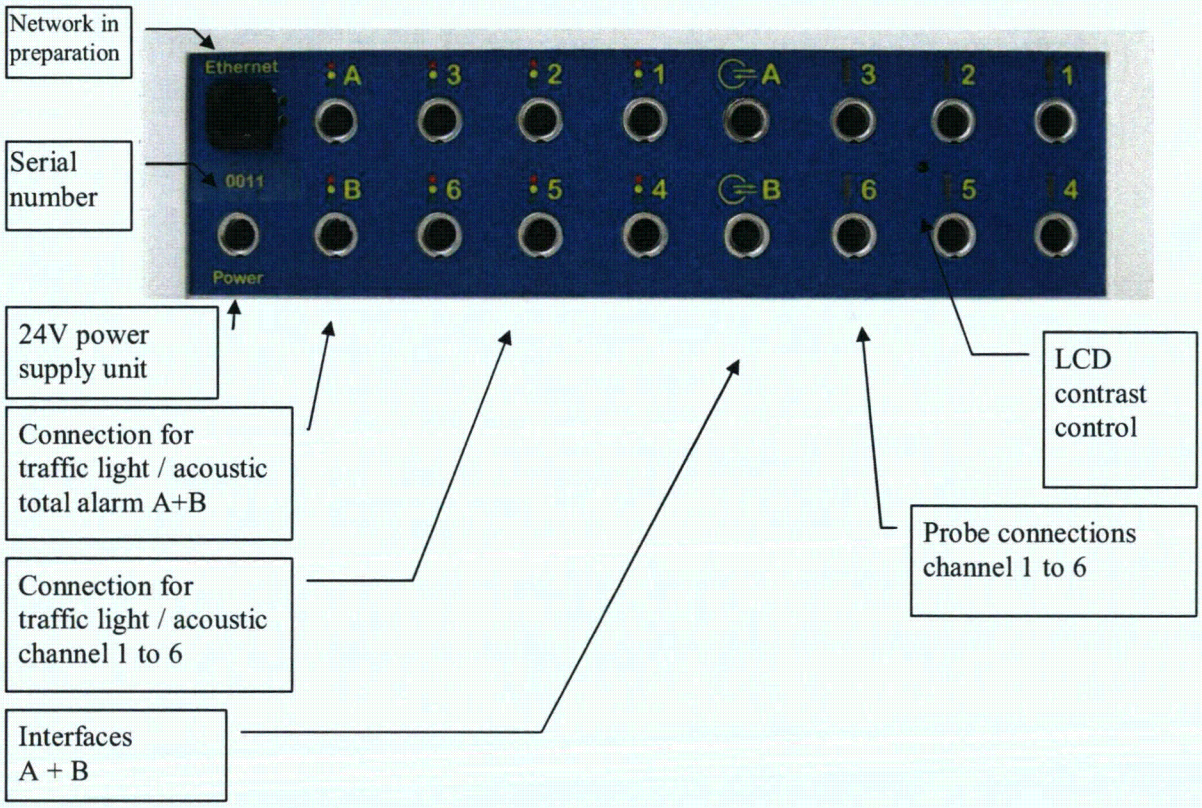
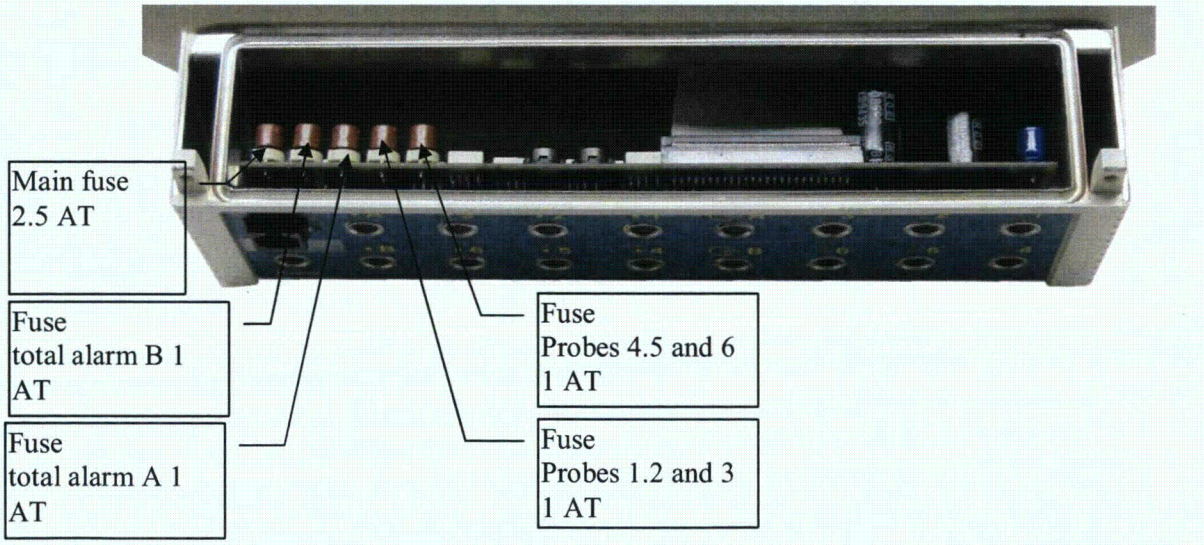
7. Connector Pin Assignment

7.1. Device View



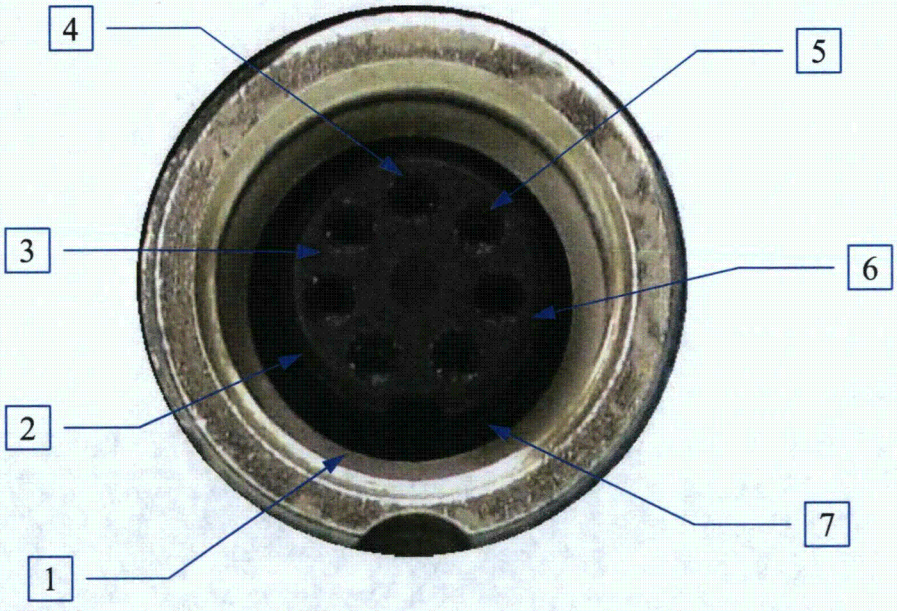
7.2. Fuses



7.3. Connector Pin Assignment Data Transmission A

The interface function (configuration) can be set on the menu (see 4.9.4):

	USB		RS-232		RS-422		RS-485
Pin	**Signal**	**Pin**	**Signal**	**Pin**	**Signal**	**Pin**	**Signal**
1	24 Volt	1	24 Volt	1	24 Volt	1	24 Volt
2	5 Volt - USB	2		2		2	
3		3	RX	3	RX – B	3	
4		4	TX	4	RX – A	4	
5	USB-DM	5		5	TX – B	5	B
6	USB-DP	6		6	TX – A	6	A
7	0 Volt - USB	7	GND	7	GND	7	GND



Socket type: Binder subminiature circular connector
Series 712 09-0427-90-07

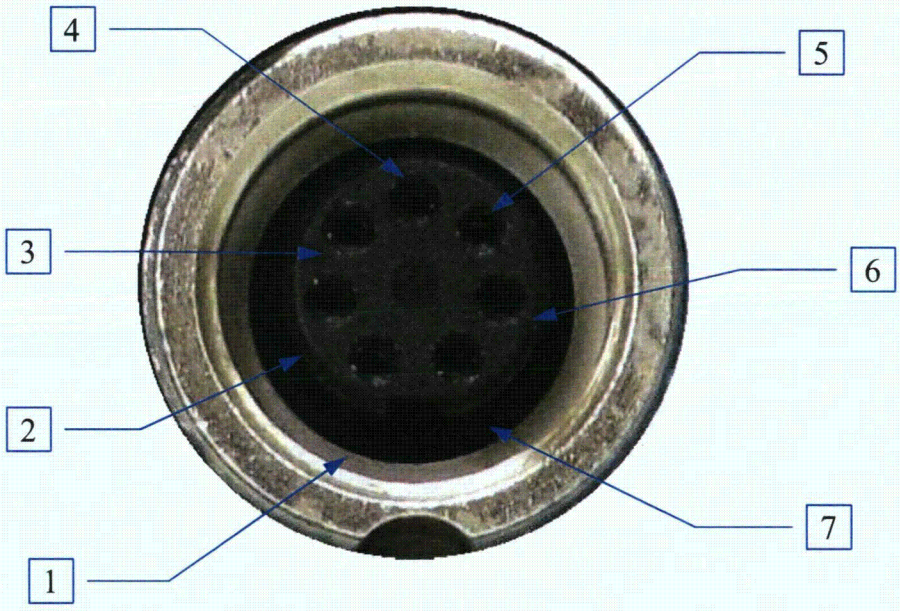
Cable connector: Series 712 coupler connector 99-0426-00-07

Connection cable: Three pair-wound shielded control line AWG 26
2P x AWG 26C

7.4. Connector Pin Assignment Data Transmission B

The interface function (configuration) can be set on the menu (see 4.9.4):

RS-232		RS-422		RS-485	
Pin	**Signal**	**Pin**	**Signal**	**Pin**	**Signal**
1	24 Volt	1	24 Volt	1	24 Volt
2	5 Volt	2	5 Volt	2	5 Volt
3	RX	3	RX – B	3	
4	TX	4	RX – A	4	
5		5	TX – B	5	B
6		6	TX – A	6	A
7	GND	7	GND	7	GND



Socket type: Binder subminiature circular connector
Series 712 09-0427-90-07

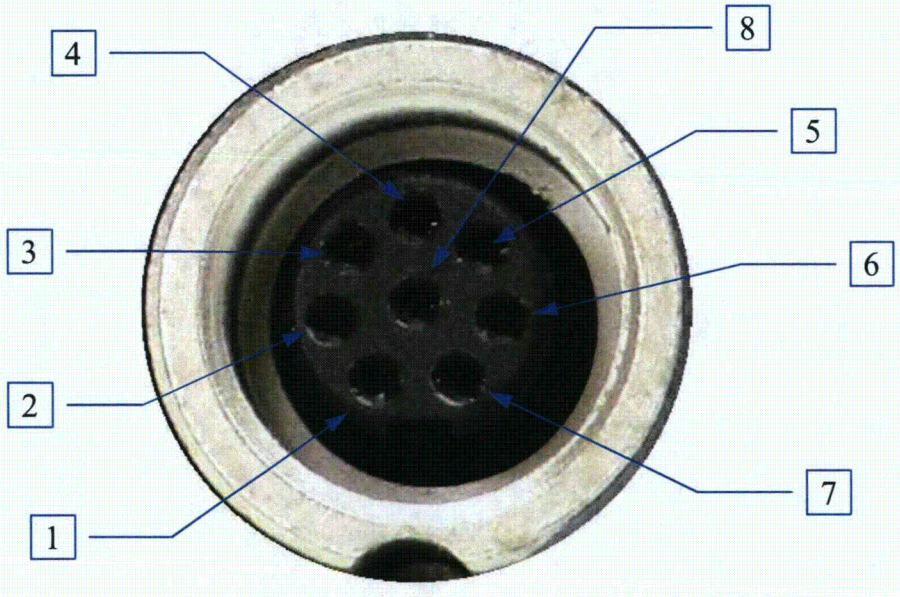
Cable connector: Series 712 coupler connector 99-0426-00-07

Connection cable: Three pair-wound shielded control line AWG 26
2P (3P) x AWG 26C

7.5. Connector Pin Assignment Alarm Output Channel 1 – 6

Pin	Signal	
1	LED light	red
2	LED light	yellow
3	LED light	green
4	LED light	common
5	Traffic light	red
6	Traffic light	yellow
7	Traffic light	green
8	Traffic light	common / GND *

* If the output is switched potential-free on the menu, the common of the relay is on pin 8.
If 24 Volt is switched at the traffic light outputs, then pin 8: 0Volt (ground).



Socket type: Binder subminiature circular connector
Series 712 flange type socket 09-0424-90-08

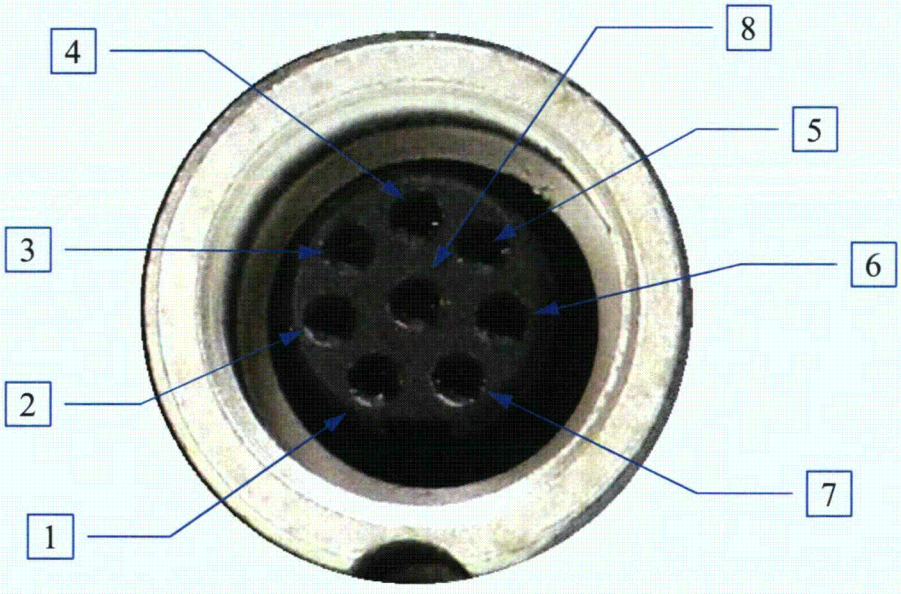
Cable connector: Series 712 coupler connector 99-0421-00-08

Connection cable: LiY 8 x 0.14

7.6. Connector Pin Assignment Total Alarm Channel A and B

Pin	Signal	
1	External quit button	
2	External quit button	
3	External acoustic	
4	Power supply for Acoustic at potential-free	
5	LED traffic light	red
6	LED traffic light	yellow
7	LED traffic light	green
8	Traffic light	common / GND *

* If the output is switched potential-free on the menu, the common of the relay is on pin 8.
If 24 Volt is switched at the traffic light outputs, then pin 8: 0Volt (ground).



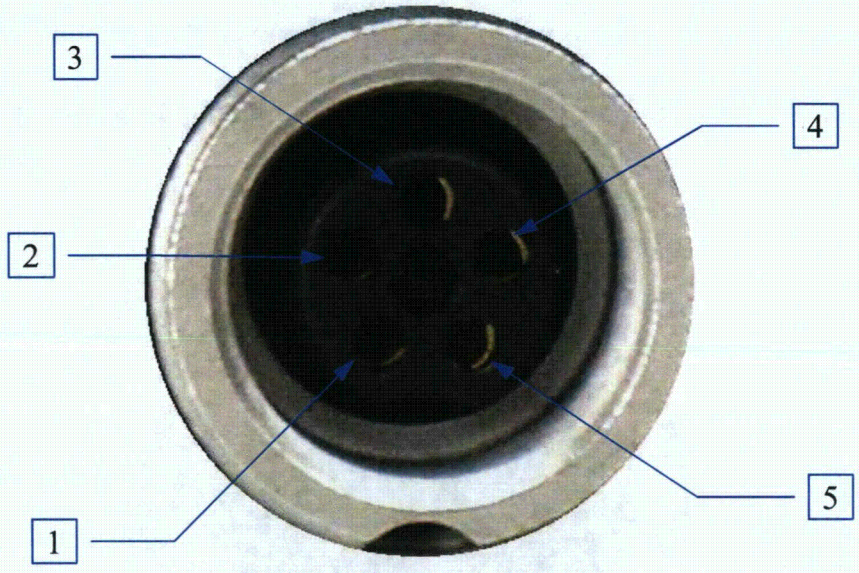
Socket type: Binder subminiature circular connector
Series 712 flange type socket 09-0424-90-08

Cable connector: Series 712 coupler connector 99-0421-00-08

Connection cable: LiY 8 x 0.14

7.7. Connector Pin Assignment Pulse Input

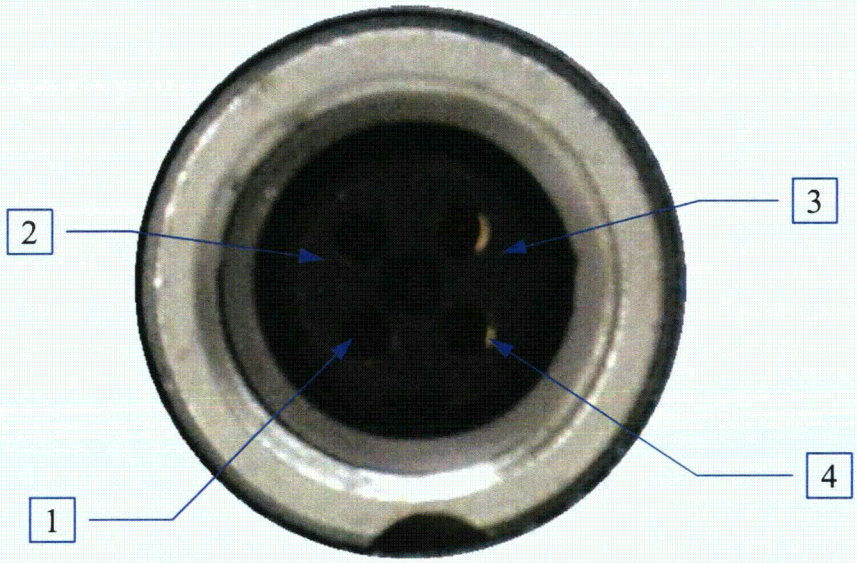
Pin	Signal
1	VCC probe
2	Pulse input
3	Probe identification
4	AD identification
5	GND



Socket type:	Binder subminiature circular connector Series 712 flange type socket 09-0428-90-05
Cable connector:	Series 712 coupler connector 99-0425-00-05
Connection cable:	Special probe cable pulse line shielded

7.8. Connector Pin Assignment Power Supply

Pin	Signal
1	24 Volt
2	24 Volt
3	GND
4	GND



Socket type:	Binder subminiature circular connector Series 712 flange type socket 09-0428-90-04
Cable connector:	Series 712 coupler connector 99-0425-00-04
Connection cable:	Wall power supply 24 Volt = 2.3 A

8. Maintenance

If used correctly, the instrument does not require any particular maintenance. The only maintenance of the ALMO 6 consists of frequent cleaning of all surfaces from dust and other deposits.

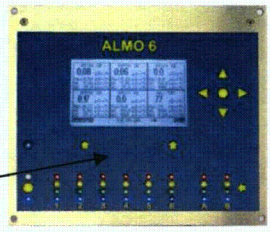
8.1. Accumulator (rechargeable batteries)

In order to check functioning of the rechargeable batteries, monitors with UPS (optional) should be disconnected from the mains once a month for one hour in order to operate with the batteries.
If the rechargeable batteries are unable to last for this time period, they have to be replaced.
In case of (rechargeable) battery operation, a battery symbol is displayed in the lowest line on the display. If the voltage is too low, it is indicated as selected in the menu under 'Error display|Undervoltage' (see 4.9.5). The instrument is turned off automatically if the voltage is too low.
After max. 2 years, the rechargeable batteries (type AA) have to be replaced by new ones.

Attention! Never use non-rechargeable batteries. The monitor can be destroyed by leaking or boiling batteries.

In case of stocking the instrument for a long time, the rechargeable batteries have to be removed in order to avoid total discharge.

9. Accessory



The instrument is integrated in a plastic console housing. A **desktop version** and one for **wall mounting** are available.

As a **build-in version**, the instrument is supplied in a stainless steel housing.

For installation in a laboratory area with **clean room conditions** the electronics and the LCD are integrated in an aluminium die-cast housing.

The desired version has to be specified in the order.

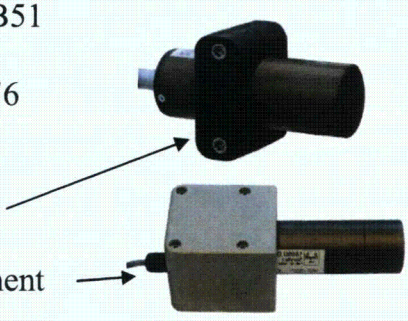
Emergency power supply

A battery pack for stand-alone power supply is integrated in the housing. The rechargeable batteries (included) are charged during mains operation by intelligent charge control. If you would like to get this version, please indicate this in your order.

Detectors

See also chapter 6.2 'Technical Data Probes'.

- Geiger-Müller counter tubes
  - Type 18545 CE measuring range 150 nSv/h - 200 µSv/h
  - Type 18550 CE measuring range 10 µSv/h - 20 mSv/h
  - Type 18509 CE measuring range 50 µSv/h - 1 Sv/h
  - Type 18529 CE measuring range 500 µSv/h - 10 Sv/h
  - Type 18526 D counts during radial radiation approx. 4 cps/µSv/h
- NaI scintillation detector
  - 1 x 1.5" NaI scintillation detector; type 25B38
    Measuring range BG - 200 µSv/h
  - 1.5 x 2" NaI scintillation detector, type 38B51
    Measuring range BG - 100 µSv/h
  - 3 x 3" NaI scintillation detector, type 76B76
    (Measured value display in cps)



- Detector holders:
  - simple wall holder (plastic element)
  - secure wall holder with terminal compartment
- Probe cable; length manufactured according to customer specifications.

Signal tower

The signal tower (Ø 70; IP 54) comes with a maximum of 4 modules.

- Siren element
  Siren element, 105 dB
  optional: Volume adjustable, acknowledgeable

- Signal element LED continuous light
  possible colors: Green
  Yellow
  Red
  Blue
  The maximum number of controllable color modules is three. You can choose any color combinations and the signal elements can be designed as a flashlight.

The signal tower can be mounted using a wall holder or a table stand.

The dimensions vary depending on the configuration.
Example: Signal light with acoustic module, 3 color modules and wall holder
70 x 310 x 100 mm³ (width x height x depth)

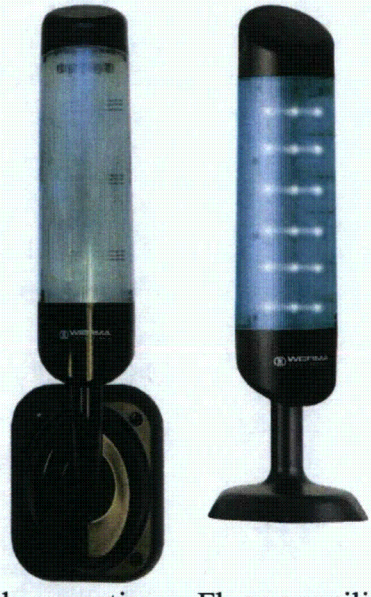
Several signal towers can be operated in parallel.

Signal tower for clean rooms

LED signal tower for use in clean rooms (Fraunhofer IPA approval, IP67/69K) and food applications (EHEDG approval); different colors and additional lighting effects adjustable, with integrated, high output buzzer (85 dB)

- Angle or floor or ceiling mounting on plates/devices possible

- A mounting plate is available for installation on ceilings or walls.



Angle mounting Floor or ceiling mounting

Dimensions example:
Angle mounting with mounting plate
140 x 500 x 140 mm³ (width x height x depth)

Flashlight

The flashlight LED is available with or without sound.

- Flashlight with sound
  Dimensions Ø 90 mm, height 80 mm

- Flashlight without sound
  Dimensions Ø 100 mm, height 80 mm

Cable to connect the alarm units

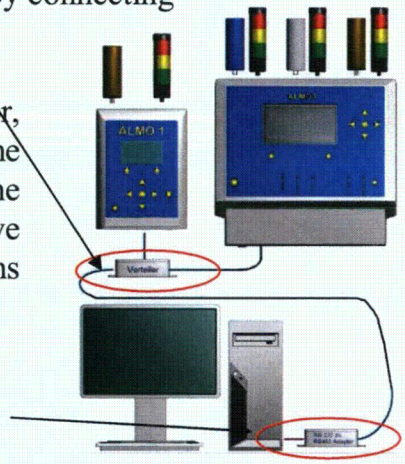
The length of the connection cable for flashlight and signal towers is manufactured according to customer specifications.

Adapter for network solutions

The order, the number of individual devices and the interface types can be mixed as needed. The maximum number of devices (including ALMO 3/6) is 16 and up to 48 probes will be supported.
No adapter is needed to transmit the data via USB and RS-232. However, the maximum length of each RS-232 connection is 10m and that of the USB connection 5m.
The length of the USB connection can be increased by connecting USB repeaters or USB hubs.

- Adapter RS-232 to RS-485 and distributor

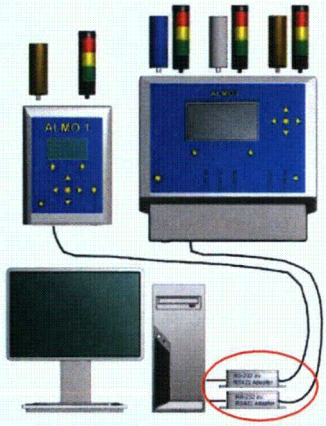
Since each ALMO has only one interface connector, the RS-485 cable must be wired in external cases. The interface is then set to RS-485 (see 4.9.4). The distributor must be in the vicinity of the respective ALMO. The total length of the RS-485 connections should not exceed 500m.



Adapter RS-232 to RS-485

- Adapter RS-232 to RS-422

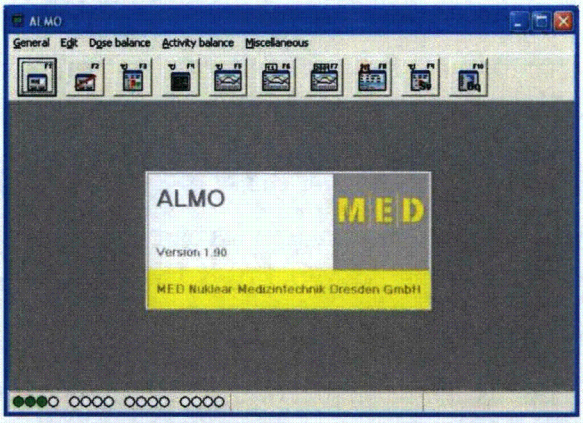
No external adapters are needed when using a multiple RS-422 card in the PC. In this case, the interface is set to RS-422 (see 4.9.4). The length of the RS-422 connections may be 500m each.

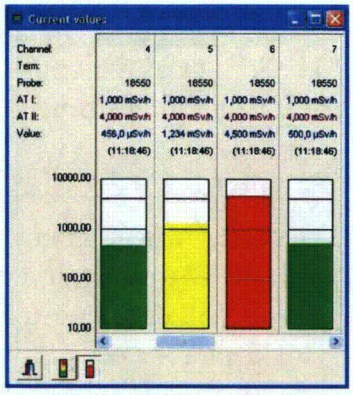


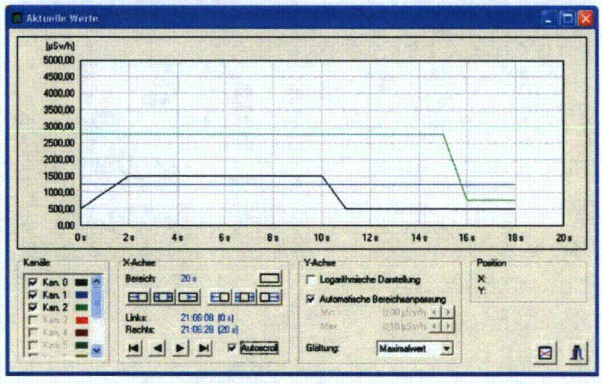
Software

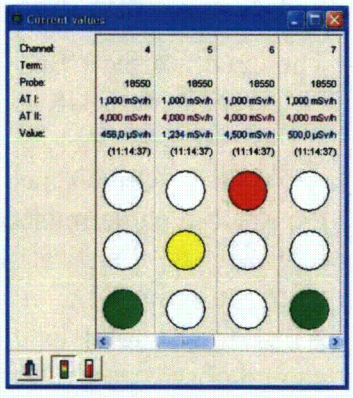
- Software ALMO

Connecting several ALMO systems to one central computer system.
A maximum of 48 detectors can be connected to the ALMO systems. The software processes the data centrally and displays them. The software is used for data storage and threshold monitoring. Software on Windows basis including 5 m connection cable (ALMO-PC system). Optionally, the software can be installed and introduction into the software will be provided.









Additional Display ALMO AD 1

The device ALMO AD 1 can be connected as an addition display to an ALMO 6 or ALMO 3. Several ALMO AD 1 can be connected in series. The measured data are supplied by ALMO 6 or ALMO 3. The alarm thresholds are defined in ALMO 6 or ALMO 3.
The setting for the device configuration and alarm assignment for exceeding of the alarm threshold or malfunctions takes place on the menu level. Visual and acoustic warnings are enabled when alarm thresholds are exceeded or if a malfunction occurs. Measuring electronics and display unit are integrated in a plastic housing. A large LC display is incorporated into the front panel of the housing. The value currently measured by the connected detector is displayed on this LC display.

Additional Probe Display ALMO ZSA

The ALMO ZSA system, in connection with the ALMO 6, allows you to display the local dose rate of up to 6 detectors, for example, Geiger-Müller or NaI detectors. The ALMO ZSA is an additional display unit for the probe measurement values. The ALMO 6 sends the probe data via an interface. Several ALMO ZSA can be operated in connection with the ALMO 6.
Two freely definable alarm thresholds can be defined in the ALMO 6 for each probe. This setting is done on the menu level of the ALMO 6. A visual / acoustic alarm is triggered whenever an alarm threshold is exceeded.
Optionally the device can be equipped with an emergency power supply. Depending on the connected components (LED traffic light), the ALMO ZSA will continue to work for up to 3 hours after power failure.

10. Service/Customer Service

Please call us if you have any questions about the device. We will be happy to assist you.

In case your device is damaged, please return it adequately and safely packed for repair/service to the following address:

MED Nuklear-Medizintechnik Dresden GmbH
Service dept. Dülmen
Ostdamm 139
48249 Dülmen

Phone: +49 (0)2594-9424-35

Fax: +49 (0)2594-9424-45

E-mail: service@nuklear-medizintechnik.de

Homepage: http://www.nuklear-medizintechnik.de

11. EC Declaration of Conformity

This is to certify that the following product:

ALMO6

Stationary dose rate meter with the option to connect 6 probes

complies with the essential protection requirements as defined in the Council Directive on the approximation of the laws of the Member States with regard to electromagnetic compatibility (89/336/EEC).

The following standards were used to assess the product:

- **Electrostatic discharge immunity test**
  Base standard: DIN EN 61000-4-2 (12.2001)
  DIN EN 61326-1; table A.1 (10.2006)

- **Electromagnetic field immunity test**
  Base standard: DIN EN 61000-4-3 (12.2006)
  DIN EN 61326-1; table A.1 (10.2006)

- **Power frequency magnetic field immunity testing**
  Base standard: DIN EN 61000-4-8 (12.2001)
  DIN EN 61326-1; table 2 (10.2006)

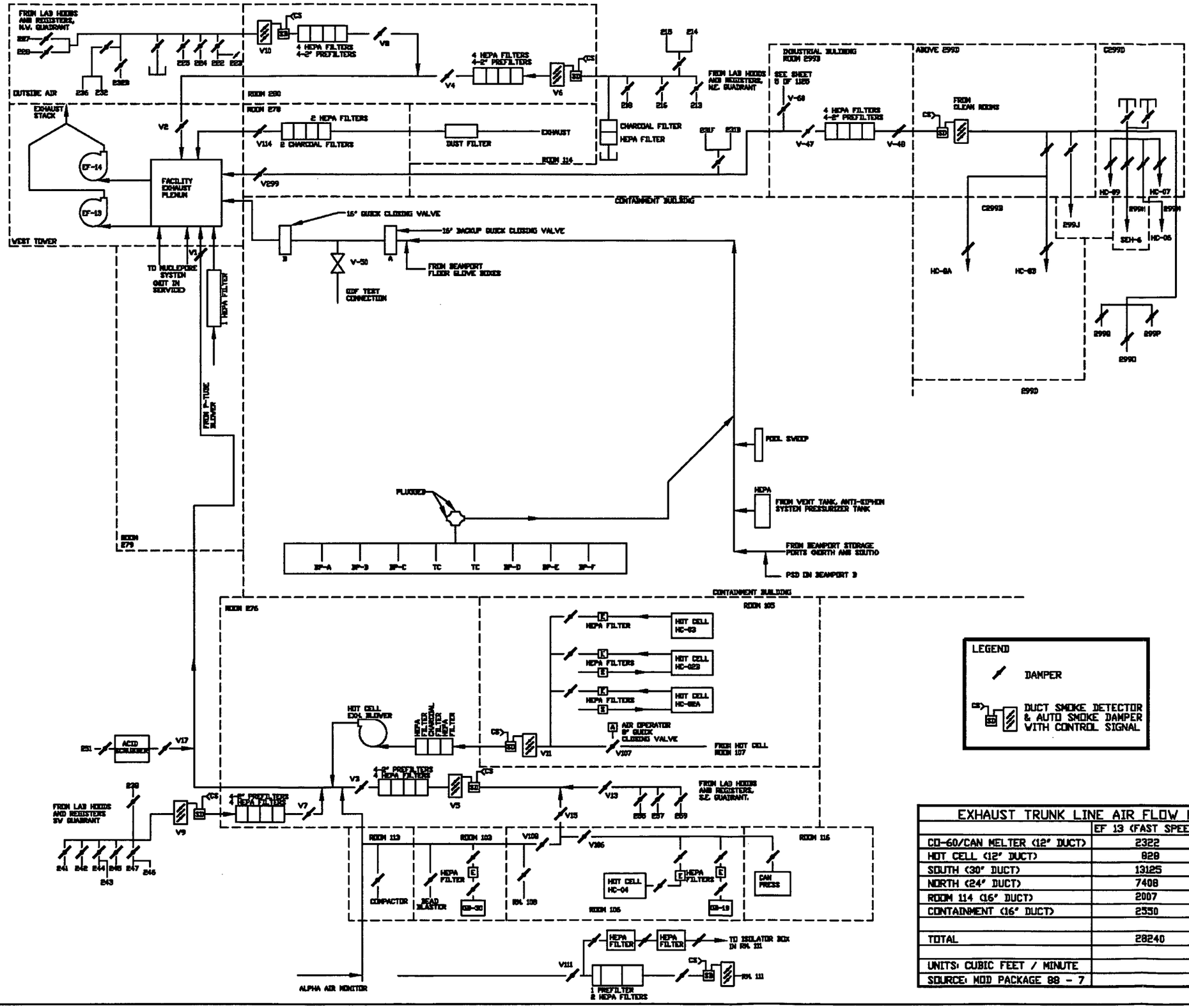
- **Radiated disturbance measurements**
  Base standard: DIN EN 55016-2-3 (08.2007)
  DIN EN 55011 clase B group 1 (11.2007)

This declaration has been submitted by the manufacturer

MED Nuklear-Medizintechnik Dresden GmbH
Dornblüthstrasse 14 a
D 01277 Dresden

Dresden, October 08, 2012

ATTACHMENT 2



NO. REV.	DESCRIPTION	DR. BY	DATE
4	UPDATED IN CAD	JDR	4/22/95
5	UPDATED PER CONTROL RM.	JDR	8/11/97
6	UPDATED PER CONTROL RM.	JCA	11/28/00
7	REMOVED EQUIPMENT	JCA	10/29/01
8	ADDED BP FLOOR GLOVE BOX	JCA	3/3/02
9	REMOVED GLOVE BOXES ADDED HC-166 H.C.	JJL	6/4/02
10	GENERAL UPDATE	JJL	8/19/02
11	ADD INDUSTRIAL BLDG	DN	12/19/02
12	GENERAL UPDATE	BJN	10/29/03
13	ADD SMOKE DETECTORS	DN	10/30/03
14	UPDATE SMOKE DETECTORS	BJN	12/22/03
15	REMOVED AIR SUPPLIES	DN	8/20/04
16	2004 GENERAL REVISION	DN	9/13/04
17	ADDED 246 ICP	CHJ	10/25/04
18	ADDED PSD IN BEAMPORT D	CHJ	12/15/04
19	ADDED VALVE V-50	DN	8/29/09
20	CHANGED # OF TOTAL PAGES	JL	12/16/09
21	REMOVE 227/228 ACID SCRUBBER	DN	1/13/2010
22	RENAMED ACID SCRUB TO 231 & INSTALLED V-17 DAMPER	DN	3/25/2011
23	CAPPED OFF EXISTING 227/228 LINE & MOVED TO NW QUAD DAMPER FOR EACH LAB	JL	9/11/2011
24	TIED ROOMS 218F AND 218B TO FILTER	AP	6/11/2012
25	WP# 12-4052, 12-173, AND 12-4256, AND 299 SUITE	AP	7/23/2012
26	ADDED HC-07 TO EXHAUST LINE IN C299D & MOVED V299D BELOW DAMPER	LR	10/19/2012
27	ADDED HC-07 AND HC-09	LR	6/4/2013
28	WP#12-9763 WP#13-7118 WP#13-7434	LR	8/19/2013
29	WP#13-10782	LR	3/12/2014
30	WAF 13-7639	DGN	5/22/2014
31	ADD DAMPER 299AA, WP#14-6432	DGN	7/17/2014
32	WP#14-9917	LR	10/28/2014
33	WP#15-1403	LR	3/20/2015

LEGEND

DAMPER

DUCT SMOKE DETECTOR & AUTO SMOKE DAMPER WITH CONTROL SIGNAL

EXHAUST TRUNK LINE AIR FLOW MEASUREMENT		
	EF 13 (FAST SPEED)	EF 14 (FAST SPEED)
CO-60/CAN MELTER (12" DUCT)	2322	2304
HOT CELL (12" DUCT)	828	1076
SOUTH (30" DUCT)	13125	13026
NORTH (24" DUCT)	7408	7352
ROOM 114 (16" DUCT)	2007	2209
CONTAINMENT (16" DUCT)	2530	2591
TOTAL	28240	28558
UNITS: CUBIC FEET / MINUTE		
SOURCE: MOD PACKAGE 88 - 7		

end

DATE:

DRAWN BY: JDR

CHECKED BY: ENGINEER

CODE:

REVISION NUMBER:

REVISION DATE:

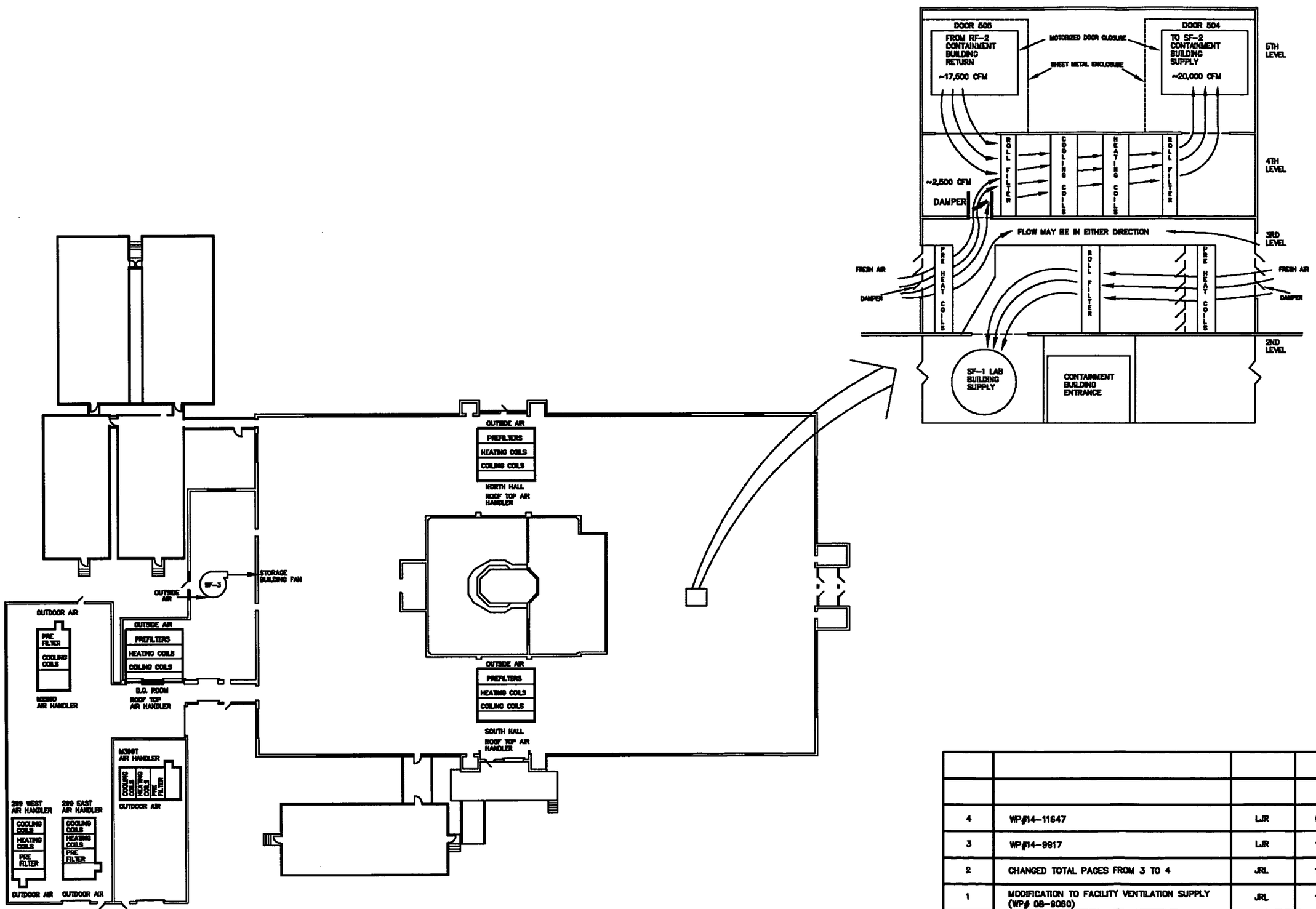
UNIVERSITY OF MISSOURI-COLUMBIA
FACILITIES OPERATIONS
research reactor facility

SCHEMATIC DIAGRAM OF LABORATORY AND CONTAINMENT BUILDINGS VENTILATION SYSTEM

MURR NUMBER: 1125

SHEET 1 OF 5

ATTACHMENT 3



REV NO.	DESCRIPTION	DR. BY	DATE
4	WP#14-11647	LJR	01/26/15
3	WP#14-9817	LJR	10/28/14
2	CHANGED TOTAL PAGES FROM 3 TO 4	JRL	12/16/09
1	MODIFICATION TO FACILITY VENTILATION SUPPLY (WP# 08-2060)	JRL	11/12/09
0	CREATED NEW SHEET FROM EXISTING DRAWING	CHJ	10/25/04

seal

DATE: 9/13/04
DRAWN BY: CHJ
CHECKED BY: ENGINEER: LPF
CODE:
REVISION NUMBER: 1
REVISION DATE: 11/12/09

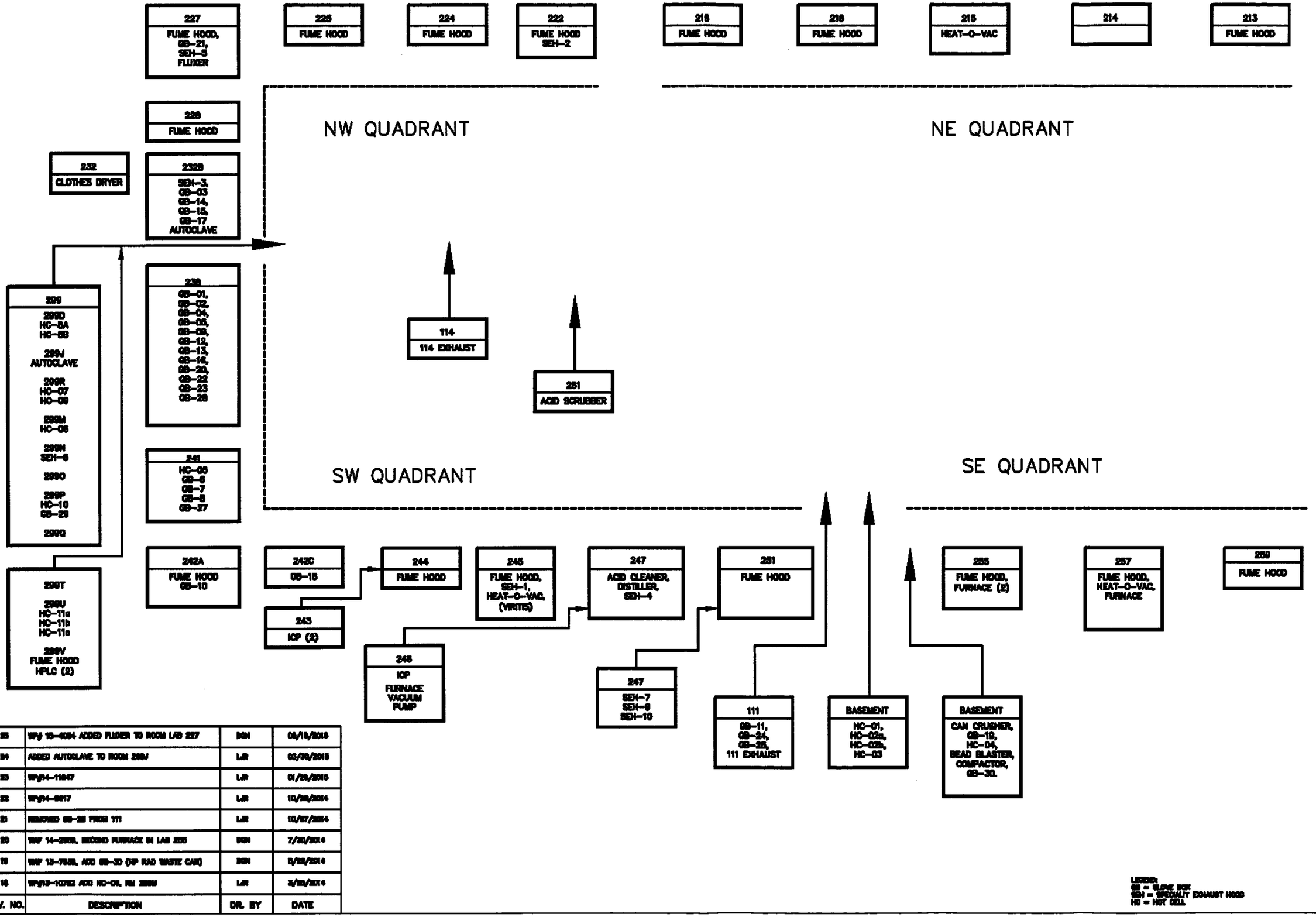
UNIVERSITY OF MISSOURI-COLUMBIA
FACILITIES OPERATIONS
research reactor facility

MURR SUPPLY AIR SCHEMATIC

MURR NUMBER: 1125

SHEET 2 OF 5

ATTACHMENT 4



REV. NO.	DESCRIPTION	DR. BY	DATE
25	WR# 15-4094 ADDED FLUKER TO ROOM LAB 227	DSN	06/15/2015
24	ADDED AUTOCLAVE TO ROOM 299M	LJR	03/30/2015
23	WR#14-11647	LJR	01/29/2015
22	WR#14-9917	LJR	10/28/2014
21	REMOVED GB-28 FROM 111	LJR	10/07/2014
20	WAF 14-2998, SECOND FURNACE IN LAB 255	DSN	7/30/2014
19	WAF 13-7535, ADD GB-30 (HP RAD WASTE CAN)	DSN	5/22/2014
18	WR#13-10761 ADD HC-05, RM 299M	LJR	3/28/2014

LEGEND:
GB = GLOVE BOX
SEH = SPECIALTY EXHAUST HOOD
HC = HOT CELL

DATE: 6/15/04
DRAWN BY: BJH
CHECKED BY: ENGINEER:
CODE:
REVISION NUMBER:
REVISION DATE:

UNIVERSITY OF MISSOURI-COLUMBIA
FACILITIES OPERATIONS
research reactor facility

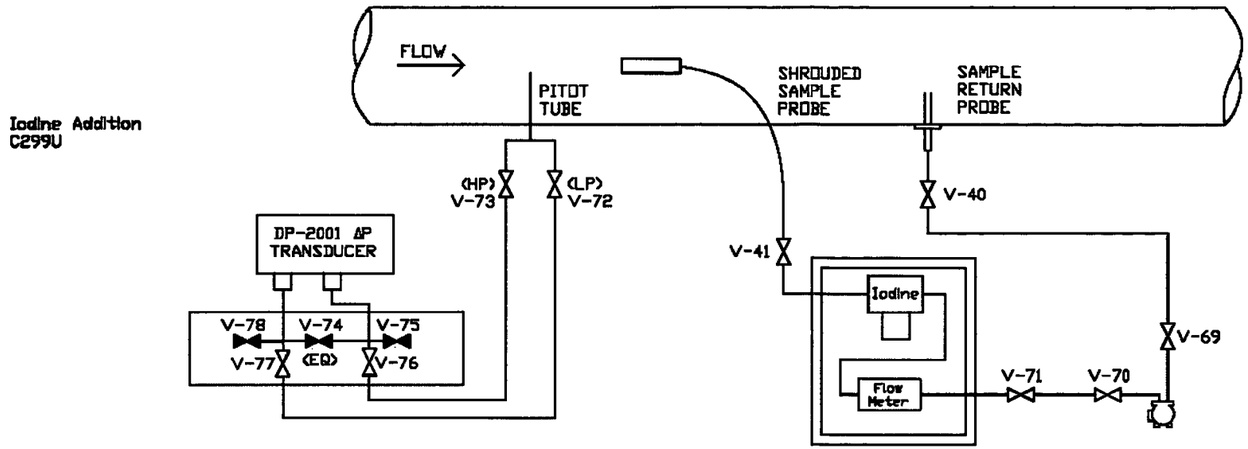
MURR EXHAUST VENTILATION LOADS

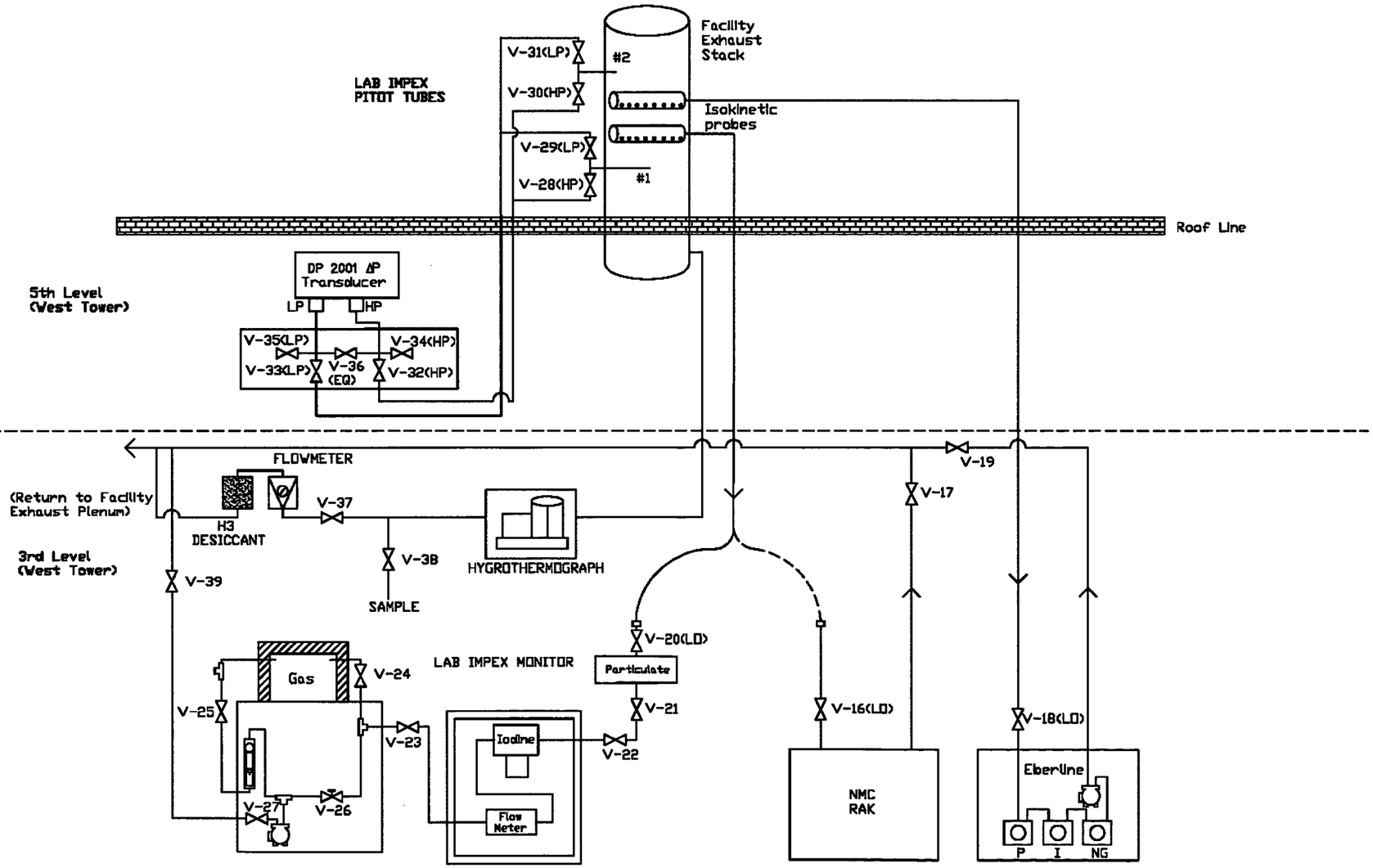
MURR NUMBER: 1125

SHEET 3 of 5

ATTACHMENT 5

REV. NO	DESCRIPTION	DR. BY	DATE
0	ADDED IODINE CONSTITUENT DETECTOR AND SAMPLING SYSTEM	JRL	12-02-93
1	ADDITION OF VALVE V-39 , CHANGED V-38 TO V-38	JH	3-24-2000
2	WR#4-9917	LJE	12-12-2014
3	UPDATED VALVE NUMBERS	LJE	09-09-2015
4	GENERAL REVISIONS	RSH	05-09-2019





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DATED 12/22/2009

DRAWN BY: JH

CHECKED BY: ENGINEER

CODE

REVISION NUMBER

REVISION DATE

UNIVERSITY OF MISSOURI-COLUMBIA
FACILITIES SUPPORT SERVICES
research reactor facility

SCHEMATIC DIAGRAM OF LABORATORY AND CONTAINMENT BUILDINGS VENTILATION SYSTEM STACK MONITORS

WORK NUMBER: 1125

SHEET 4 OF 5

ATTACHMENT 6

V-55 V-54 V-53 HC-11 EF-1
V-52 V-51 V-49 HC-11 EF-2
F.S.
SEE 1125, SHEET 4 OF 5 FOR DETAILS
AIRBORN RADIATION MONITOR
V-68 HEPA V-67
V-41 V-40
V-60
MURR EXHAUST SYSTEM SEE 1125, SHEET 1 OF 5
SHROUDED SAMPLING PROBE
MAG HEPA V-46
V-43 CHAR V-42 * NOTE 1
V-45 CHAR V-44
PT
* NOTE 1
V-58 V-56 CHAR CHAR V-59 V-57
PT MAG CV CV NOTE 2
Rm 299T
Rm 299U
F.S. H/C HEPA CHAR
HC-11A
HC-11B
HC-11C
CHAR CHAR * NOTE 1
HEPA CHAR * NOTE 1
(4) FFU'S
(3) FFU'S
NOTE 2
F.S.
SUPPLY AIR FROM BUILDING HVAC SYSTEM
CV PT (2) FFU'S
Q.C. HOOD
Rm 299V
CV V-65 HEPA MAG
V-62 CHAR V-61 * NOTE 1
V-64 CHAR V-63
PT

LEGEND:

NORMALLY CLOSED	
NORMALLY OPEN	
HEPA FILTER	HEPA
CHARCOAL FILTER	CHAR
HEPA/CHARCOAL FILTER	H/C
CONSTANT VOLUME CONTROL VALVE	CV
CENTRIFICAL FAN	
PRESSURE TRANSMITTER	PT
BACK DRAFT DAMPER	
MAGNEHELIC GAUGE	MAG
METASYS PRESSURE TRANSMITTER	PT
METASYS FLOW STATION	F.S.

NOTES:

1). FILTER BANKS IN PARALLEL CONFIGURATION NORMALLY HAVE ONE SET OF FILTERS ISOLATED.

2). SUCTION FROM HC-11 ENCLOSED MECHANICAL SPACE IN ROOM 399U.

REV. NO.	DESCRIPTION	DR. BY	DATE
7	WP#15-3918	DGN	05/27/15
6	WP#14-12168	LJR	03/20/15
5	WP#14-11647 HPLC EXHAUST LOAD / WP#14-12168 NEW HEPA FILTER IN HC-11 EXHAUST	LJR	01/26/15
4	WP#14-9917	LJR	11/20/14

ssd

DATE: 04/23/14
DRAWN BY: LJR
CHECKED BY: ENGINEER:
CODE:
REVISION NUMBER: 0
REVISION DATE: 04/23/14

UNIVERSITY OF MISSOURI–COLUMBIA
FACILITIES OPERATIONS
research reactor facility

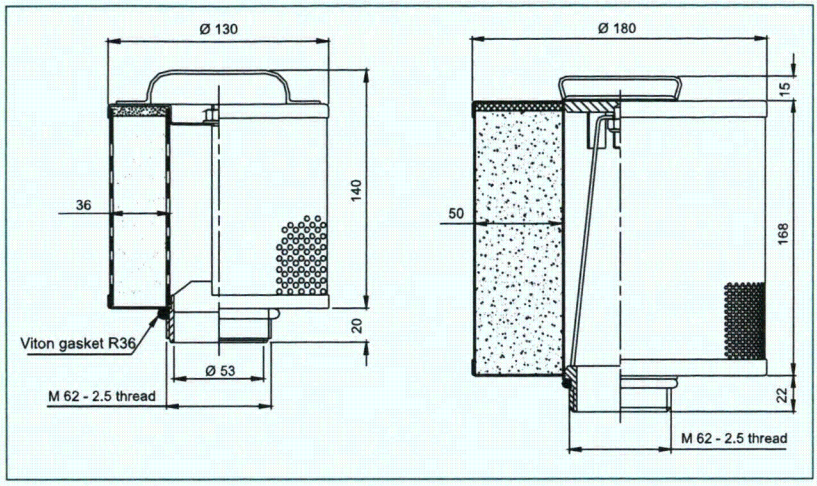
MIB EAST ADDITION EXHAUST SCHEMATIC

MURR NUMBER: 1125

SHEET 5 OF 5

ATTACHMENT 7

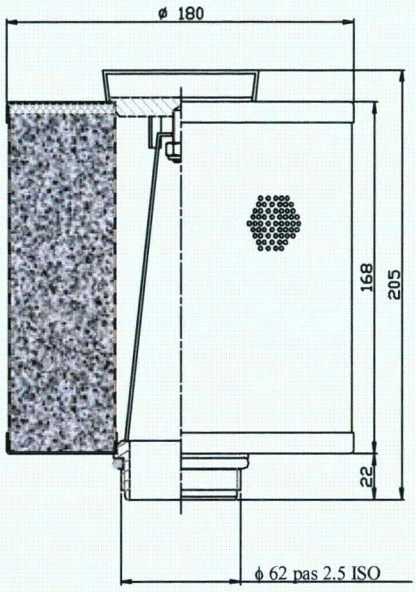
ACTIVATED CARBON FILTERS



Applications: Radioiodines trapping or other toxic gases.
Type: Filters for glove boxes and sealed enclosures.
Media: Activated carbon with specific impregnation depending on type of gas to be trapped.
Carbon bed: Layer thickness 36 or 50 mm depending on model, kept settled by compression mattress eliminating any risk of leak.
Case: Stainless steel sheet metal Z2CN18-10.
Gasket: Viton.
Handle: 1.
Temperature: 80°C maximum in continuous service.
Control: Filter weighing at 100%
Assembly: Filters to be screwed into stainless steel casings.

Reference	Model	Dimensions (ØxH) mm	Carbon volume litres	Gas or vapours to trap	Actived carbon type	Carbon impregnation	Max. Airflow / ΔP (±20%) m³/h / Pa	Thread gasket	Gasket	Unit mass kg	Unit volume m³
3603.30.00	20 m³/h activated carbon filter	130x160	1.1	Radioiodes	CA102-02	KI and TEDA	20 / 200	M62 2.5 thread	Viton R35	1.2	0.003
3603.40.03	50 m³/h activated carbon filter	180x205	3.3	Radioiodes	CA102-02	KI and TEDA	50 / 300	M62 2.5 thread	Viton R35	3.8	0.007
3603.30.02	20 m³/h activated carbon filter	130x160	1.1	Acids (HF, HCl, H2S, SO2...)	CEX002A3	KOH	20 / 130	M62 2.5 thread	Viton R35	1.2	0.003
3603.40.04	50 m³/h activated carbon filte	180x205	3.3	Acids (HF, HCl, H2S, SO2...)	CEX002A3	KOH	50 / 200	M62 2.5 thread	Viton R35	3.8	0.007
3603.30.04	20 m³/h activated carbon filter	130x160	1.1	Organic compounds	LGS048	none	20 / 100	M62 2.5 thread	Viton R35	1.2	0.003
3603.40.06	50 m³/h activated carbon filte	180x205	3.3	Organic compounds	LGS048	none	50 / 150	M62 2.5 thread	Viton R35	3.8	0.007

ADSORPTION	ATTACHMENT 7	Data Sheet		
		Reference	Index	Page
GLOVE BOX FILTER 50 $m^3.h^{-1}$ for iodine trapping		**FP.A.0153**	D	**1/1**



Article number	Carbon volume L	Airflow/Δp $m^3.h^{-1}$/Pa	Mounting	Gasket	Shipping data	
					m^3	kg
3603.40.03	3,3	50/300 40/240 30/180	Thread M62 x 2,5	Viton R35	0,007	3,8

Spécifications :

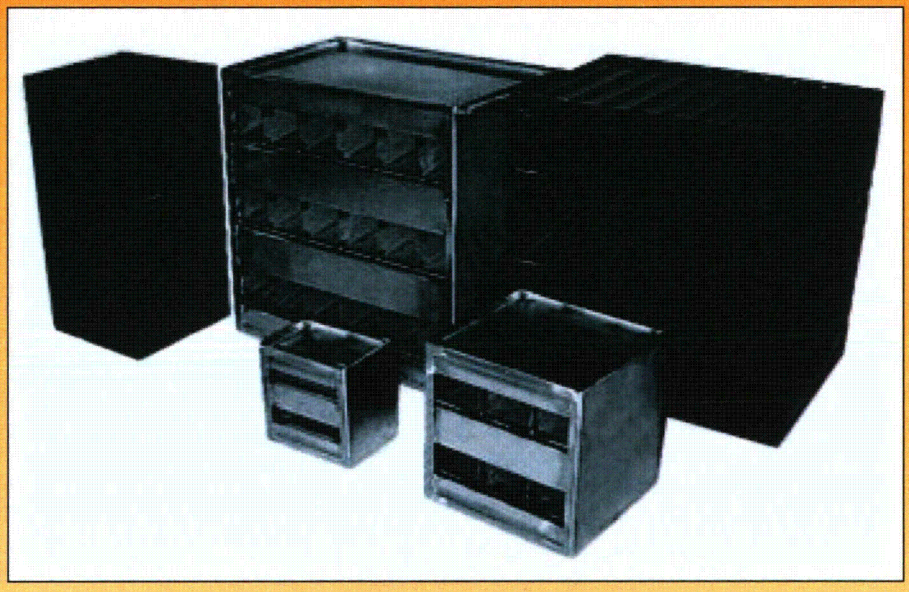
Type :	Filters for glove boxes and isolation chambers with hand.
Media :	KI + TEDA impregnated carbon for iodine trapping.
Grid :	Stainless stell perfored X2CrNi 18-9.
Gasket :	Viton R35.
Temperature :	80°C maximum continuous operation.
Control :	Weighing
Marking :	3 sheets label on the tight plastic bag.
Documentation :	Certification from the IRSN institute with charbon efficiency (Epurating ratio >80% for a relative humidity of 90%)
Applications :	Trapping of radio-iodes in the nuclear industry (molecular iodine and methyl-iodine).

camfil

CAMFIL 77/81 Bd de la République – 92257 LA GARENNE COLOMBES CEDEX France
Tél. 01.46.52.48.00 – Fax : 01.47.60.17.81

Flanders / CSC®

HEGA Filters
PB-2003-1103



HEGA Filters

Disposable, Replaceable or Refillable Adsorbers for the Control of Dangerous Gaseous Contaminants

A Wholly Owned Subsidiary of Flanders Corporation

ATTACHMENT 8

HEGA Filters: *Table of Contents*

HEGA Filters

Important Message

NOTICE . . . Compliance with installation and operation standards must be met to ensure quality performance.

HEGA filters are factory tested to meet the requirements of IES RP-CC-008-84, "Recommended Practice for Gas Phase Adsorber Cells."

HEPA filters are factory tested to meet the requirements of IES RP-CC001.3 for Type A, B, C, D or E filters:

- Industrial Grade
- Nuclear Grade
- Laminar Flow Grade
- Bio/Hazard Grade HEPA
- VLSI
- ULPA

Test results appear on both the filter label and upon the filter carton label. An additional quality assurance test report is kept on file and is available on request.

Flanders/CSC recommends that all HEGA and HEPA filters be tested in place by qualified personnel to ensure that the filters have been correctly installed in the containment housing.

Flanders/CSC service personnel are available for installations, supervision of installation, testing and certification of compliance to industry and government standards and instruction of the owner's personnel in testing and maintenance procedures.

Flanders/CSC does not guarantee that its equipment will operate at the performance levels given on the identification labels or in the catalog specifications under all conditions of installation and use, nor does Flanders/CSC guarantee the suitability of its product for the particular end use which may be contemplated by the buyer.

For best results, it is recommended that the buyer supply complete information about the operating conditions of the ventilation system to Flanders/CSC for evaluation.

When the system components are supplied to the buyer or his agent for final installation and assembly in the field, it should be under the supervision of factory trained personnel.

Failure to adhere to this recommendation or failure of the buyer to have filters timely retested and serviced will nullify or limit any warranties which might otherwise apply and may result in a compromised installation.

ATTACHMENT 8

Flanders / CSC®

Quality Assurance

Any industry that has dangerous process or exhaust gases and/or particulates has a vital concern for the health and safety of personnel. In addition to corporate concern, the United States Government has dictated that safety equipment meet minimum safety standards. Any equipment sold to meet these minimum standards has to be manufactured using accepted Quality Control procedures.

Flanders/CSC Corporation has developed a Quality Assurance program to assure that the product or service provided meets these standards. This program addresses the entire range of Flanders/CSC involvement, including the purchase of raw materials, the shortage of these raw materials, incorporation of these materials into a product or service, testing this product or service, and then shipping it to its destination.

The program of Flanders/CSC has been audited many times, and each time the program has been acceptable. An uncontrolled copy of the program manual is available with each request for Quality Assurance information. Like any dynamic document, the program is continually being revised to include recent issues of standards and specifications in order that Flanders/CSC may use the latest state-of-the-art methods in providing its products and services.

The Quality Assurance Program at Flanders/CSC Corporation has been audited and approved several times by the Nuclear Utilities Procurement and Inspection Committee, NUPIC. This committee was established by nuclear electric utilities to ensure that suppliers of goods and services can meet all applicable regulatory and quality requirements.

Notes:

1 As part of our continuing program to improve the design and quality of all our products, we reserve the right to make such changes without notice or obligation.

2 Flanders/CSC, through its limited warranty, guarantees that the products described herein will meet all specifications agreed to by the buyer and the seller.

3 ASME N509 *Nuclear Power Plant Air-Cleaning Units and Components.*

4 ASME N510 *Testing of Nuclear Air Treatment Systems.*

7013 Hwy 92E - PO Box 3
Bath, NC 27808

HEGA Filters: *Introduction*

What is a HEGA?

To be called a High Efficiency Gas Adsorber (HEGA), the adsorber must exhibit a minimum mechanical efficiency of 99.9% when tested in accordance with the Institute of Environmental Sciences designation: IES-RP-CC-008-84, "Recommended Practice for Gas Phase Adsorber Cell." In addition, the adsorber must be designed, built, filled and packaged in accordance with the intent of this standard. Since HEGA filters are manufactured in several different sizes and of several different materials, this standard is not always followed to the letter. It is the intent of the standard and the resulting performance of these adsorbers that is important. This type of adsorber is not intended to be used in odor control systems. However, if the user needs a very efficient odor control system and can justify the higher initial and operating costs, then this type of adsorber will do an excellent job. The following comparison between an odor control type adsorber vs. a HEGA may help:

An odor control type adsorber compared to a HEGA is like comparing an ASHRAE type particulate filter to a HEPA. The odor control type adsorber (like the ASHRAE type particulate filter) has a low efficiency, low pressure drop and low cost. On the other hand, the HEGA (like the HEPA) has a higher efficiency, higher pressure drop and higher cost. Both adsorbers have their place in industry, but because of these major differences they are not usually interchangeable.

Where are HEGA's Used?

HEGA's are most often used in "containment" air filtration systems. Containment air filtration systems are very high efficiency systems, used to filter and contain dangerous particulate and/or gaseous contaminants. Containment systems are most often designed to treat exhaust air from contaminated spaces, but occasionally are used in supply and recirculated air systems. Examples of facilities using these systems are:

- **Nuclear Power Plants**
- **Cancer Research Laboratories**
- **Toxicology Laboratories**
- **Animal Disease Research Facilities**
- **Chemical Agent Research Facilities**
- **Bomb Shelters (CBR)**
- **Radiopharmaceutical Plants**
- **HVAC Systems**
- **Laboratories Using Chemical Carcinogens**
- **Chemical Agent Munitions Disposal Facilities**
- **Hospital Isolation Suites**
- **Pharmacological Facilities**
- **Chemical Process Facilities**
- **Military Facilities**
- **Biological Research Facilities**
- **Department of Energy Facilities**

How Does a HEGA Work?

A High Efficiency Gas Adsorber (HEGA) filters gaseous contaminants from an airstream by adsorbing the contaminants (See Page 19, "Types of Adsorption"). With a properly designed system that includes proper adsorber selection, adsorbent and resident time, any adsorbable contaminant can be filtered and contained. (See Page 6 for "Adsorber Design and Performance." Page 20, "Residence Time").

HEGA Selection

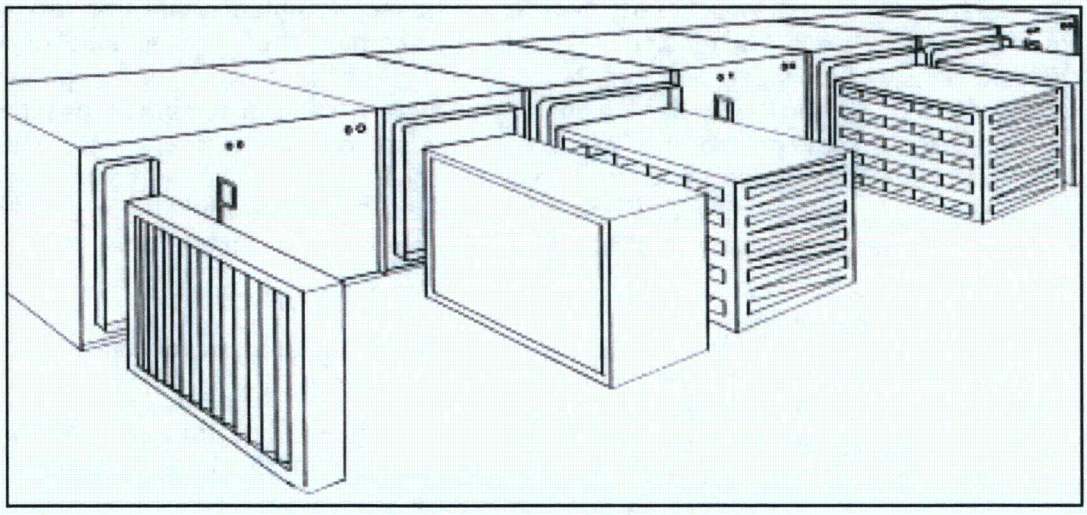
When designing a system requiring HEGAs, consider:

1. Type: "Cinersorb" (p. 13), Type IV (V-Bed) (p. 7), or Type II Tray? (p. 17)
2. Type of carbon needed? (p. 6 & 7)
3. Residence Time: (See pp. 6 & 20)
4. Need for sample canisters? (See p. 19)

Design Considerations

The following should be considered when designing a filtration system:

1. Any system that filters dangerous contaminants should incorporate bag-in/ bag-out housings to contain the contaminated filters and protect maintenance personnel during filter change-out.
2. Particulate filtration must be provided upstream of HEGA filters to prevent the adsorber from trapping particulates and thereby increasing the adsorber's pressure drop.
3. Some applications require high efficiency or HEPA filters located downstream of the adsorber to collect any fines (dust which might be contaminated) released from the adsorbent material and to act as a backup in case the first particulate filter should fail.
4. Filter trains can be easily constructed with any combination of roughing filters, high efficiency filters, HEPA filters and adsorbers (See illustration below).
5. An in-place test of both adsorbers and HEPA filters is recommended for nuclear containment systems and is becoming a more frequent requirement for many critical applications. The purpose of this in-place testing is to "validate" the installed system. The in-place test, if required, should be discussed with a Flanders/CSC factory representative prior to the selection of equipment so the system will be correctly designed to facilitate the test. In-place test equipment and service personnel are available from Flanders/ CSC to assist in the original installation and testing.
6. The filtration system should be manufactured under a good quality assurance program such as one that addresses all of the basic requirements of ASME NQA-1, "Quality Assurance Program Requirements for Nuclear Facilities."



V-Bed Adsorber Applications

From left to right: prefilter, upstream in-place test section, HEPA filter, V-bed adsorber, in-place combination test section, V-bed adsorber, HEPA filter, downstream in-place test section.

HEGA Filters: *V-Bed Adsorbers*

Carbon Adsorbers

Carbon adsorbers use activated or impregnated /activated carbon as a filtering medium to remove gaseous emissions from nuclear, biological and/or chemical process exhaust air. Due to the potentially hazardous nature of their end use, the customer should consult with Flanders/CSC technical representatives as early as possible during the design phase of a project to assure proper specifications for the adsorbers and the filtration system. Flanders/CSC personnel have many years experience with gas-phase and HEPA filtration systems and can provide assistance in adsorbent selection, residence time calculations, and system configuration.

All units are manufactured in accordance with Flanders/CSC's quality assurance program, which meets the requirements of ASME-NQA-1, "Quality Assurance Program Requirements for Nuclear Facilities." Flanders/CSC tests each adsorber to insure a minimum mechanical efficiency (the percentage of air that actually contacts the activated carbon in a system without penetrating voids or cracks) of 99.9% per IES-RP-CC-008-84, "Recommended Practice for Gas-Phase Adsorber Cells." This test of the adsorber's efficiency on test agents is used to determine if the adsorber is properly manufactured and filled, but not whether it is suitable for a given application.

Residence Time

Under actual operating conditions, the removal efficiency (the percentage of containment actually removed by the activated carbon during operation) of an adsorber is determined by the type and amount of contaminant in the gas stream, the type and amount of adsorbent, and the residence time (the time that the gas stream is in contact with the carbon). In most applications, a residence time of 0.125 second is sufficient. In other cases, residence time is a critical factor that must be calculated for the specific contaminant. (See p. 20.)

Applications

Type IV (V-Bed) adsorbers are designed for use in Flanders/CSC BF-Series and BG-Series bag-in/bag-out housings for KF-Series and KG-Series high efficiency side-service housings. Occasionally they are used in large "front and rear loading" built-up banks inside walk-in plenums, but the Type II Tray adsorber is usually best suited for that system design.

Adsorber Design and Performance

All units are made with beds of carbon mounted in a "V" configuration at various depths and residence times at rated airflow depending upon customer requirements. Various grades of carbon are available to meet specific removal requirements:

Designation A = Activated 8 x 16 mesh carbon is used to adsorb heavy solvents, elemental iodine and most odors. This carbon is specified as follows:

The activated carbon shall be coconut shell base, 8 x 16 mesh and shall have a minimum carbon tetrachloride activity of 60% when tested in accordance with ASTM D3467. The carbon shall meet the "base" carbon requirements for nuclear grade carbon.

Designation N = Nuclear grade 8 x 16 mesh carbon is specially impregnated activated carbon used to adsorb organic radioiodides. This carbon is specified as follows:

*The nuclear grade carbon shall be coconut shell base, 8 x 16 mesh that meets the requirements of *ASME N509-1996 "Reaffirmed," Section 5.2.*

Designation W = Whetlerized 12 x 30 mesh carbon is specially impregnated activated carbon used to adsorb toxic warfare gases. This carbon is specified as follows:

The activated carbon shall be specially impregnated coal base that meets the requirements of Military Standard MIL-C-0013724D.

Designation T = ASZM-TEDA (Cooperite) 12 x 30 mesh carbon used to adsorb toxic warfare gases. Performs similar to Whetlerite. Impregnants do not include chromium.

The activated carbon shall be specially impregnated coal base that meets the requirements of EA-DTL-1704A.

Other media available to meet design requirements.

Note: Carbon adsorbers can be "poisoned" by paint fumes and other gases commonly found in many facilities and must be carefully protected when stored. The customer should consult the factory representative regarding storage precautions.

DMMP - Qualified Adsorbers

Flanders/CSC model numbers

- AF-GG16-62-WSD
- AF-GG16-62-TSD
- AG-GG16-62-WSD
- AG-GG16-62-TSD

have been tested and certified for DMMP Qualification at the U.S. Army Armament Munitions and Chemical Command, Aberdeen Proving Grounds.

Adsorber Housings

V-Bed carbon adsorbers are manufactured in standard sizes for use in bag-in/bag-out and side-load housings, and are available in both gel seal and gasket seal designs. Flanders/CSC manufactures a complete line of housings for adsorbers and HEPA filters. Contact the factory or your Flanders/CSC representative for complete information on adsorbers and HEPA filter housings.

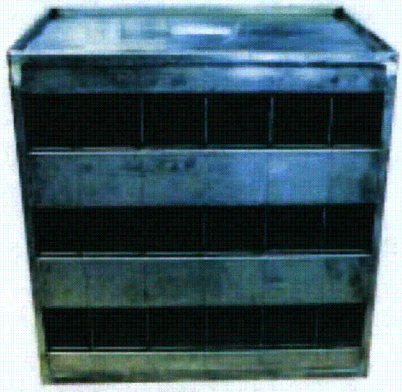
Type IV (V-Bed) Stainless Steel Frame Adsorbers

Description

The Flanders/CSC Type IV (V-Bed) adsorber is designed with either 1-inch, 1 $^{3}/_{8}$-inch or 2-inch thick beds arranged in a V-Bank configuration. This design allows a high airflow at a relatively low pressure drop. Adsorber frames are constructed of T-304 stainless steel with T-304 stainless steel perforated screens.

These adsorbers are designed for use in Flanders/CSC G-Series, BF-Series and BG-Series bag-in/bag-out housings, KF-Series and KG-Series efficiency side-serving housings.

These adsorbers are manufactured under stringent quality control procedures. Each adsorber is filled, tested and packaged in accordance with IES Designation: RP-8 (IES-RP-CC-008, "Recommended Practice for Gas Phase Adsorber Cells"). Before shipping, each adsorber is tested in accordance with this standard to assure a minimum mechanical efficiency of 99.9%.



Type IV Stainless Steel Frame Adsorber

Features

- Minimum mechanical efficiency of 99.9% when tested in accordance with IES Designation: RP-8 (IES-RP-CC-008, "Recommended Practices for Gas-Phase Adsorber Cells"). Higher efficiencies available when required.

HEGA Filters: *Suggested Specifications Type IV Stainless Steel Adsorbers*

- Designed, manufactured and tested under a Quality Assurance Program that meets the basic requirements of ASME NQA-1, "Quality Assurance Program Requirements for Nuclear Facilities."
- Available in several standard sizes allowing use in standard filter housings.
- Corrosion resistant.
- Can be filled with appropriate adsorbent to capture any adsorbable contaminant.
- Many applications: Treat exhaust air from safety cabinets, glove boxes and fume hoods, supply air to inhalation labs, etc.

Suggested Specifications Type IV Stainless Steel Adsorbers

From the tables on Pages 9 - 11, fill in the blanks for adsorber requirements.

Adsorber shall be Flanders/CSC model number____. Adsorber frame shall be constructed of 14-gauge T-304 stainless steel and have_____beds that are_____deep, arranged in a V-bank configuration. The filter frame shall be size:_____" high x_____" wide x _____" deep, and have a _____(gel/gasket) seal on one side. The rated flow shall be _____CFM at approximately _____" w.g. pressure drop and _____second residence time. Adsorber screens shall be perforated 26 gauge T-304 stainless steel supported by external spacers to prevent distortion during filling with carbon. Adsorber shall exhibit a minimum mechanical efficiency of 99.9% when tested in accordance with IES-RP-CC-008-84, "Recommended Practice for Gas-Phase Adsorber Cells." Units shall be designed, manufactured, and tested under a Quality Assurance Program that meets the requirements of ASME NQA-1, "Quality Assurance Program Requirements for Nuclear Facilities."

Ordering Information: *Type IV (V-Bed) Stainless Steel Adsorber*

Model Number Breakdown *(Example)*

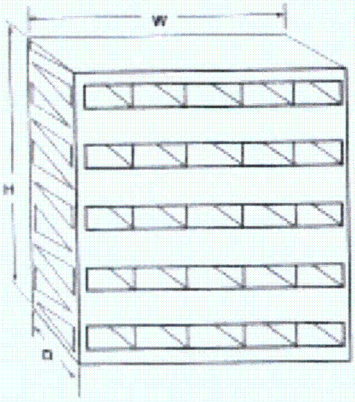
AG - GG16 - 62 - WSD

Adsorber

G= Gasket Seal
F= Gel Seal

Adsorber Size (Nominal)

	High	Wide	Deep
CC6	= 12"	x 12"	x 5 7/8"
CC12	= 12"	x 12"	x 11 1/2"
CG12	= 12"	x 24"	x 11 1/2"
CG16	= 12"	x 24"	x 16"
GC16	= 24"	x 12"	x 16"
GC12	= 24"	x 12"	x 11 1/2"
GG12	= 24"	x 24"	x 11 1/2"
GG16	= 24"	x 24"	x 16"
GG18	= 24"	x 24"	x 18"



DMMP Qualified
(Leave blank if not required)

Frame Material
S=Stainless Steel

Adsorbent Material
A = Activated Carbon (8 x 16 Mesh)
N = Nuclear Grade Carbon (8 x 16 Mesh)
W = Whetlerized Carbon (12 x 30 Mesh)
T = ASZM-TEDA Carbon (12 x 30 Mesh)

Bed Thickness
1 = 1" Bed Thickness
1 3/8 = 1 3/8" Bed Thickness
2 = 2" Bed Thickness

Number of Beds Per Cell
3 = 3 Beds per Cell
4 = 4 Beds per Cell
8 = 8 Beds per Cell
10 = 10 Beds per Cell

Notes:

1. In the charts on the following pages, pressure drop and weight will vary slightly due to variations in carbon particle size distribution and packing density.
2. Not all model number combinations above are available.

ATTACHMENT 8

HEGA Filters: *Ordering Information*

Ordering Information: *Type IV (V-Bed) Stainless Steel Adsorber*

Note: ΔP may vary by +/- 20% due to physical characteristics of the carton. These variations must be considered when sizing fans.

Full Size Gel Seal Adsorbers

Model Number	Size H x W x D w/ Gel Seal Channel (inches)	Rated Flow (CFM)	Approx. ΔP (In. W.G.)	Res. Time (sec.)	No. of Beds	Bed Depth (inches)	Max. Temp.	Approx. Carbon Net Wt. (lbs.)	Approx. Ship Wt. (lbs.)
AF-GC12-101-AS	24x12x12 1/4	500	0.90	0.083	10	1	200°F	29	92
AF-GC12-101-NS	24x12x12 1/4	500	0.90	0.083	10	1	200°F	32	95
AF-GC12-101-WS	24x12x12 1/4	500	2.00	0.083	10	1	200°F	35	98
AF-GC12-101-TS	24x12x12 1/4	500	2.00	0.083	10	1	200°F	35	98
AF-GG12-101-AS	24x24x12 1/4	1000	0.90	0.083	10	1	200°F	58	153
AF-GG12-101-NS	24x24x12 1/4	1000	0.90	0.083	10	1	200°F	64	159
AF-GG12-101-WS	24x24x12 1/4	1000	2.00	0.083	10	1	200°F	70	165
AF-GG12-101-TS	24x24x12 1/4	1000	2.00	0.083	10	1	200°F	70	165
AF-GG16-81 3/8-AS	24x24x16 3/4	1000	0.85	0.125	8	1 3/8	200°F	75	210
AF-GG16-81 3/8-NS	24x24x16 3/4	1000	0.85	0.125	8	1 3/8	200°F	80	215
AF-GG16-81 3/8-WS	24x24x16 3/4	1000	2.10	0.125	8	1 3/8	200°F	90	225
AF-GG16-81 3/8-TS	24x24x16 3/4	1000	2.10	0.125	8	1 3/8	200°F	90	225
AF-GG12-62-AS	24x24x12 1/4	700	1.75	0.125	6	2	200°F	59	162
AF-GG12-62-NS	24x24x12 1/4	700	1.75	0.125	6	2	200°F	62	165
AF-GG12-62-WS	24x24x12 1/4	700	3.90	0.125	6	2	200°F	70	173
AF-GG12-62-TS	24x24x12 1/4	700	3.90	0.125	6	2	200°F	70	173
AF-GG16-62-AS	24x24x16 3/4	1000	1.75	0.125	6	2	200°F	79	205
AF-GG16-62-NS	24x24x16 3/4	1000	1.75	0.125	6	2	200°F	86	212
AF-GG16-62-WS	24x24x16 3/4	1000	3.90	0.125	6	2	200°F	98	224
AF-GG16-62-WSD	24x24x16 3/4	1000	3.90	0.125	6	2	200°F	100	226
AF-GG16-62-TS	24x24x16 3/4	1000	3.90	0.125	6	2	200°F	98	224
AF-GG16-62-TSD	24x24x16 3/4	1000	3.90	0.125	6	2	200°F	100	226
AF-GG18-62-AS	24x24x18 3/4	1250	1.75	0.125	6	2	200°F	90	225
AF-GG18-62-NS	24x24x18 3/4	1250	1.75	0.125	6	2	200°F	96	231
AF-GG18-62-WS	24x24x18 3/4	1250	4.10	0.125	6	2	200°F	105	240
AF-GG18-62-TS	24x24x18 3/4	1250	4.10	0.125	6	2	200°F	105	240

ATTACHMENT 8

HEGA Filters: *Ordering Information*

Ordering Information: *Type IV (V-Bed) Stainless Steel Adsorber*

Note: ΔP may vary by +/- 20% due to physical characteristics of the carton. These variations must be considered when sizing fans.

Full Size Gasket Seal Adsorbers

Model Number	Size H x W x D (inches)	Rated Flow (CFM)	Approx. ΔP (In. W.G.)	Res. Time (sec.)	No. of Beds	Bed Depth (inches)	Max. Temp.	Approx. Carbon Net Wt. (lbs.)	Approx. Ship Wt. (lbs.)
AG-GC12-101-AS	24x12x11 1/2	500	0.90	0.083	10	1	200°F	29	89
AG-GC12-101-NS	24x12x11 1/2	500	0.90	0.083	10	1	200°F	32	92
AG-GC12-101-WS	24x12x11 1/2	500	2.00	0.083	10	1	200°F	35	95
AG-GC12-101-TS	24x12x11 1/2	500	2.00	0.083	10	1	200°F	35	95
AG-GG12-101-AS	24x24x11 1/2	1000	0.90	0.083	10	1	200°F	58	148
AG-GG12-101-NS	24x24x11 1/2	1000	0.90	0.083	10	1	200°F	64	154
AG-GG12-101-WS	24x24x11 1/2	1000	2.00	0.083	10	1	200°F	70	160
AG-GG12-101-TS	24x24x11 1/2	1000	2.00	0.083	10	1	200°F	70	160
AG-GG16-81 3/8-AS	24x24x16	1000	0.85	0.125	8	1 3/8	200°F	75	205
AG-GG16-81 3/8-NS	24x24x16	1000	0.85	0.125	8	1 3/8	200°F	80	210
AG-GG16-81 3/8-WS	24x24x16	1000	2.10	0.125	8	1 3/8	200°F	90	220
AG-GG16-81 3/8-TS	24x24x16	1000	2.10	0.125	8	1 3/8	200°F	90	220
AG-GG12-62-AS	24x24x11 1/2	700	1.75	0.125	6	2	200°F	59	157
AG-GG12-62-NS	24x24x11 1/2	700	1.75	0.125	6	2	200°F	62	160
AG-GG12-62-WS	24x24x11 1/2	700	3.90	0.125	6	2	200°F	70	168
AG-GG12-62-TS	24x24x11 1/2	700	3.90	0.125	6	2	200°F	70	168
AG-GG16-62-AS	24x24x16	1000	1.75	0.125	6	2	200°F	79	200
AG-GG16-62-NS	24x24x16	1000	1.75	0.125	6	2	200°F	86	207
AG-GG16-62-WS	24x24x16	1000	3.90	0.125	6	2	200°F	98	219
AG-GG16-62-WSD	24x24x16	1000	3.90	0.125	6	2	200°F	100	221
AG-GG16-62-TS	24x24x16	1000	3.90	0.125	6	2	200°F	98	219
AG-GG16-62-TSD	24x24x16	1000	3.90	0.125	6	2	200°F	100	221
AG-GG18-62-AS	24x24x18	1250	1.75	0.125	6	2	200°F	90	220
AG-GG18-62-NS	24x24x18	1250	1.75	0.125	6	2	200°F	96	226
AG-GG18-62-WS	24x24x18	1250	4.10	0.125	6	2	200°F	105	235
AG-GG18-62-TS	24x24x18	1250	4.10	0.125	6	2	200°F	105	235

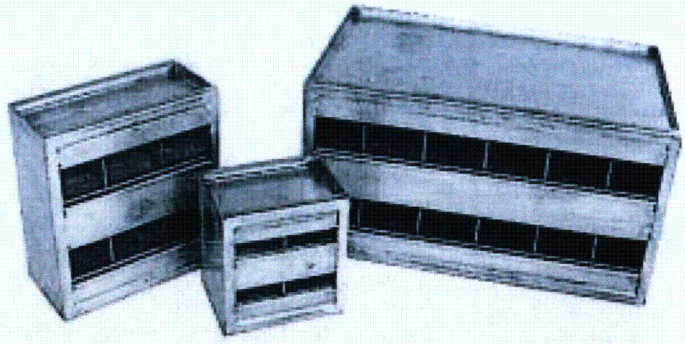
ATTACHMENT 8

Ordering Information: *Type IV (V-Bed) Stainless Steel Adsorber*

Small Size Adsorbers

Note: ΔP may vary by +/- 20% due to physical characteristics of the carton. These variations must be considered when sizing fans.

Ordering information below is for small size gel and gasket seal adsorbers, grouped by adsorbent materials (Activated Carbon, Nuclear Grade Carbon, Whetlerized Carbon and ASZM-TEDA Carbon).



Small Size Stainless Steel *Gel Seal* Adsorbers - Activated Carbon

Model Number	Size H x W x D with Gel Seal Channel (inches)	Rated Flow (CFM)	Approx. ΔP (In. W.G.)	Res. Time (sec.)	No. of Beds	Bed Depth (inches)	Max. Temp.	Approx. Carbon Net Wt. (lbs.)	Approx. Ship Wt. (lbs.)
AF-BB6-41-AS	8x 8x 6 5/8	40	0.45	0.083	4	1	200˚F	3	16
AF-CC6-41 3/8-AS	12x12x 6 5/8	55	0.90	0.125	4	1 3/8	200˚F	8	33
AF-CC12-41 3/8-AS	12x12x12 1/4	140	1.10	0.125	4	1 3/8	200˚F	14	53
AF-CC16-41 3/8-AS	12x12x16 3/4	465	0.85	0.125	4	1 3/8	200˚F	45	124

Small Size Stainless Steel *Gasket Seal* Adsorbers - Activated Carbon

Model Number	Size H x W x D (inches)	Rated Flow (CFM)	Approx. ΔP (In. W.G.)	Res. Time (sec.)	No. of Beds	Bed Depth (inches)	Max. Temp.	Approx. Carbon Net Wt. (lbs.)	Approx. Ship Wt. (lbs.)
AG-BB6-41-AS	8x8x5 7/8	40	0.45	0.083	4	1	200˚F	3	15
AG-CC6-41 3/8-AS	12x12x5 7/8	55	0.90	0.125	4	1 3/8	200˚F	8	31
AG-CC12-41 3/8-AS	12x12x11 1/2	140	1.10	0.125	4	1 3/8	200˚F	14	51
AG-CG16-41 3/8-AS	12x24x16	465	0.85	0.125	4	1 3/8	200˚F	45	121

ATTACHMENT 8

HEGA Filters: *Ordering Information*

Small Size Stainless Steel *Gel Seal* Adsorbers - Nuclear Grade Carbon

Model Number	Size H x W x D w/ Gel Seal Channel (inches)	Rated Flow (CFM)	Approx. ΔP (In. W.G.)	Res. Time (sec.)	No. of Beds	Bed Depth (inches)	Max. Temp.	Approx. Carbon Net Wt. (lbs.)	Approx. Ship Wt. (lbs.)
AF-BB6-41-NS	8x 8x 6 5/8	40	0.45	0.083	4	1	200°F	3	16
AF-CC6-41 3/8-NS	12x12x 6 5/8	55	0.90	0.125	4	1 3/8	200°F	8	33
AF-CC12-41 3/8-NS	12x12x12 1/4	140	1.10	0.125	4	1 3/8	200°F	15	54
AF-CC16-41 3/8-NS	12x12x16 3/4	465	0.85	0.125	4	1 3/8	200°F	48	127

Small Size Stainless Steel *Gasket Seal* Adsorbers - Nuclear Grade Carbon

Model Number	Size H x W x D (inches)	Rated Flow (CFM)	Approx. ΔP (In. W.G.)	Res. Time (sec.)	No. of Beds	Bed Depth (inches)	Max. Temp.	Approx. Carbon Net Wt. (lbs.)	Approx. Ship Wt. (lbs.)
AG-BB6-41-NS	8x 8x 5 7/8	40	0.45	0.083	4	1	200°F	3	15
AG-CC6-41 3/8-NS	12x12x 5 7/8	55	0.90	0.125	4	1 3/8	200°F	8	31
AG-CC12-41 3/8-NS	12x12x11 1/2	140	1.10	0.125	4	1 3/8	200°F	15	52
AG-CG16-41 3/8-NS	12x24x16	465	0.85	0.125	4	1 3/8	200°F	48	124

Small Size Stainless Steel *Gel Seal* Adsorbers - Whetlerized Carbon

Model Number	Size H x W x D w/ Gel Seal Channel (inches)	Rated Flow (CFM)	Approx. ΔP (In. W.G.)	Res. Time (sec.)	No. of Beds	Bed Depth (inches)	Max. Temp.	Approx. Carbon Net Wt. (lbs.)	Approx. Ship Wt. (lbs.)
AF-BB6-41-WS	8x 8x 6 5/8	40	1.00	0.083	4	1	200°F	4	17
AF-CC6-41 3/8-WS	12x12x 6 5/8	55	2.10	0.125	4	1 3/8	200°F	9	34
AF-CC12-41 3/8-WS	12x12x12 1/4	140	2.10	0.125	4	1 3/8	200°F	16	55
AF-CC16-41 3/8-WS	12x12x16 3/4	465	2.10	0.125	4	1 3/8	200°F	50	129

Small Size Stainless Steel *Gasket Seal* Adsorbers - Whetlerized Carbon

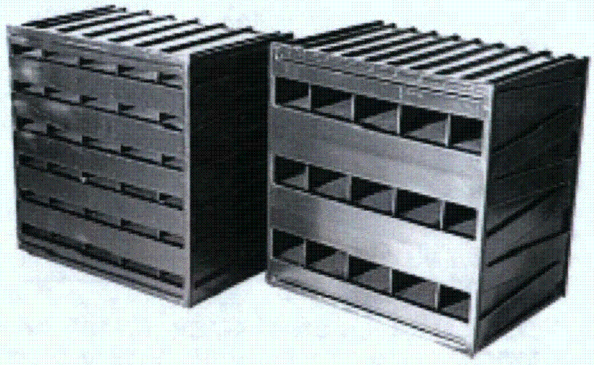
Model Number	Size H x W x D (inches)	Rated Flow (CFM)	Approx. ΔP (In. W.G.)	Res. Time (sec.)	No. of Beds	Bed Depth (inches)	Max. Temp.	Approx. Carbon Net Wt. (lbs.)	Approx. Ship Wt. (lbs.)
AG-BB6-41-WS	8x 8x 5 7/8	40	1.00	0.083	4	1	200°F	3	15
AG-CC6-41 3/8-WS	12x12x 5 7/8	55	2.10	0.125	4	1 3/8	200°F	8	31
AG-CC12-41 3/8-WS	12x12x11 1/2	140	2.10	0.125	4	1 3/8	200°F	15	52
AG-CG16-41 3/8-WS	12x24x16	465	2.10	0.125	4	1 3/8	200°F	48	124

Cinersorb: *Incineratable High Efficiency Gas Adsorber*

The Cinersorb is the solution to problems associated with the disposal of carbon adsorbers contaminated with toxic, carcinogenic, microbiological, radioactive or other dangerous contaminants.

Many facilities have a waste disposal problem regarding high-efficiency adsorbers that are loaded with dangerous contaminants. In the past, high-efficiency adsorbers (i.e.. adsorbers that exhibit a mechanical efficiency of 99.9%) have been manufactured with metal frames. Since these metal frame adsorbers cannot always be safely refilled with fresh carbon, their disposal becomes a problem.

The Flanders/CSC Cinersorb, which has a combustible frame constructed of high impact polystyrene plastic, solves this problem.



Incineration guidelines vary from contaminant to contaminant. The customer should determine that incineration meets the requirements governed by type of contaminant in question and local regulations.

Features

- Polystyrene frame allows disposal by incineration (volume reduction exceeds 95%)
- Mechanical efficiency of 99.9% when tested in accordance with IES-RP-CC-008-84, "Recommended Practice for Gas-Phase Adsorber Cells"
- Available in many sizes (See pp. 15-16), allowing use in most standard filter housings
- Easier to handle, weighs 40 to 50% less than metal frame adsorbers
- Less expensive than metal frame adsorbers
- Corrosion resistant
- Can be filled with any adsorbent to capture almost any contaminant
- Many applications, including safety cabinet, glove box and fume hood exhaust, laboratory supply air and odor control
- Designed, manufactured and tested under a Quality Assurance Program that meets the requirements of ASME-NQA-1, "Quality Assurance Program for Nuclear Facilities"

ATTACHMENT 8

HEGA Filters: *Suggested Specifications and Ordering Information for Cinersorb*

Suggested Specifications Cinersorb Disposable Carbon Adsorbers

From the tables on Pages 15-16, fill in the blanks for adsorber requirements.

Adsorber shall be Flanders/CSC model number____. Adsorber frame shall be constructed of high impact polystyrene to allow disposal of spent adsorber by incineration. Adsorbers shall have_____beds that are _____deep, arranged in a V-bank configuration. The filter frame shall be size:_____" high x_____" wide x _____" deep, and have a _____ (gel/gasket) seal on one side. The rated flow shall be _____CFM at _____" w.g. pressure drop and _____second residence time. Adsorber screens shall be perforated plastic supported by external spacers to prevent distortion during filling with carbon. Adsorber shall exhibit a minimum mechanical efficiency of 99.9% when tested in accordance with IES-RP-CC-008-84, "Recommended Practice for Gas-Phase Adsorber Cells."

Model Number Breakdown *(Example)*

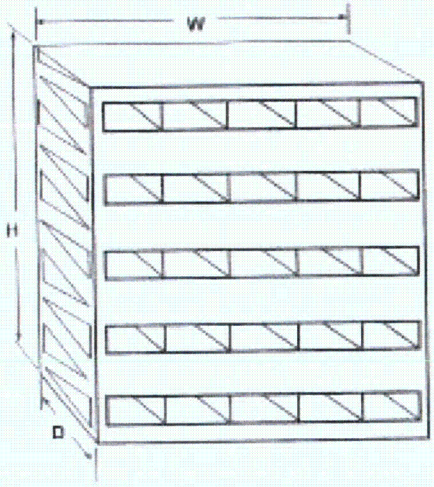
AG - GG16 - 62 - WP

Adsorber

G= Gasket Seal
F= Gel Seal

Adsorber Size (Nominal)

	High	Wide	Deep
CC12	= 12"	x 12"	x 11 1/2"
CG16	= 12"	x 24"	x 16
GC16	= 24"	x 12"	x 16"
GC12	= 24"	x 12"	x 11 1/2"
GG12	= 24"	x 24"	x 11 1/2"
GG16	= 24"	x 24"	x 16"
GG18	= 24"	x 24"	x 18"



Frame Material
P=Plastic

Adsorbent Material
A = Activated Carbon (8 x 16 Mesh)
N = Nuclear Grade Carbon (8 x 16 Mesh)
W = Whetlerized Carbon (12 x 30 Mesh)
T = ASZM-TEDA Carbon (12 x 30 Mesh)

Bed Thickness
1 = 1" Bed Thickness
1 3/8 = 1 3/8" Bed Thickness
2 = 2" Bed Thickness

Number of Beds Per Cell
3 = 3 Beds per Cell
4 = 4 Beds per Cell
8 = 8 Beds per Cell
10 = 10 Beds per Cell
12 = 12 Beds per Cell

Notes:

1. In the charts on the following pages, pressure drop and weight will vary slightly due to variations in carbon particle size distribution and packing density.
2. Not all model number combinations above are available.

ATTACHMENT 8

HEGA Filters: *Ordering Information for Cinersorb Disposable Carbon Adsorbers*

Ordering Information: *Cinersorb Disposable Carbon Adsorber*

These adsorbers are designed as *disposable* units. DO NOT refill with fresh carbon for reuse. NOT recommended for use in systems above 120° F or if contaminants will attack the polystyrene plastic frame material.

Note: ΔP may vary by +/- 20% due to physical characteristics of the carton. These variations must be considered when sizing fans.

Gel Seal Housings

Model Number	Size H x W x D with Gel Seal Channel (inches)	Rated Flow (CFM)	Approx. ΔP (In. W.G.)	Res. Time (sec.)	No. of Beds	Bed Depth (inches)	Max. Temp.	Approx. Carbon Net Wt. (lbs.)	Approx. Ship Wt. (lbs.)
AF-GC12-101-AP	24x12x12 1/4	500	0.90	0.083	10	1	120°F	23	92
AF-GC12-101-NP	24x12x12 1/4	500	0.90	0.083	10	1	120°F	25	95
AF-GC12-101-WP	24x12x12 1/4	500	2.00	0.083	10	1	120°F	26	98
AF-GC12-101-TP	24x12x12 1/4	500	2.00	0.083	10	1	120°F	26	98
AF-GG12-101-AP	24x24x12 1/4	1000	0.90	0.083	10	1	120°F	43	153
AF-GG12-101-NP	24x24x12 1/4	1000	0.90	0.083	10	1	120°F	49	159
AF-GG12-101-WP	24x24x12 1/4	1000	2.00	0.083	10	1	120°F	52	165
AF-GG12-101-TP	24x24x12 1/4	1000	2.00	0.083	10	1	120°F	52	165
AF-GG12-62-AP	24x24x12 1/4	700	1.75	0.125	6	2	200°F	59	162
AF-GG12-62-NP	24x24x12 1/4	700	1.75	0.125	6	2	200°F	59	162
AF-GG16-81 3/8-AP	24x24x16 3/4	1000	0.85	0.125	8	1 3/8	120°F	74	113
AF-GG16-81 3/8-NP	24x24x16 3/4	1000	0.85	0.125	8	1 3/8	120°F	79	118
AF-GG16-81 3/8-WP	24x24x16 3/4	1000	2.10	0.125	8	1 3/8	120°F	88	127
AF-GG16-81 3/8-TP	24x24x16 3/4	1000	2.10	0.125	8	1 3/8	120°F	88	127
AF-GG16-121-AP	24x24x16 3/4	1000	.5	0.125	12	1	120°F	120	78
AF-GG16-121-NP	24x24x16 3/4	1000	.5	0.125	12	1	120°F	120	78
AF-GG16-62-AP	24x24x16 3/4	1000	1.75	0.125	6	2	120°F	80	115
AF-GG16-62-NP	24x24x16 3/4	1000	1.75	0.125	6	2	120°F	84	119
AF-GG16-62-WP	24x24x16 3/4	1000	3.90	0.125	6	2	120°F	96	131
AF-GG16-62-TP	24x24x16 3/4	1000	3.90	0.125	6	2	120°F	96	131
AF-GG18-62-AP	24x24x18 3/4	1250	1.75	0.125	6	2	120°F	79	127
AF-GG18-62-NP	24x24x18 3/4	1250	1.75	0.125	6	2	120°F	86	131
AF-GG18-62-WP	24x24x18 3/4	1250	4.10	0.125	6	2	120°F	98	140
AF-GG18-62-TP	24x24x18 3/4	1250	4.10	0.125	6	2	120°F	100	140

ATTACHMENT 8

HEGA Filters: *Ordering Information for Cinersorb*

Ordering Information: *Cinersorb Disposable Carbon Adsorbers*

Note: Δ P may vary by +/- 20% due to physical characteristics of the carton. These variations must be considered when sizing fans.

Gasket Seal Housings

Model Number	Size H x W x D (inches)	Rated Flow (CFM)	Approx. ΔP (In. W.G.)	Res. Time (sec.)	No. of Beds	Bed Depth (inches)	Max. Temp.	Approx. Carbon Net Wt. (lbs.)	Approx. Ship Wt. (lbs.)
AG-GC12-101-AP	24x12x11 1/2	500	0.90	0.083	10	1	120˚F	23	42
AG-GC12-101-NP	24x12x11 1/2	500	0.90	0.083	10	1	120˚F	25	44
AG-GC12-101-WP	24x12x11 1/2	500	2.00	0.083	10	1	120˚F	26	45
AG-GC12-101-TP	24x12x11 1/2	500	2.00	0.083	10	1	120˚F	26	45
AG-GG12-101-AP	24x24x11 1/2	1000	0.90	0.083	10	1	120˚F	43	77
AG-GG12-101-NP	24x24x11 1/2	1000	0.90	0.083	10	1	120˚F	49	83
AG-GG12-101-WP	24x24x11 1/2	1000	2.00	0.083	10	1	120˚F	52	86
AG-GG12-101-TP	24x24x11 1/2	1000	2.00	0.083	10	1	120˚F	52	86
AG-GG12-62-WP	24x24x11 1/2	700	1.75	0.125	6	2	200˚F	59	162
AG-GG12-62-TP	24x24x11 1/2	700	1.75	0.125	6	2	200˚F	59	162
AG-GG16-81 3/8-AP	24x24x16	1000	0.85	0.125	8	1 3/8	120˚F	74	113
AG-GG16-81 3/8-NP	24x24x16	1000	0.85	0.125	8	1 3/8	120˚F	79	118
AG-GG16-81 3/8-WP	24x24x16	1000	2.10	0.125	8	1 3/8	120˚F	88	127
AG-GG16-81 3/8-TP	24x24x16	1000	2.10	0.125	8	1 3/8	120˚F	88	127
AG-GG16-121-AP	24x24x16	1000	0.5	0.125	12	1	120˚F	120	78
AG-GG16121-NP	24x24x16	1000	0.5	0.125	12	1	120˚F	120	78
AG-GG16-62-AP	24x24x16	1000	1.75	0.125	6	2	120˚F	80	115
AG-GG16-62-NP	24x24x16	1000	1.75	0.125	6	2	120˚F	84	119
AG-GG16-62-WP	24x24x16	1000	3.90	0.125	6	2	120˚F	96	131
AG-GG16-62-TP	24x24x16	1000	3.90	0.125	6	2	120˚F	96	131
AG-GG18-62-AP	24x24x18	1250	1.75	0.125	6	2	120˚F	92	127
AG-GG18-62-NP	24x24x18	1250	1.75	0.125	6	2	120˚F	96	131
AG-GG18-62-WP	24x24x18	1250	4.10	0.125	6	2	120˚F	105	140
AG-GG18-62-TP	24x24x18	1250	4.10	0.125	6	2	120˚F	105	140

Type II Tray Carbon Adsorbers

The Flanders/CSC Type II adsorber meets the design and performance criteria of IES-RP-CC-008-84, "Recommended Practice for Gas-Phase Adsorber Cell." It is primarily used by the nuclear industry. The Flanders/CSC Type II cell exhibits a minimum mechanical efficiency of 99.9% when tested in accordance with that standard.

The Flanders/CSC Type II cell incorporates two 2-inch beds. Three cells are designed to be modular with a 1000 CFM HEPA filter in both flow rate and size. By using multiple Type II cells, any required flow rate can be obtained.

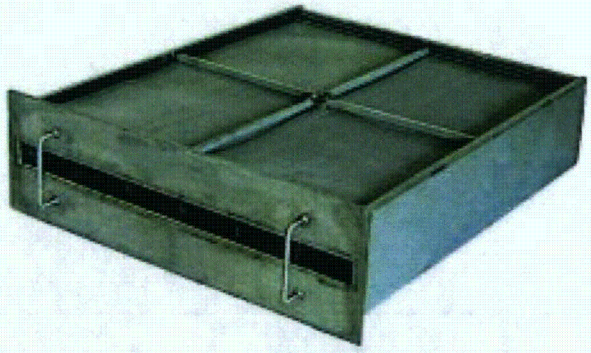
The Flanders/CSC Type II cell is made of 300-Series stainless steel. Dimensions are maintained to assure conformance with the requirements of IES-RP-CC-008-84, "Recommended Practice for Gas-Phase Adsorber Cells." It is designed, manufactured and tested under a quality assurance program that meets the basic requirements of ASME NQA-1, "Quality Assurance Program Requirements for Nuclear Facilities."

Application

Type II Tray adsorbers are designed so that three cells in parallel are modular with a 1000 CFM HEPA filter. These adsorbers are primarily used by the nuclear industry. They are usually installed in large "built-up" banks inside walk-in plenums.

Suggested Specifications

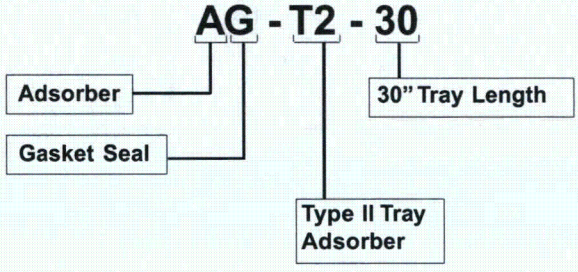
Adsorber shall be Flanders/CSC V-2 Type II adsorber tray. The adsorber frame shall be constructed of Type 304 stainless steel and have two (2), 2-inch deep beds. Adsorber screens shall be perforated 26 gage Type 304 stainless steel (0.045" dia. holes, 37% open area) with external reinforcement to prevent distortion during filling with carbon. The adsorber shall be filled with 8 x 16 mesh, granular, activated, impregnated carbon that meets the requirements of Article FF-5000 of ASME/ANSI



Standard Type II Tray Carbon Adsorber

AG-1-1997, "Code on Nuclear Air and Gas Treatment." At a rated flow of 333 CFM each shall provide a 0.25 second residence time with an approximate pressure drop of 1.10" water gage. Approximate filled weight of the adsorber is 96 lbs. with a maximum operating temperature of 200° F. The adsorber shall exhibit a mechanical efficiency of 99.9% when tested in accordance with IES-RP-CC-08-84, "Recommended Practice for Gas-Phase Adsorber Cells." The adsorber shall be designed, manufactured and tested under a Quality Assurance Program that meets the basic requirements of ASME NQA-1, "Quality Assurance Program Requirements for Nuclear Facilities."

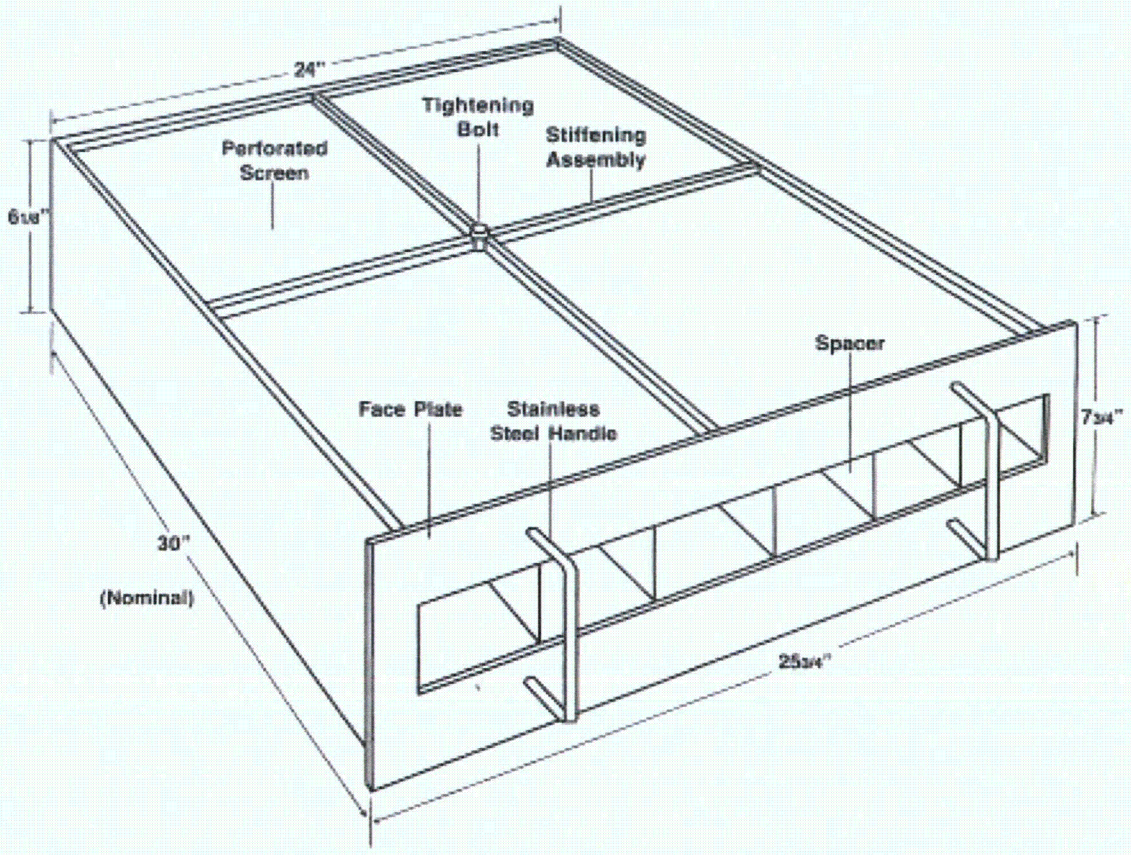
Model Number Breakdown *(Example)*



ATTACHMENT 8

HEGA Filters: *Ordering Information for Type II Tray Carbon Adsorber*

Ordering Information: *Type II Tray Carbon Adsorber*



Flanders/CSC Type II Tray Adsorber

Rated Flow (CFM)	Velocity through Carbon Bed	Mechanical Efficiency	Bed Depth	Δ P (Inches W.G.)	Approx. Filled Wt. (lbs.)	Approx. Ship Wt. (lbs.)
333	40 ft/minute	99.9%	2 inches	0.25 sec.	0.90 (±0.30)	105

Standard Options:

1 Different length cells
2 Special frame materials
3 Special adsorbents
4 Special faceplate
5 Sample canisters
6 Custom sizes

Note: Flanders/CSC's Service Division can refill and recertify most types of High Efficiency Gas Adsorbers.

ATTACHMENT 8

HEGA Filters: *Carbon Sampling Systems*

Carbon Sampling Canisters

In nuclear applications, *US Reg. Guide 1.52 details the frequency of having carbon tested for ability to remove methyl iodide. The sampler devices shown simplify the sample taking procedure. The sampler is removed, the sampler space is blanked off, and the sample is sent to the lab for analysis. No in-place test is required. (Note: If a filter is removed to provide a sample, an in-place test *must* be performed after the filter is replaced.)

Existing systems can use the compatible Flanders/CSC sampling system for easy conversion.

Carbon Sampler Blank Off Plug and Canister/Plug Removal Tool (furnished)

Radioactive Iodine Performance Test

Flanders/CSC can provide radioiodine testing services on samples of carbon to determine if the samples meet customer specifications. Tests can be expedited to prevent extended downtime of the customer's air filtration system. Tests are performed to latest versions of ASTM-D3803, ASME N509 and ASME AG-1; but, any standard radioiodine testing can be performed. Customer can also specify custom test parameters, if required.

*US Nuclear Regulatory Commission Regulatory Guide 1.52, "Design, Testing and Maintenance Criteria for Post Accident Engineered-Safety-Feature Atmosphere Cleanup System Air Filtration and Adsorption Units of Light-Water-Cooled Nuclear Power Plants."

Types of Adsorption

There are three types of adsorption that concern us: 1. Kinetic, 2. Isotopic Exchange, and 3. Complexing or Chemisorption.

Kinetic: Kinetic adsorption of a gas molecule or chemical vapor is the physical attraction of the molecule to the carbon granule by electrostatic forces. These forces, as they apply to small particles, are governed by van der Waals theories, and these attraction forces are termed van der Waals forces. Since these forces are physical in nature, the forces can be undone by physical effort. Thus, high temperature, high humidity, or other natural causes may cause an adsorbed contaminant to desorb.

Generally, the higher the boiling point, the larger the molecule size, and the lower the melting temperature, the easier the molecule is to kinetically adsorb and the stronger it is held once it is adsorbed.

Isotopic Exchange: A second "adsorption" mechanism is isotopic exchange. Radioactive materials usually have a family of isotopes. If a stable isotope is adsorbed on the carbon initially, an unstable isotopic compound will, when it comes into contact with the stable form of the element, exchange the isotopes. The

stable form is now on the airborne molecule and the radioactive form is on the molecular structure of the impregnant. An example of this is carbon impregnated with KI_3. The radioactive form of iodine in the organic form CH_3I^{131} will isotopically exchange with the iodine on the carbon. This exchange is nondirectional, meaning the adsorbed (exchanged) radioactive species of iodine may very well exchange again. The result will be a different airborne radioactive methyl iodide molecule. This new radioactive molecule may again isotopically exchange with stable iodides on the carbon in the KI_3 impregnant, and so on, until the radioactive iodine is delayed long enough to decay into stable xenon.

Complexing or Chemisorption: A third capture mechanism is chemisorption. This is the actual complexing, attaching chemically, of a radioactive iodine species to a stable impregnant that has the ability to share electrons. Once the iodine is complexed, it does NOT desorb similarly to isotopic exchange. However, it may desorb similarly to the kinetic adsorption discussed. But if it does, the entire impregnant desorbs from the carbon, not just the iodine. An example of this is to impregnate the carbon with triethylenediamine (TEDA) or some other tertiary amine.

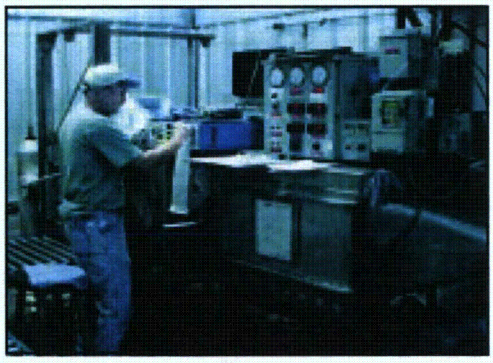
To take advantage of both impregnants and capture mechanisms, carbon can be co-impregnated. This allows the carbon to be used as a kinetic adsorber, an isotopic exchange medium and a complexing agent. As long as the operating conditions are kept within normal bounds, the carbon will perform as required. It will perform under high humidity conditions and under high temperature conditions better than a carbon with a single impregnant.

Efficiency vs. Penetration

There is often confusion between "efficiency" and "penetration" of contaminants through a carbon bed.

Efficiency is the ability for the carbon to remove a desired contaminant. Methyl iodide efficiency, for example, is determined by challenging the carbon with an actual radioactive methyl iodide vapor. The amount of the contaminant upstream of the carbon is known, and the amount that is collected on backup beds is measured. The efficiency of that carbon sample to remove methyl iodide is easily calculated by comparing the counts of the carbon sample to the counts on the backup beds. Test parameters such as temperature and relative humidity greatly affect the efficiency.

Penetration, on the other hand, is a term used to indicate the degree of leak tightness for installed carbon systems. The installed system is subjected to a test gas that is easily adsorbed, such as R-11 (trichlorofluoromethane). The penetration, or by-pass of the R-ll, is measured downstream of the filter and that amount is compared to the amount measured upstream of the filter. A penetration value in percent is easily calculated from the collected data. This is also termed mechanical efficiency.



Residence Time

Residence time is the term given to the time that a gas stream contacts a carbon bed. For example, if a carbon bed were a foot thick and the air stream moved at one foot per minute, the residence time would be one minute. It would take one minute for the air to move through the bed.

Typically, the carbon bed is 1-inch thick and the air velocity is 40-feet per minute. What would

the residence time be in that situation? (0.125 seconds) The residence time can be calculated easily from the following relationships:

$$RT = 5 \times \frac{D}{V}$$

Where:

RT = Residence time (seconds)

D = Depth of carbon bed (inches)

V = Velocity of gas through bed (feet/min)

Most of the time, the velocity will not be given and must be calculated from the relationship:

$$V = \frac{Q}{A}$$

Where:

V = Velocity of gas through bed (feet/min)

A = Unbaffled area of carbon bed (sq.ft)

Q =Quantity of gas flowing through bed (CFM)

Let's take an example from real life: Assume that Q=1,000 CFM and that a single 6 panel, 16-inch deep (in direction of air flow), 2-inch bed depth filter is to be used. To calculate the residence time, first determine the area of the carbon bed. The total area is 12.5 sq. ft. The 12.5 ft^2 is determined by actual measurements of the unbaffled bed area on one side of the carbon filter. Therefore:

$$V = \frac{Q}{A}$$

$$V = \frac{1000\ CFM}{12.5\ ft}$$

$$V = 80\ ft/min$$

And:

$$RT = \frac{5 \times D}{V}$$

$$RT = \frac{5 \times 2}{80}$$

$$RT = \frac{10}{80}$$

$$RT = 0.125\ second$$

The concept of residence time is very important from the designer's point of view. That is why Flanders/CSC is taking a lot of time to explain it fully. Flanders/CSC cannot design a system unless we know either the actual residence time required, or all of the parameters that determine the optimum residence time, (flow rate, contaminants, concentrations, temperature, humidity, required efficiency, etc.)

The residence time is critical to the chemisorption or complexing phenomena. As the gas enters the bed, it must have time to interact with the impregnants on the carbon. Too little time will mean that the contaminants will not interact completely with the carbon or impregnants. Too much time means that the system is not designed efficiently.

In summary, you need to be aware of the important of residence time because the first question we ask about an inquiry for any carbon system is, "What is the residence time requirement?" If you do not know, we will have to determine it before the best system can be designed by our engineering staff.

Capacity

The capacity of activated carbon is the percentage of its own weight that an activated carbon can adsorb of a given vapor under certain conditions. Some of these conditions are vapor concentration, temperature, humidity, air velocity, and defined breakthrough.

Example: If 100 pounds of activated carbon adsorbs 15 pounds of benzene before it reaches

a customer defined breakthrough point of 5 ppm, then the capacity of that activated carbon for benzene is 15%.

Decontamination Factor

The Decontamination Factor is the ratio of the concentration of a contaminant in the untreated air to the concentration of the contaminant in the treated air.

If anyone asks what the Decontamination Factor (DF) of a filter is, the answer can be obtained by calculating the RECIPROCAL of the penetration expressed as a fraction, or

$$DF = \frac{1}{Pen.}$$

Examples:

Penetration	Calculation	Result
40%	$DF = \frac{1}{0.40}$	DF = 2.5
0.1%	$DF = \frac{1}{0.001}$	DF = 1,000
5%	$DF = \frac{1}{0.50}$	DF = 20

Design Principles for Filtering Dangerous Chemical Contaminants

It is generally acknowledged that a properly designed filtration system to remove dangerous chemical contaminants should be as follows:

1. HEPA filters should be used to trap dangerous particulates and protect the carbon filters from collecting particulates and thereby increasing the adsorber's pressure drop.
2. Carbon filters must:
   a Exhibit a minimum mechanical efficiency of 99.9% (i.e., HEGA).
   b Use high quality coconut shell activated carbon.
   c Be sized for approximately 0.125 second residence time.
3. All filters should be installed in "Bag-in/ Bag-out" housings to protect maintenance personnel and the environment.
4. Filtration system designs should have provisions for pulling samples of air or carbon for laboratory analysis (to assist in determining when carbon adsorbers need changing).
5. The disposal of hazaradous waste (i.e., spent HEPA and HEGA filters) should also be considered. Any HEPA or HEGA filter containing regulated chemicals should be disposed of in accordance with Federal, State and local restrictions.
6. The filtration system must be manufactured under a good quality control program such as one that addressed the requirements of ASME NQA-1, "Quality Assurance Program Requirements for Nuclear Facilities."

ATTACHMENT 8

HEGA Filters: *General Information on Carbon and Adsorption Materials*

The following are some random thoughts and information that will help you form a general idea about carbon filter technology. These comments are to be considered as general axioms, and the reader should be able to "fill in" some of the unknown factors when unusual situations arise. However, there is no substitute for expert advice and opinion, and the reader is urged to contact Flanders/CSC for answers to any technical problem, specific questions or additional information.

1 Elemental iodine is adsorbed by attraction of the iodine to the carbon. This is called Kinetic adsorption.

2 Methyl iodide, which comes from elemental iodine (I_2) combining with methane must be adsorbed by chemisorption, usually in the form of isotopic exchange when KI carbon is used or complexing when TEDA carbon is used.

3 The recommended residence time for methyl iodide is 0.25 seconds residence time per 2-inch bed. Tests have shown that the carbon will perform as required at twice that velocity or half that r esidence time for a limited time period.

4 As the humidity increases, the ability of the carbon to perform is adversely affected. However, the carbon must perform at 95% relative humidity in order to meet ASME AG-1 requirements.

5 The heavier the molecular weight of a material, the easier it is to adsorb.

6 The higher the boiling temperature of a material, the easier it is to adsorb.

7 The converse of 5 and 6 is true.

8 One gram of 60% active carbon (as measured by carbon tetrachloride) has a surface area of about 1,000 square meters.

9 The adsorption coefficient of carbon is the amount of a given material that the carbon will adsorb, by weight.

10 Some hard to adsorb materials can be displaced by easier to adsorb materials. For example, acetic anhydride may displace acetone. Acetone may displace acetaldehyde, and acetaldehyde may displace acetylene.

11 The lower the concentration of a material, the harder to achieve a high removal percentage.

12 One gram of carbon will adsorb one milligram of iodine. The potential inventory of radioiodine in a nuclear power system is very small.

13 Since carbon will adsorb anything adsorbable, it can be *poisoned* by harmless materials and be unable to adsorb the material that it was designed to control. That is why the carbon should always be protected from vapors that will harm it.

14 Shelf life of carbon in properly packaged drums or in filters having a vapor barrier of some kind can be as long as five (5) years. Flanders/CSC recommends that carbon over three (3) years old be retested to assure that it meets the efficiency requirements of the original specifications.

15 Methyl iodide adsorbs-desorbs-adsorbs through the bed, exchanging iodine at each juncture. That is to say, methyl iodide can be radioactive-stable-radioactive-stable until it decays into harmless xenon.

16 Elemental iodine, once adsorbed, usually stays adsorbed.