

## **Calibration Protocol**

We would like to inform you about service orders you send to TPF Control. It concerns ISO/IEC 17025:2017 accredited calibrations according to our scope of accreditation (K-149) published by the RvA.

If you send an instrument to us for calibration we will perform the following services;

1. As-Found comparisons
2. Service and repair
3. As-Left (post) comparisons
4. Traceable calibration certificates
5. Apply the latest version of our scope with regard to uncertainty.

### **What it all means:**

#### **1. As-Found and As-Left comparisons**

The comparison of your product to our lab standard.

We perform one series of comparisons when we receive your product, and one series before it is return-shipped.

As a calibration laboratory accredited to ISO/IEC 17025:2017 we follow the ISO Guide to the Expression of Uncertainty in Measurements (GUM). Our calibrations are performed by qualified personnel following controlled test methods and procedures. The results are printed to As-Found (pre) and As-Left (post) calibration certificates.

Though calibration often is interpreted as an adjustment that restores an instrument to its original tolerance, calibration is the comparison of a value indicated by the Device Under Test (DUT) and the corresponding value of a (higher) standard.

For default calibration points, calibration methods as well as manufacturer tolerances and conformity statements see Annex A. Note these are model and make dependent.

TPF will perform adjustment to the DUT when the as-Found calibration results are beyond manufacturer tolerance. If this is not required it must be specified when placing an order.

#### **2. Calibration method (Lab and on-site)**

The calibration methods we use have been proven and accredited by the Dutch council of accreditation (RvA). By default Flow Devices (except for flow calibrators) are calibrated in a serial connection setup with working standards to prevent pollution of reference meters. The use of working standards results in a higher uncertainty. Upon request calibration can be performed with master references. Flow calibrators are calibrated in a parallel connection setup with master references. Temperature, pressure and humidity devices are calibrated with master references by comparison method.

#### **3. Service and repair**

If necessary and applicable, your product is disassembled to its core components. We inspect each component for wear, defect, contaminants and damage and then clean, repair or replace as necessary. At the same time, if applicable, we upgrade hardware that was improved since you last purchased or serviced your product.

Once your product is reassembled, it's ready for its As-Left calibration.

If your product fails any points in this test, it must be disassembled again and the maintenance process continued until your product passes our As-Left calibration.

#### **Recertification warranty**

We warrant our service, labor and parts replacements against failure for a period of 90 days from the last date of recertification, provided your product has been used under normal operating conditions and that the failure is directly related to labor performed or parts installed during the last recertification.

## Terms and conditions

### 1. **Delivery time:**

Delivery time of calibration will be one max 14 days unless stated otherwise in the order acknowledgement.

The calibration certificate will be shipped together with the instrument(s).

### 2. **Pricing:**

Pricing of calibration is through our standard pricelist which is available on request.

Pricing of non standard items on request.

### 3. **Statement of conformity - Binary decision rule explanation:**

On the calibration certificate of MesaLabs dataloggers a statement of conformity is mentioned. It's shown as pass or fail.

We apply a binary decision rule defined as follows;

1. Error (E) (DUT value – Reference value)
2. Tolerance (T) (manufacturer specification)
3. Measurement Uncertainty (MU)
4. Guardband value (GV)  $GV \geq MU$

Decision Rule:  $E + GV < T$ ; Pass. If  $E + GV \geq T$ ; Fail

Explanation of the above

During the calibration process an out of tolerance is determined using a calibration tolerance in combination with a guardband value (GV). The GV is equal to the difference between the calibration tolerance and the tolerance (T). For temperature and pressure calibrations the guardband value is greater than or equal to the maximum MU. The sum of the calibration tolerance and the guardband is less than the instrument tolerance shown on the certificate. So, the guardband eliminates false positives when applying the Binary decision rule.

For humidity (RH) calibrations the guardband value is smaller than MU. So:

$GV < MU$

The decision rule is the same:

$E + GV < T$ ; Pass. If  $E + GV \geq T$ ; Fail

So the definition of the Pass/fail rule is different for RH;  $E + MU$  could be greater than T and still the result could pass

A statement is made on the calibration certificate describing the above.

### Annex A

1. Manufacturer tolerance, see datasheet of model on website of manufacturer .
2. Default calibration points and calibration method for:

#### Gas flow devices

| Model                      | Calibration points by default<br>Gas flow  | Calibration method |
|----------------------------|--|--------------------|
| VA meters                  | 5 points to scale values   | Serial / parallel  |
| All other gas flow devices | <b>As found:</b> 50%, 100% of full scale flow and indication of 0%<br><b>As left:</b> 5%, 10%, 25%, 50%, 75%, 100% of full scale flow and indication of 0% | Serial             |

#### MesaLabs DryCal Gas Flow calibrators

Flow units are specified as ccm and sccm whereas sccm refers to standardized flow at 21.1 °C and 101325 Pa.

Ambient refers to laboratory temperature and pressure conditions at time of calibration.

The gas flow calibration is performed in a parallel gas flow setup. The pressure and temperature calibration method is by comparison of the DUT to a reference standard.

For calibration points see next page.

**MesaLabs - DryCal flow calibrators**

| Model           | Calibration points by default |  |                    |
|-----------------|-------------------------------|--|--------------------|
|                 | Gas flow                      | Pressure [ mBar ]                              | Temperature [ °C ] |
| DC-2 base       |                               | Ambient  | Ambient            |
| DC-LC-1         | 30-100-300 ccm                | -  | -                  |
| DC-MC-1         | 10-2000-5000 ccm              | -  | -                  |
| DC-HC-1         | 500-5000-30000 ccm            | -  | -                  |
| DCL-L           | 30-100-500 ccm                | -  | -                  |
| DCL-ML          | 50-1000-2000 ccm              | -  | -                  |
| DCL-M           | 100-2000-7000 ccm             | -  | -                  |
| DCL-MH          | 200-5000-20000 ccm            | -  | -                  |
| DCL-H           | 500-5000-30000 ccm            | -  | -                  |
| Defender 510-L  | 30-100-500 ccm                | -  | -                  |
| Defender 510-M  | 100-1000-5000 ccm             | -  | -                  |
| Defender 510-H  | 300-5000-30000 ccm            | -  | -                  |
| Defender 520-L  | 30-100-500 ccm                | -  | -                  |
| Defender 520-M  | 100-1000-5000 ccm             | -  | -                  |
| Defender 520-H  | 300-5000-30000 ccm            | -  | -                  |
| Defender 530-L  | 30-100-500 ccm                | -  | -                  |
| Defender 530-M  | 100-1000-5000 ccm             | -  | -                  |
| Defender 530-H  | 300-5000-30000 ccm            | -  | -                  |
| Definer 220-L   | 30-100-500 sccm               | Ambient  | Ambient            |
| Definer 220-M   | 100-1000-5000 sccm            | Ambient  | Ambient            |
| Definer 220-H   | 300-5000-30000 sccm           | Ambient  | Ambient            |
| Defender 530+ L | 30-100-500 sccm               | Ambient  | Ambient            |
| Defender 530+ M | 100-1000-5000 sccm            | Ambient  | Ambient            |
| Defender 530+ H | 300-5000-30000 sccm           | Ambient  | Ambient            |
| DryCal-500-10   | 15-90-500 sccm                | 800-825-850-875-900-925-950-975-1000-1025-1050 | 16,5-22,5-28,5     |
| DryCal-500-24   | 50-500-5000 sccm              | 800-825-850-875-900-925-950-975-1000-1025-1050 | 16,5-22,5-28,5     |
| DryCal-500-44   | 500-5000-50000 sccm           | 800-825-850-875-900-925-950-975-1000-1025-1050 | 16,5-22,5-28,5     |
| DryCal-800 DCB  |                               | 800-825-850-875-900-925-950-975-1000-1025-1050 |                    |
| DryCal-800-3    | 6-20-40 sccm                  | 0-5-10-20                                      | 16,5-22,5-28,5     |
| DryCal-800-10   | 15-90-500 sccm                | 0-5-10-20                                      | 16,5-22,5-28,5     |
| DryCal-800-24   | 50-500-5000 sccm              | 0-5-10-20                                      | 16,5-22,5-28,5     |
| DryCal-800-44   | 500-5000-50000 sccm           | 0-5-10-20                                      | 16,5-22,5-28,5     |
| DryCal-800-75   | 5000-50000-100000 sccm        | 0-5-10-20                                      | 16,5-22,5-28,5     |
| FlexCal - L     | 15-90-500 sccm                | 800-825-850-875-900-925-950-975-1000-1025-1050 | 16,5-22,5-28,5     |
| FlexCal - M     | 50-500-5000 sccm              | 800-825-850-875-900-925-950-975-1000-1025-1050 | 16,5-22,5-28,5     |
| FlexCal - H     | 500-5000-50000 sccm           | 800-825-850-875-900-925-950-975-1000-1025-1050 | 16,5-22,5-28,5     |
| DryCal 1020     | 20-50-100-250-375-500 sccm    | 800-825-850-875-900-925-950-975-1000-1025-1050 | 16,5-22,5-28,5     |
| DryCal 1500     | 50-150-375-750-1125-1500 sccm | 800-825-850-875-900-925-950-975-1000-1025-1050 | 16,5-22,5-28,5     |

**Mesalabs BGI gas flow calibrators.**

The gas flow calibration is performed in a serial gas flow setup. The pressure and temperature calibration method is by comparison of the DUT to a reference standard.

| Model             | Calibration points by default |                           |                    |
|-------------------|-------------------------------|---------------------------|--------------------|
|                   | Gas flow                      | Pressure [ mBar ]         | Temperature [ °C ] |
| Challenger 30     | 6-15-30 lpm                   |                           |                    |
| Challenger 6      | 2-4-6 lpm                     |                           |                    |
| DeltaCal 19.5     | 2-5-10-15-19 lpm              | 900-930-960-990-1020-1050 | 5-15-25-35         |
| DeltaCal 20       | 2.5-5-10-15-20 lpm            | 900-930-960-990-1020-1050 | 5-15-25-35         |
| DeltaCal 60       | 12-20-30-40-50 lpm            | 900-930-960-990-1020-1050 | 5-15-25-35         |
| TretaCal 30       | 6-15-29 lpm                   |                           |                    |
| TetraCal 6        | 1.2-3-5.5 lpm                 |                           |                    |
| TetraCal 1.2      | 0.25-0.6-1 lpm                |                           |                    |
| TetraCal Ultra 6  | 2-4-6 lpm                     |                           |                    |
| TetraCal Ultra 20 | 7-12-19.5 lpm                 |                           |                    |
| TetraCal Ultra 60 | 21-40-58 lpm                  |                           |                    |
| HiVolCal          | 400-600-900-1100-1500 lpm     | 900-930-960-990-1020-1050 | 5-15-25-35         |
| HVC2              | 400-600-900-1100-1500 lpm     | 900-930-960-990-1020-1050 | 5-15-25-35         |

### MesaLabs DataTrace loggers

The temperature, pressure and humidity calibration methods are by comparison of the DUT to a reference standard.

Conformity statement (Pass/Fail) is mentioned on all DataTrace calibration certificates. Unless otherwise agreed upon with the customer when placing the order, a conformity statement (pass/fail) will be mentioned on the certificate.

| Model        | Calibration points by default<br>Temperature [ °C ]                                   | Pressure [ psi ]   | Humidity [ % ]  |
|--------------|---|--|---|
| M3T          | -20,-10,0,10,20,30,40,50,60,70,<br>80,90,100,110,120,130,140                          |  |   |
| M4T          | -40,-20,0,20,40,60,80,100,120,140   |  |   |
| M4T with -80 | -80,-40,-20,0,20,40,60,80,100,120,140   |  |   |
| M4T ET       | -20,0,20,40,60,80,100,120,140,160,180,<br>200,220,240,260,280,300,320,340,380,<br>400 |  |   |
| M3P          | 10,20,30,40,50,60,70,80,90,100,110,<br>120,130,140                                    | 1,10,20,40,60,75 @ 25 °C<br>20,50 @ 120 °C<br>20,50 @ 135 °C |   |
| M4P          | -20,-10,0,10,20,30,40,50,60,<br>70,80,90,100,110,120,130,140                          | 1,10,20,40,60,75 @ 25 °C<br>20,50 @ 120 °C<br>20,50 @ 135 °C |   |
| M3H          | 0,10,20,30,40,50,60,70,80,85  |  | 0,20,25,30,40,50,60,70,80,90,95 @ 25 °C<br>25,30,40,60,80,90,95 @ 55 °C |
| M4H          | 0,10,20,30,40,50,60,70,80,85  |  | 0,20,25,30,40,50,60,70,80,90,95 @ 25 °C<br>25,30,40,60,80,90,95 @ 55 °C |