



Skanair® Workstation



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Safety through containment



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Diag. 1: Preliminary filter of an activated carbon filter cartridge

The concept behind the Skanair® Workstation

A quantum leap in the field of fume cupboards.

- ▲ Compared to conventional exhaust systems, the air volume required for the operation of the fume cupboard is reduced by approx. 60%.
- ▲ Air contamination is substantially reduced through the separation of suspended matter and contaminants directly beneath the working area, but also through the avoidance of unnecessary emissions.
- ▲ Building infrastructure expenses are reduced significantly as a result of which investment costs are lowered (smaller HVAC systems, less space required, simpler control systems).
- ▲ Energy requirements and thus the cost of processing the air for the fume cupboards is cut by approx. 60%.
- ▲ The flexible use of the laboratories is significantly increased, e.g. if the task or application area changes or if a new research team is deployed.
- ▲ Safety is increased by means of a comprehensive containment system in the event of average and fires, as well as filter systems for active substances.
- ▲ Improves working conditions for users.

The Skanair® Workstation is the result of intensive development work and comprehensive test series. It is an autonomous, flexible fume cupboard, designed for a wide range of laboratory work.

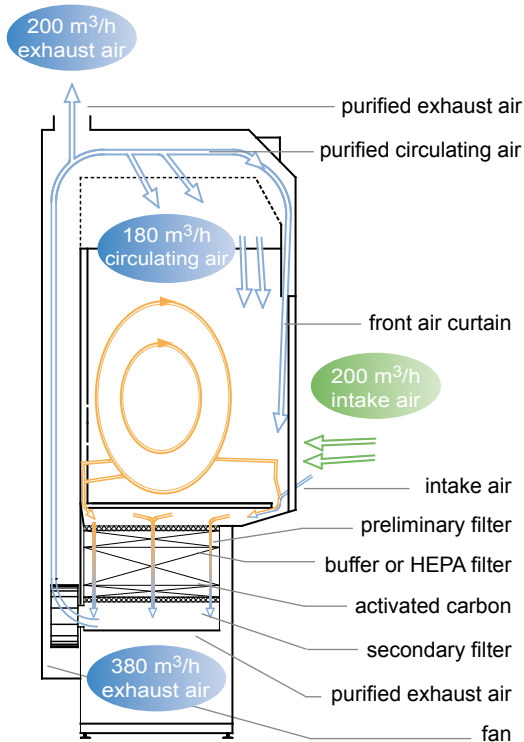
*Diag. 2: Perforated plate, front:
efficient collection of contaminants through table suction*





This is how the Skanair® Workstation functions

The Workstation is a fume cupboard with integrated aeration. The intake air is taken in from the surrounding area, i.e. the laboratory, via the front opening (Diag. 3, green arrows). This fresh air is blended with the contaminated air from the working area and is exhausted directly out to the filters before and behind the working surface (orange arrows).



Diag. 3: Functional diagram

The entire exhaust air is thus forwarded to internal ventilation via filters and subsequently to the head of the Workstation (blue arrows).

In the Workstation's head the volume flow is split up: approx. 50% is suctioned off via the in-house exhaust air system, the other 50% are targetedly returned to the front of the working area (blue arrows).

The filters are located directly underneath the working surface. In normal operations and in reduced mode the flow of exhaust air is permanently filtered, thus effectively removing the contaminants directly at their source.

- ▲ No escape of contaminants into the laboratory
- ▲ Removes the contaminants at their source, thus placing no stress on the environment
- ▲ Reduces the risky build-up of contaminants and deposits in ventilation ducts and system components

Check for standards in accordance with EN 14175

The EN 14175 standard recently published provides uniform criteria for the performance check of fume cupboard. A fume cupboard must therefore meet the following basic criteria:

- Contaminants should not be able to spread into the laboratory (retention capacity)
- Contaminants should be efficiently removed to prevent the development of a hazardous atmosphere in the fume cupboard (air exchange capacity)
- Users should be protected against splashes and splinters by means of a front panel

Essentially, four ventilation-related investigation points are checked in the course of the type examination procedure:

Retention capacity

Retention capacity is the ability of the fume cupboard to retain contaminants within the fume cupboard, thus protecting users from hazardous emissions.

The **inner grid test** measures the «potential» outbreak of contaminants. SF₆ is emitted within the extraction system as a test gas. The concentration of this gas is measured at 6 points, using 9 probes each.

The **outer grid test** measures the «actual» outbreak. At the external measuring level, i.e. 5 cm in front of the front panel, a measurement is made with 20 test probes in parallel across the entire opening. This test comprises both static measurements (with open or closed panel) and dynamic measurements (involving movement of the front panel). This simulates the behaviour of the extraction system when a user opens the front panel during a test.



Diag. 4: Inner grid test

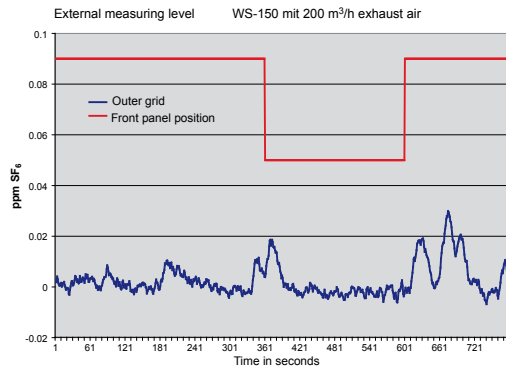


Diag. 5: Outer grid test

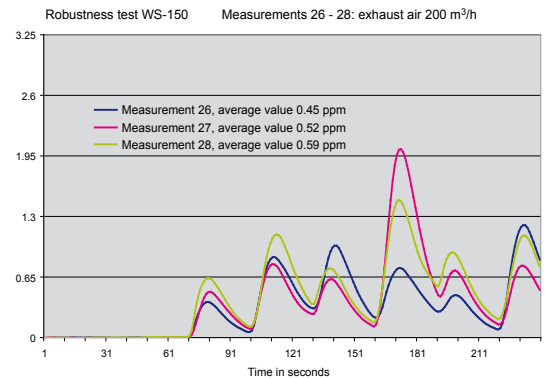


Diag. 6: Robustness test

The **robustness test** utilises the same test set-up as the outer grid test, however, a moving panel is used to investigate the behaviour of the fume cupboard in the event of disruptions, e.g. a person walking by.



Diag. 7: Skan WS-150, measuring result outer grid



Diag. 8: Skan WS-150 measuring result robustness

The position of the front panel is marked in red in the diagram. It is closed after 360 seconds and re-opened after 600 seconds. Seconds after the movements, the concentration of test gas measured at the external measuring level rises slightly but remains significantly below the threshold value of 0.65 ppm through the test.

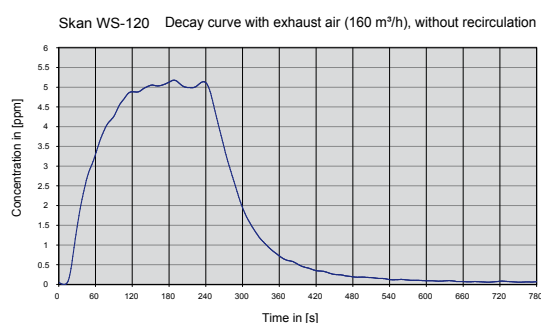
After 60 seconds the panel passes the fume cupboard every 30 seconds. As a result of the turbulences thus caused, some toxic gas always escapes. However, the average value of the toxic gas concentration measured is below the threshold value of 0.65 ppm. Importantly, it can be observed that the concentration of toxic gas drops again rapidly after the disruption.

Results for the Workstation in accordance with EN 14175
(WS-150 with 200 m³/h exhaust air volume flow)

Test	Threshold values (Average value)	Reference	WS-150	Fulfilled
Inner grid	0.1 ppm	INRS / F	< 0.01 ppm	✓
Outer grid	0.65 ppm	BG Chemie / D	< 0.01 ppm	✓
Robustness	0.65 ppm	BG Chemie / D	0.45 ... 0.59 ppm	✓

Air exchange capacity

This is a measure of the efficiency with which the contaminants are removed from the fume cupboard by the flow of exhaust air when the front panel is closed. In this case a test gas is emitted in the fume cupboard so that the concentration in the exhaust air is at a constant level of approx. 5-8 ppm. After turning off the test gas, the decaying concentration is measured.



Diag. 9: Measuring result air exchange capacity

The concentration of the test gas decays rapidly. After approx. 60 seconds it has halved and after a further 60 seconds it amounts to only one tenth of the test concentration. This means that toxic gases are rapidly removed from the Workstation and no critical concentrations develop.

Diag. 10: Safety aspect: Retention

The emission of test mist clearly demonstrates the effectiveness of the front air curtain. The test mist is directed away from the front panel opening to the interior of the fume cupboard.

Position of front panel

The test mist is retained in the fume cupboard when the front panel is opened.





Areas of application of the Skanair® Workstation

Due to its integrated suctioning and filter technology the Workstation has an extremely wide range of applications and safety when working with active or unknown substances is increased significantly. It is essential, for the proper removal of contaminants, that the practicality of the respective «fume cupboard» for the work intended is accurately tested. A few examples for applications are listed below:

Type of work	Workstation	Special extraction system or additional apparatus recommended or required
Analytical (organic) chemistry	Suitable	
Weighing (micro and half-micro range)	Suitable	
Chemical research	Suitable	
Chemical-preparative synthesis	Suitable	
Strongly smelling substances	Suitable	Washer with spot extraction
Small preparative amounts of toxic substances (e.g. chlorine)	Suitable	Washer with spot extraction
Active substances, active ingredients	Generally suitable, WS-AS	HEPA filter in 1st filter stage; alternatively: safety workbench HFC, PHC (power handling cabinet), Toxibox or insulator
Hydrogen	Not permitted	Execute work in the hydrogenation laboratory
Release of large amounts of heat (e.g. when fuming off)	Not suitable	Special fume extractor, observe instructions
Hydrofluoric acid, perchloric acid	Not suitable	Use special extractors with washers or install washer upstream
Larger amounts of highly toxic chemicals (e.g. hydrogen cyanide)	Not suitable	Observe special instructions, install washer with spot extraction upstream
Radioactive substances (dependent on the type of isotope, radiation type, dose)	(Limited) suitability	Special extractors with activated carbon and fine particle filter obligatory, observe special instructions
Larger amounts of mineral acids, ammonia, etc.	Not suitable	Use special extractors with washers or install washer upstream
Preparative synthesis, pilot laboratory	(Limited) suitability	Observe special instructions, spot extraction
Personal and product protection when handling micro-organisms	Not permitted	Microbiological safety workbench
Acidic or corrosive gases	Limited suitability	Select closed apparatus, install washer with spot extraction upstream

Special notes

Dust

There are applications during which fine dust particles, active agents, allergenic particles but only low amounts of solvents are released (e.g. when handling powders). For such cases we recommend the use of HEPA filters instead of the buffer filters. These will reliably remove the particles from the flow of exhaust air and the particles therefore do not present a contamination and risk to the building's exhaust air.

Reactive substances

When working with larger amounts of acids, amines, chlorine and similar compounds, it is advisable to install a gas washer (scrubber) upstream of the adsorption (this also applies to conventional extraction systems). This neutralises the contaminants targetedly and properly.

Secondary reactions and cross contamination

Fine particle and adsorption filters are an extremely effective method to retain contaminants. However, due to the fact that the contaminants collect, the potential for secondary reactions increases. With regard to the Workstation, this is locally restricted to the filter package (can be exchanged); with conventional fume cupboards it extends to the entire downstream ventilation system (cannot be cleaned easily).

High temperatures and desorption

Adsorption filters work most efficiently at low temperatures. With regard to applications with constant high temperatures, the circulated air is not cleaned as well. Additionally, the warm air results in a partial desorption of contaminants from the filter. This application is therefore not recommended.

Active substances

Active substances in powder form, in particular, require greater precautions. To avoid spreading, we recommend the use of a bag-out filter system for a low contamination filter exchange (WS-AS).

Ex-safety

The Workstation is designed for use in normal laboratory areas and not for work in ATEX-zones.

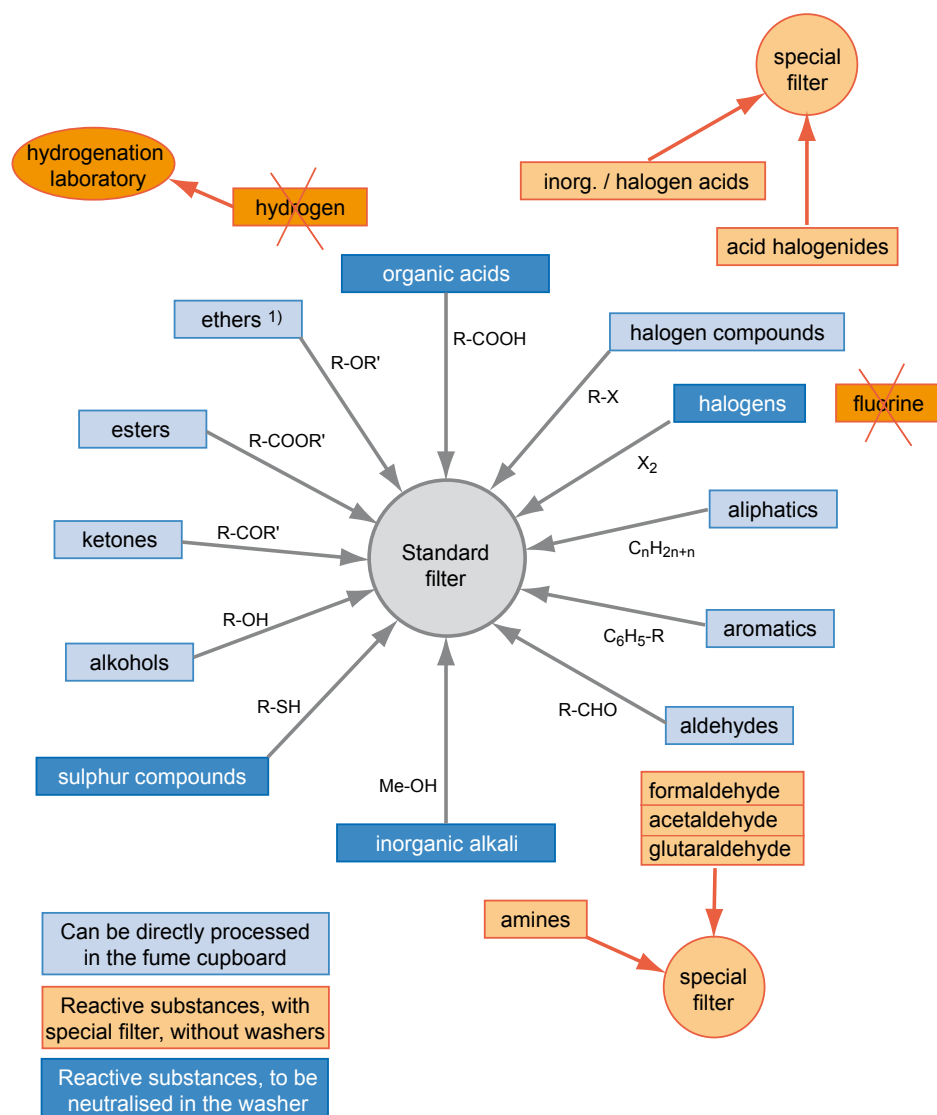


Diag. 11: Workplace for weighing

Filter systems

In the Skanair Workstation contaminants are collected and reduced directly at their source. Table suction ensures that contaminants are forwarded directly to the filters, together with the flow of exhaust air. Different filter systems are available, depending on the application. Particle and adsorption filters can be combined:

- Fine particle filter F5 as preliminary and secondary filter
- Zeolite as a buffer medium in the event of an average
- Activated carbon as adsorbent material for solvents and reagents
- HEPA filters for active substances



1) Due to the low boiling points of dimethyl ether, the capacity of the filters for these is restricted.

Filter combinations

Type	Applications	Filter combinations and flow sequence
1	Normal chemical work with gaseous emissions	<ul style="list-style-type: none"> • standard filter cartridge with preliminary particle filter, buffer adsorbent, activated carbon (total height 215 mm) • secondary particle filter
2	Work with higher requirements towards dust or allergen retention	<ul style="list-style-type: none"> • preliminary particle filter on HEPA filter cartridges (cannot be tested in situ) • low filter cartridge with preliminary particle filter (possibly buffer adsorbent), activated carbon • Secondary particle filter
3	Work with higher requirements towards dust and particle retention, e.g. for active or radioactively marked substances, with low emissions of gaseous substances	<ul style="list-style-type: none"> • preliminary particle filter on HEPA filter cartridges (height 90 mm), fitted with bag-out system for low contamination filter exchange (can be tested by scanning, requires specially installed test probe) → WS-AS • disposable filter cartridge with adsorption filter layer • secondary particle filter • exhaust air HEPA filter as police filter (can be tested integrally for retention)
4	Work with mineral acids and/or reactive gaseous components (e.g. acid chlorides)	<ul style="list-style-type: none"> • use of a gas washer connected to the process for the neutralisation of the reactive gas components (e.g. with soda), before the exhaust air is emitted into the working zone • filter combination as described at 1, or • specially prepared adsorption filter combinations
5	Work in clean zones (e.g. class 100,000 or class 9 in accordance with ISO or zone D for specific stages in manufacturing)	<ul style="list-style-type: none"> • low filter cartridge with preliminary particle filter (possibly buffer adsorbent) and activated carbon (total height: 150 mm) • HEPA filter cartridge height 68 mm (cannot be tested in situ)
6	Weighing (micro and half-micro range)	<ul style="list-style-type: none"> • Type 2 or 3, depending on the category of the substances used
7	Work with reactive strongly smelling substances (e.g. mercaptans)	<ul style="list-style-type: none"> • use of a gas washer connected to the process for the neutralisation of the reactive gas component before the exhaust air is emitted into the working zone • preliminary particle filter • specially prepared adsorption filter combinations • secondary particle filters

Standard filter



Diag. 12: Filter type 1: activated carbon filter cartridges



Diag. 13: Filter type 3: HEPA / activated carbon filter system

Flammability tests and average

In co-operation with Novartis Services AG (fire brigade and laboratory planning) and Primus AG, Skan AG executed various safety investigations in respect of fume cupboards, including flammability tests.

While the fire spread to the laboratory and the exhaust air system within only few minutes with a standards laboratory fume cupboard, the Workstation demonstrated a significantly different behaviour:

- on ignition of 2.5 litres of a hexane-methanol solution and closing of the front panel, the **fire self-extinguished within a minute.**
- on ignition of 4 litres of a hexane-methanol mixture located within a plastic bag on the working surface with the front panel open, the **fire did not spread** until the abort of the test 17 minutes later..

Fire fighting by the laboratory staff



It could also be proven that a fire can be safely and effectively extinguished by laboratory staff by closing the front panel and introducing CO₂ by means of a handheld fire extinguisher.

Object security

For specific requirements, e.g. regular unsupervised work, the Workstation can be fitted with an automatic fire extinguishing system (fire extinguishers with 6 kg CO₂ and automatic release). In the test, the fire could be extinguished within 40 seconds with an open front panel and within only a few seconds when the front panel was closed.



Diag. 14: Keep perforated plate clear and close front panel

-  comprehensive protection, even in the event of accidents
-  self-extinguishing in the event of a fire in the Workstation by closing the front panel during operation

Average

In staged average involving the Workstation, it could be confirmed that the standard filter combination (buffer and adsorption filter) normally has sufficient retention capacity for chemicals which are, e.g. spilt. In so doing, the point of penetration is only reached after approx. 4 hours when a Workstation WS 2000-120 has been contaminated with 3 litres of acetone. The final concentrations in the exhaust air measured in these tests amounted to a hundredth of the lower explosion limit. Therefore, sufficient time is provided to take countermeasures in the event of an accident (the tests were only executed for the purpose of effecting a risk estimate and cannot be extrapolated to all possible occurrences).



Diag. 15: Drain pan underneath the table top with activated carbon cartridges



Diag. 16: Drain pan underneath the table top with HEPA / activated carbon filter system



Diag. 17: Security button to release the fire extinguisher

Diag 18: Integrated fire extinguisher



Fittings and other equipment

Fittings



Diag. 19: Various Nussbaum fittings

Nussbaum fittings that can be used for various media:

- Nitrogen
- Argon
- Factory water
- Vacuum and pressurised air
- Oxygen



Diag. 20 and 21: Laboratory fittings with labelling in accordance with EN 13792

Fine pressure fittings



Diag. 22-24: Various fine pressure regulators

Fine pressure fittings for the following media are available for use in the Workstation:

- Nitrogen
- Argon
- Helium
- Pressurised air
- Carbon dioxide
- Oxygen

These fittings are available for control ranges from:

- 0...2.5 bar,
- 0...6 bar und
- 0...10 bar.

Cooling water controller with double function

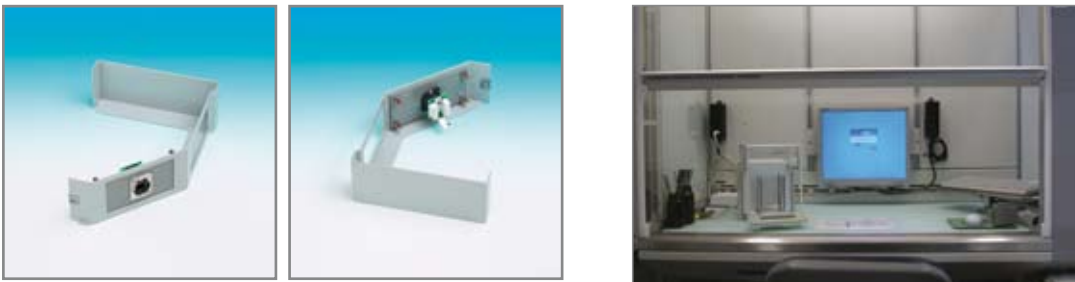
- To turn the cooling water on and off
- To dose the flow of cooling water

Diag. 25: Module for cooling water cycle



Data transmission

Results of analyses can be transmitted to the laboratory data system online.



Diag. 26-28: State-of-the-art working places with direct data link via the media column

Sockets



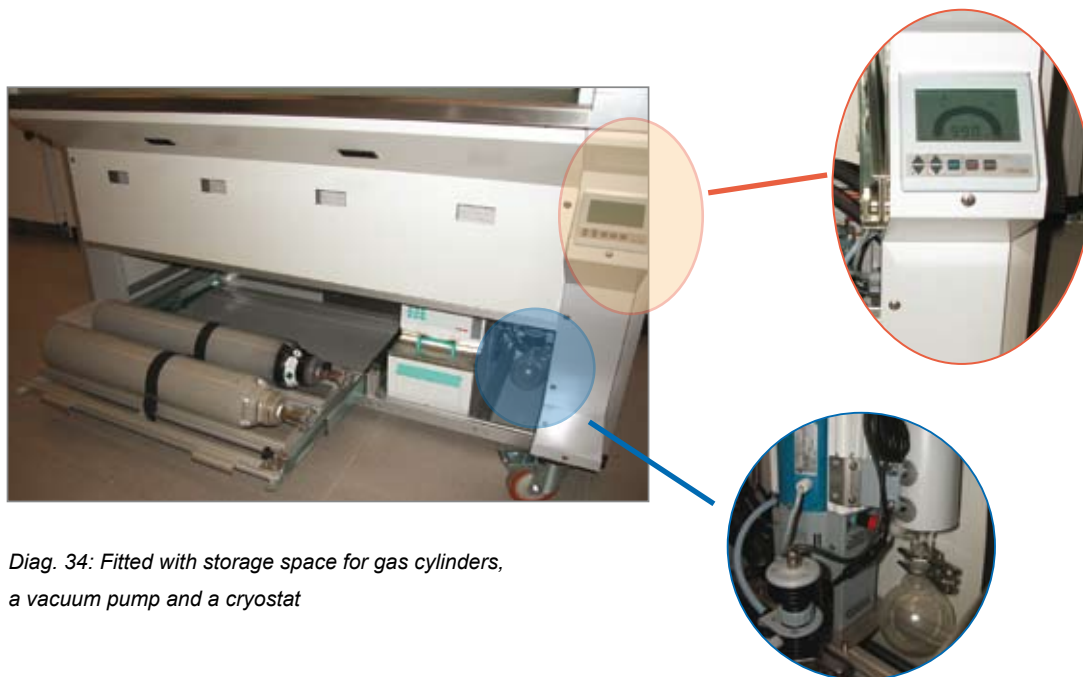
Diag. 29-32: Sockets, installed inside and outside the fume cupboard;
All sockets are centrally switched via button/switch.

Diag. 33: Workstation with various fittings



Storage space and special applications

Storage space is available underneath the filter packages. This storage space can be used in many different ways: apart from the storage of equipment and stands, a special local gas supply, the installation of a cryostat or a vacuum pump have been realised.



Diag. 34: Fitted with storage space for gas cylinders, a vacuum pump and a cryostat

Table tops



Diag. 35: Table top made of VET glass



Diag. 36: Table top made of ceramic, using a horizontal flow cabinet as an example

No diagram: The table top of the Workstation can also be made of stainless steel.

Workstation as weighing station



Diag. 37: Workstation WS-AS as protected weighing station with half-micro and micro scales


In co-operation with Mettler-Toledo it has been clarified to what extent the Workstation is suitable for work with micro and half-micro scales. The results:

- The Workstation or rather the air flow in there does not affect the precision of measurements
- The front panel opening does not have a significant impact on the measuring result
- The requirements in accordance with the measuring uncertainty test according to USP are met
- The Workstation can thus be used in conjunction with micro and half-micro scales
- There is no significant difference of measuring result between the set up in the Workstation and conventional, unventilated weighing stations (statement Mettler-Toledo)



Diag. 38: Workstation cabinet

Certificate of test measurements in accordance with EN 14175, Part 3



Flow Control and Computing Systems GmbH

Test measurements in accordance with EN 14 175, Part 3,
 As per February 2004, in the
Workstation WS-150
 of SKAN AG, 4123 Allschwil, Switzerland
 in the test laboratory of FC²S GmbH, 91083 Baiersdorf,
 from 5 April to 8 April 2004

Test measurements at 200 m³/h and 250 m³/h exhaust air*1
 Room air temperature: 20.2-20.5°C
 Supply air temperature: 20.2-21.2°C

Test of containment in accordance with subsection 5.3

All values provided are average values in ppm
 Result at 200 m³/h exhaust air for the outer grid measurement plane (5.3.6.2 a-d)
 Measuring plane front panel open 500 mm
 Average concentration in ppm from:

60 s – 360 s	361 s – 420 s	421 s – 600 s	601 s – 780 s
< 0.01**	< 0.01**	< 0.01**	< 0.01**

Robustness of containment in accordance with subsection 5.4.5

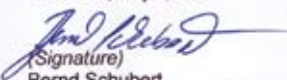
Average concentration in ppm from 60-240 s

Extract volume flow rate in m³/h	200	250
Front sash opening 500 mm		
Measurement 1	0.45	0.50
Measurement 2	0.52	0.34
Measurement 3	0.59	0.49

Test of pressure drop in accordance with subsection 5.6

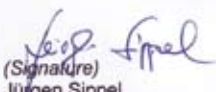
Pressure drop with front sash opening of 500 mm: 11 Pa (200 m³/h)
 Pressure drop with closed front sash: 13 Pa (200 m³/h)

The detailed report FCS/EN/50/2004 was presented to the manufacturer.
 Baiersdorf, May 6, 2004



(Signature)
Bernd Schubert

FC²S GmbH



(Signature)
Jürgen Sippel

FC²S GmbH

Notes

*1 Compared to the standard operational mode of operation of the Workstation, the following changes had to be undertaken for measuring-related reasons:

- Air extracted from the working area through the filters is evacuated to the outside through a separate extract system. Extract volume flow rate was 360 m³/h.
- The direct make-up air through the internal recirculation fan is taken from the test room. This air volume flow rate was 390 m³/h

** Detection limit (2 x sigma of the zero measurement) of the measuring device used was below 0.01 ppm for SF₆



The most important features of the Skanair® Workstation concept

Economical



- reduces the usual fresh and exhaust air volumes by 60%
- correspondingly lower energy costs
- significant cost savings in respect of building infrastructure

Flexible



- flexible set-up in a room
- more fume cupboards with restricted ventilation capacity
- corresponds with the requirements towards the flexibility of laboratory design

Ergonomic



- operating mode can be selected by the user
- eliminates the usual drafts
- supports seated activities
- light, transparent working space

Safe



- passes the air-related tests in accordance with EN 14175
- removes fine particles, aerosols and contaminants in the exhaust air, thus preventing hazardous deposits in the air ducts
- comprehensive containment in the event of average or fire
- filter systems for substances posing a higher working risk

Ecological



- collects contaminants directly at their source
- prevents their uncontrolled spread in the building's exhaust air system
- poses less stress on the environment (fewer contaminants, lower energy requirements)
- renewable filters

By the way: you can operate three Skanair® Workstations with the amount of air you require to operate a single conventional laboratory fume cupboard!