**试 验 报 告**

1 试验目的

转角扭矩仪是在螺纹连接件的装配过程中起到实时控制等关键作用的兼具扭矩和转角两种参数的传感器。新修订的转角扭矩仪校准规范的主要计量性能指标是：扭矩示值相对误差或长期稳定性、扭矩示值重复性、扭矩指示装置分辨力、回零差、同轴度、转角指示装置分辨力、转角示值误差、转角示值重复性等。试验的目的是为了验证该规范的技术要求是否科学合理、所用的测量标准是否满足要求、便于操作、采用的校准方法是否切实可行等。为此，起草小组选用 Atlas Copco 和 Desoutter 的 10 台转角扭矩仪进行了全面试验验证。

2 试验条件

2.1 测量标准器

2.1.1 扭矩标准机

2.1.2 角度编码器

2.1.3 百分表

2.1.4 检验棒

2.2 环境条件：温度：22.6℃，湿度：52%RH。

2.3 试验地点：上海市张衡路 1500 号大力楼 120 室。

3 试验方法

按照本规范规定的方法和步骤，用扭矩标准机、角度编码器、百分表、检验棒对转角扭矩仪各项计量性能指标进行校准。通过实际测量确定规范规定的技术指标是否科学合理，校准方法是否方便可行。

4 试验过程

4.1 通过目测、手感、开机等步骤对转角扭矩仪进行检查，以确定是否工作正常。

4.2 各种指标的校准

4.2.1 将转角扭矩仪安放在扭矩标准机上，重复3次施加扭矩至额定扭矩值，按照设定好的校准点对转角扭矩仪施加递增扭矩，读取并记录指示装置的示值，重复试验3次。

4.2.2 完成该方向的校准后，卸下转角扭矩仪重新安装后按照 4.2.1 的步骤进行另一个方向的校准。

4.2.3 将检验棒分别安装在被动夹头和主动夹头，转动主动夹头，使用百分表测量检验棒端头及距端头100mm处的径向圆跳动，通过计算检验转角测量夹头的同轴度。

4.2.4 将扭矩仪与角度编码器串接，并能够保证扭矩仪主轴和角度编码器的主轴能够在无扭矩负荷的情况下自由旋转。将扭矩仪和角度编码器清零，按选定的校准点以递增顺序逐级旋转主轴至360°，旋转到相应校准点时读取并记录指示装置的转角示值。此过程连续进行3次。

4.2.4 按照规范的要求计算出扭矩示值相对误差或长期稳定性、扭矩示值重复性、扭矩指示装置分辨力、回零差、同轴度、转角指示装置分辨力、转角示值误差、转角示值­重复性等。试验记录见附件1-10。

5. 结论

上述试验证明：校准规范的各项技术指标合理、校准用仪器和方法可行。

**附件1**

**转角扭矩仪校准记录格式**

送检单位 XXXXX 地址 XXXXX 证书编号 202XD42-001

制造厂 Atlas Copco 型号规格 IRTT-B 500-20 出厂编号 43361437

标准器 扭矩标准机；NE-500 ；910001 证书编号 [LSfm2021-00004](javaScript:downLoadZs(%22upload/2021/10/21/c2d708b90a7245aab139a03e9cb3a24e.pdf%22,%22LSfm2021-00004.pdf%22)) 有效期至 2023-09-21

测量范围 （2-5000）Nm不确定度/准确度等级/最大允差 0.03级

标准器 角度编码器；MANU-I/O ；14460006 证书编号2020D31-10-2412024001 有效期至 2024-04-09

测量范围 （0-360）° 不确定度/准确度等级/最大允差 ±0.4′ 温度 22.6℃ 湿度 52%RH

校准地点 上海市张衡路 1500号大力楼 120 室 校准日期 2023年09月20日

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 扭  矩  部分 | 方向 | 校准点  /Nm | 进程  /Nm | | | | 回程  /Nm | | | | 示值相对误差  /% | 示值重复性  /% | 进回程差/% | 内插误差 | 长期稳定性 |
| 1 | 2 | 3 | 平均值 | 1 | 2 | 3 | 平均值 |
| 顺时针 | 100 | 100.2 | 100.1 | 100.3 | 100.2 | 100.2 | 100.2 | 100.4 | 100.3 | 0.2 | 0.2 | 0.1 | / | / |
| 200 | 200.2 | 200.3 | 200.3 | 200.3 | 200.3 | 200.3 | 200.4 | 200.3 | 0.1 | 0.0 | 0.0 | / | / |
| 300 | 300.2 | 300.4 | 300.3 | 300.3 | 300.3 | 300.3 | 300.4 | 300.3 | 0.1 | 0.1 | 0.0 | / | / |
| 400 | 400.3 | 400.4 | 400.4 | 400.4 | 400.4 | 400.4 | 400.5 | 400.4 | 0.1 | 0.0 | 0.0 | / | / |
| 500 | 500.4 | 500.5 | 500.5 | 500.5 | / | / | / | / | 0.1 | 0.0 | / | / | / |
| 逆时针 | 100 | 99.8 | 99.7 | 99.8 | 99.8 | 99.7 | 99.7 | 99.8 | 99.7 | -0.2 | 0.1 | 0.0 | / | / |
| 200 | 199.5 | 199.7 | 199.4 | 199.5 | 199.4 | 199.6 | 199.3 | 199.4 | -0.2 | 0.2 | -0.1 | / | / |
| 300 | 299.3 | 299.6 | 299.2 | 299.4 | 299.1 | 299.4 | 299.1 | 299.2 | -0.2 | 0.1 | -0.1 | / | / |
| 400 | 399.1 | 399.4 | 399.1 | 399.2 | 399.0 | 399.3 | 399.1 | 399.1 | -0.2 | 0.1 | 0.0 | / | / |
| 500 | 499.0 | 499.2 | 499.0 | 499.1 | / | / | / | / | -0.2 | 0.0 | / | / | / |
| 分辨力：0.1Nm | | | | | | 回零差： 0.1 %FS | | | | 校准方程：/ | | | | |
| 转角部分 | 方向 | 校准点/° | 示值  /° | | | | 示值误差  /° | 示值重复性  /° | 校准点  /° | 示值  /° | | | | 示值误差  /° | 示值重复性  /° |
| 1 | 2 | 3 | 平均值 | 1 | 2 | 3 | 平均值 |
| 顺时针 | 1 | 1.0 | 1.0 | 1.0 | 1.0 | 0.0 | 0.0 | 270 | 269.3 | 269.3 | 269.4 | 269.3 | -0.7 | 0.1 |
| 90 | 89.8 | 89.9 | 89.8 | 89.8 | -0.2 | 0.1 | 360 | 359.2 | 359.2 | 359.1 | 359.2 | -0.8 | 0.1 |
| 180 | 179.6 | 179.5 | 179.6 | 179.6 | -0.4 | 0.1 | / | / | / | / | / | / | / |
| 逆时针 | 1 | 1.0 | 1.0 | 1.0 | 1.0 | 0.0 | 0.0 | 270 | 269.7 | 269.5 | 269.4 | 269.5 | -0.5 | 0.3 |
| 90 | 89.8 | 89.8 | 89.7 | 89.8 | -0.2 | 0.1 | 360 | 359.5 | 359.4 | 359.3 | 359.4 | -0.6 | 0.2 |
| 180 | 179.7 | 179.7 | 179.6 | 179.7 | -0.3 | 0.1 | / | / | / | / | / | / | / |
| 同轴度 | | | ：0.1mm | | ：0.1mm | | ：0.2mm | | 分辨力：0.1° | | | | | |
| 扩展不确定度：扭矩：*U*r=0.2% (*k*=2)  转角：*U*r =0.2% (*k*=2) | | | | | | | | | | | | | | | |

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**附件2**

**转角扭矩仪校准记录格式**

送检单位 XXXXX 地址 XXXXX 证书编号 202XD42-002

制造厂 Atlas Copco 型号规格 IRTT-B 180-13 出厂编号 43361437

标准器 扭矩标准机；NE-500 ；910001 证书编号 [LSfm2021-00004](javaScript:downLoadZs(%22upload/2021/10/21/c2d708b90a7245aab139a03e9cb3a24e.pdf%22,%22LSfm2021-00004.pdf%22)) 有效期至 2023-09-21

测量范围 （2-5000）Nm不确定度/准确度等级/最大允差 0.03级

标准器 角度编码器；MANU-I/O ；14460006 证书编号2020D31-10-2412024001 有效期至 2024-04-09

测量范围 （0-360）° 不确定度/准确度等级/最大允差 ±0.4′ 温度 22.6℃ 湿度 52%RH

校准地点 上海市张衡路 1500号大力楼 120 室 校准日期 2023年09月20日

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 扭  矩  部分 | 方向 | 校准点  /Nm | 进程  /Nm | | | | | | | | | 回程  /Nm | | | | | | | | 示值相对误差  /% | | 示值重复性  /% | | 进回程差/% | 内插误差 | 长期稳定性 |
| 1 | | 2 | | 3 | | 平均值 | | 1 | | | 2 | | 3 | | 平均值 | |
| 顺时针 | 30 | 30.09 | | 30.12 | | 30.11 | | 30.11 | | 30.11 | | | 30.12 | | 30.12 | | 30.12 | | 0.4 | | 0.1 | | 0.0 | / | / |
| 70 | 70.25 | | 70.26 | | 70.20 | | 70.24 | | 70.26 | | | 70.27 | | 70.22 | | 70.25 | | 0.3 | | 0.1 | | 0.0 | / | / |
| 100 | 100.30 | | 100.31 | | 100.27 | | 100.29 | | 100.31 | | | 100.32 | | 100.28 | | 100.30 | | 0.3 | | 0.0 | | 0.0 | / | / |
| 140 | 140.67 | | 140.52 | | 140.59 | | 140.59 | | 140.70 | | | 140.55 | | 140.61 | | 140.62 | | 0.4 | | 0.1 | | 0.0 | / | / |
| 180 | 180.86 | | 180.75 | | 180.69 | | 180.77 | | / | | | / | | / | | / | | 0.4 | | 0.1 | | / | / | / |
| 逆时针 | 30 | 30.13 | | 30.15 | | 30.10 | | 30.13 | | 30.15 | | | 30.17 | | 30.12 | | 30.15 | | 0.4 | | 0.2 | | 0.1 | / | / |
| 70 | 70.39 | | 70.42 | | 70.45 | | 70.42 | | 70.41 | | | 70.45 | | 70.48 | | 70.45 | | 0.6 | | 0.1 | | 0.0 | / | / |
| 100 | 100.62 | | 100.55 | | 100.65 | | 100.61 | | 100.65 | | | 100.58 | | 100.67 | | 100.63 | | 0.6 | | 0.1 | | 0.0 | / | / |
| 140 | 140.82 | | 140.69 | | 140.75 | | 140.75 | | 140.85 | | | 140.72 | | 140.78 | | 140.78 | | 0.5 | | 0.1 | | 0.0 | / | / |
| 180 | 181.02 | | 181.12 | | 180.99 | | 181.04 | | / | | | / | | / | | / | | 0.6 | | 0.1 | | / | / | / |
| 分辨力：0.01Nm | | | | | | | | | | | 回零差： 0.2 %FS | | | | | | | | 校准方程：/ | | | | | | |
| 转角部分 | 方向 | 校准点/° | 示值  /° | | | | | | | 示值误差  /° | | | 示值重复性  /° | | 校准点  /° | | 示值  /° | | | | | | | | 示值误差  /° | 示值重复性  /° |
| 1 | 2 | | 3 | | 平均值 | | 1 | | 2 | | 3 | | 平均值 | |
| 顺时针 | 1 | 1.0 | 1.0 | | 1.0 | | 1.0 | | 0.0 | | | 0.0 | | 270 | | 270.7 | | 270.6 | | 270.6 | | 270.6 | | 0.6 | 0.1 |
| 90 | 90.4 | 90.5 | | 90.3 | | 90.4 | | 0.4 | | | 0.2 | | 360 | | 360.7 | | 360.7 | | 360.6 | | 360.7 | | 0.7 | 0.1 |
| 180 | 180.6 | 180.6 | | 180.5 | | 180.6 | | 0.6 | | | 0.1 | | / | | / | | / | | / | | / | | / | / |
| 逆时针 | 1 | 1.0 | 1.0 | | 1.0 | | 1.0 | | 0.0 | | | 0.0 | | 270 | | 269.3 | | 269.2 | | 269.3 | | 269.3 | | -0.7 | 0.1 |
| 90 | 89.4 | 89.2 | | 89.5 | | 89.4 | | -0.6 | | | 0.3 | | 360 | | 359.2 | | 359.1 | | 359.2 | | 359.2 | | -0.8 | 0.1 |
| 180 | 179.5 | 179.2 | | 179.3 | | 179.3 | | -0.7 | | | 0.3 | | / | | / | | / | | / | | / | | / | / |
| 同轴度 | | | ：0.1mm | | | | ：0.1mm | | | | | ：0.2mm | | | | 分辨力：0.1° | | | | | | | | | |
| 扩展不确定度：扭矩：*U*r=0.2% (*k*=2)  转角：*U*r =0.2% (*k*=2) | | | | | | | | | | | | | | | | | | | | | | | | | | |

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**附件3**

**转角扭矩仪校准记录格式**

送检单位 XXXXX 地址 XXXXX 证书编号 202XD42-003

制造厂 Atlas Copco 型号规格 IRTT-B 75-10 出厂编号 42250742

标准器 扭矩标准机；NE-500 ；910001 证书编号 [LSfm2021-00004](javaScript:downLoadZs(%22upload/2021/10/21/c2d708b90a7245aab139a03e9cb3a24e.pdf%22,%22LSfm2021-00004.pdf%22)) 有效期至 2023-09-21

测量范围 （2-5000）Nm不确定度/准确度等级/最大允差 0.03级

标准器 角度编码器；MANU-I/O ；14460006 证书编号2020D31-10-2412024001 有效期至 2024-04-09

测量范围 （0-360）° 不确定度/准确度等级/最大允差 ±0.4′ 温度 22.6℃ 湿度 52%RH

校准地点 上海市张衡路 1500号大力楼 120 室 校准日期 2023年09月20日

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 扭  矩  部分 | 方向 | 校准点  /Nm | 进程  /Nm | | | | | | | | | 回程  /Nm | | | | | | | | 示值相对误差  /% | | 示值重复性  /% | | 进回程差/% | 内插误差 | 长期稳定性 |
| 1 | | 2 | | 3 | | 平均值 | | 1 | | | 2 | | 3 | | 平均值 | |
| 顺时针 | 15 | 15.04 | | 15.03 | | 15.05 | | 15.04 | | 15.05 | | | 15.04 | | 15.05 | | 15.05 | | 0.3 | | 0.1 | | 0.0 | / | / |
| 30 | 30.06 | | 30.06 | | 30.07 | | 30.06 | | 30.07 | | | 30.06 | | 30.08 | | 30.07 | | 0.2 | | 0.0 | | 0.0 | / | / |
| 45 | 45.08 | | 45.09 | | 45.11 | | 45.09 | | 45.09 | | | 45.09 | | 45.11 | | 45.10 | | 0.2 | | 0.1 | | 0.0 | / | / |
| 60 | 60.13 | | 60.15 | | 60.16 | | 60.15 | | 60.14 | | | 60.15 | | 60.17 | | 60.15 | | 0.2 | | 0.0 | | 0.0 | / | / |
| 75 | 75.18 | | 75.20 | | 75.21 | | 75.20 | | / | | | / | | / | | / | | 0.3 | | 0.0 | | / | / | / |
| 逆时针 | 15 | 14.95 | | 14.94 | | 14.94 | | 14.94 | | 14.96 | | | 14.95 | | 14.95 | | 14.95 | | -0.4 | | 0.1 | | 0.1 | / | / |
| 30 | 29.92 | | 29.89 | | 29.91 | | 29.91 | | 29.93 | | | 29.91 | | 29.91 | | 29.92 | | -0.3 | | 0.1 | | 0.0 | / | / |
| 45 | 44.87 | | 44.86 | | 44.84 | | 44.86 | | 44.88 | | | 44.88 | | 44.86 | | 44.87 | | -0.3 | | 0.1 | | 0.0 | / | / |
| 60 | 59.76 | | 59.73 | | 59.72 | | 59.74 | | 59.76 | | | 59.75 | | 59.73 | | 59.75 | | -0.4 | | 0.1 | | 0.0 | / | / |
| 75 | 74.69 | | 74.68 | | 74.69 | | 74.69 | | / | | | / | | / | | / | | -0.4 | | 0.0 | | / | / | / |
| 分辨力：0.01Nm | | | | | | | | | | | 回零差： 0.1 %FS | | | | | | | | 校准方程：/ | | | | | | |
| 转角部分 | 方向 | 校准点/° | 示值  /° | | | | | | | 示值误差  /° | | | 示值重复性  /° | | 校准点  /° | | 示值  /° | | | | | | | | 示值误差  /° | 示值重复性  /° |
| 1 | 2 | | 3 | | 平均值 | | 1 | | 2 | | 3 | | 平均值 | |
| 顺时针 | 1 | 1.0 | 1.0 | | 1.0 | | 1.0 | | 0.0 | | | 0.0 | | 270 | | 270.4 | | 270.6 | | 270.5 | | 270.5 | | 0.5 | 0.2 |
| 90 | 90.3 | 90.4 | | 90.3 | | 90.3 | | 0.3 | | | 0.1 | | 360 | | 360.6 | | 360.8 | | 360.7 | | 360.7 | | 0.7 | 0.2 |
| 180 | 180.4 | 180.5 | | 180.4 | | 180.4 | | 0.4 | | | 0.1 | | / | | / | | / | | / | | / | | / | / |
| 逆时针 | 1 | 1.0 | 1.0 | | 1.0 | | 1.0 | | 0.0 | | | 0.0 | | 270 | | 270.6 | | 270.5 | | 270.5 | | 270.5 | | 0.5 | 0.1 |
| 90 | 90.5 | 90.3 | | 90.3 | | 90.4 | | 0.4 | | | 0.2 | | 360 | | 360.6 | | 360.5 | | 360.6 | | 360.6 | | 0.6 | 0.1 |
| 180 | 180.6 | 180.4 | | 180.3 | | 180.4 | | 0.4 | | | 0.3 | | / | | / | | / | | / | | / | | / | / |
| 同轴度 | | | ：0.1mm | | | | ：0.1mm | | | | | ：0.2mm | | | | 分辨力：0.1° | | | | | | | | | |
| 扩展不确定度：扭矩：*U*r=0.2% (*k*=2)  转角：*U*r =0.2% (*k*=2) | | | | | | | | | | | | | | | | | | | | | | | | | | |

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**附件4**

**转角扭矩仪校准记录格式**

送检单位 XXXXX 地址 XXXXX 证书编号 202XD42-004

制造厂 Atlas Copco 型号规格 IRTT-B 25-10 出厂编号42200484

标准器 扭矩标准机；NE-500 ；910001 证书编号 [LSfm2021-00004](javaScript:downLoadZs(%22upload/2021/10/21/c2d708b90a7245aab139a03e9cb3a24e.pdf%22,%22LSfm2021-00004.pdf%22)) 有效期至 2023-09-21

测量范围 （2-5000）Nm不确定度/准确度等级/最大允差 0.03级

标准器 角度编码器；MANU-I/O ；14460006 证书编号2020D31-10-2412024001 有效期至 2024-04-09

测量范围 （0-360）° 不确定度/准确度等级/最大允差 ±0.4′ 温度 22.6℃ 湿度 52%RH

校准地点 上海市张衡路 1500号大力楼 120 室 校准日期 2023年09月20日

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 扭  矩  部分 | 方向 | 校准点  /Nm | 进程  /Nm | | | | | | | | | 回程  /Nm | | | | | | | | 示值相对误差  /% | | 示值重复性  /% | | 进回程差/% | 内插误差 | 长期稳定性 |
| 1 | | 2 | | 3 | | 平均值 | | 1 | | | 2 | | 3 | | 平均值 | |
| 顺时针 | 5 | 5.02 | | 5.01 | | 5.02 | | 5.02 | | 5.02 | | | 5.03 | | 5.02 | | 5.02 | | 0.3 | | 0.2 | | 0.1 | / | / |
| 10 | 10.03 | | 10.04 | | 10.06 | | 10.04 | | 10.04 | | | 10.06 | | 10.06 | | 10.05 | | 0.4 | | 0.3 | | 0.1 | / | / |
| 15 | 15.05 | | 15.06 | | 15.07 | | 15.06 | | 15.06 | | | 15.07 | | 15.08 | | 15.07 | | 0.4 | | 0.1 | | 0.1 | / | / |
| 20 | 20.08 | | 20.09 | | 20.08 | | 20.08 | | 20.09 | | | 20.1 | | 20.09 | | 20.09 | | 0.4 | | 0.0 | | 0.0 | / | / |
| 25 | 25.11 | | 25.11 | | 25.10 | | 25.11 | | / | | | / | | / | | / | | 0.4 | | 0.0 | | / | / | / |
| 逆时针 | 5 | 5.04 | | 5.05 | | 5.04 | | 5.04 | | 5.05 | | | 5.05 | | 5.04 | | 5.05 | | 0.9 | | 0.2 | | 0.1 | / | / |
| 10 | 10.06 | | 10.07 | | 10.09 | | 10.07 | | 10.07 | | | 10.08 | | 10.09 | | 10.08 | | 0.7 | | 0.3 | | 0.1 | / | / |
| 15 | 15.12 | | 15.10 | | 15.13 | | 15.12 | | 15.14 | | | 15.11 | | 15.14 | | 15.13 | | 0.8 | | 0.2 | | 0.1 | / | / |
| 20 | 20.16 | | 20.15 | | 20.13 | | 20.15 | | 20.17 | | | 20.17 | | 20.16 | | 20.17 | | 0.7 | | 0.1 | | 0.1 | / | / |
| 25 | 25.17 | | 25.18 | | 25.15 | | 25.17 | | / | | | / | | / | | / | | 0.7 | | 0.1 | | / | / | / |
| 分辨力：0.01Nm | | | | | | | | | | | 回零差： 0.1 %FS | | | | | | | | 校准方程：/ | | | | | | |
| 转角部分 | 方向 | 校准点/° | 示值  /° | | | | | | | 示值误差  /° | | | 示值重复性  /° | | 校准点  /° | | 示值  /° | | | | | | | | 示值误差  /° | 示值重复性  /° |
| 1 | 2 | | 3 | | 平均值 | | 1 | | 2 | | 3 | | 平均值 | |
| 顺时针 | 1 | 1.0 | 1.0 | | 1.0 | | 1.0 | | 0.0 | | | 0.0 | | 270 | | 270.3 | | 270.4 | | 270.3 | | 270.3 | | 0.3 | 0.1 |
| 90 | 90.2 | 90.1 | | 90.2 | | 90.2 | | 0.2 | | | 0.1 | | 360 | | 360.5 | | 360.5 | | 360.4 | | 360.5 | | 0.5 | 0.1 |
| 180 | 180.3 | 180.3 | | 180.2 | | 180.3 | | 0.3 | | | 0.1 | | / | | / | | / | | / | | / | | / | / |
| 逆时针 | 1 | 1.0 | 1.0 | | 1.0 | | 1.0 | | 0.0 | | | 0.0 | | 270 | | 269.5 | | 269.7 | | 269.5 | | 269.6 | | -0.4 | 0.2 |
| 90 | 89.6 | 89.7 | | 89.5 | | 89.6 | | -0.4 | | | 0.2 | | 360 | | 359.4 | | 359.6 | | 359.4 | | 359.5 | | -0.5 | 0.2 |
| 180 | 179.7 | 179.6 | | 179.6 | | 179.6 | | -0.4 | | | 0.1 | | / | | / | | / | | / | | / | | / | / |
| 同轴度 | | | ：0.1mm | | | | ：0.1mm | | | | | ：0.2mm | | | | 分辨力：0.1° | | | | | | | | | |
| 扩展不确定度：扭矩：*U*r=0.2% (*k*=2)  转角：*U*r =0.2% (*k*=2) | | | | | | | | | | | | | | | | | | | | | | | | | | |

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**附件5**

**转角扭矩仪校准记录格式**

送检单位 XXXXX 地址 XXXXX 证书编号 202XD42-005

制造厂 Atlas Copco 型号规格 IRTT-B 1400A-25 出厂编号43460448

标准器 扭矩标准机；NE-500 ；910001 证书编号 [LSfm2021-00004](javaScript:downLoadZs(%22upload/2021/10/21/c2d708b90a7245aab139a03e9cb3a24e.pdf%22,%22LSfm2021-00004.pdf%22)) 有效期至 2023-09-21

测量范围 （2-5000）Nm不确定度/准确度等级/最大允差 0.03级

标准器 角度编码器；MANU-I/O ；14460006 证书编号2020D31-10-2412024001 有效期至 2024-04-09

测量范围 （0-360）° 不确定度/准确度等级/最大允差 ±0.4′ 温度 22.6℃ 湿度 52%RH

校准地点 上海市张衡路 1500号大力楼 120 室 校准日期 2023年09月20日

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 扭  矩  部分 | 方向 | 校准点  /Nm | 进程  /Nm | | | | | | | | | 回程  /Nm | | | | | | | | 示值相对误差  /% | | 示值重复性  /% | | 进回程差/% | 内插误差 | 长期稳定性 |
| 1 | | 2 | | 3 | | 平均值 | | 1 | | | 2 | | 3 | | 平均值 | |
| 顺时针 | 250 | 251.6 | | 251.5 | | 251.8 | | 251.6 | | 251.7 | | | 251.6 | | 251.9 | | 251.7 | | 0.7 | | 0.1 | | 0.0 | / | / |
| 500 | 502.6 | | 502.8 | | 502.6 | | 502.7 | | 502.8 | | | 502.9 | | 502.7 | | 502.8 | | 0.5 | | 0.0 | | 0.0 | / | / |
| 700 | 703.3 | | 703.9 | | 702.9 | | 703.4 | | 703.5 | | | 704.3 | | 704.2 | | 704.0 | | 0.5 | | 0.1 | | 0.1 | / | / |
| 1100 | 1104.6 | | 1105.9 | | 1104.8 | | 1105.1 | | 1104.9 | | | 1106.2 | | 1105.3 | | 1105.5 | | 0.5 | | 0.1 | | 0.0 | / | / |
| 1400 | 1406.8 | | 1407.9 | | 1408.1 | | 1407.6 | | / | | | / | | / | | / | | 0.5 | | 0.1 | | / | / | / |
| 逆时针 | 250 | 252.3 | | 252.0 | | 251.9 | | 252.1 | | 252.4 | | | 252.3 | | 252.4 | | 252.4 | | 0.8 | | 0.2 | | 0.1 | / | / |
| 500 | 503.6 | | 503.8 | | 504.1 | | 503.8 | | 504.0 | | | 504.1 | | 504.4 | | 504.2 | | 0.8 | | 0.1 | | 0.1 | / | / |
| 700 | 705.8 | | 706.1 | | 705.3 | | 705.7 | | 706.0 | | | 706.2 | | 705.9 | | 706.0 | | 0.8 | | 0.1 | | 0.0 | / | / |
| 1100 | 1108.6 | | 1109.2 | | 1107.9 | | 1108.6 | | 1109.1 | | | 1110.0 | | 1108.9 | | 1109.3 | | 0.8 | | 0.1 | | 0.1 | / | / |
| 1400 | 1409.6 | | 1410.2 | | 1409.7 | | 1409.8 | | / | | | / | | / | | / | | 0.7 | | 0.0 | | / | / | / |
| 分辨力：0.1Nm | | | | | | | | | | | 回零差： 0.1 %FS | | | | | | | | 校准方程：/ | | | | | | |
| 转角部分 | 方向 | 校准点/° | 示值  /° | | | | | | | 示值误差  /° | | | 示值重复性  /° | | 校准点  /° | | 示值  /° | | | | | | | | 示值误差  /° | 示值重复性  /° |
| 1 | 2 | | 3 | | 平均值 | | 1 | | 2 | | 3 | | 平均值 | |
| 顺时针 | 1 | 1.0 | 1.0 | | 1.0 | | 1.0 | | 0.0 | | | 0.0 | | 270 | | 269.5 | | 269.3 | | 269.4 | | 269.4 | | -0.6 | 0.2 |
| 90 | 89.6 | 89.7 | | 89.6 | | 89.6 | | -0.4 | | | 0.1 | | 360 | | 359.3 | | 359.2 | | 359.4 | | 359.3 | | -0.7 | 0.2 |
| 180 | 179.6 | 179.4 | | 179.6 | | 179.5 | | -0.5 | | | 0.2 | | / | | / | | / | | / | | / | | / | / |
| 逆时针 | 1 | 1.0 | 1.0 | | 1.0 | | 1.0 | | 0.0 | | | 0.0 | | 270 | | 270.5 | | 270.6 | | 270.8 | | 270.6 | | 0.6 | 0.3 |
| 90 | 90.3 | 90.4 | | 90.7 | | 90.5 | | 0.5 | | | 0.4 | | 360 | | 360.8 | | 360.6 | | 360.9 | | 360.8 | | 0.8 | 0.3 |
| 180 | 180.6 | 180.4 | | 180.7 | | 180.6 | | 0.6 | | | 0.3 | | / | | / | | / | | / | | / | | / | / |
| 同轴度 | | | ：0.1mm | | | | ：0.1mm | | | | | ：0.2mm | | | | 分辨力：0.1° | | | | | | | | | |
| 扩展不确定度：扭矩：*U*r=0.2% (*k*=2)  转角：*U*r =0.2% (*k*=2) | | | | | | | | | | | | | | | | | | | | | | | | | | |

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**附件6**

**转角扭矩仪校准记录格式**

送检单位 XXXXX 地址 XXXXX 证书编号 202XD42-006

制造厂Desoutter型号规格[DRT 5 Sq 1400](https://www.desouttertools.com.cn/gongju/5/niu-ju-ce-liang-xi-tong/52/niu-ju-ban-ben/521/xuan-zhuan-chuan-gan-qi/5212/xuan-zhuan-shi-chuan-gan-qi-niu-ju-jiao-du-ce-liang/p/6151652260/drt-5-sq-1400" \o "旋转式传感器—扭矩 & 角度测量 DRT 5 Sq 1400) 出厂编号6151652260

标准器 扭矩标准机；NE-500 ；910001 证书编号 [LSfm2021-00004](javaScript:downLoadZs(%22upload/2021/10/21/c2d708b90a7245aab139a03e9cb3a24e.pdf%22,%22LSfm2021-00004.pdf%22)) 有效期至 2023-09-21

测量范围 （2-5000）Nm不确定度/准确度等级/最大允差 0.03级

标准器 角度编码器；MANU-I/O ；14460006 证书编号2020D31-10-2412024001 有效期至 2024-04-09

测量范围 （0-360）° 不确定度/准确度等级/最大允差 ±0.4′ 温度 22.6℃ 湿度 52%RH

校准地点 上海市张衡路 1500号大力楼 120 室 校准日期 2023年09月20日

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 扭  矩  部分 | 方向 | 校准点  /Nm | 进程  /Nm | | | | | | | | | 回程  /Nm | | | | | | | | 示值相对误差  /% | | 示值重复性  /% | | 进回程差/% | 内插误差 | 长期稳定性 |
| 1 | | 2 | | 3 | | 平均值 | | 1 | | | 2 | | 3 | | 平均值 | |
| 顺时针 | 250 | 252.0 | | 252.4 | | 251.8 | | 252.1 | | 252.2 | | | 252.5 | | 251.9 | | 252.2 | | 0.8 | | 0.2 | | 0.1 | / | / |
| 500 | 502.9 | | 503.1 | | 502.8 | | 502.9 | | 503.1 | | | 503.3 | | 503.0 | | 503.1 | | 0.6 | | 0.1 | | 0.0 | / | / |
| 700 | 704.3 | | 704.5 | | 703.8 | | 704.2 | | 704.5 | | | 704.6 | | 704.0 | | 704.4 | | 0.6 | | 0.1 | | 0.0 | / | / |
| 1100 | 1106.3 | | 1107.5 | | 1107.1 | | 1107.0 | | 1106.5 | | | 1107.6 | | 1107.3 | | 1107.1 | | 0.6 | | 0.1 | | 0.0 | / | / |
| 1400 | 1408.3 | | 1408.9 | | 1407.5 | | 1408.2 | | / | | | / | | / | | / | | 0.6 | | 0.1 | | / | / | / |
| 逆时针 | 250 | 248.3 | | 248.0 | | 247.9 | | 248.1 | | 248.4 | | | 248.2 | | 248.1 | | 248.2 | | -0.8 | | 0.2 | | 0.1 | / | / |
| 500 | 496.3 | | 497.0 | | 496.5 | | 496.6 | | 496.6 | | | 497.2 | | 496.6 | | 496.8 | | -0.7 | | 0.1 | | 0.0 | / | / |
| 700 | 694.6 | | 695.1 | | 694.9 | | 694.9 | | 694.7 | | | 695.3 | | 695.1 | | 695.0 | | -0.7 | | 0.1 | | 0.0 | / | / |
| 1100 | 1092.3 | | 1091.8 | | 1092.6 | | 1092.2 | | 1092.6 | | | 1092.0 | | 1092.8 | | 1092.5 | | -0.7 | | 0.1 | | 0.0 | / | / |
| 1400 | 1390.3 | | 1391.2 | | 1390.8 | | 1390.8 | | / | | | / | | / | | / | | -0.7 | | 0.1 | | / | / | / |
| 分辨力：0.1Nm | | | | | | | | | | | 回零差： 0.2 %FS | | | | | | | | 校准方程：/ | | | | | | |
| 转角部分 | 方向 | 校准点/° | 示值  /° | | | | | | | 示值误差  /° | | | 示值重复性  /° | | 校准点  /° | | 示值  /° | | | | | | | | 示值误差  /° | 示值重复性  /° |
| 1 | 2 | | 3 | | 平均值 | | 1 | | 2 | | 3 | | 平均值 | |
| 顺时针 | 1 | 1.0 | 1.0 | | 1.0 | | 1.0 | | 0.0 | | | 0.0 | | 270 | | 270.6 | | 270.5 | | 270.6 | | 270.6 | | 0.6 | 0.1 |
| 90 | 90.3 | 90.4 | | 90.3 | | 90.3 | | 0.3 | | | 0.1 | | 360 | | 360.7 | | 360.6 | | 360.7 | | 360.7 | | 0.7 | 0.1 |
| 180 | 180.5 | 180.6 | | 180.4 | | 180.5 | | 0.5 | | | 0.2 | | / | | / | | / | | / | | / | | / | / |
| 逆时针 | 1 | 1.0 | 1.0 | | 1.0 | | 1.0 | | 0.0 | | | 0.0 | | 270 | | 270.5 | | 270.4 | | 270.7 | | 270.5 | | 0.5 | 0.3 |
| 90 | 90.1 | 90.3 | | 90.4 | | 90.3 | | 0.3 | | | 0.3 | | 360 | | 360.8 | | 360.9 | | 361 | | 360.9 | | 0.9 | 0.2 |
| 180 | 180.3 | 180.5 | | 180.6 | | 180.5 | | 0.5 | | | 0.3 | | / | | / | | / | | / | | / | | / | / |
| 同轴度 | | | ：0.1mm | | | | ：0.1mm | | | | | ：0.2mm | | | | 分辨力：0.1° | | | | | | | | | |
| 扩展不确定度：扭矩：*U*r=0.2% (*k*=2)  转角：*U*r =0.2% (*k*=2) | | | | | | | | | | | | | | | | | | | | | | | | | | |

第 1 页 共 1 页 校准人员：李业 核验人员：郑熙云

**附件7**

**转角扭矩仪校准记录格式**

送检单位 XXXXX 地址 XXXXX 证书编号 202XD42-007

制造厂Desoutter型号规格[DRT 5 Sq 500](https://www.desouttertools.com.cn/gongju/5/niu-ju-ce-liang-xi-tong/52/niu-ju-ban-ben/521/xuan-zhuan-chuan-gan-qi/5212/xuan-zhuan-shi-chuan-gan-qi-niu-ju-jiao-du-ce-liang/p/6151652250/drt-5-sq-500" \o "旋转式传感器—扭矩 & 角度测量 DRT 5 Sq 500) 出厂编号011801280

标准器 扭矩标准机；NE-500 ；910001 证书编号 [LSfm2021-00004](javaScript:downLoadZs(%22upload/2021/10/21/c2d708b90a7245aab139a03e9cb3a24e.pdf%22,%22LSfm2021-00004.pdf%22)) 有效期至 2023-09-21

测量范围 （2-5000）Nm不确定度/准确度等级/最大允差 0.03级

标准器 角度编码器；MANU-I/O ；14460006 证书编号2020D31-10-2412024001 有效期至 2024-04-09

测量范围 （0-360）° 不确定度/准确度等级/最大允差 ±0.4′ 温度 22.6℃ 湿度 52%RH

校准地点 上海市张衡路 1500号大力楼 120 室 校准日期 2023年09月20日

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 扭  矩  部分 | 方向 | 校准点  /Nm | 进程  /Nm | | | | 回程  /Nm | | | | 示值相对误差  /% | 示值重复性  /% | 进回程差/% | 内插误差 | 长期稳定性 |
| 1 | 2 | 3 | 平均值 | 1 | 2 | 3 | 平均值 |
| 顺时针 | 100 | 100.6 | 100.4 | 100.8 | 100.6 | 100.7 | 100.6 | 100.9 | 100.7 | 0.6 | 0.4 | 0.1 | / | / |
| 200 | 201.2 | 200.8 | 201.1 | 201.0 | 201.3 | 200.9 | 201.3 | 201.2 | 0.5 | 0.2 | 0.1 | / | / |
| 300 | 301.6 | 301.9 | 302.0 | 301.8 | 301.7 | 302.1 | 302.2 | 302.0 | 0.6 | 0.1 | 0.1 | / | / |
| 400 | 402.3 | 403.1 | 402.8 | 402.7 | 402.5 | 403.1 | 402.9 | 402.8 | 0.7 | 0.2 | 0.0 | / | / |
| 500 | 503.0 | 503.6 | 503.8 | 503.5 | / | / | / | / | 0.7 | 0.2 | / | / | / |
| 逆时针 | 100 | 99.2 | 99.4 | 99.1 | 99.2 | 99.2 | 99.5 | 99.2 | 99.3 | -0.8 | 0.3 | 0.1 | / | / |
| 200 | 198.6 | 198.4 | 198.9 | 198.6 | 198.8 | 198.5 | 198.9 | 198.7 | -0.7 | 0.3 | 0.1 | / | / |
| 300 | 297.6 | 297.1 | 298.1 | 297.6 | 297.8 | 297.3 | 298.2 | 297.8 | -0.8 | 0.3 | 0.1 | / | / |
| 400 | 396.9 | 397.6 | 396.5 | 397.0 | 397.1 | 397.8 | 396.8 | 397.2 | -0.8 | 0.3 | 0.1 | / | / |
| 500 | 495.3 | 495.1 | 496.1 | 495.5 | / | / | / | / | -0.9 | 0.2 | / | / | / |
| 分辨力：0.1Nm | | | | | | 回零差： 0.1 %FS | | | | 校准方程：/ | | | | |
| 转角部分 | 方向 | 校准点/° | 示值  /° | | | | 示值误差  /° | 示值重复性  /° | 校准点  /° | 示值  /° | | | | 示值误差  /° | 示值重复性  /° |
| 1 | 2 | 3 | 平均值 | 1 | 2 | 3 | 平均值 |
| 顺时针 | 1 | 1.0 | 1.0 | 1.0 | 1.0 | 0.0 | 0.0 | 270 | 270.9 | 270.5 | 270.5 | 270.6 | 0.6 | 0.4 |
| 90 | 90.6 | 90.1 | 90.5 | 90.4 | 0.4 | 0.5 | 360 | 361 | 360.6 | 360.8 | 360.8 | 0.8 | 0.4 |
| 180 | 180.8 | 180.6 | 180.3 | 180.6 | 0.6 | 0.5 | / | / | / | / | / | / | / |
| 逆时针 | 1 | 1.0 | 1.0 | 1.0 | 1.0 | 0.0 | 0.0 | 270 | 269.3 | 269.2 | 269.1 | 269.2 | -0.8 | 0.2 |
| 90 | 89.6 | 89.3 | 89.7 | 89.5 | -0.5 | 0.4 | 360 | 359.2 | 359 | 359 | 359.1 | -0.9 | 0.2 |
| 180 | 179.5 | 179.3 | 179.1 | 179.3 | -0.7 | 0.4 | / | / | / | / | / | / | / |
| 同轴度 | | | ：0.1mm | | ：0.1mm | | ：0.2mm | | 分辨力：0.1° | | | | | |
| 扩展不确定度：扭矩：*U*r=0.2% (*k*=2)  转角：*U*r =0.2% (*k*=2) | | | | | | | | | | | | | | | |

第 1 页 共 1 页 校准人员：李业 核验人员：郑熙云

**附件8**

**转角扭矩仪校准记录格式**

送检单位 XXXXX 地址 XXXXX 证书编号 202XD42-008

制造厂Desoutter型号规格[DRT 5 Sq 180](https://www.desouttertools.com.cn/gongju/5/niu-ju-ce-liang-xi-tong/52/niu-ju-ban-ben/521/xuan-zhuan-chuan-gan-qi/5212/xuan-zhuan-shi-chuan-gan-qi-niu-ju-jiao-du-ce-liang/p/6151652240/drt-5-sq-180" \o "旋转式传感器—扭矩 & 角度测量 DRT 5 Sq 180) 出厂编号6151652240

标准器 扭矩标准机；NE-500 ；910001 证书编号 [LSfm2021-00004](javaScript:downLoadZs(%22upload/2021/10/21/c2d708b90a7245aab139a03e9cb3a24e.pdf%22,%22LSfm2021-00004.pdf%22)) 有效期至 2023-09-21

测量范围 （2-5000）Nm不确定度/准确度等级/最大允差 0.03级

标准器 角度编码器；MANU-I/O ；14460006 证书编号2020D31-10-2412024001 有效期至 2024-04-09

测量范围 （0-360）° 不确定度/准确度等级/最大允差 ±0.4′ 温度 22.6℃ 湿度 52%RH

校准地点 上海市张衡路 1500号大力楼 120 室 校准日期 2023年09月20日

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 扭  矩  部分 | 方向 | 校准点  /Nm | 进程  /Nm | | | | | | | | | 回程  /Nm | | | | | | | | 示值相对误差  /% | | 示值重复性  /% | | 进回程差/% | 内插误差 | 长期稳定性 |
| 1 | | 2 | | 3 | | 平均值 | | 1 | | | 2 | | 3 | | 平均值 | |
| 顺时针 | 30 | 30.20 | | 30.18 | | 30.16 | | 30.18 | | 30.22 | | | 30.20 | | 30.17 | | 30.2 | | 0.6 | | 0.1 | | 0.1 | / | / |
| 70 | 70.29 | | 70.36 | | 70.31 | | 70.32 | | 70.30 | | | 70.37 | | 70.32 | | 70.3 | | 0.5 | | 0.1 | | 0.0 | / | / |
| 100 | 100.42 | | 100.36 | | 100.48 | | 100.42 | | 100.43 | | | 100.38 | | 100.48 | | 100.4 | | 0.4 | | 0.1 | | 0.0 | / | / |
| 140 | 140.62 | | 140.53 | | 140.68 | | 140.61 | | 140.63 | | | 140.55 | | 140.69 | | 140.6 | | 0.4 | | 0.1 | | 0.0 | / | / |
| 180 | 180.75 | | 180.82 | | 180.85 | | 180.81 | | / | | | / | | / | | / | | 0.4 | | 0.1 | | / | / | / |
| 逆时针 | 30 | 29.86 | | 29.81 | | 29.90 | | 29.86 | | 29.87 | | | 29.83 | | 29.91 | | 29.9 | | -0.5 | | 0.3 | | 0.0 | / | / |
| 70 | 69.75 | | 69.72 | | 69.68 | | 69.72 | | 69.76 | | | 69.74 | | 69.70 | | 69.7 | | -0.4 | | 0.1 | | 0.0 | / | / |
| 100 | 99.65 | | 99.69 | | 99.72 | | 99.69 | | 99.66 | | | 99.71 | | 99.73 | | 99.7 | | -0.3 | | 0.1 | | 0.0 | / | / |
| 140 | 139.58 | | 139.62 | | 139.62 | | 139.61 | | 139.60 | | | 139.63 | | 139.64 | | 139.6 | | -0.3 | | 0.0 | | 0.0 | / | / |
| 180 | 179.53 | | 179.52 | | 179.59 | | 179.55 | | / | | | / | | / | | / | | -0.3 | | 0.0 | | / | / | / |
| 分辨力：0.01Nm | | | | | | | | | | | 回零差： 0.1 %FS | | | | | | | | 校准方程：/ | | | | | | |
| 转角部分 | 方向 | 校准点/° | 示值  /° | | | | | | | 示值误差  /° | | | 示值重复性  /° | | 校准点  /° | | 示值  /° | | | | | | | | 示值误差  /° | 示值重复性  /° |
| 1 | 2 | | 3 | | 平均值 | | 1 | | 2 | | 3 | | 平均值 | |
| 顺时针 | 1 | 1.0 | 1.0 | | 1.0 | | 1.0 | | 0.0 | | | 0.0 | | 270 | | 270.5 | | 270.4 | | 270.3 | | 270.4 | | 0.4 | 0.2 |
| 90 | 90.3 | 90.2 | | 90 | | 90.2 | | 0.2 | | | 0.3 | | 360 | | 360.6 | | 360.5 | | 360.5 | | 360.5 | | 0.5 | 0.1 |
| 180 | 180.3 | 180.3 | | 180.2 | | 180.3 | | 0.3 | | | 0.1 | | / | | / | | / | | / | | / | | / | / |
| 逆时针 | 1 | 1.0 | 1.0 | | 1.0 | | 1.0 | | 0.0 | | | 0.0 | | 270 | | 270.5 | | 270.5 | | 270.4 | | 270.5 | | 0.5 | 0.1 |
| 90 | 90.3 | 90.4 | | 90.2 | | 90.3 | | 0.3 | | | 0.2 | | 360 | | 360.6 | | 360.7 | | 360.6 | | 360.6 | | 0.6 | 0.1 |
| 180 | 180.4 | 180.5 | | 180.3 | | 180.4 | | 0.4 | | | 0.2 | | / | | / | | / | | / | | / | | / | / |
| 同轴度 | | | ：0.1mm | | | | ：0.1mm | | | | | ：0.2mm | | | | 分辨力：0.1° | | | | | | | | | |
| 扩展不确定度：扭矩：*U*r=0.2% (*k*=2)  转角：*U*r =0.2% (*k*=2) | | | | | | | | | | | | | | | | | | | | | | | | | | |

第 1 页 共 1 页 校准人员：李业 核验人员：郑熙云

**附件9**

**转角扭矩仪校准记录格式**

送检单位 XXXXX 地址 XXXXX 证书编号 202XD42-009

制造厂Desoutter型号规格[DRT 5 Sq 75](https://www.desouttertools.com.cn/gongju/5/niu-ju-ce-liang-xi-tong/52/niu-ju-ban-ben/521/xuan-zhuan-chuan-gan-qi/5212/xuan-zhuan-shi-chuan-gan-qi-niu-ju-jiao-du-ce-liang/p/6151652230/drt-5-sq-75" \o "旋转式传感器—扭矩 & 角度测量 DRT 5 Sq 75) 出厂编号8354662856

标准器 扭矩标准机；NE-500 ；910001 证书编号 [LSfm2021-00004](javaScript:downLoadZs(%22upload/2021/10/21/c2d708b90a7245aab139a03e9cb3a24e.pdf%22,%22LSfm2021-00004.pdf%22)) 有效期至 2023-09-21

测量范围 （2-5000）Nm不确定度/准确度等级/最大允差 0.03级

标准器 角度编码器；MANU-I/O ；14460006 证书编号2020D31-10-2412024001 有效期至 2024-04-09

测量范围 （0-360）° 不确定度/准确度等级/最大允差 ±0.4′ 温度 22.6℃ 湿度 52%RH

校准地点 上海市张衡路 1500号大力楼 120 室 校准日期 2023年09月20日

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 扭  矩  部分 | 方向 | 校准点  /Nm | 进程  /Nm | | | | | | | | | 回程  /Nm | | | | | | | | 示值相对误差  /% | | 示值重复性  /% | | 进回程差/% | 内插误差 | 长期稳定性 |
| 1 | | 2 | | 3 | | 平均值 | | 1 | | | 2 | | 3 | | 平均值 | |
| 顺时针 | 15 | 15.03 | | 15.05 | | 15.02 | | 15.03 | | 15.04 | | | 15.05 | | 15.03 | | 15.0 | | 0.2 | | 0.2 | | 0.0 | / | / |
| 30 | 30.10 | | 30.08 | | 30.11 | | 30.10 | | 30.11 | | | 30.09 | | 30.12 | | 30.1 | | 0.3 | | 0.1 | | 0.0 | / | / |
| 45 | 45.18 | | 45.20 | | 45.16 | | 45.18 | | 45.20 | | | 45.21 | | 45.18 | | 45.2 | | 0.4 | | 0.1 | | 0.0 | / | / |
| 60 | 60.25 | | 60.21 | | 60.29 | | 60.25 | | 60.26 | | | 60.23 | | 60.30 | | 60.3 | | 0.4 | | 0.1 | | 0.0 | / | / |
| 75 | 75.36 | | 75.28 | | 75.32 | | 75.32 | | / | | | / | | / | | / | | 0.4 | | 0.1 | | / | / | / |
| 逆时针 | 15 | 15.06 | | 15.04 | | 15.08 | | 15.06 | | 15.07 | | | 15.05 | | 15.08 | | 15.1 | | 0.4 | | 0.3 | | 0.0 | / | / |
| 30 | 30.12 | | 30.15 | | 30.13 | | 30.13 | | 30.13 | | | 30.15 | | 30.14 | | 30.1 | | 0.4 | | 0.1 | | 0.0 | / | / |
| 45 | 45.20 | | 45.23 | | 45.19 | | 45.21 | | 45.22 | | | 45.23 | | 45.21 | | 45.2 | | 0.5 | | 0.1 | | 0.0 | / | / |
| 60 | 60.28 | | 60.25 | | 60.26 | | 60.26 | | 60.29 | | | 60.26 | | 60.28 | | 60.3 | | 0.4 | | 0.0 | | 0.0 | / | / |
| 75 | 75.30 | | 75.32 | | 75.33 | | 75.32 | | / | | | / | | / | | / | | 0.4 | | 0.0 | | / | / | / |
| 分辨力：0.01Nm | | | | | | | | | | | 回零差： 0.1 %FS | | | | | | | | 校准方程：/ | | | | | | |
| 转角部分 | 方向 | 校准点/° | 示值  /° | | | | | | | 示值误差  /° | | | 示值重复性  /° | | 校准点  /° | | 示值  /° | | | | | | | | 示值误差  /° | 示值重复性  /° |
| 1 | 2 | | 3 | | 平均值 | | 1 | | 2 | | 3 | | 平均值 | |
| 顺时针 | 1 | 1.0 | 1.0 | | 1.0 | | 1.0 | | 0.0 | | | 0.0 | | 270 | | 269.6 | | 269.6 | | 269.5 | | 269.6 | | -0.4 | 0.1 |
| 90 | 89.8 | 89.7 | | 89.8 | | 89.8 | | -0.2 | | | 0.1 | | 360 | | 359.5 | | 359.4 | | 359.4 | | 359.4 | | -0.6 | 0.1 |
| 180 | 179.8 | 179.6 | | 179.6 | | 179.7 | | -0.3 | | | 0.2 | | / | | / | | / | | / | | / | | / | / |
| 逆时针 | 1 | 1.0 | 1.0 | | 1.0 | | 1.0 | | 0.0 | | | 0.0 | | 270 | | 269.7 | | 269.5 | | 269.7 | | 269.6 | | -0.4 | 0.2 |
| 90 | 89.8 | 89.7 | | 89.9 | | 89.8 | | -0.2 | | | 0.2 | | 360 | | 359.6 | | 359.4 | | 359.6 | | 359.5 | | -0.5 | 0.2 |
| 180 | 179.8 | 179.6 | | 179.8 | | 179.7 | | -0.3 | | | 0.2 | | / | | / | | / | | / | | / | | / | / |
| 同轴度 | | | ：0.1mm | | | | ：0.1mm | | | | | ：0.2mm | | | | 分辨力：0.1° | | | | | | | | | |
| 扩展不确定度：扭矩：*U*r=0.2% (*k*=2)  转角：*U*r =0.2% (*k*=2) | | | | | | | | | | | | | | | | | | | | | | | | | | |

第 1 页 共 1 页 校准人员：李业 核验人员：郑熙云

**附件10**

**转角扭矩仪校准记录格式**

送检单位 XXXXX 地址 XXXXX 证书编号 202XD42-010

制造厂Desoutter型号规格[DRT 5 Sq 25](https://www.desouttertools.com.cn/gongju/5/niu-ju-ce-liang-xi-tong/52/niu-ju-ban-ben/521/xuan-zhuan-chuan-gan-qi/5212/xuan-zhuan-shi-chuan-gan-qi-niu-ju-jiao-du-ce-liang/p/6151652220/drt-5-sq-25) 出厂编号012203230

标准器 扭矩标准机；NE-500 ；910001 证书编号 [LSfm2021-00004](javaScript:downLoadZs(%22upload/2021/10/21/c2d708b90a7245aab139a03e9cb3a24e.pdf%22,%22LSfm2021-00004.pdf%22)) 有效期至 2023-09-21

测量范围 （2-5000）Nm不确定度/准确度等级/最大允差 0.03级

标准器 角度编码器；MANU-I/O ；14460006 证书编号2020D31-10-2412024001 有效期至 2024-04-09

测量范围 （0-360）° 不确定度/准确度等级/最大允差 ±0.4′ 温度 22.6℃ 湿度 52%RH

校准地点 上海市张衡路 1500号大力楼 120 室 校准日期 2023年09月20日

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 扭  矩  部分 | 方向 | 校准点  /Nm | 进程  /Nm | | | | | | | | | 回程  /Nm | | | | | | | | 示值相对误差  /% | | 示值重复性  /% | | 进回程差/% | 内插误差 | 长期稳定性 |
| 1 | | 2 | | 3 | | 平均值 | | 1 | | | 2 | | 3 | | 平均值 | |
| 顺时针 | 5 | 5.02 | | 5.01 | | 5.01 | | 5.01 | | 5.02 | | | 5.02 | | 5.03 | | 5.0 | | 0.3 | | 0.2 | | 0.2 | / | / |
| 10 | 10.03 | | 10.04 | | 10.04 | | 10.04 | | 10.04 | | | 10.04 | | 10.05 | | 10.0 | | 0.4 | | 0.1 | | 0.1 | / | / |
| 15 | 15.06 | | 15.08 | | 15.06 | | 15.07 | | 15.07 | | | 15.08 | | 15.08 | | 15.1 | | 0.4 | | 0.1 | | 0.1 | / | / |
| 20 | 20.08 | | 20.10 | | 20.07 | | 20.08 | | 20.09 | | | 20.10 | | 20.09 | | 20.1 | | 0.4 | | 0.1 | | 0.0 | / | / |
| 25 | 25.12 | | 25.09 | | 25.10 | | 25.10 | | / | | | / | | / | | / | | 0.4 | | 0.1 | | / | / | / |
| 逆时针 | 5 | 5.01 | | 5.03 | | 5.02 | | 5.02 | | 5.03 | | | 5.03 | | 5.03 | | 5.0 | | 0.4 | | 0.4 | | 0.2 | / | / |
| 10 | 10.04 | | 10.06 | | 10.04 | | 10.05 | | 10.05 | | | 10.06 | | 10.05 | | 10.1 | | 0.5 | | 0.2 | | 0.1 | / | / |
| 15 | 15.06 | | 15.07 | | 15.04 | | 15.06 | | 15.07 | | | 15.08 | | 15.07 | | 15.1 | | 0.4 | | 0.2 | | 0.1 | / | / |
| 20 | 20.09 | | 20.08 | | 20.06 | | 20.08 | | 20.11 | | | 20.09 | | 20.09 | | 20.1 | | 0.4 | | 0.1 | | 0.1 | / | / |
| 25 | 25.10 | | 25.13 | | 25.11 | | 25.11 | | / | | | / | | / | | / | | 0.5 | | 0.1 | | / | / | / |
| 分辨力：0.01Nm | | | | | | | | | | | 回零差： 0.1 %FS | | | | | | | | 校准方程：/ | | | | | | |
| 转角部分 | 方向 | 校准点/° | 示值  /° | | | | | | | 示值误差  /° | | | 示值重复性  /° | | 校准点  /° | | 示值  /° | | | | | | | | 示值误差  /° | 示值重复性  /° |
| 1 | 2 | | 3 | | 平均值 | | 1 | | 2 | | 3 | | 平均值 | |
| 顺时针 | 1 | 1.0 | 1.0 | | 1.0 | | 1.0 | | 0.0 | | | 0.0 | | 270 | | 269.4 | | 269.3 | | 269.4 | | 269.4 | | -0.6 | 0.1 |
| 90 | 89.6 | 89.5 | | 89.6 | | 89.6 | | -0.4 | | | 0.1 | | 360 | | 359.3 | | 359.2 | | 359.2 | | 359.2 | | -0.8 | 0.1 |
| 180 | 179.5 | 179.4 | | 179.5 | | 179.5 | | -0.5 | | | 0.1 | | / | | / | | / | | / | | / | | / | / |
| 逆时针 | 1 | 1.0 | 1.0 | | 1.0 | | 1.0 | | 0.0 | | | 0.0 | | 270 | | 270.5 | | 270.5 | | 270.7 | | 270.6 | | 0.6 | 0.2 |
| 90 | 90.3 | 90.2 | | 90.3 | | 90.3 | | 0.3 | | | 0.1 | | 360 | | 360.6 | | 360.6 | | 360.9 | | 360.7 | | 0.7 | 0.3 |
| 180 | 180.4 | 180.3 | | 180.5 | | 180.4 | | 0.4 | | | 0.2 | | / | | / | | / | | / | | / | | / | / |
| 同轴度 | | | ：0.1mm | | | | ：0.1mm | | | | | ：0.2mm | | | | 分辨力：0.1° | | | | | | | | | |
| 扩展不确定度：扭矩：*U*r=0.2% (*k*=2)  转角：*U*r =0.2% (*k*=2) | | | | | | | | | | | | | | | | | | | | | | | | | | |

第 1 页 共 1 页 校准人员：李业 核验人员：郑熙云