please specify one of them when ordering.

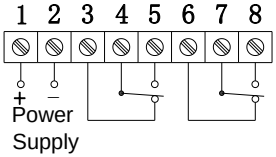

Fig. 9 Wiring diagram (Relay DPDT)

4.4.2 Signal output PNP

The power supply is DC 24V.

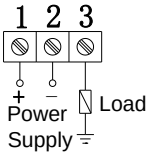

Fig. 10 Wiring diagram (PNP)

4.4.3 Signal output NAMUR

The power supply is DC 8.2V.

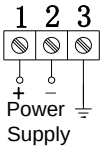

Fig. 11 Wiring diagram (NAMUR)

4.5 Instrument panel

4.5.1 Wiring terminal

Terminal 1 is connected to the positive pole of the power supply, terminal 2 is connected to the negative pole of the power supply.

1) Signal output Relay DPDT

Terminals 4 and 7 are public ends, terminals 3 and 6 are normally closed contacts, and terminals 5 and 8 are normally open contacts.

2) Signal output PNP

Terminal 3 is signal output.

3) Signal output NAMUR

Terminal 3 is GND.

4.5.2 Indicator light

Facing forward to the instrument panel, the left side is signal output and power supply indicator light.

4.5.3 Regulating element

There are 10 levels of adjustment from 0 to 9 in two code dials, and there are indicating arrows in the middle of the code dials. The screwdriver is used for different levels of adjustment. Facing forward to the instrument panel, the left side is delay setting and the right side is sensitivity adjustment.

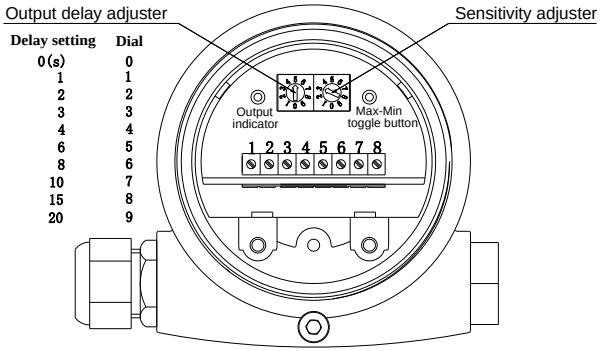

Fig. 12 Instrument panel

5. Debugging

5.1 Information

Indicator lights and regulating elements can be seen on the instrument panel.

Indicator light: signal output and power supply indicator light.

Regulating element: a coded disk used for setting output delay and sensitivity adjustment.

5.2 Function indication

Indicator light used to indicate the status of the switch.

Power supply indicator: the indicator will turn after power on and turn off after power off.

Signal output indicator light: the indicator light will turn after the switch sate changed, referring to Fig. 10 Function table.

5.3 Function adjustment

5.3.1 Delay setting

When leaving the factory, the action delay is set to zero. If the output relay jitter is caused by the large liquid level fluctuation, the delay can be set a little longer until the jitter is eliminated.

5.3.2 Sensitivity adjustment

When leaving the factory, the sensitivity is set to "3", which is less than "3" and higher than "3". If the density of the medium is greater than that of water, the action point will move to the direction of the tuning fork, in this case, the sensitivity can be reduced. If the density of the medium is less than that of water, the action point will move to the direction of the terminal box, in this case, the sensitivity can be improved. In the sensitivity adjustment process, the user should adjust under the guidance of the manufacturer.

5.4 Test

After power on, lift the tuning fork and vertically insert it into the water. The insertion depth is greater than 13mm. At this time, the output indicator light is on and the relay will close, and then lift the tuning fork out of the water, the output indicator is off and the relay will release, which indicates that switch works normal.

5.5 Action point

The level switch …can measure the minimum density up to 0.5g/cm3

If the tuning fork is mounted vertically downward, the action point of the level switch is 13mm.

If the tuning fork is mounted vertically upward, the action point of the level switch is 37mm.

If the tuning fork is mounted horizontally, the action point of the level switch is 4mm.

Note: The action point is set in the factory, and the reference medium is water.

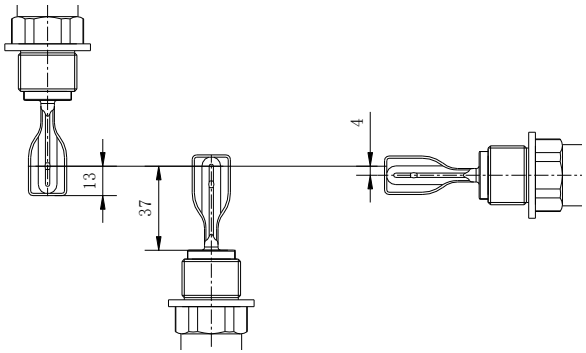

Fig. 13 Action point

5.6 Founction table

Note: the following table shows the switch state related to the set operation and object level.

5.6.1 Signal output Relay DPDT

	Level	Switch state	Indicator light
Max. Level			Green 
Max. Level			Red 
Min. Level			Red 
Min. Level			Green 
Failure state			Red flasing 

Fig. 14 Function table (Relay DPDT)

5.6.2 Signal output PNP

	Level	Switch state	Indicator light
Max. Level			Green 
Max. Level			Red 
Min. Level			Red 
Min. Level			Green 
Failure state			Red flashing 

Fig. 15 Function table (PNP)

5.6.3 Signal output NAMUR

1) Rising edge trigger L-H

	Level	Signal output	Indicator light
Max. Level		+ 0.6~1.0mA 2 ——►1	○
Max. Level		+ 2.2~2.8mA 2 ——►1	Red ☼
Min. Level		+ 0.6~1.0mA 2 ——►1	○
Min. Level		+ 2.2~2.8mA 2 ——►1	Red ☼
Failure state		＞2.2mA	

Fig. 16 Function table (NAMUR)

2) Falling edge trigger H-L

	Level	Signal output	Indicator light
Max. Level		+ 2.2~2.8mA 2 ——►1	Red ☼
Max. Level		+ 0.6~1.0mA 2 ——►1	○
Min. Level		+ 2.2~2.8mA 2 ——►1	Red ☼
Min. Level		+ 0.6~1.0mA 2 ——►1	○
Failure state		＜1.0mA	

Fig. 17 Function table (NAMUR)

6.Maintenance

6.1 Maintenance

Use in accordance with this manual, no special maintenance is required under normal circumstances.

6.2 Usage

1) The electrical power supply should be stable during operation, and the electrical shielding should be considered for signal transmission;
2) Solid installation and reliable wiring are also the primary guarantee for the normal operation of the switch;
3) Strong vibration should be avoided when switch works;
4) The switch should not work beside the environment and objects with strong magnetic field;
5) The explosion-proof switch shall be inspected in a safe place during fault inspection, and its explosion-proof performance shall be ensured after troubleshooting;
6) Switch electrical structure should avoid direct rain and sunlight, should take protective measures.

6.3 Troubleshooting

This instrument has the highest functional safety, but it may still fail during operation. Possible reasons:
1) Tuning fork;
2) Process connection;
3) Power supply;
4) Signal processing.
In troubleshooting, the output signal is first checked. In most cases, the fault can be detected and removed by this method.

6.4 Fault analysis and disposal

6.4.1 there is output signal without media coverage

Reason:
Working voltage is too low
Electronic component damage
There is something attached to the tuning fork
Wrong installation position
Disposal:
Check the working voltage
Replace the electronic component
Something attached to the tuning fork
Check the surface of the tuning fork, and if so, remove the attachment
A position in a container where dead zones or bubbles do not form

6.4.2 Position deviation of action point of media coverage is too large

Reason:
Sensitivity setting incorrect
Tuning fork is damaged
Disposal:
Adjust the sensitivity dial
Check the tuning fork for damage or severe corrosion

6.4.3 There is on signal output when the tuning fork is covered totally

Reason:	Disposal:
Sensitivity setting incorrect	Adjust sensitivity dial
Medium density is too low	Ensure the density of medium above 0.5g/cm^3
Instrument is broken	Replace the instrument

Note:

1) The replacement of electronic parts can only be completed by trained professional technicians. After the replacement, complete debugging must be carried out;

2) After the above inspection and disposal, the instrument still cannot work normally. Please contact the manufacturer.

7.Disassembly

Warning:

Before disassembly, attention should be paid to dangerous operating conditions, such as high pressure, high temperature, corrosive or toxic media in the container.

Refer to the instructions in the section "installation" and "electrical connection" to complete the required operation steps in the reverse order.

For explosion-proof instruments, the terminal box cover is only allowed to be opened when there is no atmospheric environment.

8. Information on Ex-proof

8.1 Application of explosion-proof product shall be strictly in accordance with the following

The explosion-proof product has been inspected by National Supervision and Inspection Center for Explosion Protection and Safety of Instrumentation (NEPSI) and conforms to relative requirements in standard GB/T 3836.1-2021, GB/T 3836.2-2021, and its explosion-proof mark is Ex db II C T3…T6 Gb

The following points shall be observed during using this product:

● Ambient temperature: -40℃ to +60℃;

● The principle of "DO NOT OPEN WHILE ENERGIZED" shall be adhered on site;

● Cable entry device is to be purchased, and its explosion-proof mark is Ex db IIC and explosion-proof certificate shall be provided; check whether its ambient temperature is in accordance with requirement; its connecting thread is M20×1.5, which shall be screwed down at the time of installation;

● The allowable deviation between the outer diameter of cable shield and inner diameter of the seal ring of purchased cable entry is ±1mm;

● Make absolutely sure that housing of the product shall be ground reliably during using the product;

● The relationship between temperature group and max. temperature of the medium to be measured is as following:

Temperature group	T3	T4	T5	T6
Max. temperature of the medium to be	190	130	95	80

● Dangerous corrosive gas to aluminum alloy shall not exist on installation site;

● Repairing shall be carried out on safe site; repairing can be carried out only after making sure there is no inflammable gas exists on site.

Installation, use, maintenance and inspection shall be carried out according to stipulations in Product instructions, GB/T 3836.15-2017- Electrical apparatus for explosive gas atmospheres Part 15: Electrical installations in hazardous areas(other than mines), GB50257-2014-Code for construction and acceptance of electric device for explosion atmospheres and fire hazard electrical equipment installation engineering, GB/T 3836.13-2021- Electrical apparatus for explosive gas atmospheres Part 13: Repair and overhaul for apparatus used in explosive gas atmospheres and GB/T 3836.16-2017- Electrical apparatus for explosive gas atmospheres Part 16: Inspection and maintenance of electrical installation.

8.2 Application of IS product shall be strictly in accordance with the following

The IS product has been inspected by National Supervision and Inspection Center for Explosion Protection and Safety of Instrumentation (NEPSI) and conforms to relative requirements in standard GB/T 3836.1-2021, GB/T 3836.4-2021, and its explosion-proof mark is Ex ia IIC T3…T6 Ga. The product and safety barrier will comprise the IS explosion protection system.

The following points shall be observed during using this product:

- Ambient temperature: -40℃ to +60℃;
- The relationship between temperature group and max. temperature of the medium to be measured is as following:

Temperature group	T3	T4	T5	T6
Max. temperature of the medium to be	190	130	95	80

- IS parameters of magnetic float switch are:

U：Ui=16V Ii=52mA Pi=1.0W Ci≈0uF Li≈0mH

- Dangerous corrosive gas to housing of product shall not exist at the installation site;
- The connection cable between the product and safety barrier is shielded cable (must have insulated shield), cross-sectional area of each core shall be more than 0.5 mm2 and its shielding layer will earth at safe site. Routing of cable shall be prevented from electromagnetic interference as far as possible;
- No customer is allowed to change parts of the product. In case of any failure during the operation of the product, the customer shall work together with manufacturer to solve the product and eliminate the damage to product.

Installation, use, maintenance and inspection shall be carried out according to stipulations in Product instructions, GB/T 3836.13-2021- Electrical apparatus for explosive gas atmospheres Part 13: Repair and overhaul for apparatus used in explosive gas atmospheres, GB/T 3836.15-2017- Electrical apparatus for explosive gas atmospheres Part 15: Electrical installations in hazardous areas(other than mines), GB/T 3836.16-2017- Electrical apparatus for explosive gas atmospheres Part 16: Inspection and maintenance of electrical installation (other than mines) and GB50257-2014-Code for construction and acceptance of electric device for explosion atmospheres and fire hazard electrical equipment installation engineering.

9. Model

AaDbc-d-e/f-g

a mateial of terminal box, blank is optional;

D Ex-db;

b process connection (no connection with Ex), can be NPT, R, G, MR, FC, F;

c material of tuning fork and process connection, can be SS316L (V), hastelloy (HC), SS electropolishing (VE), SS coating with PFA (VED), SS coating with ECTFE (VEC);

d type of process connection, can be a combination of numbers and letters (no connection with Ex);

e signal output (no connection with Ex db), can be JT, TR, NR (Ex ia),TW;

f special requirements, can be blank or HT;

g insertion length, max. 3200mm.

10.Warranty

Under the prerequisite that users operate the product according to stipulations in relative documents, within the guarantee period of 12 months from shipping date, if the products cannot operate normally due to quality issues or be not in accordance with technical conditions stipulated in documents, they can be repaired or replaced free of charge.

11. Accessories

Packing list; product instructions; product certificate; screwdriver; additional fittings or accessories to be ordered by customer.

Special Statement：This manual is subject to Chinese, English is only for

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Zip: 201600
E-mail: info@ksr-kuebler.com.cn

A division of the WIKA Group

安 装 使 用 说 明

Mounting and operating instruction

请保存留用

Please retain for future usage

TLS 音叉液位开关

TLS Tuning fork level switch

版本号：V TLS_(C/E) V1.0_26.01.2022

Version: V TLS_(C/E) V1.0_26.01.2022

目录

符号说明

本说明书使用以下符号：

注意
遵循本说明书，以正确的方法安装、使用 TLS 型音叉液位开关，否则可能会导致开关工作异常或损坏。

警示
必须严格遵循说明操作，否则可能造成人身伤害或开关严重损毁。

信息
正确使用开关的相关信息。

电气安装说明
正确电气安装相关的内容。

安全信息

在安装及使用 TLS 音叉液位开关之前，务必仔细阅读本说明书。.
安装、配置人员须具有相关的专业知识及技能。
使用本设备时须遵循相关的安全法规。
非法操作及使用造成的损失，不在质保范围内。
应采用相应措施以减免该设备失效带来的人身及财产损失。
TLS 音叉液位开关不能承受过重的拉力、压力等。

危险！

工作人员处于罐体内部或是其他密闭场合，有可能发生中毒或窒息。做好必要的保护措施（如呼吸装置，防护衣等）。

应用及使用场合

音叉液位开关的结构及原理，使其适用于所有液体，主要用于容器和管道中的溢出保护、干运行保护和泵运转保护，在石油、化工、水/废水、食品饮料、制药、冶金、轻工业等行业应用广泛。

结构及功能

音叉液位开关由音叉、过程连接、振动驱动装置、检测电路和电子仓组成，是一种通用型的液位开关。
音叉液位开关的核心部件是位于音叉内的振动驱动装置，驱动音叉达到其谐振频率，当音叉被介质浸没时，音叉的频率降低，此频率变化由电子线路检测出来并转换成一个开关量信号，达到液位报警或控制的目的。
特别说明：传感器部分（叉体、延长管、过程连接和电子仓）的材质为不锈钢。

拆除运输包装及安全运输保护

从运输包装上小心将 TLS 音叉液位开关拆下。
查看包装上的说明，在取出 TLS 音叉液位开关之前，将所有安全运输保护装置拆卸掉。
禁止抓住音叉取出 TLS 音叉液位开关！

安装

TLS 音叉液位开关用卡盘或螺纹接头安装于罐体或管道（参见产品型号和尺寸图）。

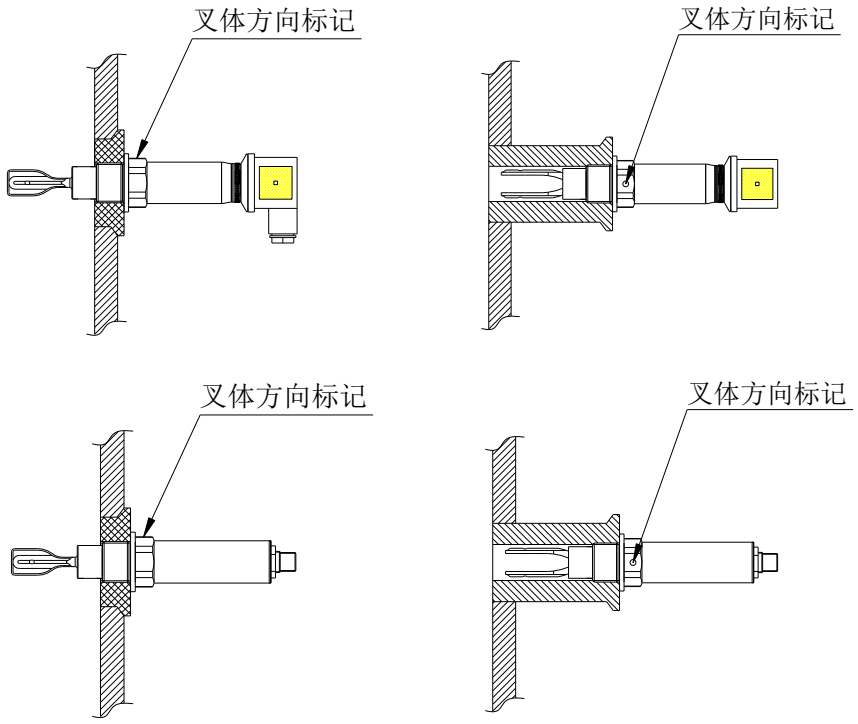
罐体安装

安装前先要确认罐体的安装口的大小及直径足够安装 TLS 音叉液位开关。安装 TLS 音叉液位开关，按照安装方式不同，可以分为螺纹安装和卡盘安装。

螺纹安装：

安装时，对于粘度较高的液体，音叉方向标记必须冲上，电气接口保持在水平方向，如螺纹安装（正确）所示。

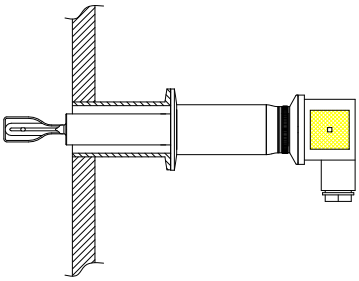
安装时，对于粘度较高的液体，如果音叉方向标记没有冲上，会对测量造成影响；另外，由于管座过长，音叉缩进管座内，会很容易造成叉体堵料产生误动作，如螺纹安装（错误）所示。

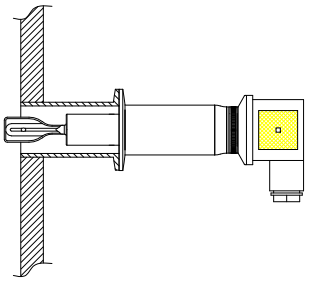


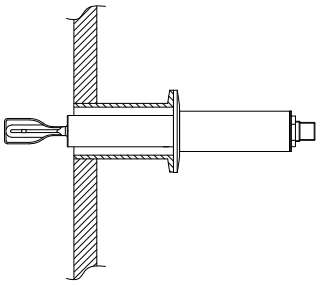
螺纹安装（正确）　　螺纹安装（错误）

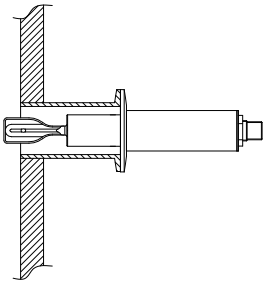
卡盘安装：

安装时，对于粘度较高的液体，开关的延长管要深入罐体内，如卡盘安装图（正确）所示，如果音叉缩进焊接管，音叉容易堵料产生误动作，如卡盘安装图（错误）所示。





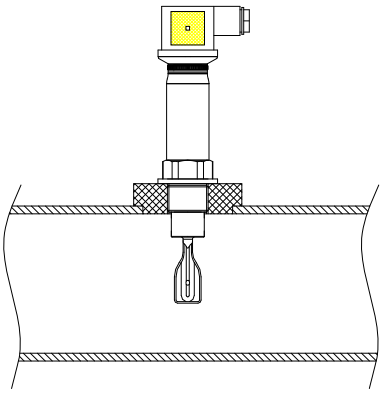


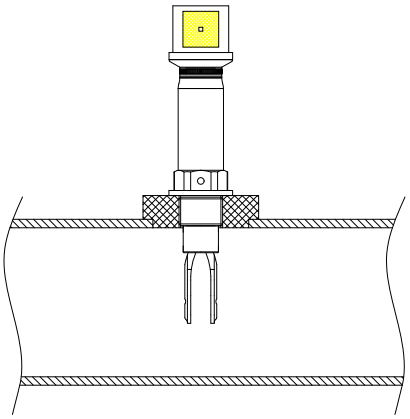


卡盘安装图（正确）　　卡盘安装图（错误）

管道安装

TLS 音叉液位开关用螺纹管座安装于管道上，安装时，要保证音叉方向标记与流体流向一致，管道安装图（正确）所示，如果音叉方向标记不遵循此规定，会对测量结果造成影响，如管道安装图（错误）所示。





管道安装图（正确）　　管道安装图（错误）

扳手

TLS 音叉液位开关，如果是螺纹过程接头，六角对边尺寸是 30mm（依据标准 ISO272），按照此尺寸选择扳手。

TLS 音叉液位开关安装在罐体和管道。

如果是螺纹接口，必须按照密封要求，将螺纹旋入到位。

如果是卡盘接口，必须使用合适的螺钉、螺母及垫片，垫片的材质与介质，以及工作温度和工作压力相匹配。

音叉作为振动检测部件，在安装过程中要注意。

严禁外力的碰撞和人为的损伤。

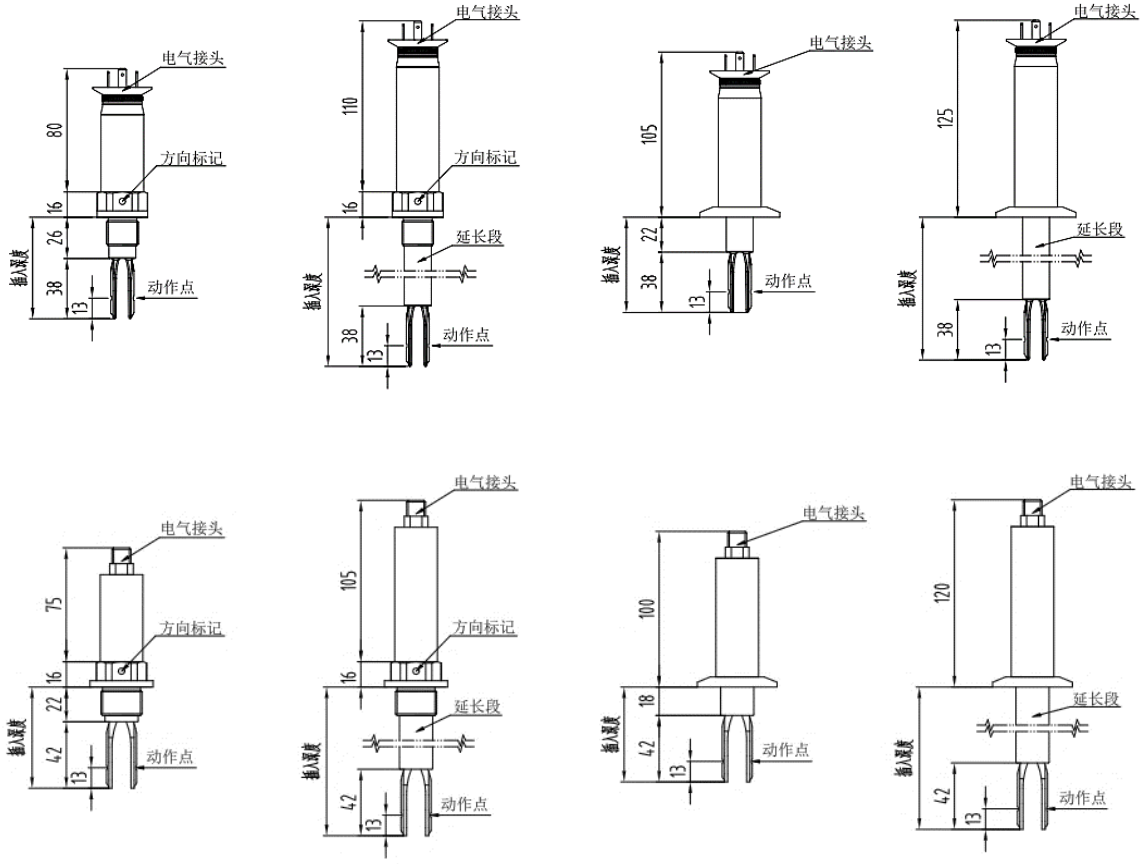
当罐体内的液体是有压、有毒、易燃的危险性液体时，安装前应放空罐体内的液体，必要时应进行冲洗，待内部干净后再进行安装。

外形尺寸

音叉长度 38mm，42mm。

插入深度 L 的范围 60（43/47）~3000mm。

音叉液位开关外形尺寸如下所示：



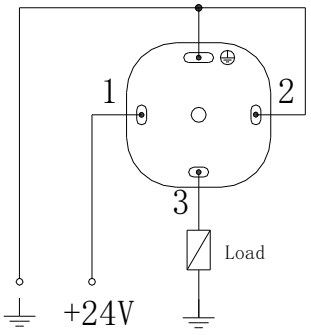
电气连接

开关通断信号的工作点在产品出厂时已经完善。
开关安装好后才能接线，按照端子接线图进行接线。
接线图可以直接参看电子仓上的产品铭牌。

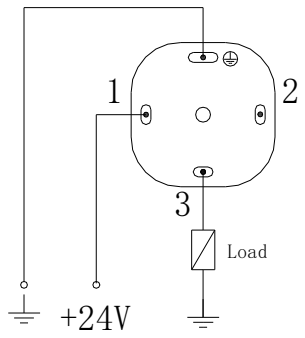
供电电源 10~30V DC。
高位检测和低位检测对应不同的接线图，请根据现场的需求确定。
接线图如下所示：

1. 赫斯曼接头

1）PNP 输出

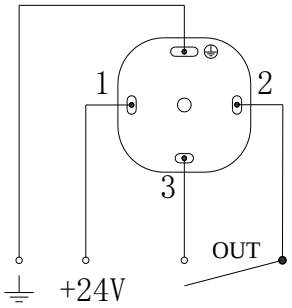


高限检测



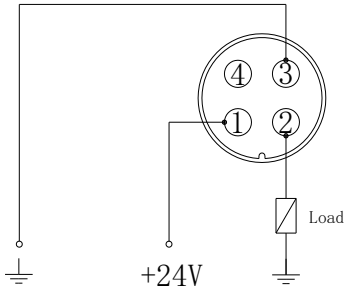
低限检测

2）继电器输出

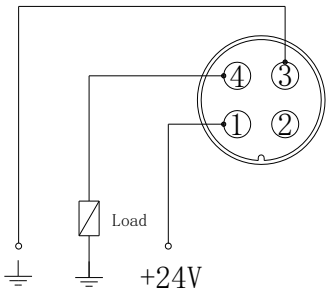


2. M12 接头

1）PNP 输出



高限检测



低限检测

选择连接电缆

4 芯电缆

选择的连接电缆线必须能符合环境条件（温度、腐蚀性气体、天气等）。

接线

电气连接必须按照设备适用的规则进行，并由具有资格的人员完成。

请按照正确的步骤进行电缆连接。

1. 赫斯曼接头

1）拧松插头顶部的螺钉，将插头和插座拆开；

2）拧松插头的电缆螺纹接头，并把插头内的端子拆下；

3）去掉连接电缆大约 5cm 的外皮，以及大约 1cm 的芯线绝缘；

4）将电缆穿过电缆螺纹接头并插入插头壳体中；

5）按照接线图将芯线末端与端子相连接；

6）将插头端子卡入插头壳体中；

7）将插头和插座安装好，并拧紧插头顶部的螺钉。

2. M12 接头

1）取出 M12 航空插座（端部带有规定长度的线缆）；

2）将 M12 航空插座的定位凹点与音叉开关本体上的航空插头的定位凸点对准；

3）按压 M12 航空插座的端部，保证插座按照定位位置插入插头；

4）拧紧 M12 航空插座外部的锁紧螺母；

5）确保 M12 航空插座和插头的连接可靠。

调校

通常情况下，开关通断信号的工作点在产品出厂时已经完善。正常情况下不需要再做调整。

动作点

TLS 音叉液位开关可测量介质的最小密度可以达到 0.5g/cm3。

音叉长度 38mm，42mm，对应不同的动作点。

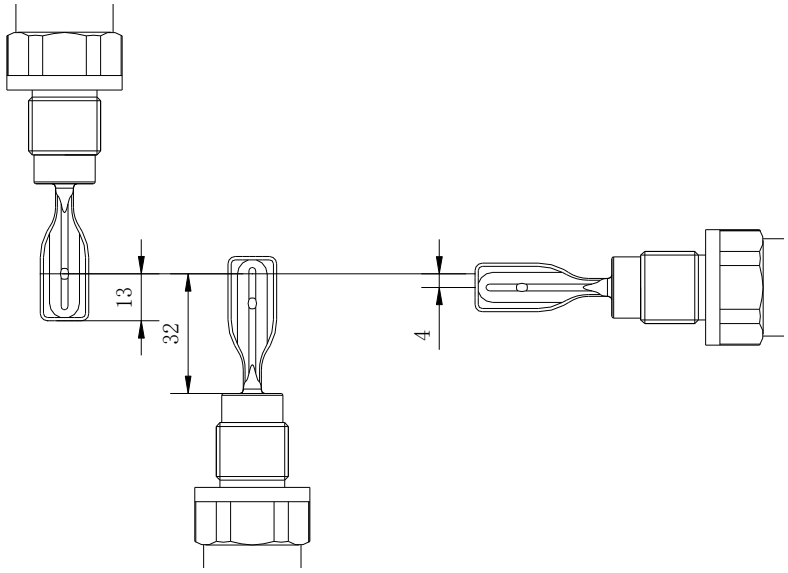
1. 音叉长度 38mm

TLS 音叉液位开关的动作点是 13mm，音叉垂直向下安装。

TLS 音叉液位开关的动作点是 32mm，音叉垂直向上安装。

TLS 音叉液位开关的动作点是 4mm，音叉水平安装。

注意：动作点在出厂前设定，参考介质是水。



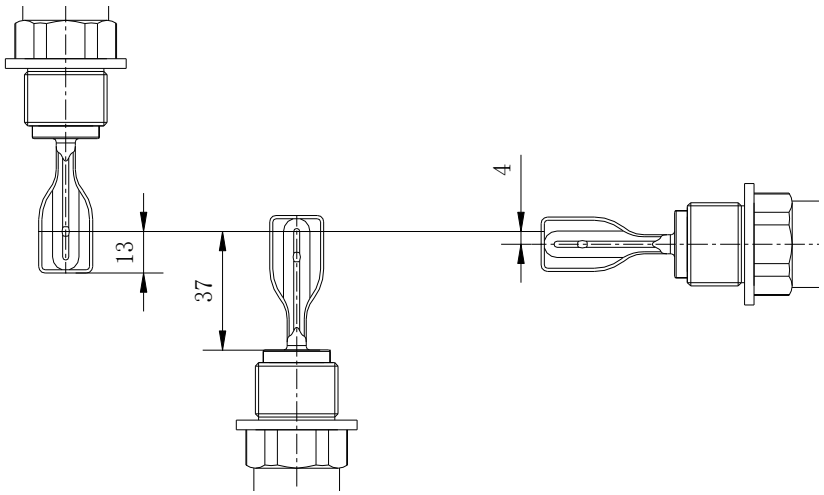
2. 音叉长度 42mm

TLS 音叉液位开关的动作点是 13mm，音叉垂直向下安装。

TLS 音叉液位开关的动作点是 37mm，音叉垂直向上安装。

TLS 音叉液位开关的动作点是 4mm，音叉水平安装。

注意：动作点在出厂前设定，参考介质是水。



性能

TLS 音叉液位开关的精度是±1mm。

TLS 音叉液位开关的回差≤2mm。

TLS 音叉液位开关的重复性是 0.1mm。

响应时间：

当音叉从无介质覆盖到有介质覆盖，并到达设定的动作点时，响应时间是 0.5s。

当介质从有介质覆盖到无介质覆盖，并到达设定的动作点时，响应时间是 1s。

功能指示

1. 赫斯曼接头

1） PNP 输出

赫斯曼接头与电子仓结合部位，有用于显示开关状态的 360°指示灯，用于指示开关的动作状态。

高限检测，上电后指示灯为绿色，液位上升，音叉被介质覆盖，达到动作点，电压信号从 0V 变为 24V，指示灯变为红色。

低限检测，上电后指示灯为红色，液位上升，音叉被介质覆盖，达到动作点，电压信号从 24V 变为 0V，指示灯变为绿色。

故障状态，红灯闪烁。

2） 继电器输出

赫斯曼接头与电子仓结合部位，有用于显示开关状态的 360°指示灯，用于指示开关的动作状态。

上电后指示灯为绿色，继电器常开，液位上升，音叉被介质覆盖，达到动作点，指示灯变为红色，继电器闭合。

2. M12 接头

1） PNP 输出

M12 接头有用于显示开关状态的指示灯，用于指示开关的动作状态。

绿灯指示开关的电源，黄灯指示开关信号。

上电后，绿灯亮。

高限检测，液位上升，音叉被介质覆盖，达到动作点，电压信号从 24V 变为 0V，黄灯从亮变为熄灭。

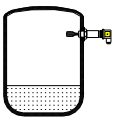
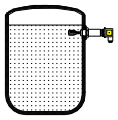
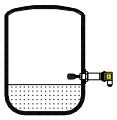
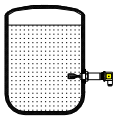
低限检测，液位下降，音叉不再被介质覆盖，达到动作点，电压信号从 24V 变为 0V，黄灯从亮变为熄灭。

注意

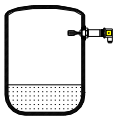
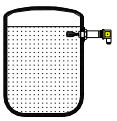
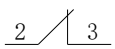
开关状态与液位的对应关系。

1. 赫斯曼接头

1） PNP 输出

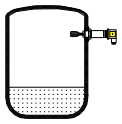
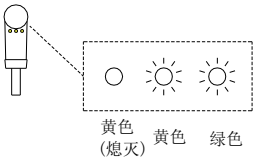
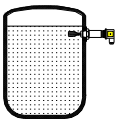
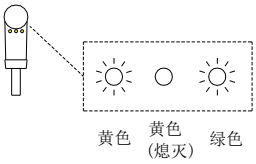
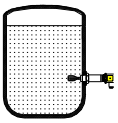
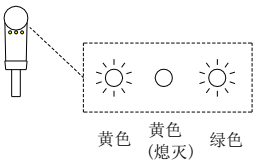
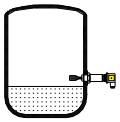
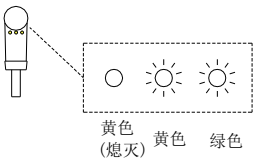
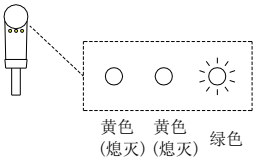
	液位	开关状态	指示灯
高限位			绿色 
高限位			红色 
低限位			红色 
低限位			绿色 
故障状态			红灯闪烁 

2）继电器输出

	物位	开关状态	指示灯
液位			绿色 
液位			红色 
故障状态			红色 闪烁 

2. M12 接头

1）PNP 输出

	液位	开关状态	指示灯
高限位		1 2	
高限位		1 2	
低限位		1 4	
低限位		1 4	
报警			不适用
报错			

功能测试

1. 赫斯曼接头

1） PNP 输出

上电后，指示灯亮，音叉振动，说明 TLS 音叉液位开关可以工作。

把 TLS 音叉液位开关提起，并垂直插入水中，当插入深度超过 13mm 时，电压信号可以在 24V 和 0V 之间切换，指示灯的颜色切换，说明开关功能正常。

2）继电器输出

上电后，指示灯亮，音叉振动，说明 TLS 音叉液位开关可以工作。

把 TLS 音叉液位开关提起，并垂直插入水中，当插入深度超过 13mm 时，继电器信号可以在常开和常闭之间切换，指示灯的颜色切换，说明开关功能正常。

2. M12 接头

1）PNP 输出

上电后，指示灯亮，音叉振动，说明 TLS 音叉液位开关可以工作。

把 TLS 音叉液位开关提起，并垂直插入水中，当插入深度超过 13mm 时，电压信号可以在 24V 和 0V 之间切换，指示灯的颜色切换，说明开关功能正常。

保养维护

如果正确使用，TLS 音叉液位开关无需保养及维护，但需要定期对安装构架做目视检查。

做功能测试时，必须首先拆下开关。
做功能测试时，可能引起下游控制单元的非预期工作，存在人身及财产损害风险。

日常使用要严格遵循下列要求的规定。

1. 工作时的电气供电应该稳定，信号传输应考虑电气的屏蔽；
2. 安装的牢固和接线的可靠也是开关正常工作的首要保证；
3. 开关工作时应避免强烈的振动；
4. 开关不应在强磁场的环境和物体旁工作；
5. 开关的电气结构应避免直接雨淋和日晒，应采取防护措施。

故障处理

下表中列出了 TLS 液位开关常见的故障及可能的原因与解决办法。

故障	序号	原因	处理	
			方法	地方
上电 音叉不振动 指示灯不亮	1	接线错误 电源线接反了	按照接线图正确接线	现场
	2	电路模块损坏	更换电路模块	返厂处理
上电 音叉振动 指示灯不亮	1	灯损坏	更换指示灯	返厂处理
	2	电路模块损坏	更换电路模块	返厂处理
上电 音叉振动 指示灯的颜色相反	1	接线错误 高限检测和低限检测选择错误	按照接线图正确接线	现场
	2	电路模块损坏	更换电路模块	返厂处理
音叉没有介质覆盖，但是有开关动作（包含电压信号改变和指示灯颜色切换）	1	电源电压低	检查供电电源	现场
	2	电路模块损坏	更换电路模块	返厂处理
	3	音叉上粘附有杂物	检查音叉表面，清理干净音叉表面粘附的杂物	现场
	4	罐体安装	修改螺纹或卡盘过程接头的长度	现场

		音叉缩进螺纹或卡盘过程接头内（介质粘度高）		
	5	管道安装 音叉的方向与流体的流动方向没有对齐	调整音叉的安装位置	现场
实际动作点与设定动作点相差较大	1	现场介质的密度与水的密度相差较大	动作点现场无法调整	返厂处理
	2	音叉损坏 （现场确认音叉是否有变形或表面损伤）	如果音叉损坏，现场无法维修	返厂处理
音叉被介质完全覆盖，但是没有开关动作（包含电压信号改变和指示灯颜色切换）	1	现场介质密度＜0.5g/cm^3	动作点现场无法调整	返厂处理
	2	音叉损坏 （现场确认音叉是否有变形或表面损伤）	如果音叉损坏，现场无法维修	返厂处理

技术参数

序号	规格信息	说明
1	工作压力 (MPa)	-0.1～6.4
2	工作温度（℃）	-40~150℃
3	介质密度 (Kg/m3)	≥500
4	材质	不锈钢
5	音叉长度 (mm)	38，42
6	测量范围 (mm)	60（43/47）～3000mm
7	输出信号	PNP-3 线制，继电器
8	供电电压	10~30VDC
9	功耗	＜1W
10	环境温度	-40~60℃
11	精度	±1mm
12	回差	≤2mm
13	重复性	0.1mm
14	响应时间	0.5s，1s
15	电气连接	赫斯曼接头（M16×1.5） M12 接头（M12×1.0）
16	防护等级	IP65/IP66，IP68

铭牌

铭牌上标有产品型号、编号 S/N、工作温度和工作压力等信息。
铭牌上标有接线图。

附件

装箱单；产品说明书；产品合格证；用户附加订购的配件或附件。

CONTENT

Symbol legend

The following symbols are used in these operating instructions:

Warning
Instructions on correct installation and proper operation of the Level Transmitters … Failing to comply with these instructions can lead to malfunction of or damage to the Level

Precaution
Instructions which must be complied with to avoid injury or property damage or loss of the type permit.

Information
Facts and information concerning proper operation of the Level Sensors …

Instructions for electrical installation
Information on proper electrical installation.

Safety information

Read these instructions before installing the Level Switch TLS… and putting them into operation.

These instructions are intended for the specialists in charge of mounting, installation and setup.

Comply with the relevant safety regulations when using the equipment.

Unauthorized access and impermissible use of the equipment will result in the loss of guarantee and liability protection.

Measures must be taken to prevent risks to persons and property in the event of a defect in the Level Switch TLS….

Level Switch TLS… must not be exposed to heavy mechanical loads.

Danger!

There is a risk of poisoning or suffocation when working in container or other closed places. Relevant personal protection measures (e.g. respiratory devices, protective clothing, etc.) must be taken before work is carried out

Application and field of use

The structure and principle of tuning fork level switch make it suitable for all liquids. Tuning fork level switch is mainly used for overflow protection of container and dry-run protection of pump, widely used in petroleum, chemical industry, water/waste water, food and beverage, pharmaceutical, metallurgy, light industry and other industries.

Structure and functional description

The Level Switch TLS… is composed of tuning fork, process connection, vibration driving device, circuit module and junction box. It is a kind of universal level switch, which is basically applicable to the liquid level measurement of all liquids.
The core component of tuning fork level switch is the vibration driving device located in tuning fork, which drives the tuning fork to reach its resonant frequency. When tuning fork is immersed by the medium, the frequency of the tuning fork decreases, and the frequency change is detected by the circuit module and converted into a switching signal to achieve the purpose of level alarm or control.
Special note: sensor parts (tuning fork, extension, process connection, junction box) are made of stainless steel.

Removal of transport packaging and transport safety devices

Remove the Level Switch TLS…carefully from the transport packaging.

See the instructions on the shipping packaging; remove all transport safety devices before removing the Level Switch TLS….

Never forcibly remove the Level Switch TLS… from the packaging by taking hold of the tuning fork!

Installation

The Level Switch TLS… is installed in container using clamping or thread connection. (See the model and dimensions)

Installation in container

Prior to installation, make sure the installation size in container matches the size of product's process connection.

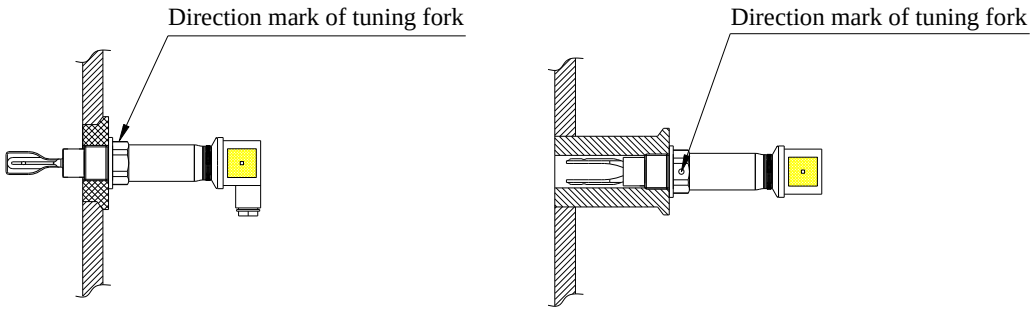
The Level Switch TLS…, according to the process connection, can be divided into thread installation and clamping installation.

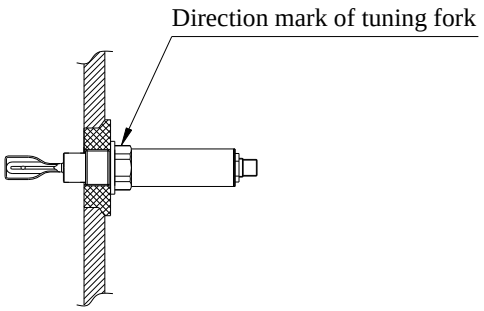
Prior to installation, make sure the installation size in container matches the size of product's process connection.
The Level Switch TLS…, according to the process connection, can be divided into thread installation and clamping installation.

Thread installation

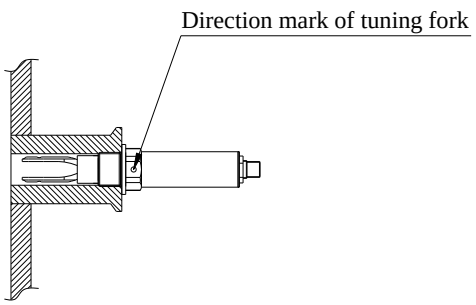
When installing, for liquids with high viscosity, the direction mark of the tuning fork must be upward, as shown in thread installation diagram (correct).

When installing, for the liquid with high viscosity, if the direction mark of the tuning fork is not upward, it will affect the measurement. In addition, due to the thread connection is too long, the tuning fork is indented into the thread connection, which will easily accumulate medium and cause the wrong action, as shown in the thread installation diagram (incorrect).





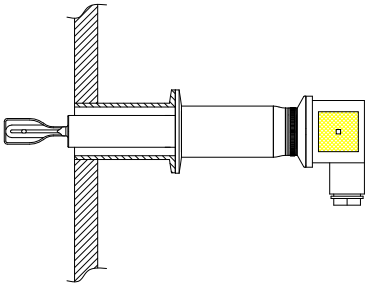
Thread installation (correct)

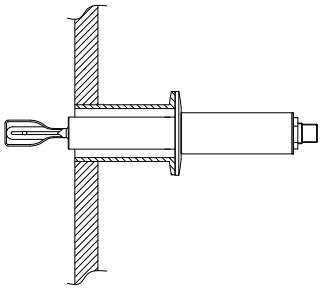


Thread installation (incorrect)

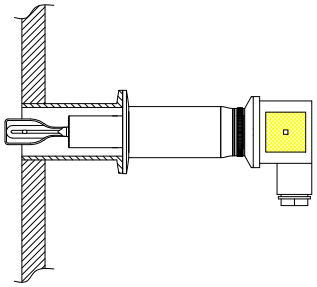
Clamping installation

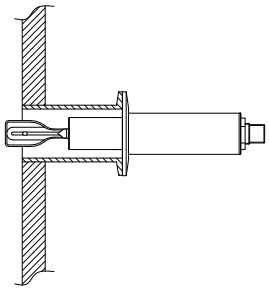
When installing, for the liquid with high viscosity, the extension part of the level switch should be deep into the container, as shown in the clamping installation diagram (correct). If the tuning fork is indented into clamping connection, it is easy to accumulate medium and cause the wrong action, as shown in the clamping installation diagram (incorrect).





Clamping installation (correct)

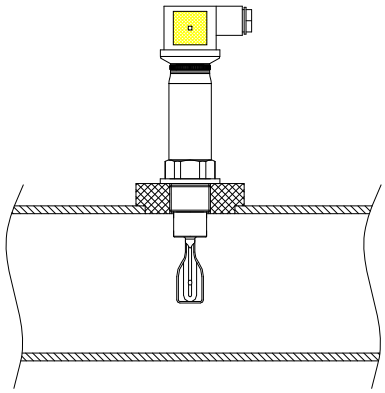




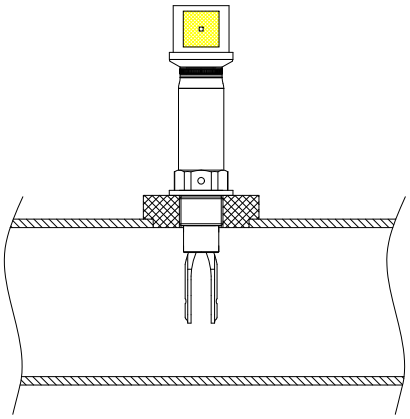
Clamping installation (incorrect)

Installation on pipe

The Level Switch TLS… is installed on the pipe with thread connection. During installation, the direction mark of the tuning fork should be consistent with the flow direction of the fluid, as shown in the pipe installation diagram (correct). If the direction mark of the tuning fork does not comply with this regulation, it will affect the measurement results, as shown in the pipe installation diagram (incorrect).



Pipe installation (correct)



Pipe installation (incorrect)

Wrench

If Level Switch TLS…is thread connection, the size of hexagon is 30mm (ISO 272). Selecting the wrench according to the size.

The Level Switch TLS…, is installed in container or pipe.

If Level Switch TLS…is thread connection, the thread must be screwed in place according to the sealing requirements.

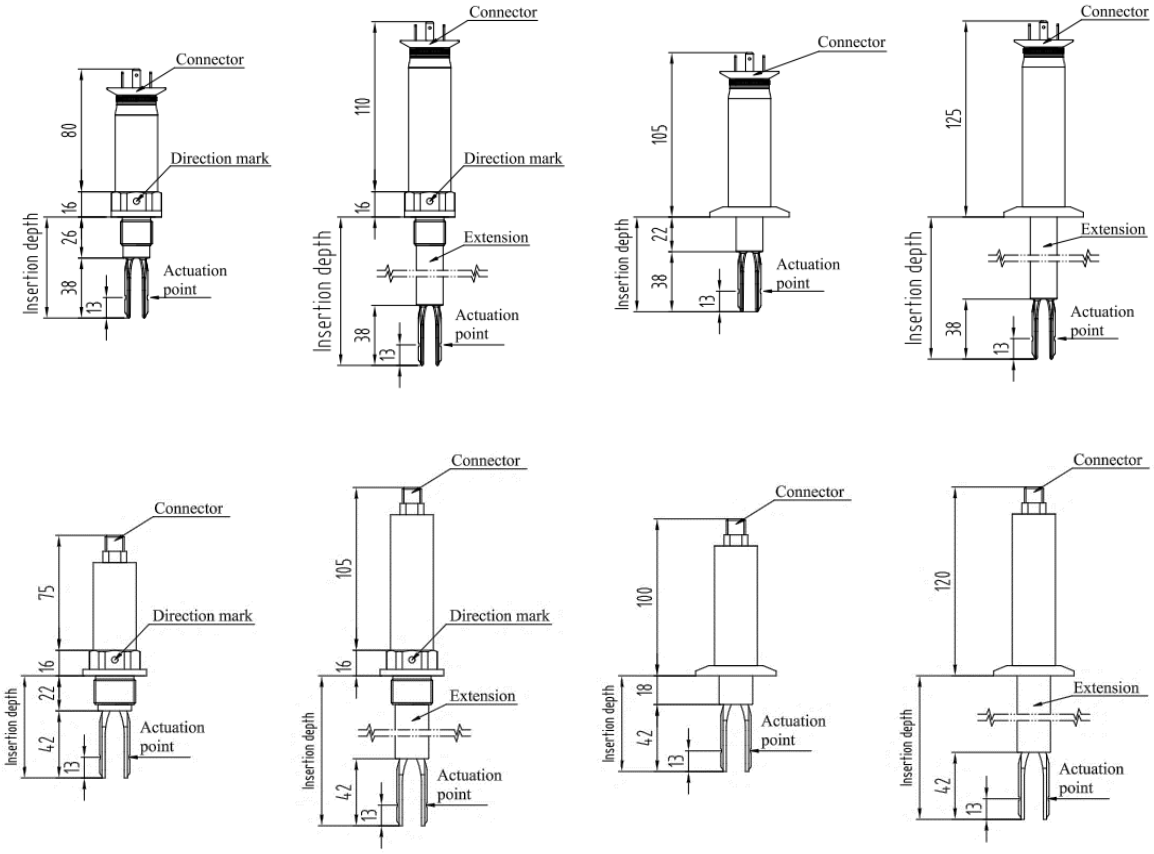
If Level Switch TLS…is clamping connection, suitable bolts, washers and nuts should be used. For suitable gaskets, make sure it is consistent to the medium and operation temperature and pressure.

For tuning fork, as a vibration detection part, the tuning fork should be paid attention to during the installation process, and The collision of external forces and man-made damage are strictly prohibited.

When the liquid in the tank is a pressure, toxic, flammable and dangerous liquid, the liquid in the tank should be emptied before installation, and should be flushed when necessary, and then installed after the internal clean.

Dimensions

The length of the tuning fork is 38mm, 42mm.
The insertion depth ranges from 60(43/47) to 3000mm.
The dimensions of the level switch TLS… is as follows.



Electrical connection

The working point of the switch has been improved when the product leaves the factory.

Wiring can only be done after the level switch is installed. Wiring can be done according to the wiring diagram.

The wiring diagram can be seen directly from nameplate pasted on the outside of terminal box.

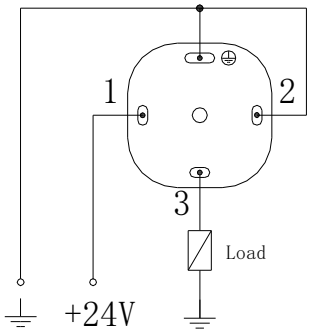
The power supply is 10~30 V DC.

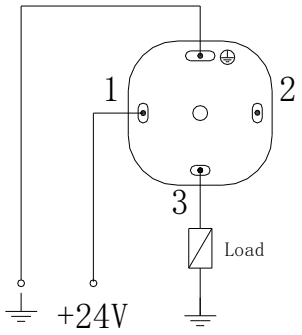
Max. level and Min. level detection correspond to different wiring diagrams, please determine according to the requirements of site.

The wiring diagram is as follows:

1. Hersman connector

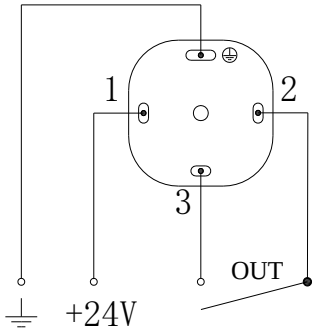
1) Signal output - PNP





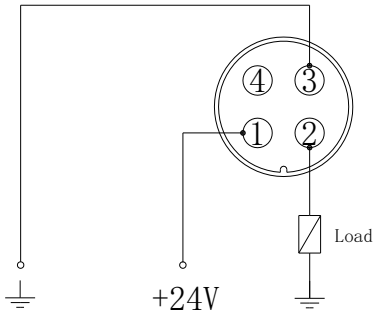
Max. level Min. level

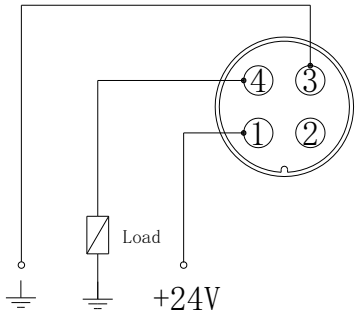
2) Signal output - Relay



2. M12 connector

1) Signal output - PNP





Max. level Min. level

Selecting the connection cable

T**he connection cable is 4 core cable!**

The connection cable must be selected as suitable for the expected ambient conditions (temperature, aggressive atmosphere, weathering, etc.).

Cable Connection

Electrical connections must be carried out in accordance with applicable rules for equipment and by qualified personnel.

The operation steps of cable connection are as follows.

1. Hersman connector

1) Loosen the screw at the top of the plug and disassemble the plug and socket;
2) Unscrew the cable connector of the plug and remove the terminal in the plug;
3) Remove the outer skin of the connecting cable about 5cm and the core wire insulation about 1cm;
4) Put the cable through the cable connector and insert it into the plug shell;
5) Connect the end of the core wire with the terminal according to the wiring diagram;
6) Clip the terminal into the plug shell;
7) Install the plug and socket, and tighten the screw at the top of the plug.

2. M12 connector

1) Take out the M12 aviation socket (cable with specified length at the end);
2) Align the positioning bent of the M12 aviation socket with the positioning bump of the aviation plug on the tuning fork switch body;
3) Press the end of the M12 aviation socket to ensure that the socket inserts the plug according to the positioning position;
4) Tighten the locking nut outside the M12 aviation socket;
5) Make sure the connection of M12 aviation socket and plug is reliable.

Debugging

Under normal circumstances, the action point of the level switch has been setting in the factory. No further adjustment is required under normal circumstances.

Action point

The level switch TLS…can measure the minimum density of the medium up to 0.5g/cm^3.

The length of fork body is 38mm, 42mm.

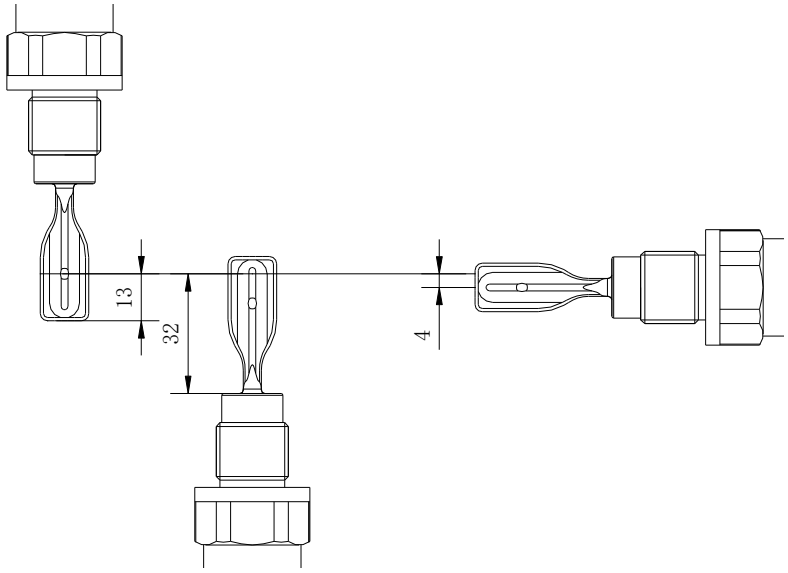
1. The length of fork body is 38mm

If the tuning fork is mounted vertically downward, the action point of the level switch TLS…is 13mm.

If the tuning fork is mounted vertically upward, the action point of the level switch TLS…is 32mm.

If the tuning fork is mounted horizontally, the action point of the level switch TLS… is 4mm.

Note: the action point is set in the factory, and the reference medium is water.



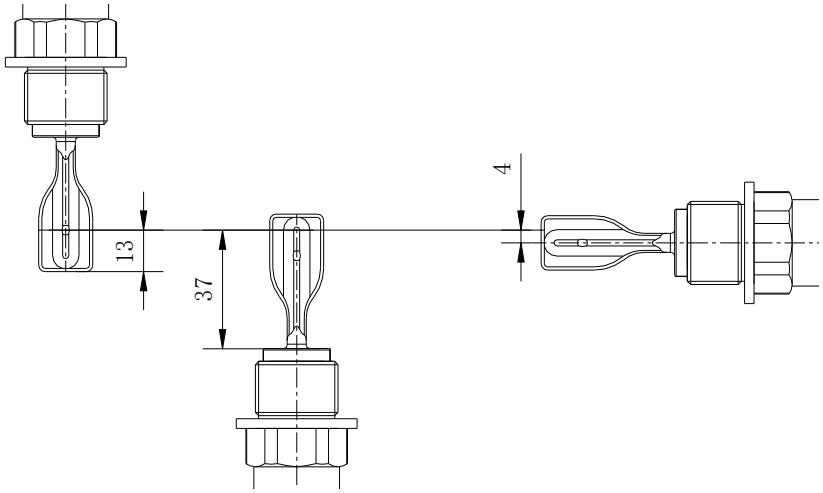
2. The length of fork body is 42mm

If the tuning fork is mounted vertically downward, the action point of the level switch TLS…is 13mm.

If the tuning fork is mounted vertically upward, the action point of the level switch TLS…is 37mm.

If the tuning fork is mounted horizontally, the action point of the level switch TLS… is 4mm.

Note: the action point is set in the factory, and the reference medium is water.



Performance

The accuracy of the level switch TLS… is ±1mm.

The switching difference of the level switch TLS… is ⩽2mm.

The repeatability of the level switch TLS… is 0.1mm.

Response time:

When the tuning fork is changed from no medium covered to medium covered and reaches the setting action point, the respond time is 0.5s.

In contrast, when the tuning fork is changed from medium covered to no medium covered and reaches the setting action point, the respond time is 1s

Function indication

1. Hersman connector

1) Signal output – PNP

Output indicator light used to indicate the switch state.

Max. level: Power on, the color of indicator light is green. As the liquid level rises, the tuning fork is covered by medium and reaches the setting action point, the voltage signal is changed from 0V to 24V and the color of indicator light is changed from green to red.

Min. level: Power on, the color of indicator light is red. As the liquid level rises, the tuning fork is covered by medium and reaches the setting action point, the voltage signal is changed from 24V to 0Vand the color of indicator light is changed from red to green.

Failure state: The color of indicator light is red flashing.

2) Signal output – Relay

Output indicator light used to indicate the switch state. Power on, the state of relay is OFF and the color of indicator light is green. As the liquid level rises, the tuning fork is covered by medium and reaches the setting action point, the state of relay is ON and the color of indicator light is changed from green to red.

2. M12 connector

The green light indicates the power supply. The yellow light indicates the signal output.

Power on, the green light is on.

Max. level: as the liquid level rises, the tuning fork is covered by medium and reaches the setting action point, the voltage signal is changed from 24V to 0V and the yellow light is changed from lit to no lit.

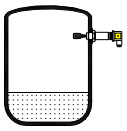
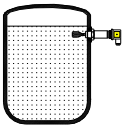
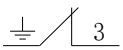
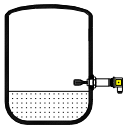
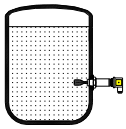
Min. level: as the liquid level drops, the tuning fork is not covered by medium and reaches the setting action point, the voltage signal is changed from 24V to 0Vand the yellow light is changed from lit to no lit.

Note

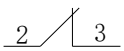
The following table shows the switch state related to the indicator light and level.

1. Hersman connector

1) Signal output - PNP

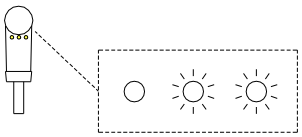
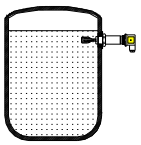
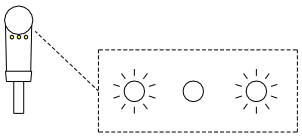
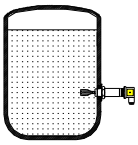
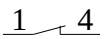
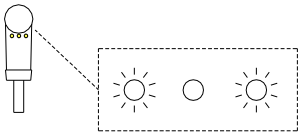
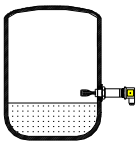
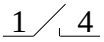
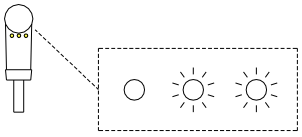
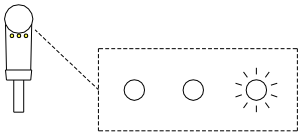
	Level	Switch state	Indicator light
Max. Level			Green 
Max. Level			Red 
Min. Level			Red 
Min. Level			Green 
Failure state			Red flashing 

2） Signal output – Relay

	Level	Switch	Indicator
Liquid Level			Output indicator Green 
Liquid Level			Output indicator Red 
Failure state			Output indicator Red flashing 

2. M12 connector

1) Signal output - PNP

	Level	Switch state	Indicator light
Max. Level			 Yellow Yellow Green (No lit)
Max. Level			 Yellow Yellow Green (No lit)
Min. Level			 Yellow Yellow Green (No lit)
Min. Level			 Yellow Yellow Green (No lit)
Alarm			Not Applicable
Error			 Yellow Yellow Green (No lit) (No lit)

Function test

1. Hersman connector

1) Signal output – PNP

After power on, the indicator light is on, and the tuning fork is vibrating, which indicates that the level switch TLS…can work normally.

Lift the level switch TLS… and insert it into the water vertically. When the insertion depth is greater than 13mm, the voltage signal can change between 24V and 0Vand the color of indicator light can change between green and red which indicates that the switch works normal.

2) Signal output – Relay

After power on, the indicator light is on, and the tuning fork is vibrating, which indicates that the level switch TLS…can work normally.

Lift the level switch TLS… and insert it into the water vertically. When the insertion depth is greater than 13mm, the state of relay can change between ON and OFF and the color of indicator light can change between green and red which indicates that the switch works normal.

2. M12 connector

After power on, the green light is on, and the tuning fork is vibrating, which indicates that the level switch TLS…can work normally.

Lift the level switch TLS… and insert it into the water vertically. When the insertion depth is greater than 13mm, the voltage signal can change between 24V and 0Vand the yellow light can change between on and off, which indicates that the switch works normal.

Maintenance

Level Switch TLS… function free of maintenance if used properly. However, they must be subjected to a visual check within the framework of regular inspection.

A functional test can only be carried out after the sensor has been dismantled. During the functional test, unintended process operations can be activated in the downstream control unit. Risk of property or personal damage.

Daily use should strictly follow the following requirements.

1. The power supply should be stable during operation, and the electrical shielding should be considered for signal transmission;
2. Firm installation and reliable wiring are also the primary guarantee for the normal operation of the switch;
3. Strong vibration should be avoided when switch works;
4. The switch should not work beside the environment and objects with strong magnetic field;
5. Switch electrical structure should avoid direct rain and sunlight, should take protective measures.

Fault handling

The common faults of the level switch TLS… and their possible causes and solutions are listed in the table below.

Faults	No.	Causes	Solutions	
			Method	Place
Power on The tuning fork is not vibrating The indicator light is off	1	Wiring error The power supply cable is connected in reverse	Wiring correctly according to the wiring diagram	On site
	2	Circuit module damage	Replace circuit module damage	Back to factory
Power on The tuning fork is vibrating The indicator light is off	1	The indicator light is broken	Replace the indicator light	Back to factory
	2	Circuit module damage	Replace circuit module damage	Back to factory
Power on The tuning fork is vibrating The color of indicator light is reverse	1	Wiring error The Max. and Min. level detection selection error	Wring according to the wiring diagram	On site
	2	Circuit module damage	Replace circuit module damage	Back to factory
The tuning fork is not covered by medium, but has an on-off action (include voltage signal change and the color of indicator light change)	1	Power supply is too low	Check the power supply	On site
	2	Circuit module damage	Replace circuit module damage	Back to factory
	3	There is something attached to the tuning fork	Check the surface of the tuning fork, and if so, remove the attachment	On site
	4	Installation in container Tuning fork indented into thread or clamping connection (the liquid with high viscosity)	Modify the length of thread and clamping connection	On site
	5	Installation on pipe Tuning fork is not consistent with the flow direction of the fluid	Adjust the installation position of the switch	On site
The actual action point is quite different from the setting action point	1	The density of the site medium differs greatly from that of water	The action point cannot be adjusted on site	Back to factory
	2	Tuning fork is damaged (Confirm on site whether there is deformation and damage to the tuning fork)	If the tuning fork is damaged, there is no way to handle on site	Back to factory
The tuning fork is covered totally by medium, but no	1	The density of the site medium is $<0.5g/cm^3$	The position of action point	Back to factory

on-off action (include voltage signal change and the color of indicator light change)			cannot be adjusted on site	
	2	Tuning fork is damaged (Confirm on site whether there is deformation and damage to the tuning fork)	If the tuning fork is damaged, there is no way to handle on site	Back to factory

Note: please give us a call in case of any difficulties. We will do everything we can to provide you with the required advice and help.

Technical data

Item	Specification information	Explanation
1	Operation pressure (MPa)	-0.1～6.4
2	Operation temperature (℃)	-40~150
3	S.G. (Kg/m^3)	≥500
4	Material	Stainless steel
5	Length of tuning fork (mm)	38, 42
6	Measuring range (mm)	60(43/47)～3000
7	Output signal	PNP-3 wire, Relay
8	Supply voltage	10~30VDC
9	Power Consumption	＜1W
10	Environment temperature	-40~60℃
11	Accuracy	±1mm
12	Switching difference	≤2mm
13	Repeatability	0.1mm
14	Respond time	0.5s, 1s
15	Electrical connection	Hersman connector (M16×1.5) M12 connector(M12×1.0)
16	IPXX	IP65/IP66, IP68

Nameplate

Nameplate marked with product model, product number, operation pressure and temperature. Nameplate marked with wiring diagram.

Accessories

Packing list; product instruction; product certificate; additional fittings or accessories to be ordered by customer.

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