**实验报告**

关于计量校准规范《固定源烟气流速（量）参比方法用S型皮托管校准规范》中需要进行的实验内容如下所述。

1 实验装置

实验装置为：

|  |  |  |  |
| --- | --- | --- | --- |
| 序号 | 设备名称 | 技术指标 | 用途 |
| 1 | 流速标准器 | 流速标准器可采用L型皮托管或激光多普勒流速仪  准确度等级：不超过被校皮托管校准系数允许误差的1/2 | 用于获取标准流速值 |
| 2 | 风洞 | （1）测试段水力直径不小于0.5m；  （2）流场均匀性≤0.5%；  （3）流场稳定性≤0.5%；  （3）流速范围：（1~30）m/s，流速测量扩展不确定度≤1%；  （4）俯仰角测量范围：-45°~45°；  偏航角测量范围：-45°~45°；  俯仰角和偏航角不确定度≤0.1°。 | 用于产生标准流速 |

配套设备为

|  |  |  |  |
| --- | --- | --- | --- |
| 序号 | 设备名称 | 技术指标 | 用途 |
| 1 | 差压计 | 量程：（-1250~1250）Pa  分辨力≤1Pa  准确度等级优于1.0级 | 气密性检查 |
| 2 | 气压计 | 0.1级以上 | 测量大气压力 |
| 3 | 温度计 | 最大允许误差：±0.1℃ | 测量温度 |
| 4 | 湿度计 | 最大允许误差：±5% | 测量湿度 |

2实验内容

固定源烟气流速（量）参比方法用S型皮托管的校准。

3实验结果

实验主要进行S型皮托管的校准，由于S型皮托管的特点，不能识别气流角度，且在烟道中测量时，烟道内气流复杂，导致测量的数据有较大误差，为解决这个问题，进行了大量实验，包括较大对S型皮托管的影响等。

3.1 校准过程

3.1.1一般检查

外观检查确定皮托管标识清晰明确（制造厂家、型号、出厂编号、校准系数、测头方向等信息）,皮托管堵塞和漏气检查方法见表4

表4 皮托管堵塞和漏气检查方法

|  |  |
| --- | --- |
| 皮托管堵塞检查方法 | 将总压接头和静压接头分别接通气源，用手分别放在总压孔和静压孔处，能明显感觉到气流流出，说明未堵塞。 |
| 皮托管漏气检查方法 | 将总压接头和静压接头分别接压力计，使用气源分别接通总压孔和静压孔，是压力达到750Pa或压力计满量程的75%以上，以较小则为准，撤走气源，迅速堵住总压孔和静压孔，保持20s以上，压力下降低于25Pa，则密封良好 |

3.1.2 校准前准备

a）将S型皮托管两个引压管通过聚四氟乙烯引压软管与微压计连接，并进行漏气检查。

b）将S型皮托管通过固定杆固定在坐标架上。并测量S型皮托管测量孔到坐标架转动中心位置的长度。并将该长度输入测量软件中。

c）使用水平尺，使S型皮托管测量孔在同一水平面上。

d）将S皮托管测量孔通过坐标架移动到风洞测试中心位置，保持S型皮托管气流标识方向与风洞内气流流动方向保持一致。

e）使用测角仪器测量皮托管延长杆与风洞轴线夹角，并调整坐标架位置，使S型皮托管延长杆与风洞轴线夹角为90°。

f）将坐标架位置置零。

3.1.3 皮托管系数校准

3.1.3.1 校准点位置确定

a）在0.9*v*max~1.0*v*max 、0.4 *v*max ~ 0.6 *v*max 、*v*min~1.1*v*min不少于3个流速下进行校准。

b）俯仰角和偏航角如表5所示

表5 校准位置一览表

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 序号 | 俯仰角（°） | 偏航角（°） | 序号 | 俯仰角（°） | 偏航角（°） |
| 1 | -45 | -45 | 20 | -45 | 45 |
| 2 | -40 | -40 | 21 | -40 | 40 |
| 3 | -35 | -35 | 22 | -35 | 35 |
| 4 | -30 | -30 | 23 | -30 | 30 |
| 5 | -25 | -25 | 24 | -25 | 25 |
| 6 | -20 | -20 | 25 | -20 | 20 |
| 7 | -15 | -15 | 26 | -15 | 15 |
| 8 | -10 | -10 | 27 | -10 | 10 |
| 9 | -5 | -5 | 28 | -5 | 5 |
| 10 | 0 | 0 | 29 | 0 | 0 |
| 11 | 5 | 5 | 30 | 5 | -5 |
| 12 | 10 | 10 | 31 | 10 | -10 |
| 13 | 15 | 15 | 32 | 15 | -15 |
| 14 | 20 | 20 | 33 | 20 | -20 |
| 15 | 25 | 25 | 34 | 25 | -25 |
| 16 | 30 | 30 | 35 | 30 | -30 |
| 17 | 35 | 35 | 36 | 35 | -35 |
| 18 | 40 | 40 | 37 | 40 | -40 |
| 19 | 45 | 45 | 38 | 45 | -45 |
| 序号 | 俯仰角（°） | 偏航角（°） | 序号 | 俯仰角（°） | 偏航角（°） |
| 39 | -45 | 0 | 58 | 0 | -45 |
| 40 | -40 | 0 | 59 | 0 | -40 |
| 41 | -35 | 0 | 60 | 0 | -35 |
| 42 | -30 | 0 | 61 | 0 | -30 |
| 43 | -25 | 0 | 62 | 0 | -25 |
| 44 | -20 | 0 | 63 | 0 | -20 |
| 45 | -15 | 0 | 64 | 0 | -15 |
| 46 | -10 | 0 | 65 | 0 | -10 |
| 47 | -5 | 0 | 66 | 0 | -5 |
| 48 | 0 | 0 | 67 | 0 | 0 |
| 49 | 5 | 0 | 68 | 0 | 5 |
| 50 | 10 | 0 | 69 | 0 | 10 |
| 51 | 15 | 0 | 70 | 0 | 15 |
| 52 | 20 | 0 | 71 | 0 | 20 |
| 53 | 25 | 0 | 72 | 0 | 25 |
| 54 | 30 | 0 | 73 | 0 | 30 |
| 55 | 35 | 0 | 74 | 0 | 35 |
| 56 | 40 | 0 | 75 | 0 | 40 |
| 57 | 45 | 0 | 76 | 0 | 45 |

3.1.3.2 校准程序

a）打开风机，调整风速至第一个校准流速点。

b）调整坐标架至第一个俯仰角和偏航角位置。

c）稳定20s以上，标准风速和被校S型皮托管的读取采用间歇读数方法，一次校准过程中有效读数次数不得少于3次，取其平均值作为该次校准的流速值。

d）移动坐标架至下一个俯仰角和偏航角位置，重复b）操作。

e）依次按表5中的俯仰角和偏航角进行校准，直到该流速下的所有俯仰角和偏航角校准完成。

f）调整风速到下一个校准风速点，重复b）~e）步骤，直至校准完成。

3.2 测量数据

表1 充分发展流场超声流量计校准数据

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 校准地点 | | | 烟气流量实验室 | | | | | 校准时间 | | | / | |
| 标准值（m/s） | | | 5 | | | 温度（℃） | | | | 33 | | |
| 湿度（%RH） | | | 48 | | | 密度 | | | | 1.12kg/m3 | | |
| S皮托管原校准系数 | | | 0.80 | | | 其它 | | | | 大气压：99.924kPa | | |
| 校准位置 | 俯仰角（°） | 偏航角（°） | | 被校皮托管值（Pa） | | | | | 标准风速（m/s）□或  标准皮托管值（Pa）☑ | | | |
| 1 | 2 | | 3 | | 1 | | 2 | 3 |
| 1 | -45 | -45 | | 5.22 | 5.18 | | 5.09 | | 14.31 | | 14.26 | 14.13 |
| 2 | -40 | -40 | | 7.08 | 7.03 | | 6.94 | | 14.27 | | 14.09 | 14.19 |
| 3 | -35 | -35 | | 9.06 | 8.98 | | 9.00 | | 14.31 | | 14.12 | 14.28 |
| 4 | -30 | -30 | | 11.26 | 11.23 | | 11.23 | | 14.36 | | 14.22 | 14.30 |
| 5 | -25 | -25 | | 13.41 | 13.29 | | 13.25 | | 14.22 | | 14.07 | 14.11 |
| 6 | -20 | -20 | | 15.09 | 15.01 | | 15.05 | | 14.21 | | 14.14 | 14.16 |
| 7 | -15 | -15 | | 17.13 | 16.97 | | 17.11 | | 14.18 | | 14.03 | 14.02 |
| 8 | -10 | -10 | | 20.74 | 20.65 | | 20.55 | | 14.12 | | 13.96 | 14.02 |
| 9 | -5 | -5 | | 20.57 | 20.40 | | 20.50 | | 14.14 | | 14.02 | 13.98 |
| 10 | 0 | 0 | | 21.58 | 21.52 | | 21.47 | | 14.27 | | 14.22 | 14.19 |
| 11 | 5 | 5 | | 21.43 | 21.42 | | 21.30 | | 14.17 | | 14.06 | 14.10 |
| 12 | 10 | 10 | | 21.55 | 21.45 | | 21.37 | | 14.1 | | 14.08 | 13.96 |
| 13 | 15 | 15 | | 23.48 | 23.47 | | 23.37 | | 14.15 | | 14.01 | 14.09 |
| 14 | 20 | 20 | | 24.48 | 24.31 | | 24.40 | | 14.17 | | 14.05 | 14.03 |
| 15 | 25 | 25 | | 24.36 | 24.28 | | 24.23 | | 14.23 | | 14.04 | 14.14 |
| 16 | 30 | 30 | | 22.46 | 22.30 | | 22.45 | | 14.24 | | 14.15 | 14.12 |
| 17 | 35 | 35 | | 21.04 | 20.95 | | 20.99 | | 14.04 | | 13.93 | 13.95 |
| 18 | 40 | 40 | | 24.39 | 24.22 | | 24.25 | | 14.19 | | 14.02 | 14.00 |
| 19 | 45 | 45 | | 26.93 | 26.75 | | 26.92 | | 14.15 | | 14.06 | 14.07 |
| 20 | -45 | 45 | | 5.67 | 5.57 | | 5.65 | | 14.4 | | 14.34 | 14.27 |
| 21 | -40 | 40 | | 6.85 | 6.68 | | 6.83 | | 14.41 | | 14.40 | 14.39 |
| 22 | -35 | 35 | | 8.75 | 8.70 | | 8.55 | | 14.39 | | 14.19 | 14.33 |
| 23 | -30 | 30 | | 11.30 | 11.28 | | 11.14 | | 14.41 | | 14.38 | 14.38 |
| 24 | -25 | 25 | | 13.24 | 13.14 | | 13.12 | | 14.14 | | 13.95 | 14.02 |
| 25 | -20 | 20 | | 15.15 | 15.11 | | 14.96 | | 14.27 | | 14.08 | 14.15 |
| 26 | -15 | 15 | | 16.64 | 16.63 | | 16.57 | | 14.12 | | 13.99 | 14.03 |
| 27 | -10 | 10 | | 21.04 | 20.94 | | 20.94 | | 14.19 | | 14.07 | 14.17 |
| 28 | -5 | 5 | | 20.68 | 20.62 | | 20.65 | | 14.26 | | 14.22 | 14.11 |
| 29 | 0 | 0 | | 21.58 | 21.54 | | 21.54 | | 14.27 | | 14.24 | 14.18 |
| 30 | 5 | -5 | | 21.32 | 21.20 | | 21.29 | | 14.2 | | 14.10 | 14.13 |
| 31 | 10 | -10 | | 21.78 | 21.72 | | 21.62 | | 14.14 | | 13.98 | 13.99 |
| 32 | 15 | -15 | | 23.42 | 23.29 | | 23.25 | | 14.17 | | 14.06 | 13.99 |
| 33 | 20 | -20 | | 23.79 | 23.72 | | 23.76 | | 14.11 | | 14.03 | 14.08 |
| 34 | 25 | -25 | | 23.28 | 23.19 | | 23.20 | | 14.09 | | 13.96 | 13.93 |
| 35 | 30 | -30 | | 22.74 | 22.65 | | 22.61 | | 14.18 | | 14.06 | 14.09 |
| 36 | 35 | -35 | | 23.88 | 23.86 | | 23.71 | | 14.05 | | 13.98 | 14.04 |
| 37 | 40 | -40 | | 28.53 | 28.47 | | 28.52 | | 14.17 | | 14.05 | 14.07 |
| 38 | 45 | -45 | | 27.88 | 27.80 | | 27.68 | | 14.19 | | 14.00 | 14.11 |
| 39 | -45 | 0 | | 18.75 | 18.60 | | 18.71 | | 14.14 | | 14.04 | 14.04 |
| 40 | -40 | 0 | | 20.62 | 20.55 | | 20.43 | | 14.17 | | 14.04 | 14.09 |
| 41 | -35 | 0 | | 20.73 | 20.62 | | 20.58 | | 14.12 | | 14.11 | 14.01 |
| 42 | -30 | 0 | | 21.26 | 21.13 | | 21.20 | | 14.14 | | 13.99 | 14.03 |
| 43 | -25 | 0 | | 21.92 | 21.90 | | 21.74 | | 14.19 | | 14.17 | 14.06 |
| 44 | -20 | 0 | | 21.13 | 20.99 | | 21.05 | | 14.25 | | 14.11 | 14.23 |
| 45 | -15 | 0 | | 21.14 | 20.98 | | 21.12 | | 14.17 | | 14.14 | 14.07 |
| 46 | -10 | 0 | | 21.39 | 21.31 | | 21.25 | | 14.17 | | 14.11 | 14.02 |
| 47 | -5 | 0 | | 21.51 | 21.31 | | 21.47 | | 14.1 | | 14.06 | 13.96 |
| 48 | 0 | 0 | | 21.58 | 21.42 | | 21.46 | | 14.27 | | 14.23 | 14.26 |
| 49 | 5 | 0 | | 20.56 | 20.48 | | 20.55 | | 14.28 | | 14.09 | 14.26 |
| 50 | 10 | 0 | | 20.90 | 20.83 | | 20.82 | | 14.21 | | 14.06 | 14.12 |
| 51 | 15 | 0 | | 18.01 | 17.83 | | 17.86 | | 14.24 | | 14.06 | 14.21 |
| 52 | 20 | 0 | | 15.28 | 15.16 | | 15.19 | | 14.2 | | 14.09 | 14.19 |
| 53 | 25 | 0 | | 14.17 | 14.13 | | 14.08 | | 14.24 | | 14.04 | 14.10 |
| 54 | 30 | 0 | | 13.61 | 13.49 | | 13.60 | | 14.44 | | 14.34 | 14.37 |
| 55 | 35 | 0 | | 13.35 | 13.30 | | 13.32 | | 14.44 | | 14.25 | 14.30 |
| 56 | 40 | 0 | | 12.62 | 12.48 | | 12.51 | | 14.4 | | 14.34 | 14.22 |
| 57 | 45 | 0 | | 9.89 | 9.82 | | 9.82 | | 14.39 | | 14.21 | 14.22 |
| 58 | 0 | -45 | | 17.01 | 16.85 | | 16.86 | | 14.23 | | 14.19 | 14.16 |
| 59 | 0 | -40 | | 18.60 | 18.46 | | 18.58 | | 14.09 | | 14.01 | 13.91 |
| 60 | 0 | -35 | | 19.58 | 19.51 | | 19.53 | | 14.14 | | 14.09 | 14.08 |
| 61 | 0 | -30 | | 20.93 | 20.77 | | 20.84 | | 14.15 | | 14.09 | 14.14 |
| 62 | 0 | -25 | | 21.34 | 21.17 | | 21.17 | | 14.16 | | 14.12 | 13.99 |
| 63 | 0 | -20 | | 21.39 | 21.30 | | 21.34 | | 14.18 | | 14.17 | 14.03 |
| 64 | 0 | -15 | | 21.22 | 21.07 | | 21.09 | | 14.11 | | 14.03 | 14.03 |
| 65 | 0 | -10 | | 21.14 | 21.09 | | 20.95 | | 14.19 | | 14.10 | 14.16 |
| 66 | 0 | -5 | | 21.04 | 20.89 | | 20.85 | | 14.16 | | 14.12 | 14.15 |
| 67 | 0 | 0 | | 21.58 | 21.44 | | 21.50 | | 14.27 | | 14.09 | 14.18 |
| 68 | 0 | 5 | | 20.92 | 20.86 | | 20.76 | | 14.15 | | 14.07 | 14.11 |
| 69 | 0 | 10 | | 21.07 | 20.88 | | 20.98 | | 14.14 | | 14.02 | 14.10 |
| 70 | 0 | 15 | | 21.97 | 21.88 | | 21.90 | | 14.24 | | 14.13 | 14.20 |
| 71 | 0 | 20 | | 21.67 | 21.49 | | 21.64 | | 14.13 | | 14.12 | 13.96 |
| 72 | 0 | 25 | | 21.70 | 21.69 | | 21.69 | | 14.2 | | 14.15 | 14.04 |
| 73 | 0 | 30 | | 20.99 | 20.96 | | 20.80 | | 14.2 | | 14.06 | 14.12 |
| 74 | 0 | 35 | | 20.10 | 19.91 | | 19.96 | | 14.28 | | 14.14 | 14.16 |
| 75 | 0 | 40 | | 18.97 | 18.96 | | 18.78 | | 14.15 | | 13.98 | 13.98 |
| 76 | 0 | 45 | | 17.30 | 17.19 | | 17.11 | | 14.16 | | 14.15 | 14.09 |

3.3输入量的标准不确定度评定

不确定度分量包括测量重复性引入的不确定度，标准装置溯源引入的不确定度。

3.3.1 标准器溯源引入的不确定度

标准器L型皮托管不确定度为0.41%，k=2，则



3.3.2 标准皮托管测量重复性引入的不确定度

标准皮托管测得值如表1所示，采用极差法计算重复型，并取最大值为器测量重复性。



由测量重复性引入的不确定度见表C.2为



3.3.3 标准器不确定度



3.3.4 被校皮托管引入的不确定度

被校皮托管主要由测量重复性引入的不确定度，见表C.2中



表2 各点由重复性引入的相对不确定度

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 标准皮托管压力值（Pa） | | | 标准风速值（m/s） | | | 重复性 | 相对不确定度 | S型皮托管压力值（Pa） | | | S型皮托管测量值（m/s） | | | 重复性 | 相对不确定度 |
| 1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 |
| 14.31 | 14.26 | 14.13 | 5.06 | 5.05 | 5.02 | 0.02 | 0.22% | 5.22 | 5.18 | 5.09 | 2.44 | 2.43 | 2.41 | 0.02 | 0.42% |
| 14.27 | 14.09 | 14.19 | 5.05 | 5.02 | 5.03 | 0.02 | 0.22% | 7.08 | 7.03 | 6.94 | 2.84 | 2.83 | 2.82 | 0.02 | 0.35% |
| 14.31 | 14.12 | 14.28 | 5.06 | 5.02 | 5.05 | 0.02 | 0.23% | 9.06 | 8.98 | 9.00 | 3.22 | 3.20 | 3.21 | 0.01 | 0.16% |
| 14.36 | 14.22 | 14.30 | 5.06 | 5.04 | 5.05 | 0.01 | 0.17% | 11.26 | 11.23 | 11.23 | 3.59 | 3.58 | 3.58 | 0.00 | 0.05% |
| 14.22 | 14.07 | 14.11 | 5.04 | 5.01 | 5.02 | 0.02 | 0.18% | 13.41 | 13.29 | 13.25 | 3.91 | 3.90 | 3.89 | 0.01 | 0.21% |
| 14.21 | 14.14 | 14.16 | 5.04 | 5.02 | 5.03 | 0.01 | 0.09% | 15.09 | 15.01 | 15.05 | 4.15 | 4.14 | 4.15 | 0.01 | 0.09% |
| 14.18 | 14.03 | 14.02 | 5.03 | 5.00 | 5.00 | 0.02 | 0.19% | 17.13 | 16.97 | 17.11 | 4.42 | 4.40 | 4.42 | 0.01 | 0.16% |
| 14.12 | 13.96 | 14.02 | 5.02 | 4.99 | 5.00 | 0.02 | 0.20% | 20.74 | 20.65 | 20.55 | 4.87 | 4.86 | 4.85 | 0.01 | 0.15% |
| 14.14 | 14.02 | 13.98 | 5.02 | 5.00 | 5.00 | 0.02 | 0.20% | 20.57 | 20.40 | 20.50 | 4.85 | 4.83 | 4.84 | 0.01 | 0.14% |
| 14.27 | 14.22 | 14.19 | 5.05 | 5.04 | 5.03 | 0.01 | 0.09% | 21.58 | 21.52 | 21.47 | 4.97 | 4.96 | 4.95 | 0.01 | 0.09% |
| 14.17 | 14.06 | 14.10 | 5.03 | 5.01 | 5.02 | 0.01 | 0.13% | 21.43 | 21.42 | 21.30 | 4.95 | 4.95 | 4.93 | 0.01 | 0.11% |
| 14.10 | 14.08 | 13.96 | 5.02 | 5.01 | 4.99 | 0.01 | 0.17% | 21.55 | 21.45 | 21.37 | 4.96 | 4.95 | 4.94 | 0.01 | 0.14% |
| 14.15 | 14.01 | 14.09 | 5.03 | 5.00 | 5.02 | 0.01 | 0.17% | 23.48 | 23.47 | 23.37 | 5.18 | 5.18 | 5.17 | 0.01 | 0.08% |
| 14.17 | 14.05 | 14.03 | 5.03 | 5.01 | 5.01 | 0.01 | 0.17% | 24.48 | 24.31 | 24.40 | 5.29 | 5.27 | 5.28 | 0.01 | 0.12% |
| 14.23 | 14.04 | 14.14 | 5.04 | 5.01 | 5.02 | 0.02 | 0.24% | 24.36 | 24.28 | 24.23 | 5.28 | 5.27 | 5.26 | 0.01 | 0.09% |
| 14.24 | 14.15 | 14.12 | 5.04 | 5.03 | 5.02 | 0.01 | 0.15% | 22.46 | 22.30 | 22.45 | 5.07 | 5.05 | 5.07 | 0.01 | 0.12% |
| 14.04 | 13.93 | 13.95 | 5.01 | 4.99 | 4.99 | 0.01 | 0.14% | 21.04 | 20.95 | 20.99 | 4.90 | 4.89 | 4.90 | 0.01 | 0.08% |
| 14.19 | 14.02 | 14.00 | 5.03 | 5.00 | 5.00 | 0.02 | 0.23% | 24.39 | 24.22 | 24.25 | 5.28 | 5.26 | 5.26 | 0.01 | 0.12% |
| 14.15 | 14.06 | 14.07 | 5.03 | 5.01 | 5.01 | 0.01 | 0.10% | 26.93 | 26.75 | 26.92 | 5.55 | 5.53 | 5.55 | 0.01 | 0.12% |
| 14.40 | 14.34 | 14.27 | 5.07 | 5.06 | 5.05 | 0.01 | 0.15% | 5.67 | 5.57 | 5.65 | 2.55 | 2.52 | 2.54 | 0.01 | 0.30% |
| 14.41 | 14.40 | 14.39 | 5.07 | 5.07 | 5.07 | 0.00 | 0.03% | 6.85 | 6.68 | 6.83 | 2.80 | 2.76 | 2.79 | 0.02 | 0.43% |
| 14.39 | 14.19 | 14.33 | 5.07 | 5.03 | 5.06 | 0.02 | 0.23% | 8.75 | 8.70 | 8.55 | 3.16 | 3.15 | 3.13 | 0.02 | 0.39% |
| 14.41 | 14.38 | 14.38 | 5.07 | 5.07 | 5.07 | 0.00 | 0.03% | 11.30 | 11.28 | 11.14 | 3.59 | 3.59 | 3.57 | 0.02 | 0.25% |
| 14.14 | 13.95 | 14.02 | 5.02 | 4.99 | 5.00 | 0.02 | 0.24% | 13.24 | 13.14 | 13.12 | 3.89 | 3.88 | 3.87 | 0.01 | 0.15% |
| 14.27 | 14.08 | 14.15 | 5.05 | 5.01 | 5.03 | 0.02 | 0.23% | 15.15 | 15.11 | 14.96 | 4.16 | 4.16 | 4.14 | 0.02 | 0.21% |
| 14.12 | 13.99 | 14.03 | 5.02 | 5.00 | 5.01 | 0.01 | 0.16% | 16.64 | 16.63 | 16.57 | 4.36 | 4.36 | 4.35 | 0.01 | 0.08% |
| 14.19 | 14.07 | 14.17 | 5.03 | 5.01 | 5.03 | 0.01 | 0.15% | 21.04 | 20.94 | 20.94 | 4.90 | 4.89 | 4.89 | 0.01 | 0.08% |
| 14.26 | 14.22 | 14.11 | 5.05 | 5.04 | 5.02 | 0.02 | 0.18% | 20.68 | 20.62 | 20.65 | 4.86 | 4.85 | 4.86 | 0.00 | 0.05% |
| 14.27 | 14.24 | 14.18 | 5.05 | 5.04 | 5.03 | 0.01 | 0.10% | 21.58 | 21.54 | 21.54 | 4.97 | 4.96 | 4.96 | 0.00 | 0.04% |
| 14.20 | 14.10 | 14.13 | 5.04 | 5.02 | 5.02 | 0.01 | 0.12% | 21.32 | 21.20 | 21.29 | 4.94 | 4.92 | 4.93 | 0.01 | 0.10% |
| 14.14 | 13.98 | 13.99 | 5.02 | 5.00 | 5.00 | 0.02 | 0.19% | 21.78 | 21.72 | 21.62 | 4.99 | 4.98 | 4.97 | 0.01 | 0.13% |
| 14.17 | 14.06 | 13.99 | 5.03 | 5.01 | 5.00 | 0.02 | 0.22% | 23.42 | 23.29 | 23.25 | 5.17 | 5.16 | 5.16 | 0.01 | 0.12% |
| 14.11 | 14.03 | 14.08 | 5.02 | 5.01 | 5.01 | 0.01 | 0.09% | 23.79 | 23.72 | 23.76 | 5.21 | 5.21 | 5.21 | 0.00 | 0.05% |
| 14.09 | 13.96 | 13.93 | 5.02 | 4.99 | 4.99 | 0.02 | 0.20% | 23.28 | 23.19 | 23.20 | 5.16 | 5.15 | 5.15 | 0.01 | 0.07% |
| 14.18 | 14.06 | 14.09 | 5.03 | 5.01 | 5.02 | 0.01 | 0.15% | 22.74 | 22.65 | 22.61 | 5.10 | 5.09 | 5.08 | 0.01 | 0.10% |
| 14.05 | 13.98 | 14.04 | 5.01 | 5.00 | 5.01 | 0.01 | 0.09% | 23.88 | 23.86 | 23.71 | 5.22 | 5.22 | 5.21 | 0.01 | 0.12% |
| 14.17 | 14.05 | 14.07 | 5.03 | 5.01 | 5.01 | 0.01 | 0.14% | 28.53 | 28.47 | 28.52 | 5.71 | 5.70 | 5.71 | 0.00 | 0.04% |
| 14.19 | 14.00 | 14.11 | 5.03 | 5.00 | 5.02 | 0.02 | 0.23% | 27.88 | 27.80 | 27.68 | 5.64 | 5.64 | 5.62 | 0.01 | 0.12% |
| 14.14 | 14.04 | 14.04 | 5.02 | 5.01 | 5.01 | 0.01 | 0.12% | 18.75 | 18.60 | 18.71 | 4.63 | 4.61 | 4.62 | 0.01 | 0.14% |
| 14.17 | 14.04 | 14.09 | 5.03 | 5.01 | 5.02 | 0.01 | 0.16% | 20.62 | 20.55 | 20.43 | 4.85 | 4.85 | 4.83 | 0.01 | 0.16% |
| 14.12 | 14.11 | 14.01 | 5.02 | 5.02 | 5.00 | 0.01 | 0.14% | 20.73 | 20.62 | 20.58 | 4.87 | 4.85 | 4.85 | 0.01 | 0.13% |
| 14.14 | 13.99 | 14.03 | 5.02 | 5.00 | 5.01 | 0.02 | 0.18% | 21.26 | 21.13 | 21.20 | 4.93 | 4.91 | 4.92 | 0.01 | 0.11% |
| 14.19 | 14.17 | 14.06 | 5.03 | 5.03 | 5.01 | 0.01 | 0.15% | 21.92 | 21.90 | 21.74 | 5.01 | 5.00 | 4.98 | 0.01 | 0.14% |
| 14.25 | 14.11 | 14.23 | 5.04 | 5.02 | 5.04 | 0.01 | 0.17% | 21.13 | 20.99 | 21.05 | 4.91 | 4.90 | 4.90 | 0.01 | 0.12% |
| 14.17 | 14.14 | 14.07 | 5.03 | 5.03 | 5.01 | 0.01 | 0.12% | 21.14 | 20.98 | 21.12 | 4.92 | 4.90 | 4.91 | 0.01 | 0.13% |
| 14.17 | 14.11 | 14.02 | 5.03 | 5.02 | 5.00 | 0.02 | 0.18% | 21.39 | 21.31 | 21.25 | 4.94 | 4.94 | 4.93 | 0.01 | 0.11% |
| 14.10 | 14.06 | 13.96 | 5.02 | 5.01 | 4.99 | 0.02 | 0.18% | 21.51 | 21.31 | 21.47 | 4.96 | 4.94 | 4.95 | 0.01 | 0.16% |
| 14.27 | 14.23 | 14.26 | 5.05 | 5.04 | 5.05 | 0.00 | 0.05% | 21.58 | 21.42 | 21.46 | 4.97 | 4.95 | 4.95 | 0.01 | 0.13% |
| 14.28 | 14.09 | 14.26 | 5.05 | 5.02 | 5.05 | 0.02 | 0.22% | 20.56 | 20.48 | 20.55 | 4.85 | 4.84 | 4.85 | 0.01 | 0.06% |
| 14.21 | 14.06 | 14.12 | 5.04 | 5.01 | 5.02 | 0.02 | 0.18% | 20.90 | 20.83 | 20.82 | 4.89 | 4.88 | 4.88 | 0.01 | 0.06% |
| 14.24 | 14.06 | 14.21 | 5.04 | 5.01 | 5.04 | 0.02 | 0.21% | 18.01 | 17.83 | 17.86 | 4.54 | 4.51 | 4.52 | 0.01 | 0.17% |
| 14.20 | 14.09 | 14.19 | 5.04 | 5.02 | 5.03 | 0.01 | 0.14% | 15.28 | 15.16 | 15.19 | 4.18 | 4.16 | 4.17 | 0.01 | 0.14% |
| 14.24 | 14.04 | 14.10 | 5.04 | 5.01 | 5.02 | 0.02 | 0.24% | 14.17 | 14.13 | 14.08 | 4.02 | 4.02 | 4.01 | 0.01 | 0.11% |
| 14.44 | 14.34 | 14.37 | 5.08 | 5.06 | 5.07 | 0.01 | 0.11% | 13.61 | 13.49 | 13.60 | 3.94 | 3.93 | 3.94 | 0.01 | 0.16% |
| 14.44 | 14.25 | 14.30 | 5.08 | 5.04 | 5.05 | 0.02 | 0.22% | 13.35 | 13.30 | 13.32 | 3.91 | 3.90 | 3.90 | 0.00 | 0.06% |
| 14.40 | 14.34 | 14.22 | 5.07 | 5.06 | 5.04 | 0.02 | 0.21% | 12.62 | 12.48 | 12.51 | 3.80 | 3.78 | 3.78 | 0.01 | 0.18% |
| 14.39 | 14.21 | 14.22 | 5.07 | 5.04 | 5.04 | 0.02 | 0.21% | 9.89 | 9.82 | 9.82 | 3.36 | 3.35 | 3.35 | 0.01 | 0.12% |
| 14.23 | 14.19 | 14.16 | 5.04 | 5.03 | 5.03 | 0.01 | 0.09% | 17.01 | 16.85 | 16.86 | 4.41 | 4.39 | 4.39 | 0.01 | 0.16% |
| 14.09 | 14.01 | 13.91 | 5.02 | 5.00 | 4.98 | 0.02 | 0.22% | 18.60 | 18.46 | 18.58 | 4.61 | 4.59 | 4.61 | 0.01 | 0.13% |
| 14.14 | 14.09 | 14.08 | 5.02 | 5.02 | 5.01 | 0.01 | 0.07% | 19.58 | 19.51 | 19.53 | 4.73 | 4.72 | 4.72 | 0.00 | 0.06% |
| 14.15 | 14.09 | 14.14 | 5.03 | 5.02 | 5.02 | 0.01 | 0.07% | 20.93 | 20.77 | 20.84 | 4.89 | 4.87 | 4.88 | 0.01 | 0.13% |
| 14.16 | 14.12 | 13.99 | 5.03 | 5.02 | 5.00 | 0.02 | 0.21% | 21.34 | 21.17 | 21.17 | 4.94 | 4.92 | 4.92 | 0.01 | 0.14% |
| 14.18 | 14.17 | 14.03 | 5.03 | 5.03 | 5.01 | 0.02 | 0.18% | 21.39 | 21.30 | 21.34 | 4.94 | 4.93 | 4.94 | 0.01 | 0.07% |
| 14.11 | 14.03 | 14.03 | 5.02 | 5.00 | 5.01 | 0.01 | 0.10% | 21.22 | 21.07 | 21.09 | 4.92 | 4.91 | 4.91 | 0.01 | 0.12% |
| 14.19 | 14.10 | 14.16 | 5.03 | 5.02 | 5.03 | 0.01 | 0.11% | 21.14 | 21.09 | 20.95 | 4.92 | 4.91 | 4.89 | 0.01 | 0.16% |
| 14.16 | 14.12 | 14.15 | 5.03 | 5.02 | 5.03 | 0.00 | 0.04% | 21.04 | 20.89 | 20.85 | 4.90 | 4.89 | 4.88 | 0.01 | 0.16% |
| 14.27 | 14.09 | 14.18 | 5.05 | 5.02 | 5.03 | 0.02 | 0.21% | 21.58 | 21.44 | 21.50 | 4.97 | 4.95 | 4.96 | 0.01 | 0.11% |
| 14.15 | 14.07 | 14.11 | 5.03 | 5.01 | 5.02 | 0.01 | 0.10% | 20.92 | 20.86 | 20.76 | 4.89 | 4.88 | 4.87 | 0.01 | 0.13% |
| 14.14 | 14.02 | 14.10 | 5.02 | 5.00 | 5.02 | 0.01 | 0.15% | 21.07 | 20.88 | 20.98 | 4.91 | 4.89 | 4.90 | 0.01 | 0.15% |
| 14.24 | 14.13 | 14.20 | 5.04 | 5.02 | 5.04 | 0.01 | 0.13% | 21.97 | 21.88 | 21.90 | 5.01 | 5.00 | 5.00 | 0.01 | 0.07% |
| 14.13 | 14.12 | 13.96 | 5.02 | 5.02 | 4.99 | 0.02 | 0.20% | 21.67 | 21.49 | 21.64 | 4.98 | 4.96 | 4.97 | 0.01 | 0.14% |
| 14.20 | 14.15 | 14.04 | 5.04 | 5.03 | 5.01 | 0.02 | 0.20% | 21.70 | 21.69 | 21.69 | 4.98 | 4.98 | 4.98 | 0.00 | 0.00% |
| 14.20 | 14.06 | 14.12 | 5.04 | 5.01 | 5.02 | 0.02 | 0.17% | 20.99 | 20.96 | 20.80 | 4.90 | 4.89 | 4.88 | 0.01 | 0.16% |
| 14.28 | 14.14 | 14.16 | 5.05 | 5.03 | 5.03 | 0.01 | 0.17% | 20.10 | 19.91 | 19.96 | 4.79 | 4.77 | 4.78 | 0.01 | 0.17% |
| 14.15 | 13.98 | 13.98 | 5.03 | 5.00 | 5.00 | 0.02 | 0.20% | 18.97 | 18.96 | 18.78 | 4.66 | 4.65 | 4.63 | 0.01 | 0.17% |
| 14.16 | 14.15 | 14.09 | 5.03 | 5.03 | 5.02 | 0.01 | 0.08% | 17.30 | 17.19 | 17.11 | 4.45 | 4.43 | 4.42 | 0.01 | 0.19% |

3.3.5 合成标准不确定度的评价

3.3.5.1 标准不确定度汇总表

表3 标准不确定度汇总表

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 符号 | 不确定度来源 | 输入不确定度 | 系数*pi* | 合成不确定度 |
|  | 重复性 | 043% | 1 | 0.43% |
|  | 溯源证书 | 0.32% | -1 | 0.32% |
| 合成标准不确定度：，扩展不确定度：，k=2 | | | | |

3.3.5.2 合成标准不确定度

输入量彼此独立不相关，所以合成标准不确定度按下式得到：



3.3.6 扩展不确定度的评定

固定源烟气流速（量）参比方法用S型皮托管的校准，取覆盖因子k=2,校准结果的不确定度为

