White Paper

Weighing in a filtered fume hood

Ohaus balance & Erlab ductless filtering fume hood

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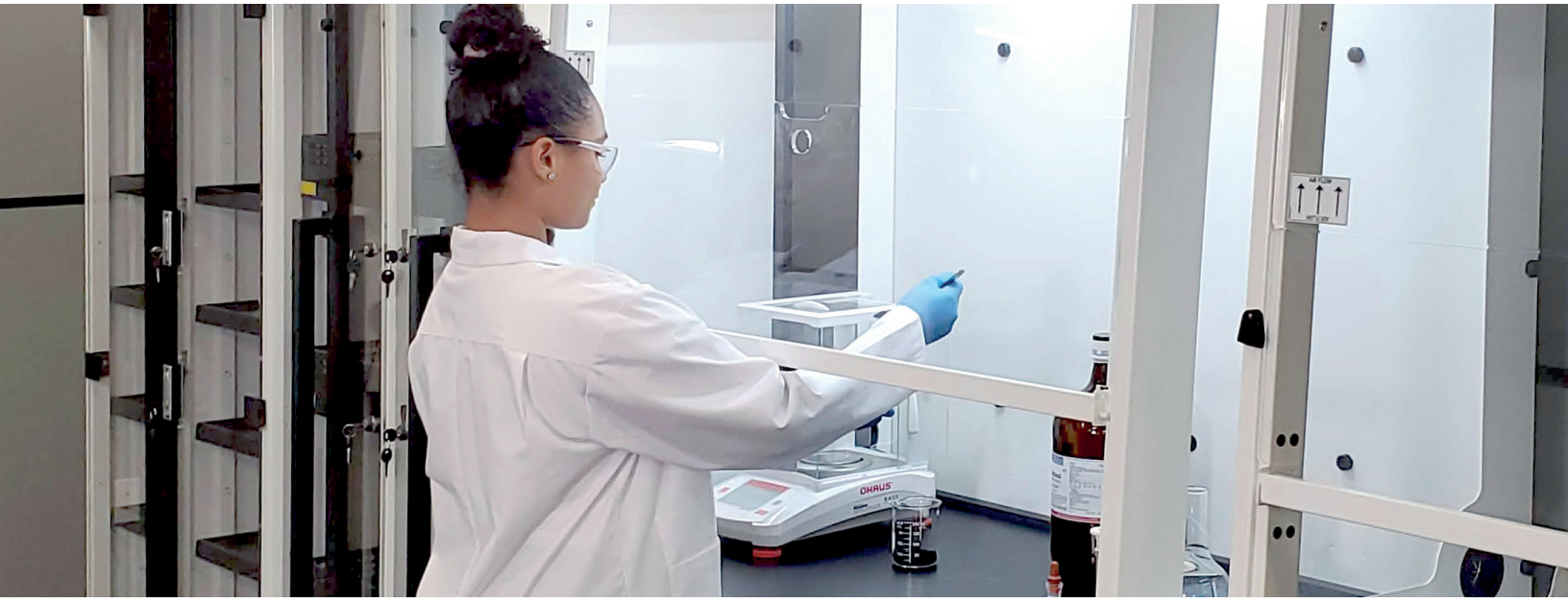


The purpose of this paper is to show that accurate weighing results can be attained when choosing the proper combination of a balance within the appropriate ductless filtering fume hood. Weighing requires accuracy, especially when the readability of a balance reaches 0,01 mg or more. In many applications the samples being weighed might be harmful or dan-gerous for the operator to inhale and the use of a filtered fume hood is required for the protection of the laboratory personnel. When using a hood, air flow, drafts, and vibrations can adversely affect the weighing perfor-mance of a balance and eventually cause errors to the measurement.

Equipment

Ductless Filtering Fume Hood

For protection of the operator an Erlab Captair 391 Ductless Filtering Fume Hood is selected because it is specifically designed to protect users against inhalation of chemi-cals while also accommodating the specific requirements needed for the use of a balance. This hood complies with international safety standards, such as AFNOR NF X 15:211. To comply with this standard, face velocities of the unit must be maintained between 0.4 and 0.6 m/s which requires a total airflow equal to around 220 m3/h. Despite this airflow, the unit is designed to minimize the turbulence that occurs in the enclosure and absorb the vibration that is generated by the fan. The hood was also equipped with a Trespa ToplabPlus work surface to minimize conduction of vibration to the balance.

Balance

Choosing a quality balance with applicable features will ensure a high accuracy of weighing. The Ohaus Explorer Semi-Micro balance is a modular model that easily fits within the fil-tered fume hood. To keep the vibration to a minimum, the balance includes a set of four infrared sensors to engage the automatic doors, an ionizer, and a grid pan. The display can be separated from the base of the balance to a distance of 1.5m with a standard cable. The automatic doors as well as the ionizer, tare and a number of other commands can be actioned with the use of four infrared sensors. This way there is no need for the operator to touch the balance during the weighing procedure which both adds to the protection of the operator as well as minimizes disturbances influencing the balance's performance. The grid pan helps the balance to stabilize up to 1 s faster.
The model used for validation was the Explorer EX225D/AD equipped with an accessory grid pan. Balance's readability is 0,01 mg up to 120g capacity and 0, 1 mg from 120g to the full capacity of 220g.

Validation Procedure

Testing

All tests were performed twice, with and without the air flow turned on and in both cases the results obtained were within the limits of PN-EN 45501 for Non-Automatic Weighing Instruments.

The validation process has been performed by an independent party, Pesage Creuen Mi-chel. A set of calibrated weights were used. The class of calibrated weight was E2. All weights were certified on the 18th of June 2015, by SPF Economie (certificate number: E6/ SMD-ENS/2015/011055.). The set of calibrated weights was comprised of the following: 1 mg, 2 mg, 2*mg, 5 mg, 20 mg, 20*mg, 50 mg, 100 mg, 200 mg, 200*mg, 500 mg, 1 g, 2 g, 2*g, 5 g, 10 g, 20 g, 20* g, 50 g, 100 g, 200 g. All calibrated weights comply to 71/317/ CEE (26th of June 1971) and to 74/1478/CEE (4th of March 1974).

The following tests have been performed:

1. Performance test without tare

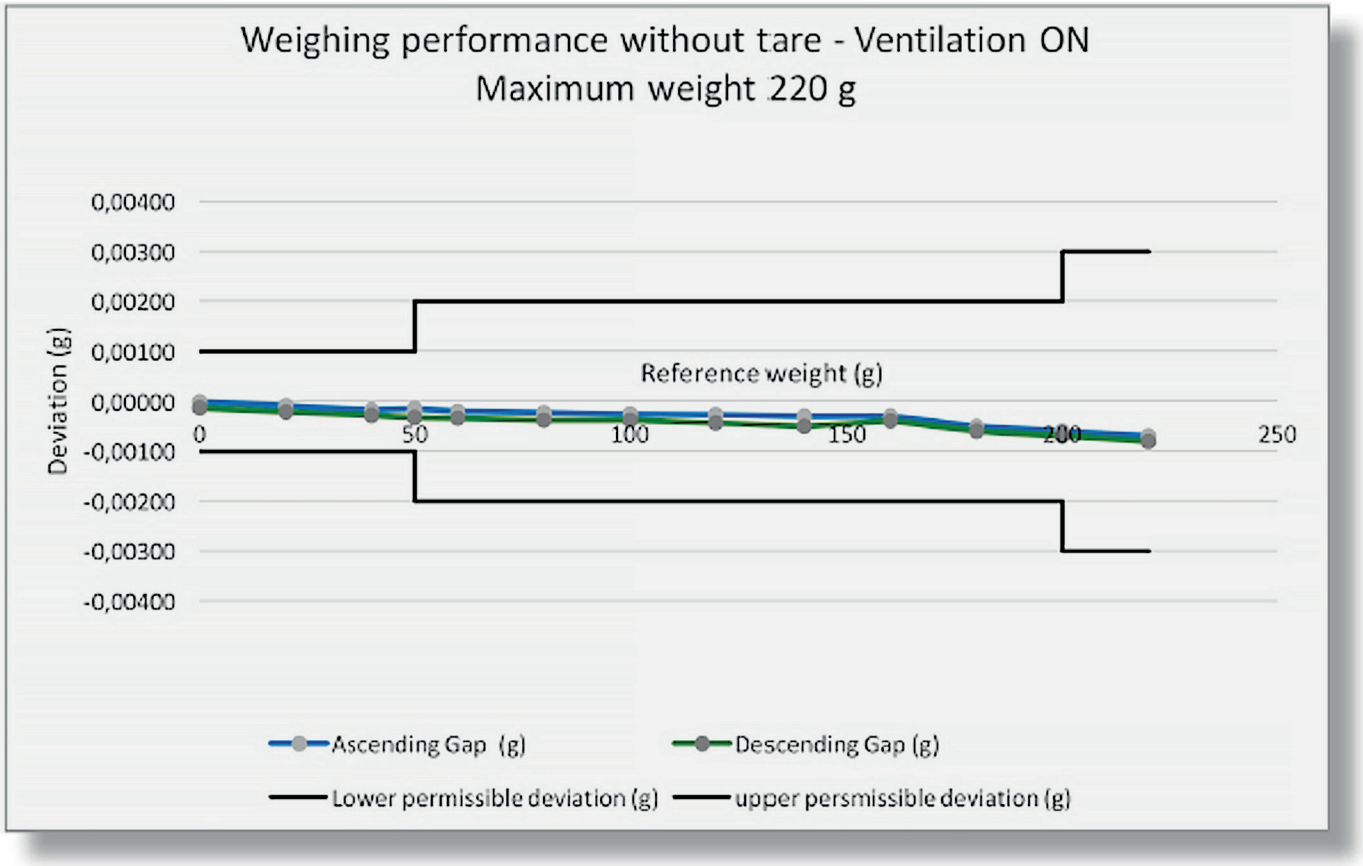
2. Eccentricity

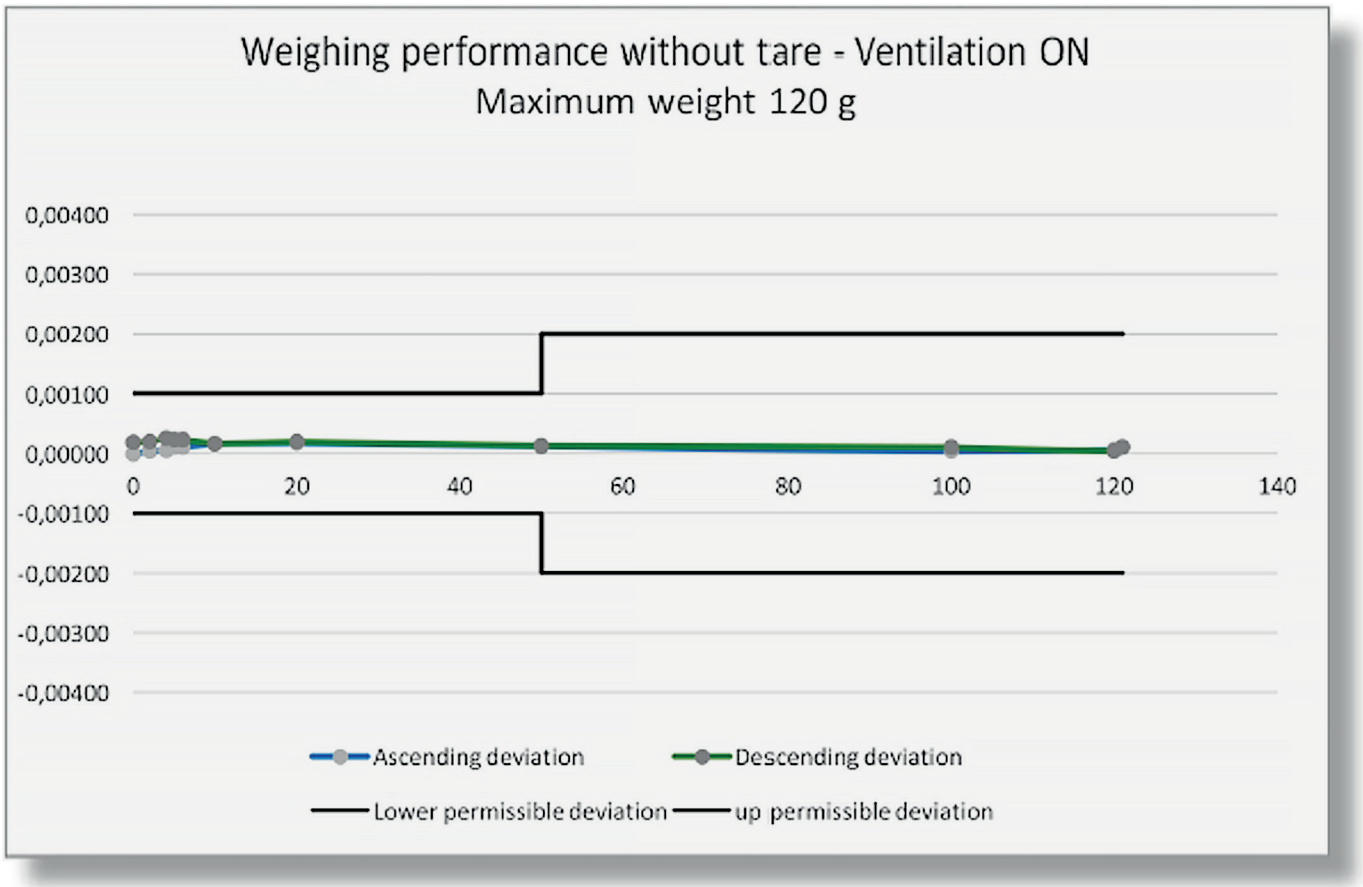
3. Repeatility

Test Results

Weighing performance without tare

Two test procedures have been performed, up to maximum 120g and 220g capacity se-parately. Both of these were done with and without the air flow turned on. Without air flow within the normal parameters of balance usage as compared to usage of a balance in a filtered fume hood. This ensures that the comparison is of equal stature. For each procedure a selection of test weights was placed on the pan in ascending and descending order. In both cases, for each maximum capacity, the results obtained were within the limits of maximum permissible errors as described in the norm.


Weighing performance without tare - Ventilation ON
Maximum weight 220 g
0,00400
0,00300
0,00200
0,00100
0,00000
-0,00100
-0,00200
-0,00300
-0,00400
Deviation (g)
Reference weight (g)
0
50
100
150
200
250
Ascending Gap (g)
Descending Gap (g)
Lower permissible deviation (g)
upper persmissible deviation (g)


Weighing performance without tare - Ventilation ON
Maximum weight 120 g
0,00400
0,00300
0,00200
0,00100
0,00000
-0,00100
-0,00200
-0,00300
-0,00400
0
20
40
60
80
100
120
140
Ascending deviation
Descending deviation
Lower permissible deviation
up permissible deviation

Reference weight (g)	upper permissible deviation (g)	Ascending Gap (g)	Descending Gap (g)	Lower permissible deviation (g)
0,001	0,001	-0,00001	-0,00014	-0,001
20	0,001	-0,00009	-0,00022	-0,001
40	0,001	-0,00018	-0,00029	-0,001
50	0,001	-0,00015	-0,00032	-0,001
50	0,002	-0,00015	-0,00032	-0,002
60	0,002	-0,00020	-0,00034	-0,002
80	0,002	-0,00023	-0,00038	-0,002
100	0,002	-0,00025	-0,00038	-0,002
120	0,002	-0,00027	-0,00044	-0,002
140	0,002	-0,00030	-0,0005	-0,002
160	0,002	-0,00030	-0,0004	-0,002
180	0,002	-0,00050	-0,0006	-0,002
200	0,002	-0,00060	-0,0007	-0,002
200	0,003	-0,00060	-0,0007	-0,003
220	0,003	-0,00070	-0,0008	-0,003

Table 1. Recorded Deviation between measured values and reference weight with fan of the fume hood turned on. Balance range up to 220g.

Reference weight (g)	upper permissible deviation (g)	Ascending Gap (g)	Descending Gap (g)	Lower permissible deviation (g)
0,001	0,001	-0,00001	0,00019	-0,001
2	0,001	0,00003	0,0002	-0,001
4	0,001	0,00005	0,00025	-0,001
5	0,001	0,00010	0,00023	-0,001
6	0,001	0,00010	0,00023	-0,001
10	0,001	0,00016	0,00016	-0,001
20	0,001	0,00017	0,0002	-0,001
50	0,001	0,00012	0,00013	-0,001
50	0,002	0,00012	0,00013	-0,002
100	0,002	0,00004	0,00011	-0,002
120	0,002	0,00006	0.00003	-0,002
121	0,002	0,00010	0,0001	-0,002

Table 2. Recorded Deviation between measured values and reference weight with fan of the fume hood turned on. Balance range up to 120g.

Eccentricity

Since the balance is a dual range instrument, two test procedures have been executed. For the 0,01 mg readability range a 40g test weight has been used and for the upper range with 0, 1 mg readability a 70g and 75g test weight load has been used. Tests were performed both with and without the air flow turned on. Obtained results met the criteria described in the norm.

Figure 1: location of eccentricity measuring points.

Location	Reference weight (g)	Measured value (g)	Maximum permissible deviation (g)	Deviation (g)
1	75.000	75.0000	0.002	0.0000
2	75.000	75.0006	0.002	0.00006
3	75.000	75.0004	0.002	0.00004
4	75.000	74.9999	0.002	-0.0001
1	70.000	69.99980	0.002	-0.00020
2	70.000	69.99978	0.002	-0.00022
3	70.000	69.99979	0.002	-0.00021
4	70.000	69.99976	0.002	-0.00024

Table 3: Results of eccentricity test with 70g and 75g test weight. Fan of the fume hood turned on. Balance up to 220g.

Location	Reference weight (g)	Measured value (g)	Maximum permissible deviation (g)	Deviation (g)
1	40.000	40.0001	0.001	0.0000
2	40.000	40.0002	0.001	0.00006
3	40.000	40.0003	0.001	0.00004
4	40.000	39.9999	0.001	-0.0001

Table 4: Results of eccentricity test with 40g test weight. Fan of the fume hood turned on. Balance up to 120g.

Repeatability

Similar to the previous test procedures, repeatability tests have been performed sepa-rately for the 120g and 220g weighing ranges. For the 0,01 mg readability range two test weights have been used, namely 60g and 120g. The remaining range with 0, 1 mg reada-bility has been tested with 1 00g and 200g test weights respectively.

	Reference weight (g)	Measured value (g)	Maximum permissible deviation (g)	Deviation (g)
1	100.000	100.00004	0.002	0.00004
2	100.000	100.00001	0.002	0.00001
3	100.000	100.00009	0.002	0.00009
4	100.000	100.00004	0.002	0.00004
5	100.000	100.00015	0.002	0.00015

Table 5. Results of repeatability test with 100 g test weight. Fan of the fume hood turned on. Balance range up to 220 g.

	Reference weight (g)	Measured value (g)	Maximum permissible deviation (g)	Deviation (g)
1	200.000	200.00020	0.002	0.00020
2	200.000	200.00030	0.002	0.00030
3	200.000	200.00020	0.002	0.00020
4	200.000	200.00030	0.002	0.00030
5	200.000	200.00030	0.002	0.00030

Table 6. Results of repeatability test with 200 g test weight. Fan of the fume hood turned on. Balance range up to 220 g.

	Reference weight (g)	Measured value (g)	Maximum permissible deviation (g)	Deviation (g)
1	60.000	60.00006	0.002	0.00006
2	60.000	60.00000	0.002	0.00000
3	60.000	60.00002	0.002	0.00002
4	60.000	60.00004	0.002	0.00004
5	60.000	60.00003	0.002	0.00003

Table 7. Results of repeatability test with 60 g test weight. Fan of the fume hood turned on. Balance range up to 120 g.

	Reference weight (g)	Measured value (g)	Maximum permissible deviation (g)	Deviation (g)
1	120.000	120.00001	0.002	0.00001
2	120.000	120.00004	0.002	0.00004
3	120.000	120.00005	0.002	0.00005
4	120.000	120.00007	0.002	0.00007
5	120.000	120.00005	0.002	0.00005

Table 8: Results of repeatability test with 120 g test weight. Fan of the fume hood turned on. Balance range up to 120 g. .

Conclusion

Test results show that the balance's performance when placed under a filtered fume hood during normal operation does not change drastically, allowing the balance to perform within the limits stated in the EN-PN 45501 for Non-Automatic Weighing Instruments.

Vibrations and air-flow disturbances caused by the Captair 391 Ductless Filtering Fume Hood have no negative effect on EX225D/AD performance. The combination of the Ohaus balance and Erlab hood allows for both safe and accurate measurements.

The Erlab Research and Development laboratory

About Erlab

Since 1968, **Erlab** has been a specialist, inventor and world leader in **ductless, zero-emission filtering fume hoods for laboratories** to provide total safety in chemical handling.

1 Erlab filtration

We provide technologies to protect laboratory staff from inhaling chemicals. This is made possible thanks to our **Research and Development (R&D) department,** which has continuously improved our filtration technology **for more than 50 years.** That's why, in 2009, we invented the **ERLAB ABOVE** label for tried and tested filtration technology.

2 The AFNOR NF X 15-211: 2009 standard

Erlab's filtration technology conforms to the **NF X 15-211: 2009 standard,** the industry's most demanding standard for molecular filtration, developed by a committee of independent scientists and specialized manufacturers.

This text imposes performance criteria linked to:

- Filtration efficiency
- Containment efficiency
- Air face velocity
- Documentation: **chemical listing**

3 The ESP program

A set of three services included with the purchase of each device designed to ensure your safety.

eValiQuest Risk analysis – Determination of protection needs – Determination of ergonomic needs.

ValiPass Certified installation – Total safety for handling.

ValiGuard Ongoing monitoring – Preventative and maintenance inspections – Device reconfiguration based on protection needs – Development of handling.

4 Flex technology

The combination of molecular and particulate filtration technologies allows a single device to meet laboratories' protection needs. This innovation from Erlab's R&D department offers unprecedented **flexibility, versatility and value.** A single device can be reconfigured over time and easily reassigned to other applications.

5 Smart technology

Smart technology is a **simple and innovative** means of communication that improves safety. This technology uses a light and sound signal to indicate the user's level of protection. The advantages of the technology are:

1/ Light pulsation: Real-time communication via LED light pulses intuitively alerts the user to the device's operating status.

2/ Simplicity: One-touch activation.

3/ Detection system: The exclusive detection system continuously monitors filtration performance.

4/ Built-in monitoring: This service provides direct access to the **status, settings and history** of your device.

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