Union Electric
Callaway Plant

PO Box 620
Fulton, MO 65251

June 1, 2005

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Mail Stop P1-137
Washington, DC 20555-0001

ULNRC-05152

Ameren UE

Ladies and Gentlemen:

DOCKET NUMBER 50-483
CALLAWAY PLANT UNIT 1
UNION ELECTRIC CO.
FACILITY OPERATING LICENSE NPF-30
REQUEST FOR AUTHORIZATION FOR USE OF
DELTA PROTECTION RESPIRATORY PROTECTION EQUIPMENT

Pursuant to the provision of 10 CFR 20.1703, "Use of Individual Respiratory Protection Equipment," and 10 CFR 20.1705, "Application for use of higher assigned protection factors," Union Electric Company (AmerenUE) is requesting an authorization to use French designed self fed respiratory equipment with an assigned protection factor (APF).

Specifically, AmerenUE has identified the Delta Protection Mururoa BLU self fed single use suits, and Mururoa V4 F1 and V4 MTH2 air supplied single use suits as having benefits from a contamination control, heat stress reduction, and respiratory protection point of view. These suits have no NIOSH approval for use as a respirator in the United States. Pursuant to 10 CFR 20.1703(b), AmerenUE must request authorization for use of equipment that has not been tested or certified by NIOSH, or for which there is no schedule for testing or certification. Pursuant to 10 CFR 20.1705, AmerenUE must obtain authorization from the Nuclear Regulatory Commission before using assigned protection factors in excess of those specified in Appendix A of 10 CFR 20. Since these suits have no NIOSH approval for use as a respirator in the United States, AmerenUE is requesting authorization for their use as respiratory protection equipment and assignment of a protection factor. Additionally, AmerenUE is requesting exemption from 10 CFR 20.1703(f), which requires provision of the standby rescue persons.

Enclosure 1 provides the documentation supporting this request. As described in the enclosure, approval of the request would improve worker safety in areas of airborne

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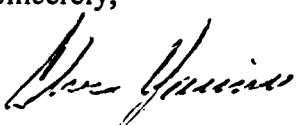
radioactivity and high potential for facial/skin contamination from hot particles. In addition, the full body cooling effect will help us eliminate concerns that have come up in the past outages regarding heat stress. This will result in reduced outage time, as well as the reduction of personal contamination events. This request satisfies the requirements of 10 CFR 20.2301 in that it is authorized by law and will not result in undue hazard to life or property.

Enclosure 2 lists AmerenUE's commitments contained in this letter.

Approval of this request will allow AmerenUE to proceed with procedure changes and complete training necessary for the use of the Mururoa model V4 F4, V4 MTH2, and BLU suits prior to our next refueling outage. Therefore, AmerenUE is requesting approval by August 1, 2005 in order to support use during the fall 2005 refueling outage.

If you have any questions regarding this submittal, please contact Mr. Keith D. Young, Manager - Regulatory Affairs at (573) 676-8659 or Mr. Dave Shafer, Superintendent – Licensing at (314) 554-3104.

Sincerely,



Chris R. Younie
Manager Callaway Operations

BFH/
Enclosure: 1 Exemption / Approval Request
2 List of Commitments

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APPROVAL REQUEST FOR THE USE OF DELTA PROTECTION MURUROA BLU SINGLE USE ENCAPSULATING SUITS"

1.0 INTRODUCTION

1.1 PURPOSE

10 CFR 20.1703(b) indicates that all respiratory equipment that is not certified by NIOSH must be submitted to the NRC for analysis and approval based on quantified test data. 10 CFR 20.1705 requires authorization from the Commission before using Assigned Protection Factor (APF) in excess of those specified in Appendix A.

In addition, 10 CFR 20.1703(f) requires provision of standby rescue persons, whenever an unaided individual would have difficulty in extricating himself or herself from an atmosphere supplying suit.

AmerenUE proposes the use of the Mururoa "fully enclosed suit" models BLU (self fed single use suits), and V4 F1 and V4MTH2 (air supplied single use suits) manufactured by Delta Protection, France. The purpose of this letter is to request approval for the use of the suits from Delta Protection and for authorization to use an APF of 2000 with the Mururoa suits. And, because of the advanced safety features for emergency breathing and emergency escape built into these models, AmerenUE requests approval for the use of the Mururoa suits without dedicated rescue personnel.

1.2 REGULATORY REQUIREMENTS

1.2.1 Requirements of 10 CFR 20.1703 and Appendix A

The following regulatory requirements are relevant to this request.

> 10 CFR 20.1703, Use of Individual Respiratory Protection Equipment, requires that if a licensee assigns or permits the use of respiratory protection equipment to limit the intake of radioactive material, (a) the licensee shall use only respiratory protection equipment that is tested and certified by NIOSH.
>
> 10 CFR 20.1703(b) allows that if the licensee wishes to use equipment that has not been tested or certified by NIOSH, or for which there is no schedule for testing or certification, the licensee shall submit an application to the NRC for authorized use of this equipment.
>
> 10 CFR 20.1703(f) requires provision of standby rescue persons, whenever an unaided individual would have difficulty in extricating himself or herself from an atmosphere-supplying suits.
>
> 10 CFR 20.1705, Application for Use of Higher Assigned Protection Factors, requires that the licensee shall obtain authorization from the Commission before

> using assigned protection factors in excess of those specified in Appendix A to Part 20.
>
> Appendix A, Assigned Protection Factors lists as item II, Atmosphere supplying respirators (particulate, gases and vapors), Suit in a continuous flow operating mode, no NIOSH approval schedule is currently available for atmosphere supplying suits. This equipment may be used in an acceptable respiratory protection program as long as all the other minimum program requirements with the exception of fit testing, are met (i.e., 10 CFR 20.1703).

Therefore, based on the above requirements, AmerenUE must obtain approval for the use of the respiratory protection suits and assignment of a protection factor for the suits.

1.2.2 Criteria for Application

The NRC has established certain criteria that permit a licensee to request an exemption from regulatory requirements. These criteria are established in 10 CFR 20.2301 and are:

> "The Commission may, upon application by a licensee or upon its own initiative grant an exemption from the requirements of the regulations in this part, it is determines the exemption is authorized by law and would not result in undue hazard to life or property."

The NRC has authority under 10 CFR 20.1703(b) and 10 CFR 20.1705 to grant exemptions from the requirements of NRC regulations. Therefore, this requested exemption is "authorized by law", as required by 10 CFR 20.2301. The technical justification demonstrates that there will be no undue hazard to life or property. Several models of the Mururoa suit product line from Delta Protection has been approved for use in commercial nuclear power plants including Duke Energy Corporation by NRC letter dated June 30, 2003 and Exelon Generation Company by NRC letter dated January 31, 2005. In addition, the Mururoa suits have been widely used in western European nuclear power plants for more than 20 years. This equipment is also sold and used in China, South Africa and South America.

2.0 TECHNICAL JUSTIFICATION

2.1 SCOPE

AmerenUE reviewed the following documents from Delta Protection, France:

(a) Users and Maintenance Guide for the Suits and the Blowing Unit
(b) European Standard EN 1073-1 (Attachment 2.5.8)
(c) Test Report #200323085/2120 (Attachment 2.5.3)

(d) Certificate No. for Mururoa BLU suits
(e) Technical information on Mururoa V4 model ventilated suits
(f) European Standard CEN/TC 162 N 738 for ventilated protective clothing
(g) Protection Factor determined during fit test exercises for V4 F1
(h) Certificate No. 0073/197/162/12/97/0028 for Mururoa V4 F1 issued by the Institute for Nuclear Protection and Security
(i) User Instructions for Mururoa V4 F1 and V4 MTH2
(j) Certificate No. 0073/197/162/01/96/0001 issued for Mururoa V4 MTH2 by the Institute for Nuclear Protection and Security
(k) Protection Factor determined during fit test exercises for V4 MTH2

The European Standards (Attachment 2.5.8 and 2.5.10) requires that suit material be tested for resistance to abrasion, flex cracking, puncture, blocking, tear and flammability, strength of seams, joins and assemblies, damage resistance of exhaust valves, designed flow rates for pressure range of supplied air, noise level and quality of the visor. According to the testing standard, three workers should perform standard exercises, each wearing two different suits inside a chamber filled with a test agent (Sodium Chloride) and measure the leakages during the exercise regimen lasting 20 minutes. Operating parameters are set to manufacturer's instructions. Standard exercises include walking on a treadmill at 2 mph (3 minutes), moving arms up and down above head while looking upward (3 minutes) and squatting continuously (3 minutes). To ensure worker's comfort, 2 additional practical exercises - walking at 2 mph (5 minutes) and loading a bucket with wood chips from the base of a hopper and emptying it into the opening on top (15 minutes) - should be performed by two workers at specified air flow rates.

Test Report No 200323085/2120 (Attachment 2.5.3) states that the Mururoa BLU passed in all categories tested and provided a protection factor greater than 20,000. Certificate No. 0073/197/162/12/97/0028 (Attachment 2.5.12) states that the Mururoa V4 F1 passed in all categories tested and provided a protection factor greater than 50,000. Certificate No. 0073/197/162/01/96/0001 (Attachment 2.5.14) states that the Mururoa V4 MTH2 passed in all categories tested and provided a protection factor greater than 50,000. Please note that the term 'protection factor' used in the European Standard is equivalent to the 'fit factor' used in the United States and is not the same as the Assigned Protection Factor used in 10 CFR 20. Based on a review of the manufacturer's documentation, the Mururoa model suits represent a better design than the currently approved "bubble hood" and "rain suit" combination and provide better worker protection with the data supporting an APF of 2000. In addition, the self fed suit will allow the use of advanced protection without the need of supplied air hose lines, which can be cumbersome, and limiting from a performance perspective in various applications.

2.2 REFERENCES

1. 10 CFR 20.1703 Use of individual respiratory protection equipment.
2. 10 CFR 20.1705 Application for use of high assigned protection factors.
3. Appendix A to 10 CFR 20 Assigned Protection Factors for Respirators.
4. Regulatory Guide 8.15, Rev 1 Acceptable Programs for Respiratory Protection.
5. NUREG-0041 Manual of Respiratory Protection Against Airborne Radioactive Materials.
6. European Standard EN 1083-1 (Attachment 2.5.8).
7. Test Report #200323085/2120 for the Mururoa BLU suit, dated
8. European Standard CENRC 162 N 738 (July 1996).
9. EC Type Examination Certificate No. 0073/197/162/12/97/0028 for the Mururoa V4 F1 suit, dated December 10, 1997.
10. EC Type Examination Certificate No. 0073/197/162/12/96/0001 for the Mururoa V4 MTH2 suit, dated January 10, 1996.

2.3 DISCUSSION

AmerenUE recently had the opportunity to evaluate the information supplied for the Mururoa BLU self fed single use suits , and the Mururoa V4 F1 and V4 MTH2 air supplied single use suits manufactured by Delta Protection, 30200 Bagnols su C'eze, France. The results of the test evaluation have been documented.

2.3.1 Suit Construction

The Mururoa model BLU suits meet the European Standard EN.1073-1 and the manufacturer is ISO 9002 certified. The Mururoa models V4 F1 and V4 MTH2 suits meet IS0 81 94 and the European Standard EN.NF 1073-1 and the manufacturer is IS0 9001 certified. The manufacturer indicates that approximately 60,000 Mururoa style garments/suits are used by European Nuclear Power plants each year.

The Mururoa suits have the following desirable features that are not available in the "bubblehoods" and "rain suits" manufactured in the United States:

1) One piece single use suit that includes welded gloves and booties with tie straps
2) Fire proof (up to 65 deg C)
3) Made of PVC or Ethyfuge (vinyl acetate) with reinforced elbows, knees and crotch areas.
4) Dual zippers - metal zipper inside and plastic zipper outside
5) Helmet made of clear PVC material that provides distortion-free vision and large enough for wearing a headset

6) Welded sleeve to insert communication cable
7) A removable strip near the mouth that could be used for emergency breathing in case of loss of supplied air
8) An egress strip stretching from left arm, over the head, to right arm that is used for undressing and for self-rescue in an emergency, such as loss of supplied air
9) Two exhaust valves that provide ventilation, and also protect from overpressure
10) Very low noise level at maximum air flow
11) Air flow to hands, feet, face and chest.

All the Mururoa suits are designed for single use. The primary applications consist of preventing penetration of solid and liquid particles, radioactive and toxic particles, plus microorganisms. There are two exhaust vents on the back - one behind the neck and one at lower back. The exhaust vents have patented magnetic seals to prevent any entry of contaminants if powered air is lost. The suits are made of non-flammable PVC or polyethylene/vinyl acetate (Ethyfuge) which is fully incinerable. The suits should not be brought in direct contact with any material colder than 41 deg F or hotter than 140 deg F. Open flames or sparks could melt or perforate the skin. There is a shelf-life of 3 years for the suits and storage between 32 deg F and 140 deg F in original packing is required by manufacturer.

The Mururoa BLU Self Fed single use suit is powered by a Micronel Powered Air Purifying blowing unit. The battery powered blowing unit has the capability to run for a minimum of four (4) hours, while supplying air to the user at 600 L/min or 20 CFM. In addition, the unit can operate at a lower air flow rate of 400 L/min, or 14 CFM for longer periods of time. A warning alarm is present if the units supplied voltage is not reached, or if the airflow is not reaching the minimum required, such as during long usage periods approaching 4 hours in duration. The battery unit is capable of supporting a minimum of 500 charges. The unit uses four (4) High capacity, high efficiency (HEPA) Pro 2000 filter cartridges "PF10 P3" that are designed for single use. All particle filters have a 10 year shelf life as indicated by the manufacturer. The blowing unit is inserted into a pouch that is inside the suit, thus preventing exposure to contamination. The unit is then connected to an internal distribution network for full body cooling and respiratory protection. Noise level is kept below 75 DB. Air flows through manifolds to the chest, hands and feet.

Air hoses of any length can be used with the Mururoa V4 F1 and V4 MTH2 single use suits. For the Mururoa model V4 F1 suit breathing air is required at 85 psig measured at the inlet. A regulator at the inlet can adjust the air flow from 41 CFM maximum to 9 CFM at the minimum. The regulator cannot shut off the air supply to ensure user safety. Noise level is kept between 76 dB at maximum air flow to 58 dB at minimum air flow. Air flows through manifolds to the chest, hands and feet.

For the Mururoa model V4 MTH2 suit breathing air is required at about the same pressure (87 psig) as model V4 F1 suit. The regulator can adjust air flow between 17 CFM to 38 CFM. Noise level varies from 66 dB at minimum air flow to 76 dB at maximum air flow. There are two additional air vents near the chin for cooling the face. The Mururoa air supplied single use suits are approved for use with 16 different fittings in Europe and can be fitted with Schrader or Foster or CEJN fitting.

2.3.2 Safety Features of Mururoa BLU self fed suits and V4 F1 and V4 MTH2 air supplied suits

The Mururoa model BLU, V4 F1, and V4 MTH2 suits are light-weight (2.5 lbs), made of fire-retardant material and can be used in temperatures up to 140 deg F. Contact with open flames or grinding/welding sparks is prohibited. Built-in gloves, booties with binding ties, reinforced elbows, knees and crotch protect against accidental tear, puncture and cracking. A transparent helmet with 6" X 8" clear face plate provides distortion-free view. Dual magnetic ventilation valves provide needed ventilation and relief of excess pressure in case suit is squeezed/pinched unexpectedly. In case of loss of air, the user can remove the mouth strip and move the opening close to his face, or enlarge the opening, to breathe outside air. Alternately, the user can pull the escape strip from either forearm, over the head and towards the other forearm, and rip the suit in two halves. This escape strip is normally used for egress from the suit when the work activity has been completed.

The Mururoa suit design does not permit its use in an immediately dangerous to life and health (IDLH) atmosphere. AmerenUE plans to use this suit for protection against radioactive particulate contamination only. The Mururoa suits are also not designed for use with any personal cooling units such as a Vortex tube, but can be used with a cooling vest supplied by the manufacturer, if desired.

2.3.3 Test Conclusion

Based on the information received from the manufacturer, AmerenUE has determined that the Mururoa BLU self fed suits, and Mururoa V4 F1 and V4 MTH2 air supplied suits offer a safer and more efficient means to protect workers in areas of high radiological contamination and in areas where there is a potential for airborne contamination. The existing rain suits and bubblehoods provide cooling only to the head and force workers to wear the ensemble in a manner that makes self-rescue nearly impossible, thus requiring a rescue worker to be stationed nearby. Ease of removal of the Mururoa suits provides for more desirable self- rescue features, and provides a means to undress that minimizes the potential for personnel contamination events. In addition, the powered air approach enables free and clear movement, thus ridding ourselves of the undesirable task of running hose lines within the work environment.

2.3.4 Implementation

AmerenUE has a respiratory program in full compliance with 10 CFR 20. The Mururoa BLU self fed single use suits, and V4 F1 and V4 MTH2 air supplied single use suits will be integrated into Callaway's respiratory program using the information provided by the manufacturer. Plant procedures will be revised to ensure single use only and appropriate suit disposal after each use. New lesson plans will be developed to train workers on Mururoa suits features, donning, use, removal and disposal after each use, cautions and use of mouth strip and tear off strips for routine and emergency egress. Radiation Protection personnel will be provided additional training for selection, approval, issue, equipment set-up, operation and maintenance instructions for each of the Mururoa suits. The Mururoa suits safety features, namely the tear-off mouth strip and the emergency tear-off strip, make it unnecessary for any standby rescue person. Further justification for eliminating the rescue person provision include the fact that workers wearing suits are typically under continuous surveillance by Radiation Protection technicians using remote video monitoring or under direct Radiation Protection surveillance at the job location due to radiological conditions. The ability to eliminate the rescue worker is also an ALARA consideration since the work areas where air-supplied suits are used are typically areas with higher radiation and contamination levels. Cavity decon, equipment decon are specifically targeted for the use of the Mururoa BLU self fed single use suit. These areas would benefit by the elimination of air lines, which may be a hindrance to overall outage performance.

AmerenUE will use the Corrective Action Request System (CARS) to document any unexpected problems and track corrective actions taken. Problems associated with the suits will be communicated to the manufacturer to ensure that operating experience is shared with other users. A relationship with the manufacturer will also be developed that allows operating experience from other users to be incorporated into AmerenUE processes. AmerenUE will be pleased to share this experience with the NRC and other utilities that may be interested in the Mururoa suits. Delta Protection has in place a vendor-user alert system so as to report any deviations, or deficiencies within the product and manufacturing process should they arise. The manufacturer is subjected to checks from the International Product Safety News (IPSN) to insure the product has no risk of injury to the user. A second organization called Quality Service Association (ASQUAL) performs annual inspections of the factory to certify that the product manufactured is of the same quality approved by the IPSN Notified Body. Several destructive/non-destructive tests are performed by the manufacturer for each order received from clients. Any defects reported by clients, investigations and corrective actions are documented. Customers are notified of any problems and products are recalled if necessary. This information is made available to ASQUAL for their annual inspections.

AmerenUE currently uses the bubblehood for jobs involving high potential for skin contamination from discrete radioactive particles and to prevent intake of airborne contaminates. Because the bubblehood covers only the face and torso, workers have to wear protective clothing, 2 pairs of gloves, rubber shoes and cotton booties and tape for

sealing. Chances of cross contamination during undressing/exit from contaminated areas are high. The Mururoa suits offer a better alternative (with their unitized construction and ease of removal) and should protect the worker much better against facial/skin contamination and airborne radioactivity. Approval of a protection factor of 2000 for the Mururoa suits would allow use of the Mururoa suits in AmerenUE's efforts to control contamination incidents and prevent intakes during operational activities at the Callaway Plant.

2.4 CONCLUSION

AmerenUE requests the approval for the use of the suits as per 10 CFR 20.1703(b) which requires use of respiratory protection equipment that is tested and certified by NIOSH. Based on in-house test conclusions, and review of manufacturer documentation the plant has determined that the Mururoa suits offer a safer and more efficient means to protect workers in areas of high radiological contamination and in areas where there is a potential for airborne contamination. Pursuant to 10 CFR 20.1703(b), AmerenUE is hereby requesting authorization to use the recently evaluated Mururoa BLU, V4 F1, and V4 MTH2 respiratory protection suits and equipment that are manufactured in France. Pursuant to 10 CFR 20.1705, AmerenUE is also requesting authorization to use an APF of 2000 with the Mururoa suits. The review of the manufacturer's documentation has shown that these suits provide better design and protection that supports the requested APF. Additionally, the suits have advanced safety features for emergency breathing and emergency escape. These advanced features allow self rescue during emergencies to be a reasonable expectation. Therefore, AmerenUE is also requesting exemption from 10CFR20.1703(f) in order to use the Mururoa suits without dedicated rescue personnel. All tests results indicate that this request for exemption is reasonable, is authorized by law, and will not result in undue hazard to life or property

ULNRC-05152
Enclosure 1
Attachment 2.5.3

"Test Report" No. 200323085/2120 for both Mururoa BLU suits

Testing and Certificate Bodies
in the BG-PRÜFZERT

[testing and certification system of the professional associations]

BIA
Berufsgenossenschaftliches
Institut für Arbeitsschutz
[BG-Institute for occupational safety and health]

Date : **18.06.2004**

TEST REPORT

No. 200323085/2120

1	**Requested by**	Delta Protection Z. A. du Berret 30200 Bagnols-sur-Ceze France
2	**Specimen tested**	Fan-assisted ventilated contamination protection garment
2.1	Manufacturer	Delta Protection Z. A. du Berret 30200 Bagnols-sur-Ceze
2.2	Type and description	Protective suit with exhaust valves, filters and fan Mururoa Blu Ethyfuge and Mururoa Blu PVC
	Description	Protective suit: **Mururoa Blu Ethyfuge** **Mururoa Blu PVC** fan : C500X-012ER-A B60 battery : C501A-012AK-A charger : Micronel C510L-230XX-A filter : Scott PF 10 Delta Protection P3
2.3	Purpose	Protective garment offering contamination protection with turbine and four particle filters Class 4 protection factor rating as per EN 1073-1: 1998 Device class TH3 PSL as per EN 12941: 1998 Minimum turbine operating time with the battery charged: 4 hours
2.4	Date of manufacture	2003
2.5	Miscellaneous	-.-

3	**Test**	
3.1	**Type of test**	Construction type test
3.2	**Date of test**	February to May 2004
3.3	**Test methods and bases**	EN 1073-1: 1998 and EN 12941: 1998
4	**Appreciation, fitness for use**	Fan-assisted ventilated contamination protection garments Mururoa Blu Ethyfuge and Mururoa Blu PVC fitted out as described in point 2.2 meet the requirements for device class TH3 PSL. Further, fan-assisted contamination protection garments Mururoa Blu Ethyfuge and Mururoa Blu PVC fitted out as described in point 2.2 meet the requirements provided under 4.4.2, 4.5, 4.6, 4.8, 4.11, 4.12, 4.13 and 4.14, and flame resistance to 4.2 under EN 1073-1: 1998 and also meet the requirements under 4.3 relating to the class 4 protection factor rating.

Miscellaneous information

Points 8 (identification) and 9 (instructions for use) under EN 12941: 1998 were not tested. This test report only applies to the fan-assisted contamination protection garment fitted out as described in point 2.2 that is designed to be used with four filters.

Compliance with point 5 of the protocol enclosed is required.

5 Validity of the test report

The results found are only applicable to the tested objects.

Restrictions on the validity and use of this test report:

6 General information

This test report comprises 12 pages.

Pages 1 to 3 contain the overall test result and may only be published in full.

The test protocol with detailed information is part of the test report.

This test report DOES NOT ENTITLE the manufacturer to use the GS mark, the BG mark or the CE mark.

Besides, regulations relating to the tests and certifications by test and certification centres within BG-PRÜFZERT are applicable, in association with the general terms of "Hautpverband der gewerblichen Genossenschaften e. V".

For the appreciation:	For the test:
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Hans-Ulrich Tobys, Engineer	b. o. Claudia Lietz
Certified professional	Director of the test laboratory

Test protocol

1. Test based on: EN 1073-1: 1998 and EN 12941: 1998

2. Type of test: Construction type test

3. Requested by: Delta Protection

4. Test specimen

4.1 Version: Protective suit with exhaust valves, filters and fan

4.2 Description: **Mururoa Blu Ethyfuge or Mururoa Blu PVC**

4.3 Identification: Protective garment: Mururoa Blu Ethyfuge
Mururoa Blu PVC

Fan	: C500X-012ER-A B60
Battery	: C501A-012AK-A
Charger	: Micronel C510L-230XX-A
Filter	: Scott PF 10
	Delta Protection P3

4.4 Device class: TH3 PSL

4.5 Number of filters: The tests were performed with the respiratory protection device running, fitted with four filters.

5. Device version

The fan-assisted ventilated contamination protection garment with four respiratory protection filters comprises a protective Mururoa Blu Ethyfuge or Mururoa Blu PVC suit in sizes 3 and 4 and a Delta Protection C500 fan.
The Mururoa Blu Ethyfuge and Mururoa Blu PVC protective garments have a similar design, other than the material of the suit, and they have similar wearing properties.
The two variants of the protective garment were tested as part of the procedure.
The rated output volume of the ventilation device can be set to either 400 l/min or 600 l/min.
The minimum operating time of the fan is four hours when the battery is fully charged.
All the tests were performed in the severest conditions claimed by the manufacturer.
According to the manufacturer, the particle filters mentioned in point 2.2 can be used indifferently.
Only identical filter types may be used. When the filters are replaced, the four filters need to be changed at the same time.

6. Mechanical strength

Before the tests on the filters, the filters were subjected to a mechanical strength test as per EN 12941: 1998, paragraph 7.11.

The tests were conducted on Mururoa Blu Ethyfuge or Mururoa Blu PVC protective suits.

The requirements were met.

7. Thermal strength

7.1 Requirement

The overall device and the two specimens of each type of tested filter are to be stored in accordance with the storage conditions recommended by the manufacturer for (72 ± 1) hours respectively after being exposed to extreme temperature and humidity values.

At the end of the storage time, there shall be no significant deformation of the main components of the device and the components shall not come off from the device.

7.2 Conditioning

Conditioning was in accordance with the manufacturer's storage conditions, at a temperature of 30 °C (75 % humidity) and -10 °C.
The conditioned device was then subjected to visual inspection.
The device was subsequently assessed as part of the test.
The tests were performed with Mururoa Blu Ethyfuge and Mururoa Blu PVC protective suits.
The thermal strength requirements applicable to the respiratory protection device were met.

8. Alert and checking systems

8.1 Requirements

Systems shall be provided to directly or indirectly check if the set rated output volume is reached.

TH2 and TH3 class devices shall have an alert system if the output volume is too low.

If a low output alert system is provided, the manufacturer shall provide a means to check if it is operating.

8.2 Test results

For checking the operating of the air supply unit and its alert system function, the electronic alert system integrated into the blowing system was used.
When the blowing system is started up, the operating of the alert system in the device is verified and reported by a sound signal lasting approximately 2 seconds. According to the manufacturer, the alert system is triggered when the minimum operating conditions are no longer met.

The alert systems were tested as delivered and after storage at certain temperatures.

With the two settings of the rated output volume, the alert system is triggered at a battery voltage of 10.4 volts.

The output volume at the alert system triggering limit was determined during a resistance alert (increase in filter resistance) and a voltage alert (drop in the power supply voltage).

With the two settings of the rated output volume, the relevant rated output volume was reached.

The requirements were met.

9. Air supply and duration of use

9.1	Setting of the rated output volume:	600 l/min
9.2	Minimum blower operating time:	4 hours (manufacturer's claim)

9.3 Requirement

The tests are to be performed with the battery fully charged, new filters, suit closed.

The tests are to be performed with the type of filter offering the greatest hydrodynamic resistance.

After the stated usage time, the rated output volume must be reached when the setting of the rated output volume is at its maximum value of 600 l/min.

9.4 Test result

The blowing systems were tested as delivered and after storage at certain temperatures.

Rated output volume [l/min]	$Q_{(0\,h)}$ [l/min]	$Q_{(4\,h)}$ [l/min]	U_{AL} [V]	U_{min} [V]
600	618	609	10.4	10.6
600	613	604	10.4	10.7

Avec $Q_{(0\,h)}$ = Initial output volume
$Q_{(4\,h)}$ = output volume after four hours of operation
$U_{(AL)}$ = alarm system battery voltage with the cover open
$U_{(min)}$ = minimum battery voltage determined after four hours of operation

The rated output volume of 600l/min was reached after the minimum operating time of four hours.

The requirements were met.

10. Dust accumulation capacity

10.1 Dust is accumulated by means of new filters and a fully charged battery on a Sheffield feeler connected to an artificial lung with an output volume per minute of 30 l/min (20 lifts/min, 1/5 l/min, sinusoidal).

The filter and blower are exposed to the test atmosphere.

The test dust is dolomitic dust as per EN 143.

With devices with blower filters of the H3 device class and (400 ± 100) mg/m³ dust concentration, dust is accumulated till the product of the dust concentration and the test time reaches 200 mg*h/m³ for particle filters and 100 mg*h/m³ for combined filters.

10.2 Requirement

The minimum output volume shall be reached after dust accumulation.
The tests shall be performed at the maximum setting of the rated output volume of 600 l/min.
The filters used during the accumulation shall meet the requirements in respect of the degree of transmission of particle filters.

10.3 Test results

Conditioning	Scott PF10	Delta Protection P3
Dust concentration [mg/m³]	428	435
Accumulation value [mg*h/m³]	214	216
Initial output volume [l/min]	605	618
Output volume after accumulation [l/min]	600	600

The rated output volume was reached.

The requirements were met.

11. Resistance to respiration

11.1 Requirement
The maximum expiration resistance with the blower operating and an expiration output volume of 160 l/min shall never exceed 500 Pa.
The test shall be performed with the type of filter offering the least aerodynamic resistance.
The tests shall be performed at the maximum rated output volume setting of 600 l/min.

11.2 Test results

Filter	Delta P3	Scott PF10
Resistance to expiration [Pa]	172 - 187	179 - 204

The tests were performed on Mururoa Blu Ethyfuge and Mururoa Blu PVC protective suits.

The requirement was met.

12. Filter permeation degree [D]

12.1 Requirements

Maximum filter permeation degree 0.2 %

12.2 Output volume: 150 l/min

12.3 Type of test

Test of the degree of permeation of individual filters

12.4 Test results

Filter		Scott PF10		Delta Protection P3	
Test	Conditioning	D-NaCl[%]	D-oil [%]	D-NaCl[%]	D-oil [%]
1	As per point 6	0.004	0.004	0.004	<0.005
2	As per point 6	0.004	0.003	0.005	0.006
3	As per points 6 and 7	0.006	0.003	0.007	0.0040
4	As per points 6 and 7	0.004	0.006	0.005	0.002
5	After accumulation	0.004	0.004	0.002	0.004

The requirements were met.

13. Multiple filters

If the device has several filters through which part of the total output volume flows, the output volume through each filter shall be equal.

This requirement is deemed to be met by multiple filters where the maximum difference in the aerodynamic resistance of the filters used is ≤ 0.2 in relation to the mean aerodynamic resistance.

The requirement was met by the filters of the system.

14. Flame resistance

After removal from the flame, no part of the safety system shall continue to burn. The tests were performed with Mururoa Blu Ethyfuge and Mururoa Blu PVC protective suits.

The requirements were met.

15. Strength of the supply tube and joints

As no unprotected supply tube is used in the protective suit, this test is irrelevant.

16. Resistance to crushing of the supply tube

As no unprotected supply tube is used in the protective suit, this test is irrelevant.

17. Connections and interconnections (4.4.2 EN 1073-1: 1998)

Connections and interconnections between the suit and removable elements such as sleeves and gloves or between shoes and trouser legs shall withstand a tensile force of 100N. The tests were performed with Mururoa Blu Ethyfuge and Mururoa Blu PVC protective suits.

The requirements were met.

18. Strength of the helmet visor

The helmet of the Mururoa Blu Ethyfuge safety suit is worn in the same way as on the person and placed on a feeler with the centre line horizontal.
A steel ball (D = 22 mm, m = 44g) is dropped on the middle of the visor from a height of 130 cm.

After an impact perpendicular to the surface, the visor shall show no visible damage. The tests were performed with Mururoa Blu Ethyfuge and Mururoa Blu PVC protective suits.

The requirement was met.

19. Noise generated

19.1 Requirement

The noise of the fan shall not exceed 75 dB(A).
The tests shall be performed at the maximum rated output volume setting of 600 l/min.

19.2 Test result

Sound at the ears of the wearer of the device: 70.5 dB(A)

The requirement was met.

20. Exhaust system / exhaust valves

20.1 The exhaust valves shall be protected from soiling and mechanical damage.

The requirement was met.

20.2 The exhaust valves shall be in perfect working order after being subjected to a continuous expiration air output of 600 l/min for 60 s.

The requirement was met.

20.3 The casing of the exhaust valves shall be fitted on the respiratory connection so as to withstand an axial tensile force of 50 N for 10 seconds.

The requirement was met.

21. Internal leaks

21.1 Test conditions

Conveyor belt speed:	5 km/h
Exercise time:	2 min
Air intake speed:	2 m/s
Types of exercise:	E 1 = standing
	E 2 = walking
	E 3 = walking while speaking
	E 4 = raising the arms
	E 5 = bending the knees

In addition to the exercises under EN 1073-1: 1998, the exercises that are critical for protective suits under EN 12941:1998 (walking while speaking) were performed. When the suit is closed, exercises with side draughts are not needed.

21.2 Requirements relating to class 4 under EN 1073-1: 1998

Internal leaks shall not exceed 0.01 % in any exercise.

The leak shall not exceed a mean value (MW) of 0.005 % in any test.

21.3 Requirements relating to class TH3 under EN 12941: 1998

Internal leaks shall not exceed 0.2% in any exercise or test.

21.4 Test performance

The tests were performed at the minimum rated output volume setting, i.e. 400 l/min.
Persons 6, 7, 9 and 10 who were subjected to the test wore the respiratory protective system as delivered and persons 1 to 5 and 8 wore the respiratory protective system after storage at certain temperatures.
Tests 3 to 7 were performed with the Mururoa Blu Ethyfuge protective suit and tests 1, 2 and 8 to 10 were performed with the Mururoa Blu PVC protective suit.
The results of tests 1 to 10 were determined with an NaCl aerosol.

21.5 Test results

	Test / Person subjected to the test									
Exercise	1/1	2/2	3/3	4/4	5/5	6/6	7/7	8/8	9/9	10/10
1	0.003	0.002	<0.001	<0.001	0.002	0.003	<0.001	0.002	0.002	0.002
2	0.003	0.003	0.002	0.004	0.002	0.003	0.005	0.003	0.002	0.004
3	0.004	0.001	0.002	0.004	0.003	0.004	0.003	0.003	0.002	0.004
4	0.003	0.007	0.003	0.009	0.004	0.009	0.004	0.002	0.001	0.004
5	0.002	0.007	0.003	0.009	0.004	0.009	0.004	0.002	0.001	0.004
MW	0.003	0.002	0.002	0.003	0.002	0.003	0.003	0.003	0.002	0.003

The requirements were met.

22. Pressure in the suit (4.12 EN 1073-1: 1998)

22.1 Requirements

Positive pressure shall not exceed 1000 Pa on average and 2000 Pa as the peak value.
Positive pressure shall be maintained.
Tests shall be performed at the maximum setting of the rated output volume, i.e. 600 l/min.
Tests shall be analogous to those mentioned in point 21.1.

22.2 Test results (pressure in Pa)

Test/Person	**Exercise**				
	1	**2**	**3**	**4**	**5**
1	170 - 180	130 - 200	120 - 240	120 - 220	40 - 300

The requirement was met.

23. Practical performance test

For the practical performance test:
- the Mururoa Blu Ethyfuge protective suit was assessed with tests 1 and 2
- and the Mururoa Blu PVC protective suit was assessed with performance test 3

subjectively by wearers of the device as provided in EN 12941: 1998.

23.1 Assessment by wearers of device 1

Putting on and taking off:	second person required
Accessibility of all control systems:	no remark
Weight distribution:	no complaint
Safety of connecting pieces and connections:	no complaint
Resistance to fogging of the sight window:	no complaint
Visual distortion through the sight window:	no complaint
Field of vision:	no complaint
Recognition of characters (150 mm at 6 m)	legible
Understanding with a supervisor:	no complaint
Distribution of the weight of the worn device:	no complaint
Accidental switching on and off:	no complaint
Influence of the air output volume:	no complaint
Fitness of the alert system:	adequate alert signal
Freedom of movement of the head:	no complaint
Comfortable for the wearer:	no complaint
Additional information:	none

23.2 Assessment by wearers of device 2

Putting on and taking off:	second person required
Accessibility of all control systems:	no complaint
Weight distribution:	no complaint
Safety of connecting pieces and connections:	no complaint
Resistance to fogging of the sight window:	no complaint
Visual distortion through the sight window:	no complaint
Field of vision:	no complaint
Recognition of characters (150 mm at 6 m)	legible
Understanding with a supervisor:	no complaint
Distribution of the weight of the worn device:	no complaint
Accidental switching on and off:	no complaint
Influence of the air output volume:	no complaint
Fitness of the alert system:	adequate alert signal
Freedom of movement of the head:	no complaint
Comfortable for the wearer:	no complaint
Additional information:	none

23.3 Assessment by wearers of device 3

Putting on and taking off:	second person required
Accessibility of all control systems:	no complaint
Weight distribution:	no complaint
Safety of connecting pieces and connections:	no complaint
Resistance to fogging of the sight window:	no complaint

Visual distortion through the sight window:	no complaint
Field of vision:	no complaint
Recognition of characters (150 mm at 6 m)	legible
Understanding with a supervisor:	no complaint
Distribution of the weight of the worn device:	no complaint
Accidental switching on and off:	no complaint
Influence of the air output volume:	no complaint
Fitness of the alert system:	adequate alert signal
Freedom of movement of the head:	no complaint
Comfortable for the wearer:	no complaint
Additional information:	none

24. Carbon dioxide in the inspired air

24.1 Requirement

The carbon dioxide content of the inspired air (dead space) measured when the blower is running shall not exceed a concentration of 1.0 by volume.

Tests shall be performed with the minimum setting of the rated output volume, i.e. 400 l/min.

24.2 Test performance

The Mururoa Blu PVC safety suit was worn in the same way as by the wearer and placed on a suitable test unit and the CO2 concentration in the inspired air was determined.

24.3 Test results

Test	Concentration % by vol.
1	0.58

The requirement was met.

25. Field of vision through the helmet

25.1 Requirement

Main field of vision:	≥ 70 %
Secondary field of vision:	≥ 80 %

25.2 Test results

Main field of vision	Secondary field of vision
100	100

The requirement was met.

26. Mass of the respiratory protection device

Fan	0.96 kg
Accumulator	1.41 kg
4 filters	0.56 kg
Protective suit	2.00 kg
Total mass (5 kg max)	4.93 kg
Mass carried on the head (1.5 kg max)	irrelevant

The requirements were met.

The test results provided in this document refer to the tested objects.
No inference about the homogeneity of the production may be made.

Berufsgenossenschaftliches Institut
für Arbeitsschutz – BIA –

pp

Christoph Thelen, engineer

Manager

Werner Piontkowski

ULNRC-05152
Enclosure 1
Attachment 2.5.4

Mururoa BLU PVC Instructions for Use

DELTA PROTECTION
Z.A du Berret
30200 BAGNOLS-SUR-CEZE - FRANCE
✆ (33) 04 66 89 18 36
✉ (33) 04 66 89 36 31

VENTILATED PROTECTIVE CLOTHING FOR ONE-TIME USE, "BLOWER SUPPORTED" TYPE (VENTILATED AND INTERNALLY PRESSURIZED) AGAINST PARTICULATE RADIOACTIVE CONTAMINATION; ACCORDING TO STANDARD EN 1073-1 (March 1998)

The Instructions for use have to be read and respected.

Warning:

- The selection and use of an individual protective suit must conform to the European guidelines EEC 89/656 of 30/11/1989.
- The user must first examine and evaluate the risks associated with the adoption and use of the individual protective suit selected.
- For this procedure, he will find guidance in the "Guide pour la sélection et l'utilisation des appareils de protection respiratoire" (guidelines for the selection and use of breathing protection devices), published by AFNOR, no. S76-005 CR 529. Investigation by the user must also consider the hindrance to rapid doffing of the equipment in an emergency, as well as the radiological consequences (radiation) to the person affected.

Introduction:

- This suit was developed for one-time use for protection against particulate radioactive hazards in accordance with standard EN 1073-1 and its use can be extended to cover protection against particles of all kinds.
- This (protective) clothing must be used only under supervision by the group leader in charge, who must first verify specifically that:
  - This suit provides protection corresponding to the categories of hazard faced.
  - The blowing unit of the ventilated suit is operating properly.
  - The particle filters used (type PF 10 ref. 0312103 or type DP P3 ref. 17 86 000) afford the necessary protection against the hazardous substances encountered during use.
  - All use of the suit takes place under supervision (either by physical presence or by video link) and all life-saving equipment is ready and available in case of emergency during the operation.

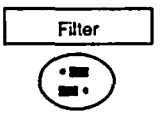
DESCRIPTION

The Mururoa BLU protective suit is used with a B60 blowing unit, delivering 400 or 600 l/minute (according to choice) and P3PF10 or DPP3 filters. The suit protects the wearer (whole body) against harmful solid particles, splashes and soiling.

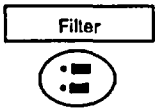
The equipment comprises a Mururoa BLU protective suit, a blowing unit, a battery, a charging device and 4 P3PF10 or DP P3 filters.

Selecting delivery of 400 l/min or 600 l/min: remove the rubber closure cap on the blowing unit unit to obtain access to the setting plugs. Move the lower red plug to the left to set the fan to 400 l/min and to the right to set it to 600 l/min position. NB: do not touch the top plug. Then fix the rubber closure cap back over the opening.

400 l/min:



600 l/min:



LIMITATIONS TO USE

- The filter apparatus must not be used in an unknown environment. In case of any doubt, isolating protective devices must be used, irrespective of the atmosphere present.
- Only filters of type PF 10 (ref. 03 12 103) or type DP P3 (ref. 17 86 000) may be used.
- The filtering apparatus should not be used in confined spaces (e.g. tunnels, tanks) or in conditions of lack of oxygen or presence of heavy gases (e.g. carbon dioxide).
- The filtering apparatus may only be used once if the air contains more than 18% oxygen by volume.
- The particle filters do not give protection against gases or vapours.
- The particle filters may only be used once against radioactive substances, micro-organisms (viruses, bacteria, moulds) or enzymes.
- Operating conditions: +5°C - +35°C, relative humidity less than 75%.

This protective clothing must be used with the blowing unit running. If the fan breaks down, the equipment no longer provides breathing protection and excessive levels of carbon dioxide may build up. (Danger of suffocation!).

Before use, it is essential to check:

- the condition and integrity of the protective suit and the breathing pipe.
- the condition and integrity of the blowing unit and its battery (no chock or failure).
- the condition and integrity of the P3 filter.

BATTERY

The technology of the battery (NiMh) demands that it should be fully charged before use and between times. The battery must therefore be removed and recharged each time it has been used. Nominal total recharging time is 8 hours.

CHARGING THE BATTERY

Charge the battery before use. Battery temperature before charging must be between +10°C and +30°C. Always use the charger developed for use with the B60 blowing unit (the charger is supplied with the blowing unit). The battery must be charged in a dry place at room temperature, away from direct sunlight and dust. Remove the battery block from the blowing unit by means of the release device. Push the charging plug fully into the charger adapter.

Connect the battery charger to the electricity mains (110-240 V/50-60 Hz)
Battery charger warning light displays: ——— Charging
——— Maintaining charge

ⓘ A battery cannot be used until the warning lights show " Maintaining charge ".

DONNING THE SUIT

- The wearer (of the protective clothing), aided by a dresser, conducts a visual inspection of the condition of the (protective) clothing and its components, removes the transport protection (cardboard on the visor and inside the clothing) and the protective film on the visor.
- He then lays the suit out flat and fits the blowing unit as follows:
  - Insert the blowing unit in the pocket provided for the purpose
  - Connect the pipe of the suit to the output of the blowing unit
  - Screw in the 4 filter cartridges and check that they are firmly seated against the blowing unit (for a hermetic seal).

Note: Fit the blowing unit with its fully charged battery (the battery clips into position under the blowing unit).

Fitting:
- Push back the two lateral stainless steel closures
- Fit the battery under the bottom of the blowing unit, pushing in the plug
- Pull the closures up and push them back towards the middle of the battery to secure the fastening on both sides.

Removal
- Pull the closures first outwards and then downwards to release the battery.

- He switches on the blowing unit and gets into the lower part of the suit through the opening at the back.
- His dresser then closes the two zip fasteners (sliding fastener + zip fastener) and ensures a hermetic seal by applying adhesive tape over the whole length of the opening. He ties the laces of the overboots round the ankle.
- The wearer makes sure that the air supply, blowing unit and excess pressure valves are working properly by bending down sharply several times.
- He can then enter the area of operations.

DOFFING THE SUIT

- The suit can be removed using the strip provided for the purpose. For this, the suit must still be ventilated. The dresser pulls the orange strip that runs from wrist to wrist over the top of the helmet and rolls both the front and back parts so that the contamination is inside and cannot come into contact with the wearer.
- It must be possible to remove the helmet quickly in case of need. Also pay attention to any other devices that could hinder removal of the suit (external safety harness, adhesive tape, etc.).

IMPORTANT

- Should the suit begin to lose air, if condensation begins to appear on the visor or the wearer feels unusual warmth, he should leave the area of operations immediately.
- Remember that the suit remains pressurized for a little while, even after the air supply is interrupted.

STORAGE

In original packaging, protected from light, at temperatures between +5°C and +45° C. Shelf life three years in original packaging.

EMERGENCY DEVICE

Tearing off the safety strip on the front of the helmet enables the wearer to breathe the outside air.
If the wearer (of the protective suit) tears off the doffing strip, the upper part of his body can be disengaged from the garment within 5 seconds.

BLOWING UNIT ALARM DEVICE

- The blowing unit that supplies the protective suit is provided with two audible warning devices which are triggered as follows:
  - Low throughflow (e.g. filter blocked by a foreign body), intermittent signal - - - - - - - - - - -
  - Weak battery (discharged battery), continuous signal _____ for several minutes.

Warning: Immediately after the end of the weak battery alarm (up to 15 minutes, depending on equipment) the system goes into safety mode and switches off the blowing unit automatically.
It is therefore vital to stop work as soon as the alarm sounds, as the potential danger is great.

If the blowing unit alarm sounds during operations:
- Leave the contaminated area immediately.
- Find the cause of the alarm (weak battery, blocked filter)
- Clear the problem before returning to the contaminated zone.

ERGONOMICS

The materials employed as combined and presented are not hazardous or in any particular respect noxious (e.g. irritant to the skin) for the wearer.

REMARKS

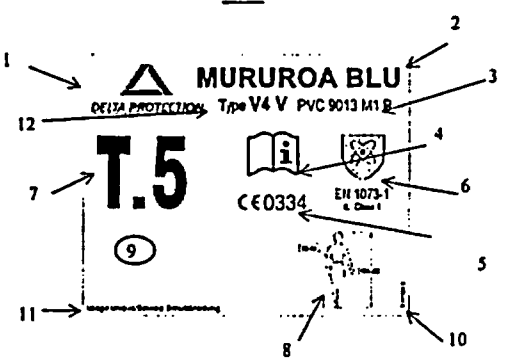
Disposable protective clothing

TECHNICAL CHARACTERISTICS OF THE MATERIALS

Type of test		Reference standard	Performance grade
Results for whole suit	Bending strength Abrasion strength Perforation strength Tear strength Flame resistance Strength of welded seams*	EN 1073-1	Inapplicable, as one-time use Class 6 (> 2000 cycles NF EN 530) Class 1 (> 10N NF EN 863) Class 3 (> 20N NF EN ISO 9073-4) Requirements met (EN 1146) Class 4 (> 125N ISO 5082)*
Results with respect to whole suit**		EN 1073-1	Protective clothing Class 4. Designates the nominal protection factor of the suit (Class 4: nominal protection factor of 20 000)

*: Mechanical strength (to ISO 5082) of the doffing strip or safety strip also corresponds to Class 4.
**: The protection factor results were obtained in the laboratory, and may vary more or less under actual working conditions.

KEY



DELTA PROTECTION
✆ 04 66 89 18 36

Position:

The labels are located on both outlet valves on the helmet and the back of the suit.

1. Manufacturer
2. Model name

Main material of the garment, and its fire resistance according NFP 92 507 : M1
NFG 07 184 : B

3. "Open book" pictogram: indication that the instructions for use should be read
4. EC mark. The garment conforms to standards relating to manufacture monitoring, type 11b in accordance with guidelines 89/686/EWG. 0334 is the identification number of the organization responsible for production control.
5. 

EN 1073-1: Requirements and test methods for ventilated protective clothing against particulate radioactive contamination. IL: Class 4 defines the nominal protection factor of the clothing (Class 4 nominal protection factor 20,000).

6. Garment size
7. Measurements of the different sizes.
8. Position for: date of manufacture, goods batch number and expiry date.
9. Number and reference of label checking
10. Certification of one-time use clothing to standard EN 1073-1
11. Internally ventilated type of protective clothing: type V4 V.

Garment EC certified by:
BIA
Berufsgenossenschaftliches Institut für Arbeitssichutzt
Alte Heerstraße 111
53754 Sankt Augustin - ALLEMAGNE
Telephone: +49 22 41 2 31-02 - Fax: +49 22 41 2 31 22 34

ULNRC-05152
Enclosure 1
Attachment 2.5.5

Mururoa BLU Ethyfuge Instructions for Use

DELTA PROTECTION
Z.A du Berret
30200 BAGNOLS-SUR-CEZE - FRANCE
✆ (33) 04 66 89 18 36
✉ (33) 04 66 89 36 31

VENTILATED PROTECTIVE CLOTHING FOR ONE-TIME USE, "BLOWER SUPPORTED" TYPE (VENTILATED AND INTERNALLY PRESSURIZED) AGAINST PARTICULATE RADIOACTIVE CONTAMINATION; ACCORDING TO STANDARD EN 1073-1 (March 1998)

The instructions for use have to be read and respected.

Warning:

- The selection and use of an individual protective suit must conform to the European guidelines EEC 89/656 of 30/11/1989.
- The user must first examine and evaluate the risks associated with the adoption and use of the individual protective suit selected.
- For this procedure, he will find guidance in the "Guide pour la sélection et l'utilisation des appareils de protection respiratoire" (guidelines for the selection and use of breathing protection devices), published by AFNOR, no. S76-005 CR 529. Investigation by the user must also consider the hindrance to rapid doffing of the equipment in an emergency, as well as the radiological consequences (radiation) to the person affected.

Introduction:

- This suit was developed for one-time use for protection against particulate radioactive hazards in accordance with standard EN 1073-1 and its use can be extended to cover protection against particles of all kinds.
- This (protective) clothing must be used only under supervision by the group leader in charge, who must first verify specifically that:
  - This suit provides protection corresponding to the categories of hazard faced.
  - The blowing unit of the ventilated suit is operating properly.
  - The particle filters used (type PF 10 ref. 0312103 or type DP P3 ref. 17 86 000) afford the necessary protection against the hazardous substances encountered during use.
  - All use of the suit takes place under supervision (either by physical presence or by video link) and all life-saving equipment is ready and available in case of emergency during the operation.

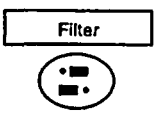
DESCRIPTION

The Mururoa BLU protective suit is used with a B60 blowing unit, delivering 400 or 600 l/minute (according to choice) and P3PF10 or DPP3 filters. The suit protects the wearer (whole body) against harmful solid particles, splashes and soiling.

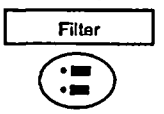
The equipment comprises a Mururoa BLU protective suit, a blowing unit, a battery, a charging device and 4 P3PF10 or DP P3 filters.

Selecting delivery of 400 l/min or 600 l/min: remove the rubber closure cap on the blowing unit unit to obtain access to the setting plugs. Move the lower red plug to the left to set the fan to 400 l/min and to the right to set it to 600 l/min position. NB: do not touch the top plug. Then fix the rubber closure cap back over the opening.

400 l/min:



600 l/min:



LIMITATIONS TO USE

- The filter apparatus must not be used in an unknown environment. In case of any doubt, isolating protective devices must be used, irrespective of the atmosphere present.
- Only filters of type PF 10 (ref. 03 12 103) or type DP P3 (ref. 17 86 000) may be used.
- The filtering apparatus should not be used in confined spaces (e.g. tunnels, tanks) or in conditions of lack of oxygen or presence of heavy gases (e.g. carbon dioxide).
- The filtering apparatus may only be used once if the air contains more than 18% oxygen by volume.
- The particle filters do not give protection against gases or vapours.
- The particle filters may only be used once against radioactive substances, micro-organisms (viruses, bacteria, moulds) or enzymes.
- Operating conditions: +5°C - +35°C, relative humidity less than 75%.

This protective clothing must be used with the blowing unit running. If the fan breaks down, the equipment no longer provides breathing protection and excessive levels of carbon dioxide may build up. (Danger of suffocation!).

Before use, it is essential to check:

- the condition and integrity of the protective suit and the breathing pipe.
- the condition and integrity of the blowing unit and its battery (no chock or failure).
- the condition and integrity of the P3 filter.

BATTERY

The technology of the battery (NiMh) demands that it should be fully charged before use and between times. The battery must therefore be removed and recharged each time it has been used. Nominal total recharging time is 8 hours.

CHARGING THE BATTERY

Charge the battery before use. Battery temperature before charging must be between +10°C and +30°C. Always use the charger developed for use with the B60 blowing unit (the charger is supplied with the blowing unit). The battery must be charged in a dry place at room temperature, away from direct sunlight and dust. Remove the battery block from the blowing unit by means of the release device. Push the charging plug fully into the charger adapter.

Connect the battery charger to the electricity mains (110-240 V/50-60 Hz)
Battery charger warning light displays: _____ Charging
_____ Maintaining charge

ⓘ A battery cannot be used until the warning lights show " Maintaining charge ".

DONNING THE SUIT

- The wearer (of the protective clothing), aided by a dresser, conducts a visual inspection of the condition of the (protective) clothing and its components, removes the transport protection (cardboard on the visor and inside the clothing) and the protective film on the visor.
- He then lays the suit out flat and fits the blowing unit as follows:
  - Insert the blowing unit in the pocket provided for the purpose
  - Connect the pipe of the suit to the output of the blowing unit
  - Screw in the 4 filter cartridges and check that they are firmly seated against the blowing unit (for a hermetic seal).

Note: Fit the blowing unit with its fully charged battery (the battery clips into position under the blowing unit).

Fitting:
- Push back the two lateral stainless steel closures
- Fit the battery under the bottom of the blowing unit, pushing in the plug
- Pull the closures up and push them back towards the middle of the battery to secure the fastening on both sides.

Removal
- Pull the closures first outwards and then downwards to release the battery.

- He switches on the blowing unit and gets into the lower part of the suit through the opening at the back.
- His dresser then closes the two zip fasteners (sliding fastener + zip fastener) and ensures a hermetic seal by applying adhesive tape over the whole length of the opening. He ties the laces of the overboots round the ankle.
- The wearer makes sure that the air supply, blowing unit and excess pressure valves are working properly by bending down sharply several times.
- He can then enter the area of operations.

DOFFING THE SUIT

- The suit can be removed using the strip provided for the purpose. For this, the suit must still be ventilated. The dresser pulls the blue strip that runs from wrist to wrist over the top of the helmet and rolls both the front and back parts so that the contamination is inside and cannot come into contact with the wearer.
- It must be possible to remove the helmet quickly in case of need. Also pay attention to any other devices that could hinder removal of the suit (external safety harness, adhesive tape, etc.).

IMPORTANT

- Should the suit begin to lose air, if condensation begins to appear on the visor or the wearer feels unusual warmth, he should leave the area of operations immediately.
- Remember that the suit remains pressurized for a little while, even after the air supply is interrupted.

DELTA PROTECTION
0: 04 66 89 18 36

STORAGE

In original packaging, protected from light, at temperatures between +5°C and +45° C. Shelf life three years in original packaging.

EMERGENCY DEVICE

Tearing off the safety strip on the front of the helmet enables the wearer to breathe the outside air.
If the wearer (of the protective suit) tears off the doffing strip, the upper part of his body can be disengaged from the garment within 5 seconds.

BLOWING UNIT ALARM DEVICE

- The blowing unit that supplies the protective suit is provided with two audible warning devices which are triggered as follows:
  - Low throughflow (e.g. filter blocked by a foreign body), intermittent signal - - - - - - - - - -
  - Weak battery (discharged battery), continuous signal _____ for several minutes.

Warning: Immediately after the end of the weak battery alarm (up to 15 minutes, depending on equipment) the system goes into safety mode and switches off the blowing unit automatically.
It is therefore vital to stop work as soon as the alarm sounds, as the potential danger is great.

If the blowing unit alarm sounds during operations:
- Leave the contaminated area immediately.
- Find the cause of the alarm (weak battery, blocked filter)
- Clear the problem before returning to the contaminated zone.

ERGONOMICS

The materials employed as combined and presented are not hazardous or in any particular respect noxious (e.g. irritant to the skin) for the wearer.

REMARKS

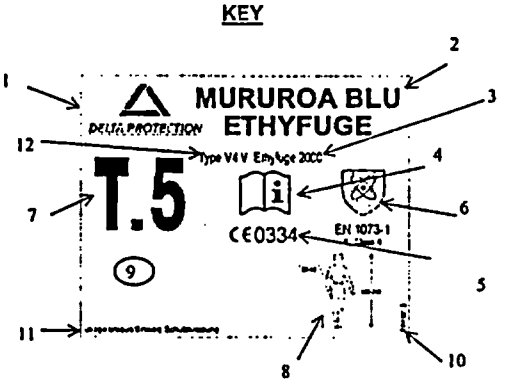
Disposable protective clothing

TECHNICAL CHARACTERISTICS OF THE MATERIALS

Type of test		Reference standard	Performance grade
Results for whole suit	Bending strength Abrasion strength Perforation strength Tear strength Flame resistance Strength of welded seams*	EN 1073-1	Inapplicable, as one-time use Class 6 (> 2000 cycles NF EN 530) Class 1 (> 10N NF EN 863) Class 3 (> 20N NF EN ISO 9073-4) Requirements met (EN 1146) Class 3 (> 75N ISO 5082)*
Results with respect to whole suit**		EN 1073-1	Protective clothing Class 4. Designates the nominal protection factor of the suit (Class 4: nominal protection factor of 20 000)

*: Mechanical strength (to ISO 5082) of the doffing strip or safety strip also corresponds to Class 3.
**: The protection factor results were obtained in the laboratory, and may vary more or less under actual working conditions.

KEY



Q: 04 66 89 18 36

Position:

The labels are located on both outlet valves on the helmet and the back of the suit.

1. Manufacturer
2. Model name
3. Main material of the garment
4. "Open book" pictogram: indication that the instructions for use should be read
5. EC mark. The garment conforms to standards relating to manufacture monitoring, type 11b in accordance with guidelines 89/686/EWG. 0334 is the identification number of the organization responsible for production control.
6. 

EN 1073-1: Requirements and test methods for ventilated protective clothing against particulate radioactive contamination. IL: Class 4 defines the nominal protection factor of the clothing (Class 4 nominal protection factor 20,000).

7. Garment size
8. Measurements of the different sizes.
9. Position for: date of manufacture, goods batch number and expiry date.
10. Number and reference of label checking
11. Certification of one-time use clothing to standard EN 1073-1
12. Internally ventilated type of protective clothing: type V4 V.

Garment EC certified by:
BIA
Berufsgenossenschaftliches Institut für Arbeitssichutzt
Alte Heerstraße 111
53754 Sankt Augustin - ALLEMAGNE
Telephone: +49 22 41 2 31-02 - Fax: +49 22 41 2 31 22 34

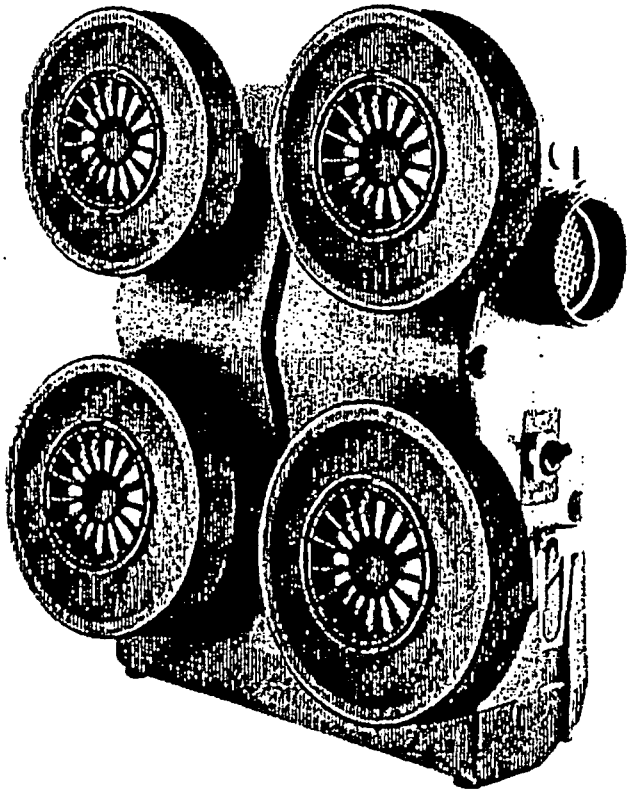
ULNRC-05152
Enclosure 1
Attachment 2.5.6

Instruction Manual for C500 Blowing Unit

DELTA PROTECTION

Bacou-Dalloz

INSTRUCTION MANUAL
BLOWING UNIT BLU C500



Compact Air Supply Unit (CASU)

Part No:	**C500X-012EK-A B30**	300/200 l/min
Part No:	**C500X-012EK-A B60**	600/400 l/min
Class:	EN12941: 1998 TH3 PSL	

To be used with:

Battery Module	C501A-012AK-A
Intercon Cable	C502L-012XX-A
Cigarette Lighter Cable	C503L-012XX-A
Power Supply	C504L-230XX-A
Charger	C510L-230XX-A
Flow Control	C401X-500A9

DELTA PROTECTION

Bacou-Dalloz

Index

1 Important Instruction

- **Caution:** Carefully read this instruction and implement necessary steps as indicated before initial use.

1.1 Application Field

- The Blowing Unit BLU with corresponding modules can be used in connection with an overall protective suit for various applications.
- Particular standards and technical regulations have to be considered.

1.2 Description and Operating Mode (see also 7.1 Explosive Drawing)

- The blowing unit BLU consists of 4 filter threads Rd40 and the blower with electronics control.
- The unit is equipped with an Rd52-thread for the air hose.
- With the lever switch the BLU can be set ON and OFF.
- The air flow is pre-adjusted and marked by the colour of the service cover (see 1.5)
- The battery housing contains the rechargeable NiMH batteries. The 4-pole-plug can be fixed to both the blower housing and the battery for charging.

1.3 Insufficient Air Flow

- If the fan does not perform the required airflow the unit starts an intermittent warning signal "Low Flow" (interval approx. 0.5 seconds). From the start of the warning signal there is a remaining security running time of approx. 15 min at 20 °C.

1.4 Total discharge of Battery

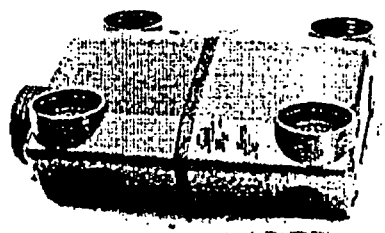
- Battery end is signalised by a continuous warning signal "Low Battery". From the start of the warning signal there is a remaining security running time of approx. 15 min at 20 °C.
- **Caution:** Afterwards the BLU has to be switched off in order to avoid possible damage of the battery (total discharge of the battery)

1.5 Preparation of the Blowing Unit BLU

- Visual control in view of damages
- Are the 4 filters sealing placed correctly.?
- Check pre adjusted air flow by mean of service cover colour:

C500X-012EK-A

B60 :BLACK	**600**	**400 lpm**
B30 :RED	**300**	**200 lpm**



picture 1

1.6 Filter

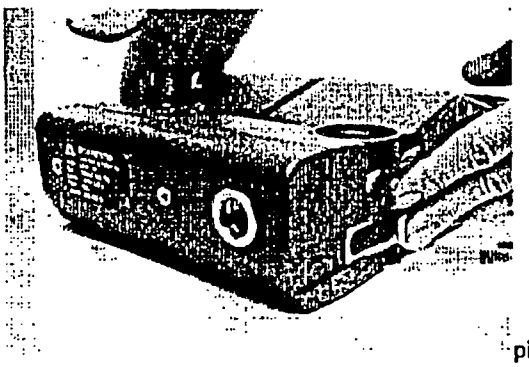
- Put the blowing unit into operation only with correctly screwed filters.
- Only use the specified DP PF10 or DP P3 filters.
- **Caution:** The unit performs the pre-adjusted airflow only with the specified filters. Non observing may result in danger of life.
- Screw the filters in order that all sealings are pressed and the filter connections tight.
- Only use 4 filters of same type (changed same time).

2 Putting into operation of the Blower Unit BLU

- Various power connection/source possibilities:
  - Standard battery (chapter 2.1)
  - Battery via interconnection cable (chapter 2.2)
  - External power supply 12 VDC (chapter 2.3 and chapter 2.5)
  - External power supply 90-264 VAC (chapter 2.4 and chapter 2.6)
- Notice also chapter 1 2 "Operating Mode"

2.1 Operation directly from the battery module I

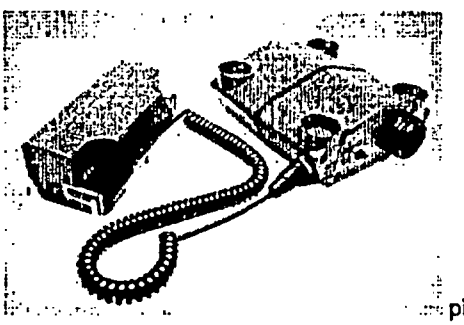
- Attach the battery module to the BLU unit (see picture 2)
- **Caution:** Only use fully charged batteries (see chapter 4 "Battery Loading")



picture 2

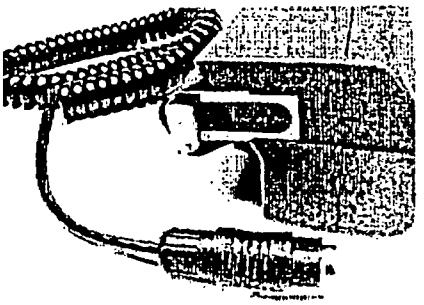
2.2 Battery function via interconnection cable

- Connect the battery module to the cable according to picture 3.
- **Caution:** Only use fully charged batteries (see chapter 4 "Battery Loading")



picture 3

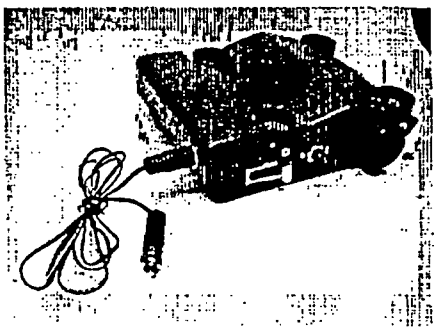
- The battery module has to be attached separately.
- Unlocking device according to picture 4



picture 4

2.3 External power with cigarette lighter connector 12VDC

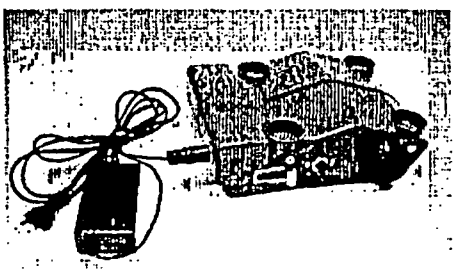
- This cable can be directly connected to the battery module. The cigarette connector fits into an ordinary car cigarette lighter plug. .
- **Caution:** The Blowing unit BLU cannot be set on when connecting both, interconnection cable and external power.



picture 5

2.4 External power with power supply 90 -264VAC

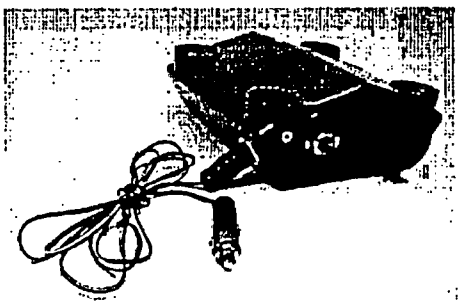
- The power supply can be directly connected to the battery module.
- **Caution:** The Blowing unit BLU cannot be set on when connecting both, interconnection cable and external power.



picture 6

2.5 External power with cigarette lighter connector cable 12VDC (without battery)

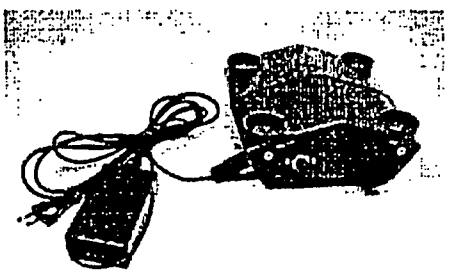
- This cable can be directly connected to the Blowing unit BLU. The cigarette connector fits into an ordinary car cigarette lighter plug.
- **Caution: No warning signal** in case of power cut.



picture 7

2.6 External power with power supply 90-264VAC (without battery)

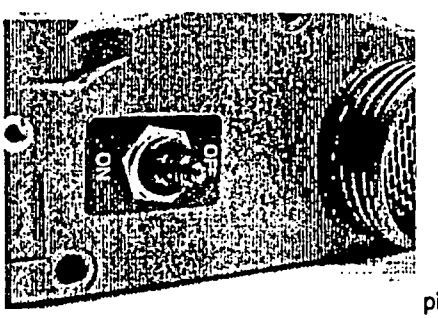
- The power supply can be directly connected to the Blowing unit BLU
- **Caution: No warning signal** in case of power cut.
-



picture 8

2.7 Functioning control

- Switch the Blowing unit BLU on according to picture 9. Close the air exhaust (Rd52) of the Blowing unit (for example with your hand)



picture 9

2.7.1 BLU functions correctly

When the blower rotations are increasing (louder sound) together with alarm signal "Low Flow" (0,5 seconds interval).
In case the airflow falls below nominal value an intermitting alarm signal starts (0,5 seconds interval).

2.7.2 Defective alarm signal

Increasing rotations and no alarm signal. .
Caution: Do no longer use the Blowing unit BLU. The BLU needs to be serviced.

2.7.3 Defective housing

Increasing blower rotations together with alarm signal.
Caution: Do no longer use the Blowing unit BLU. The BLU needs to be serviced

2.7.4 Battery charging

Constant alarm signal (continuous tone) means low battery.
Caution: Do no longer use the Blowing unit BLU. Exchange the battery module for a fully charged battery module.

2.7.5 Airflow control (option)

The airflow control measures the airflow.
- Hold the measuring instrument within a distance of 5 cm from the outlet adapter and read the airflow on the indication.
- Important: do not hold the Blowing unit BLU against a bright light source in order to avoid failure function.

picture 10

3 Operation of the Blowing unit BLU with Protective Suit or protective hood.

3.1 Fixation of air hose

- Screw the air hose by mean of the Rd52-nut to the BLU and possibly also to the protective suit or protective hood. Screw tightly until the sealing is pressed and the hose connection is leak proof.

3.2 Fixation of the Blowing unit to the Protective Suit

- Functioning control as described under 2.7
- Read and respect the protective suit instructions for use.

4 Battery Charging

4.1 Charger unit for 90-264VAC

- Connect the battery module with the cable to the charger unit
- Indication lamp red shines constantly: the module is in charging condition and **may not be used.**
- Indication lamp red flashes slowly: the module is fully charged and ready for use. .
- Indication lamp red flashes quickly: too high or too low temperature. The charger unit **may not be used** and first has to be brought to normal/correct temperature.

4.2 Charging condition of battery module

- In order to have always charged battery modules available, connect the module to the charger after every use.
- Before the first use, charge/discharge roughly 5 times the battery to have the full capacity.
- See also chapter 2.7.4.

5 Maintenance

5.1 Cleaning

- *Ordinary cleaning with soapy water and only with openings and air exhaust closed.*
- **Caution:** Showering only with shower cap and the blowing unit running.

5.2 Sterilisation (for medical applications)

- See special instructions.

5.3 Maintenance and Inspection

- The Blowing unit does not need maintenance for approx. 1000 hours.
- After this period of use all adjustments have to be checked by the technical servicing department.

5.4 Technical service

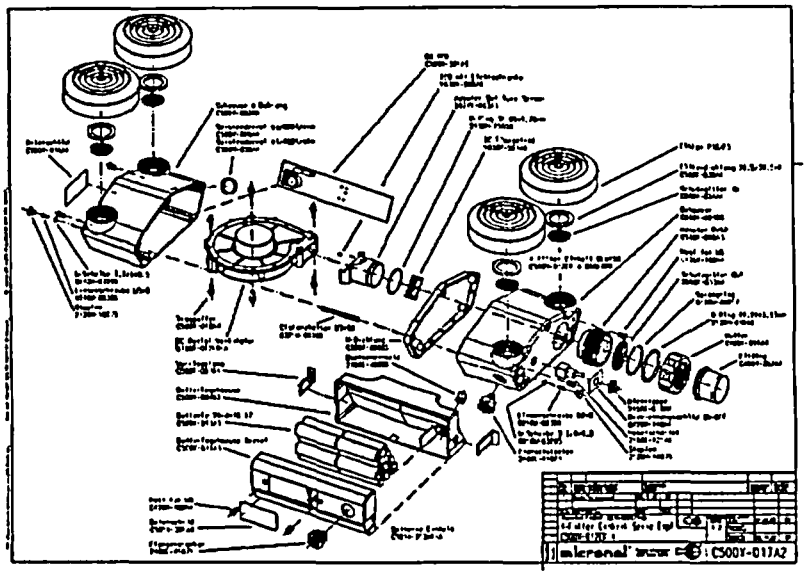
- **Execution of all kind of service work only by authorized qualified staff.**

6 Malfunction

- The blowing unit does not start: no Battery or empty battery
- Alarm signal: see chapter 2.7
- *Running time is not reached. Battery insufficiently charged or defective.*

7 Replacement Parts

7.1 Blowing unit drawing



7.2

Part Description	Part Number
- Blower Unit	C500X-012EK-A B60 oder B30
- Battery Module	C501A-012AK-A
- Intercon Cable	C502L-012XX-A
- Cigarette Lighter Cable	C503L-012XX-A
- Power Supply	C504L-230XX-A
- Charger Unit	C510L-230XX-A
- Filters	XXXXXXXXX
- Service Cover red	C500X-030B4
- Service Cover black	C500X-009B4
- Filter Sealing	C420X-011A4

8 Storage

- Storage of the blowing unit within the packing at room temperature of – 10 / + 60 °C.
- Charging of battery at least once a year.
- After use store the blowing unit in proper condition (cleaned).

9 Waste Management

- Disposal of the Units according to local/national regulations for waste disposal. Plastic parts weighing more than 10 gr are marked with the material identification.

10 Technical Data

Part	Description		Capacity	
BLOWING UNIT C500x-012EK-AB60	Service cover black		600 Pa – 600 l/min	
	Running time with fully charged battery		minimum 4 h	
	Service cover red		280 Pa – 400 l/min	
	Running time with fully charged battery		minimum 7 h	
BLOWING UNIT C500x-012EK-AB30	Service cover black		420 Pa – 300 l/min	
	Running time with fully charged battery		minimum 11 h	
	Service cover red		200 Pa – 200 l/min	
	Running time with fully charged battery		minimum 18 h	
BLOWING UNIT C500x-012EK-ABXX	Measuring at air density of		1,2 kg/m^3	
	Blower		Electronically controlled radial fan	
	Sensor		Optical airflow sensor	
	Warning signal	Whistle (continuous sound)	15 min. before battery end	
		Beep (0,5s interval)	not enough airflow (Low flow) see 1.3	
	Material/Colour		NORYL GFN1-211 / blue	
	Weight		1000 gr without filters	
	Dimensions (without filters)		192 x 190 x 76 mm	
	Application range		+ 10 / + 50 °C	
FILTERS	Filter class		P3	
	Filter Type(thread Rd40x1/7")		DP PF 10	DP P3
	Weight		90 gr/filter	130 gr / filter
	Shower Cap		EPDM black	
Battery	Nominal voltage		12 VDC	
	Capacity		9 Ah	
	Type (rechargeable)		NiMH	
	Regular charging time		7 h	
	Number of charging cycles		500	
	Material/Colour		NORYL GFN1-211 / bleu	
	Weight		1440 gr	
	Dimensions d x h		88 x 190 x 70 mm	
	Application range		+ 10 / + 50 °C	
Charger	Type		C510L-230XX-A	
	Entrance voltage range		90 – 264 V / 50/60 Hz	
	Exhaust voltage		12 VDC	
	Charger plug		4 pôles	
	Material / Colour		PPE-V1 125°C, noir	
	Dimensions d x h		105 x 68 x 39 mm	
External power supply	External battery		12 VDC spiral cable 2,5 m streched	
	With cigarette lighter plug		12 VDC spiral cable 2,5 m streched	
	With power supply		230 VAC spiral cable 2,5 m streched	

11 Warranty and Liability

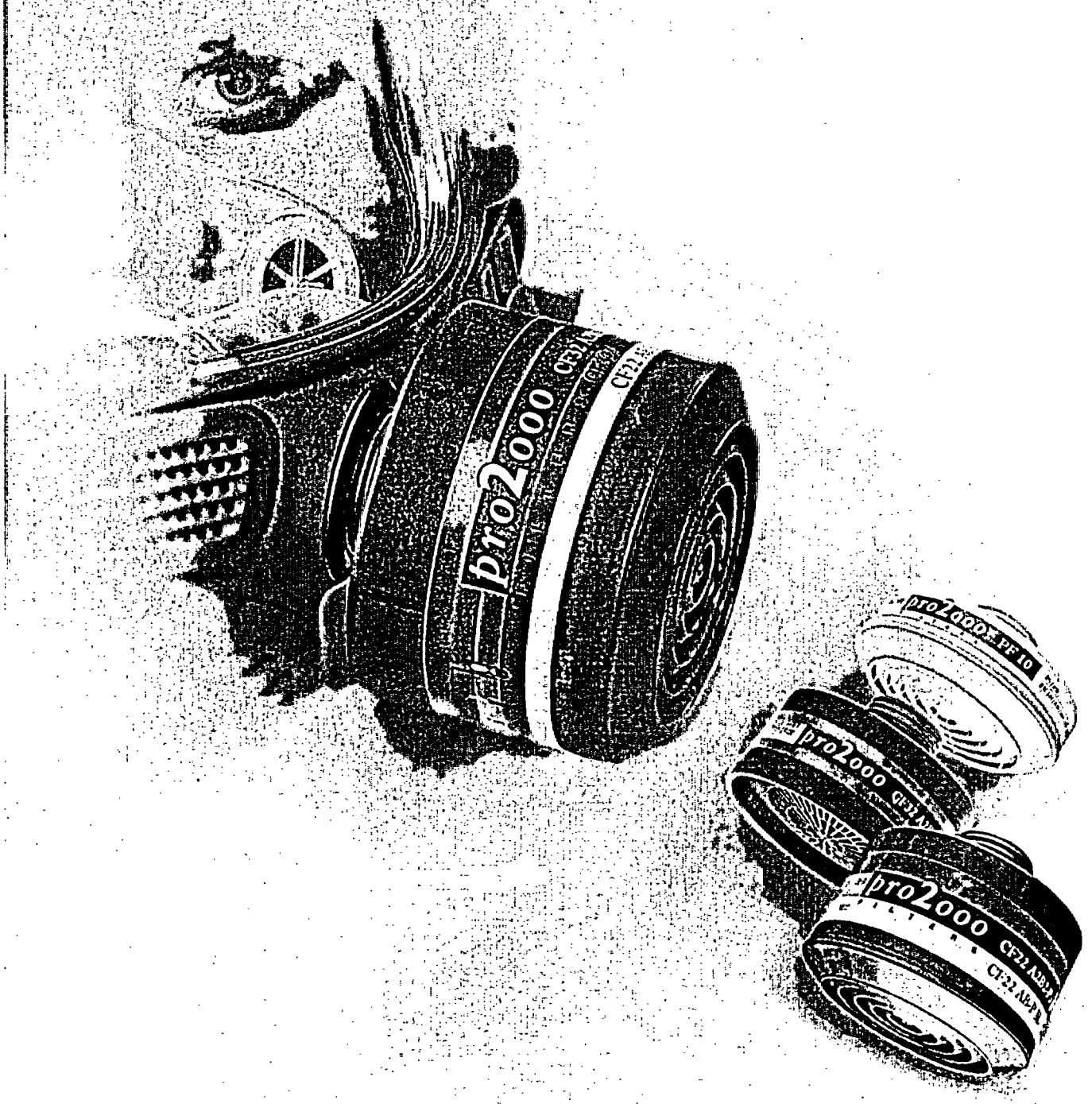
Our warranty period will be in accordance upon in each case from the date of delivery. The warranty covers any defects in material or workmanship. It is our decision whether the defective part or parts will be replaced, repaired or the invoice value of the non replaced part or parts be reimbursed.; and further liability, in particular, subsequent damages, are excluded. We do not accept any liability for alterations or repairs of any kind, not performed by us or a specialist recommended by us, in addition the warranty will expire in such a case.

ULNRC-05152
Enclosure 1
Attachment 2.5.7

PRO 2000 Filters Description and Technical Data

PRO2000 FILTERS

FOR RESPIRATORY
PROTECTIVE EQUIPMENT



SCOTT

PRO2000

FILTER RANGE

The Pro2000 filter range embraces the entire selection of respiratory filters, all of which conform to EN standards and carry the CE mark. Pro2000 filters are particularly suitable for use with the Scott's full face masks and powered respirators. The Pro2000 filter connector meets the EN 148-1 standard, 40 mm thread.

PRO2000 FILTERS

- Particle filters trap wide range of particulate impurities, e.g. solid particles, smoke, welding fumes, aerosols, mists, micro-organisms (bacteria and viruses) plus radioactive particles.
- Gas filters protect against hazardous gases and vapours.
- Combined filters protect against both gaseous and particulate contaminants.

Features of the particle filter

Particle filter element is made of high-quality microfibre, which, together with accurate manufacturing technology, creates an exceptionally uniform filter element structure.

- PF10 P3 features a high capacity filter element; trapping even the smallest particles, with an efficiency 99,999 %.
- The filter element is extremely water-repellent.
- The vast intake area reduces the likelihood of clogging and resistance.

Features of the gas filters

Scott utilises superior raw material which is activated and impregnated to produce the best performance by Pro2000 filters.

- The microporous structure of the carbon consists of minute capillaries, which give the granules an extended area for adsorption.
- The gas filter features high retention capacity for a long working life.
- Less carbon means lighter filter element and less resistance – a real benefit for the user.
- With a safe margin to EN requirements, Pro2000 gas filters perform effectively using only 220–320 ml of carbon.

HOW TO SELECT A FILTER?

- Will the atmosphere contain sufficient oxygen (21 vol%) throughout the period of exposure?
- Which hazardous substances are likely to be present?
- Which forms do the airborne contaminants take? Are they particles, gases or vapour or indeed a mixture of these.
- What effects can these substances have on the respiratory organs? Special attention is needed if there are several substances that may interact, either by reacting chemically, or by having synergistic adverse health effects.
- What are the concentrations in the atmosphere?
- What are the relevant occupational exposure limits (OEL) or safe exposure levels?

The level of protection required can be calculated as follows:

1. Divide the measured workplace concentration by the OEL-value of the substance
2. After that select the respirator, which has a protection factor superior to the required level of protection.

$$\text{Protection factor needed} = \frac{\text{Workplace concentration}}{\text{OEL value of the contaminant}}$$

Protection factor needed?

Contaminant:	harmful airborne dust
Measured concentration	5 mg/m³ *[time-weighted average]*
OEL	0.2 mg/m³

The minimum protection factor needed: 5/0.2 = 25.

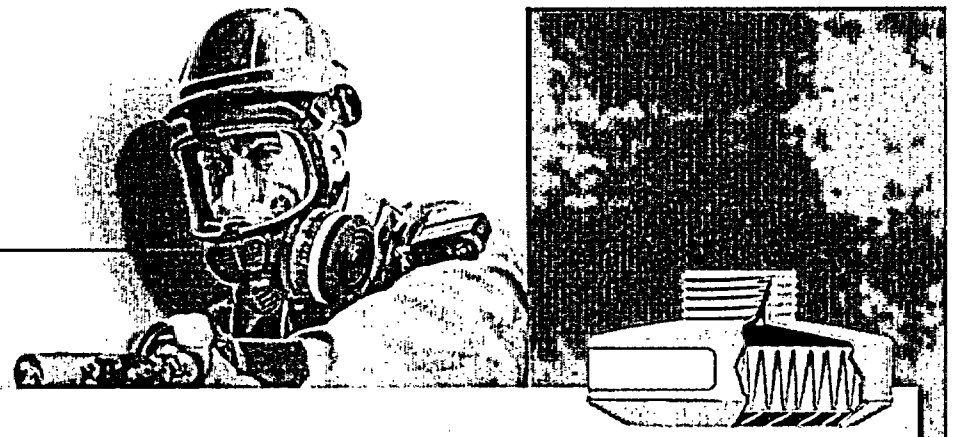
Protection factor 25 is needed and as the calculated value for multiples of the limit show that half mask with P3-filter will provide adequate protection.

What is the maximum permitted concentration of contaminant when using a full face mask with B2-gas filter?

Contaminant	Chlorine (Cl_2)
OEL	1 ppm

Full face mask with a gas filter has a workplace protection factor of 400, which means that full face mask is allowed to use in multiples of 400 x OEL concentration.

The max concentration can be calculated: 400 x 1 ppm (Cl_2) = 400 ppm = 0,04 vol.% of chlorine.



PARTICLES

Particle filter performance

The risk caused by particles depends on

- The physical, biological and chemical properties of the contaminant
- Particle size and form
- Concentration in the ambient air, and exposure time
- Work pace; the more rapid respiration, the more particles are inhaled.

The particle filter element employs a number of mechanisms to remove particles from the air. The basic concept of particle filtration is similar to that of a sieve, which removes all particles down to a certain particle size. Other means include impaction, interception and diffusion.

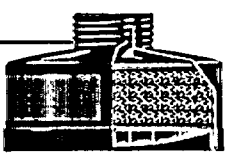
Particle filter capacity to EN 143.

Class	Capacity	Max permitted penetration NaCl (solid, dusts)	Max permitted penetration Paraffin oil (liquid, aerosols)	Limits of use Max permitted exposure level
P1	Low capacity *(against coarse and minor solid particles)*	20 %	20 %	4 x OEL-value
P2	Medium capacity *(against solid and liquid hazardous particles)*	6 %	6 %	12 x OEL-value
P3	High capacity *(against solid and liquid toxic particles as well as radioactive particles and micro-organisms)*	0,05 %	0,05 %	With a half mask 30 x OEL value. With a full face mask 400 x OEL value.

Particle filter operation life

- Filter does not wear out but gets clogged with particles and moisture, which results in increased breathing resistance. Particle filter must be changed when breathing becomes burdensome.
- Against radioactive substances, micro-organisms and enzymes, particle filter is recommended on a single use basis.
- The particle filter and combined filter must be changed at the latest when breathing resistance is noticeable.

GASES AND VAPOURS



Gaseous substances

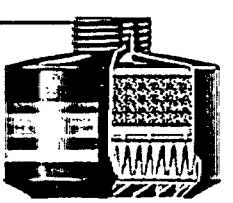
Gaseous impurities have various effects on health

- They can irritate the membranes of respiratory organs, the eyes and skin
- They can reach the lungs and cause damages
- They can be absorbed in the blood and cause temporary or permanent damage to various parts of the body
- They can cause irreparable damage to the nervous system
- The most hazardous gases can intoxicate or suffocate, and even destroy individual bodily organs
- They can be lethal

The effects of the harmful gases depend on

- The characteristics of the gas or vapour; its toxicity and substance
- The concentration of the contaminant in the air
- Duration of exposure to the contaminant
- The chemical compound of the contaminant
- The ability to react chemically with organic tissue as well as the propensity to be absorbed in the blood
- Personal characteristics e.g. rate of respiration, condition of the blood circulation and sensitivity of the person

COMBINED FILTERS



Combined filters remove hazardous gases and vapours as well as solid and liquid particles. The particle filter traps aerosol-based particles such as paint droplets. When spraying liquid substances (e.g. pesticides) a combined filter must be used.

Physiological effects of particulates on human body

Minor effects, inert	effect of concentration, e.g. <5 mg/m^3 slight irritation, > 30 mg/m^3 high irritation
Detrimental, hazardous	changes in lung tissues, e.g. silica dust, quartz, pulmonary fibrosis, e.g. asbestos and other fibres mesothelioma, cancer
Poisonous	e.g. metal fumes, lead, chromium, cadmium, mercury
Airborne radioactive substances	can cause severe damages, e.g. cancer
Micro-organisms, biological agents	can cause hazardous diseases, e.g. farmer's lung

How far the particles penetrates depend on the particle size - the smaller the size the more greater hazard they can cause

Particle size	*Pulmonary tract*
> 10 µm	Membranes of nose and mouth
> 5 ... 10 µm	Cilia, nose, trachea, bronchi
< 5 µm	In the lungs, pleura
< 1 µm	Alveoli

Particle forms

- ***Dusts*** are airborne solid particles, which are generated during the processing of organic and inorganic substances. Solid particles can be mineral, metal, coal, wood, or crop dusts as well as various fibres, e.g. asbestos, silicate, fibreglass.
- ***Fumes***, evaporating metal creates fumes during cooling. Hot material reacts with oxygen and creates oxides. Lead smelting, for example produces lead oxide fumes; in welding, iron oxide and other metal fumes are produced.
- ***Smoke*** consists of small coal and soot particles which incorporate both liquid droplets and solid particles.
- ***Mists*** are airborne droplets which are created when a fluid disperses in air in form of small particles, e.g. oil mists during metal working, when cutting or grinding.
- ***Micro-organisms***, e.g. bacteria, viruses, spores.
- ***Radioactive particles*** are generated as a result of radiation.

GAS FILTER PERFORMANCE

Examples of gas filter applications

A-FILTER

Filters gases and vapours from organic compounds with a boiling point over 65 °C.

Examples of specific hydrocarbons: toluene, benzene, xylene, styrene, turpentine, cyclohexane, carbon tetrachloride, trichloroethylene.

Some solvents are often used as mixtures, e.g. benzene-based solvents, petroleum spirits, mineral turpentine, white spirit, solvent naphtha.

Thinners are solvent mixtures that usually contain toluene, methyl-isobutyl ketone, thisobutanol and ethylene glycol.

Other organic compounds: dimethyl formamide, phenol, furfuryl alcohol, diacetone alcohol.

In addition some raw ingredients and additives in plastics, e.g. phthalates, phenol resins, epoxy plastics. Polychlorinated biphenyls as PCB isomers.

B-FILTER

Inorganic gases and vapours

e.g. chlorine, nitrogen dioxide, hydrogen sulphide (H_2S), hydrogen cyanide (HCN), hydrogen chloride (HCl), cyanide compounds, phosphorus and phosphoric acid.

E-FILTER

Organic acids, acid gases and generally gaseous acids, e.g. nitric acid, propionic acid, sulphur dioxide, sulphuric acid, formic acid.

K-FILTER

Ammonia and its organic ammonia derivatives, organic amines such as methylamine, ethylamine, ethylenediamine, diethyl-amine.

AX-FILTER

Gases and vapours from organic compounds with a boiling point below 65 °C.

E.g. acetaldehyde, acetone, butane, butadiene, diethyl ether, dichloromethane, dimethyl ether, ethylene oxide, methanol, methylene chloride, methyl acetate, methyl formate, vinyl chloride.

Note! Certain low boiling organic gases can be filtered with either B- or E- or K-filter, e.g. formaldehyde (B) and methylamine (K), see Scott Health & Safety instructions for use of AX-filter.

Hg-P3-FILTER

Mercury and its inorganic compounds, organic mercury compounds, mercury alkyls, mercury vapours, ozone.

(Note! Always used as a combined filter).

REACTOR-P3 FILTER

Radioactive iodine and its organic compounds such as methyl iodide (always used as a combined filter).

Gas filter capacity

Class	Capacity	Max gas concentration EN 141. *Negative pressure respirators*	Max gas concentration. EN 12941 & 12942. *Powered respirators*
Class 1	Low capacity	1000 ppm (0,1 %)	500 ppm (0,05 %)
Class 2	Medium capacity	5000 ppm (0,5 %)	1000 ppm (0,1 %)
Class 3	High capacity	10 000 ppm (1 %) *)	5 000 ppm (0,5 %)

**) NOTE! Test gas concentration with A-filter in class 3. is 0,8 vol% (EN141).*

Gas filter capacity EN 141

Filter type	Test gas	Minimum allowed breakthrough time for gases in different classes 1. class	2. class	3. class
A	Cyclohexane C_6H_{12}	70 min	35 min	65 min (0,8 vol%)
B	Chlorine Cl_2	20 min	20 min	30 min
	Hydrogen sulphide H_2S	40 min	40 min	60 min
	Hydrogen cyanide HCN	25 min	25 min	35 min
E	Sulphur dioxide SO_2	20 min	20 min	30 min
K	Ammonia NH_3	50 min	40 min	60 min

Special filters

Filter type	Test gas	Minimum allowed break-through time	Test gas concen-tration
AX [EN 371]	Dimethyl ether CH_3-O-CH_3	50 min	0,05 vol %
	Isobutane C_4H_{10}	50 min	0,25 vol %
Hg-P3 [EN 141]	Mercury vapour Hg	100 hours	1,6 ml/mg

Gas filter classification with powered air respirators EN 12941 and 12942

Filter type	Test gas	Minimum allowed breakthrough time for gas in different classes 1. class	2. class	3. class
A	Cyclohexane C_6H_{12}	70 min	70 min	35 min
B	Chlorine Cl_2	20 min	20 min	20 min
	Hydrogen sulphide H_2S	40 min	40 min	40 min
	Hydrogen cyanide HCN	25 min	25 min	25 min
E	Sulphur dioxide SO_2	20 min	20 min	20 min
K	Ammonia NH_3	50 min	50 min	40 min

NOTE! The test gas concentrations are different from those of EN 141.

HOW LONG FILTER WORKS?

The service life of a filter depends on

- Concentration and characteristics of the workplace contaminant
- Filter capacity, e.g. filter class, compare workplace concentrations to test values
- Breathing volume and work rate
- Humidity of the air
- Temperature of the atmosphere

Gas filter test performance

Gas filter lifetime is tested by directing the test gas through the filter at 30 l/min, which is equivalent to the volume of air per minute used by an average person carrying out medium heavy work. The filter lifetime can be roughly calculated by comparing the concentration at the workplace and the minimum break-through times required for the filter type.

How to calculate lifetime of a gas filter?

$$T = \frac{1\,000\,000 \times G}{V \times C}$$

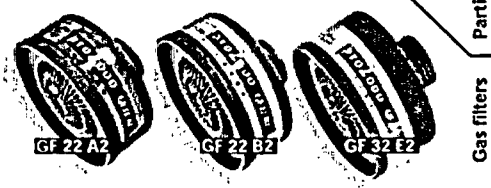
T = Time in minutes

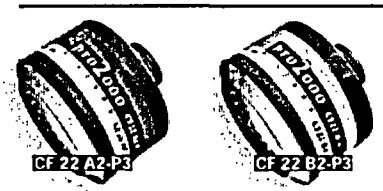
G = Capacity of the gas filter to absorb impurities (g)

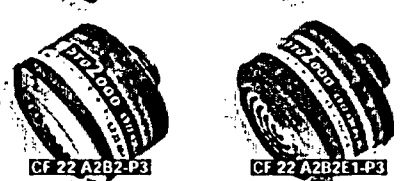
V = Breathing rate (l/min)

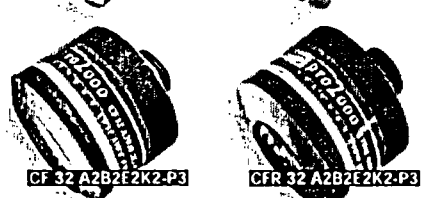
C = Concentration of the contaminant in the ambient air

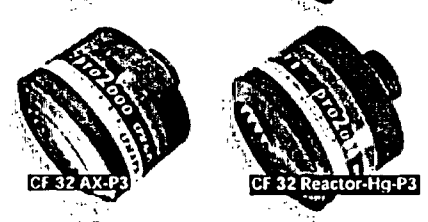
PRO2000 FILTERS











	Colour code	Filter	Main area of application	Weight g	Ref. nr	Storage time Years
Particle filter		PF10 P3	Solid and liquid particles, radioactive and toxic particles, plus micro-organisms, e.g. bacteria and viruses.	74	052670	10
Gas filters		GF22 A2	Organic gases and vapours, e.g. solvents with a boiling point higher than 65°C.	190	042870	5
		GF22 B2	Inorganic gases and vapours, e.g. chlorine, hydrogen sulphide, hydrogen cyanide, fluorine, cyanogen chloride, phosgene.	195	042871	5
		GF32 E2	Acid gases and vapours, e.g. sulphur dioxide, hydrogen fluoride, formic acid, nitric acid.	305	042972	5
		GF22 K2	Ammonia and organic ammonia derivatives.	255	042873	5
		GF22 A2B2	Organic and inorganic gases and vapours.	195	042874	5
		GF32 A2B2E2K2	Organic, inorganic and acid gases and vapours as well as ammonia.	320	042979	5
		GF32 AX	Gases and vapours from organic compounds with a boiling point lower than 65°C.	268	042970	5
Combined filters		CF22 A2-P3	Organic gases and vapours, e.g. solvents with a boiling point higher than 65°C, solid and liquid, radio-active and toxic particles, plus micro-organisms, e.g. bacteria and viruses.	230	042670	5
		CF32 A2-P3		340	043070	5
		CF22 B2-P3	Inorganic gases and vapours, e.g. chlorine, hydrogen sulphide, hydrogen cyanide, fluorine, cyanogen chloride, phosgene and solid and liquid, radioactive and toxic particles, plus micro-organisms, e.g. bacteria and viruses.	265	042671	5
		CF32 E2-P3	Acid gases and vapours, e.g. sulphur dioxide, hydrogen fluoride, nitric acid, solid and liquid, radioactive and toxic particles plus micro-organisms.	265	043072	5
		CF22 K2-P3	Ammonia and organic ammonia derivates, solid and liquid, radioactive and toxic particles, plus micro-organisms, e.g. bacteria and viruses.	370	042673	5
		CF22 A2B2-P3	Organic and inorganic gases and vapours, solid and liquid, radioactive and toxic particles, plus micro-organisms, e.g. bacteria and viruses.	265	042674	5
		CF22 A2B2E1-P3	Organic, inorganic and acid gases and vapours, solid and liquid particles, radioactive and toxic particles, plus micro-organisms, e.g. bacteria and viruses.	270	042678	5
		CF32 A2B2E2K2-P3	Organic, inorganic and acid gases and vapours as well as ammonia and organic ammonia derivatives, solid and liquid, radioactive and toxic particles, plus micro-organisms, e.g. bacteria and viruses.	370	042799	5
		CFR32 A2B2E2K2-P3 (CFR=Reduced opening)		370	043699	5
		CF32 AX-P3	Gases and vapours from organic compounds with a boiling point lower than 65°C, solid and liquid, radioactive and toxic particles, plus micro-organisms, e.g. bacteria and viruses.	310	042770	5
		CF32 Reactor-Hg-P3	Mercury and mercury compounds, radioactive iodine and its organic compounds like methyl iodide plus ozone, solid and liquid, radioactive and toxic particles, plus micro-organisms, e.g. bacteria and viruses.	307	042777	5
		CFR32 Reactor-Hg-P3		328	043679	5
		CF22 A1E1Hg-P3	Organic and acid gases and vapours, mercury and mercury compounds and ozone, solid and liquid, radio-active and toxic particles, plus micro-organisms, e.g. bacteria and viruses.	268	042778	5

FILTER GUIDE

Explanations
Use air-line = compressed air-line is recommended
Use SCBA = due to the dangerous nature of the hazard use Self Contained Breathing Apparatus

Note!

This filter recommendation is applicable only to Scott Health & Safety filters and should not be used if other filters are used.

Before use of this guide the risk assessment must be done at the workplace. The substances must be identified and measured. Airborne contamination levels must be compared with acceptable limits. The maximum exposure limits must not be exceeded! The filtering device must not be used if the environment and contamination are unknown or if the composition of the atmosphere is likely to change disadvantageously. In case of doubt, insulating respirators which function independently from the atmosphere must be used. The filtering device may be used only if the oxygen content of the air is 18-23 vol. %. Gas filters do not protect against particles. Similarly, particle filters do not provide protection against gases or vapour. In case of doubt, use combined filters. Normal filtering device do not protect against certain gases such as CO (carbon monoxide), CO_2 (carbon dioxide) and N_2 (nitrogen).

Substance	*Filter recommendation*
A	
Acetaldehyde	AX
Acetic acid	A-P3
Acetic anhydride	A
Acetone	AX
Acetonitrile	A
Acetylene	Use air-line
o-Acetylsalicylic acid	P3
Acrolein (2-propenal)	AX
Acrylaldehyde	AX
Acrylamide	A-P3
Acryl acid	A, E
Acrylamide	A-P3
Acrylonitrile	A
Aldrin	A-P3
Allyl alcohol	A
Allylamine	K (B or AX)
Allylbromine	A
Allyl 2,3-epoxypropyl ether	A
Allyl chloride	A
Allyl glycidyl ether (AGE)	A
Allyl-isocyanate	A2B2-P3
Allyl propyl disulfide	B
Aluminium alkyl compounds	P3
Aluminium chloride	AX
Aluminium metal and oxide	P3
Aluminium welding fumes	P3
Aluminium, soluble salts	P3
4-Aminoazobenzene	A-P3
4-Aminodiphenyl salts	Use SCBA
2-Aminoethanol	A
2-Aminopyridine	A-P3
3-Amino-1,2,4-triazole	A
Ammonia	K
Ammonium chloride fume	K-P3
Ammonium sulfamate (Ammate)	P3
n-Amyl acetate	A
sec-Amyl acetate	A
Aniline & homologues	A
Anisidine, o-, p-isomers	A-P3
Antimony and compounds (as SB)	P3
Antimony trioxide	P3
p-Aramid respirable fibres	P3
Argon	Use air-line
Arsenic & compounds (except Arsine)	P3
Arsenic trioxide	P3
Arsine	Use air-line
Asbestos	P3
Asphalt (petroleum fumes)	A-P3
Atrazine	P3
Azinphos-methyl (ISO)	A-P3
Aziridine	ABEK

Substance	*Filter recommendation*
B	
BGE	A
y-BHC (ISO)	A-P3
Barium compounds	P3
Benomyl (ISO)	A-P3
Benzene	A
Benzenethiol	A
Bentzene -1,2,4-tri-carbolxylic acid 1,2 anhydride	A-P3
Benzidene salts	A-P3
Benzidine	A-P3
p-Benzoquinone	A-P3
Benzoyl peroxide	A-P3
Benzyl butyl phtalate	A-P3
Benzyl chloride	B-P3
Beryllium compounds	Use SCBA
Biphenyl	A-P3
Bismuthtelluride	P3
Bismuthtelluride, Se-doped	P3
Borates, (Tetra) sodium salts	P3
Bornan-2-one	A-P3
Boron oxide	P3
Boron tribromide	Use air-line
Boron trifluoride	Use air-line
Bromacil (ISO)	A-P3
Bromine	B-P3
Bromine pentafluride	Use air-line
Bromochloromethane	AX
Bromoethane	AX
Bromoethylene	AX
Bromoform	A
Bromomethane	AX
1,3-Butadiene	AX
Butane	AX
Butanethiol	B
2-Butanone	A
2-Butoxyethanol (Butyl cellosolve)	A-P3
Butyl acetate	A
sec-Butyl acetate	A-P3
tert-Butyl acetate	A
Butyl acrylate	A
n-Butyl alcohol	A
sec-Butyl alcohol	A
tert-Butyl alcohol	A
N-Butylamine	A
tert-Butyl chromate (as Cro3)	P3
n-Butylglycidyl ether	A
n-Butyl lactate	A-P3
2-sec Butylphenol	A
p-tert Butyltoluene	A
C	
Cadmium, dust & salts (as Cd)	P3
Cadmium oxide fume (as Cd)	P3
Caesium hydroxide	P3
Calcium carbonate	P3
Calcium cyanamide	P3
Calcium hydroxide	P3
Calcium oxide	P3

Substance	*Filter recommendation*
Camphor, synthetic	A-P3
e-Caprolactam	A-P3
Captafol (ISO)	A-P3
Captan (ISO)	A-P3
Carbaryl (ISO)	A-P3
Carbofuran (ISO)	A-P3
Carbon black	P3
Carbon dioxide	Use air-line
Carbon disulfide	B-P3
Carbon monoxide	Use air-line
Carbon tetrabromide	A-P3
Carbon tetrachloride	A
Carbonyl chloride (phosgene)	B-P3
Carbonyl fluoride	B
Catechol (Pyrocatechol)	A-P3
Cellulose	P3
Cement	P3
Chlordane (ISO)	A-P3
Chlorinated biphenyls	A-P3
Chlorine	B
Chlorine dioxide	B
Chlorine trifluoride	B
Chloroacetaldehyde	A
a-Chloroacetophenone (Phenacyl chloride) (CN)	A-P3
Chloroacetyl chloride	A-P3
Chlorobenzene (Monochlorobenzene)	A
o-Chlorobenzylidene malononitrile (CS)	A-P3
2-Chlorobuta-1, 3-diene	AX-P3
Chlorodimethyl ether	AX
1-Chloro-2, 3-epoxypropane (Epichlorohydrin)	A
Chloroethane	AX
2-Chloroethanol (Ethylene chlorohydrin)	A
Chloroethylene	A
Chloroform (Trichloromethane)	AX
bis-Chloromethyl ether	B
1-Chloro-1-nitropropane	B
Chloropicrin (PS)	A
ß-Chloroprene	AX-P3
o-Chlorostyrene	A
2-Chlorotoluene	B-P3
2-Chloro-6-(trichloromethyl) pyridine	A-P3
Chlorpyrifos (ISO)	A-P3
Chromates, certain insoluble forms	P3
Chromic acid and Chromates (as Cr)	P3
Chromite (chromate) (as Cr)	P3
Chromium, sol. chromic, chromous salts (as Cr)	P3
Coal dust in mines	A-P3
Coal tar pitch volatiles (as cyclohexane solubles)	A-P3
Cobalt metal, dust and fume (as Co)	P3

Substance	*Filter recommendation*
Copper fume, dusts & mists (as Cu)	P3
Cotton dust, raw	P3
Cresols all isomers	A-P3
Cristobalite	P3
Crotonaldehyde	A
Cumene	A
Cyanamide	B-P3
Cyanides, except hydrogen cyanide, cyanogens & cyano-genchloride, (as CN)	B-P3
Cyanogen	Use air-line
Cyanogen chloride	Use air-line
Cyclohexane	A
Cyclohexnol	A
Cyclohexanone	A
Cyclohexene	A
Cyclohexylamine	A
Cyclonite (RDX)	B-P3
1,3 Cyclopentadiene	AX
D	
2,4-D (2,4-Dichloro-phenoxy acetic acid)	A-P3
DDT (Dichlorodiphenyl-trichloroethane)	A-P3
DDVP, see Dichlorvos	A-P3
Decaborane	B-P3
Demeton	A-P3
Diacetone alcohol	A
1,2-Diaminoethane	A, K
Diazinon	A-P3
Diazomethane	B-P3
Diborane	Use air-line
1,2-Dibromoethane	A
2-n-Dibutylamino-ethanol	A
Dibutyl phosphate	A-P3
Dibutyl phthalate	A-P3
Dichloracetylene	Use SCBA
1,2-Dichlorobenzene	A
1,4-Dichlorobenzene	A
3,3'-Dichlorobenzidine	Use air-line
1,3-Dichloro-5, 5-dimethyl hydantoin	ABE-P3
1,1-Dichloroethane	AX
1,2-Dichloroethane	A
Dichloroethyl ether	A
Dichloromethane	AX
1,1-Dichloro-1-nitroethane	A
1,2-Dichloropropane	A
Dichloropropene	A
2,2-Dichloro-propionic acid	A
Dichlorvos (DDVP) (ISO)	A-P3
Dicyclohexyl phthalate	A-P3
Dicyclopentadiene	A-P3
Dicyclopenta-dienyliron	A-P3
Dieldrin (ISO)	A-P3
Diethylamine	K

2-Diethylaminoethanol	K
Diethylene triamine	A-P3, K-P3
Diethyl ether	AX
Diethyl phthalate	A-P3
Difluorodibromo-methane	AX
Diglycidyl ether	A-P3
o-Dihydroxybenzene	A-P3
Diisobutyl ketone	A
Diisopropylamine	K
Dimethoxymethane	AX
N,N-Dimethyl acetamide	A
Dimethylamine	K
Dimethylaminobenzene	A
N,N-Dimethylaniline	A
Dimethylbenzene	A
Dimethylcarbamyl chloride	A-P3
Dimethyl ether	AX
NN-Dimethylethylamine	K
Dimethylformamide	A
1,2-Dimethyl-hydrazine	K
Dimethyl phthalate	P3
Dimethyl sulphate	AP3
Dinitrobenzene	A-P3
Dinitro-o-cresol	B-P3
1,4-Dioxane	A-P3
Dioxathion (ISO)	A-P3
Diphenylamine	A-P3
Diphenylmethane diisocyanate (MDI)	A2B2-P3
Dipropylene glycol methyl ether	A
Diquat Dibromide (ISO)	P3
Disulfoton	ABE-P3
2,6-Di-tert-butyl-para-cresol	P3
Diuron (ISO)	P3
Divinyl benzene	A
E	
Emery	P3
Endosulfan (ISO)	P3
Endrin (ISO)	P3
Epichlorohydrin	A
1,2-Epoxypropane	AX
2,3-Epoxy-1-propanol	A
Ethanethiol	AX, B
2-Ethoxyethanol	A
2-Ethoxyethyl acetate (Cellosolve acetate)	A
Ethyl acetate	A
Ethyl acrylate	A
Ethyl alcohol (Ethanol)	A
Ethylamine	K
Ethyl amyl ketone (5-Methyl-3-heptanone)	A
Ethylbenzene	A
Ethyl bromide	AX
Ethyl butyl ketone (3-heptanone)	A
Ethyl chloride	AX
Ethylene chlorohydrin	A
Ethylene glycol	A-P3
Ethylene glycol dinitrate and/or Nitroglycerin	A
Ethylene glycol mono-ethyl ether acetate	A
Ethylene oxide	AX
Ethylenimine	K
Ethyl ether	AX
Ethyl formate	AX
Ethyl mercaptan	AX
4-Ethylmorpholine	A-P3
Ethyl silicate	A
F	
Fenchlorofoss (ISO)	A-P3
Ferbam (ISO)	P3
Ferrocene (ISO)	A-P3
Ferrovanadium dust	P3
Flour dust	P3
Fluoride (as F)	P3
Fluorine	B
Formaldehyde	AX, B, E
Formamide	A-P3
Formic acid	E-P3
Fuel oils (various)	A-P3
Furfural	A
Furfuryl alchohol	A
G	
Gasoline	A
Germanium tetrahydride	Use air-line
Glass, fibrous or dust	P3
Glutaraldehyde	A-P3
Glycerol, mist	A-P3
Glycerol trinitrate	A-P3
Glycol ethers	A
H	
Hafnium	P3
Helium	Use air-line
Heptan-2-one	A
Heptan-3-one	A
Hexachlorobenzene	A
Hexachlorocyclo-pentadiene	A
Hexachloroethane	A-P3
Hexamethyl diisocyanate	A2B2-P3
Hexamethyl-phosphoramide	A-P3
Hexane (n-hexane)	A
2-Hexanone	A
Hexone	A
Hexylene glycol	A
Hydrazine	K-P3
Hydrazine salts	K-P3
Hydrazobenzene	ABEK-P3
Hydrocarbon solvents	A-P3
Hydrogenated terphenyls	A-P3
Hydrogen bromide	B-P3
Hydrogen chloride	B-P3
Hydrogen cyanide	B-P3
Hydrogen fluoride (as F)	E-P3
Hydrogen peroxide	B-P3
Hydrogen sulfide	B
Hydroquinone	A-P3
2-Hydroxypropyl acrylate	A
I	
IGE (2,3.Epoxypropyl isopropyl ether)	A
Indene	A
Indium & Compounds (as In)	P3
Iodine	B-P3
Iodoform	A-P3
Iodomethane	AX
Iron oxide, fume (as FE)	P3
Iron pentacarbonyl	A-P3
Iron salts	P3
Isoamyl acetate	A
Isoamyl alcohol	A
Isobutane	AX
Isobutyl acetate	A
Isobutyl alcohol	A
Isophorone	A
Isophorone diisocyanate	A2B2-P3
Isopropyl acetate	A
Isopropyl alcohol	A
Isopropylamine	B
n-Isopropylaniline	A
Isopropyl benzene (as Cumene)	A
Isopropyl ether	A
Isopropyl glycidyl ether	A
L	
Lead and compounds (except lead alkyls)	P3
Lead alkyls	A-P3
Lindane	A-P3
Lithium hydride	P3
Lithium hydroxide	P3
M	
Magnesium oxide fume (as Mg)	P3
Malathion	A-P3
Maleic anhydride	A-P3
Manganese & compounds (as Mn)	P3
Manganese fume (as Mn)	P3
Manganese cyclopentadienyl tricarbonyL	A-P3
Manganese tetroxide	P3
Mercury alkyls (as Hg)	Hg-P3
Mercury & its inorganic divalent compounds	Hg-P3
Mesitylene	A
Mesityl oxide	A
Methacrylic acid	A-P3
Methacrylonitrile	AB-P3
Methane	Use air-line
Methanethiol, see Methyl mercaptan	B
Methanol	AX
Methomyl (ISO)	P3
Methoxychlor (ISO)	P3
2-Methoxyethanol (Methyl cellosolve)	A
Methyl acetate	AX
Methyl acrylate	A
Methyl acrylonitrile	A
Methyl alcohol (Methanol)	AX
Methylamine	K
Methyl amyl alcohol	A
Methyl n-amyl ketone (2-Heptanone)	A
Methyl bromide	AX
Methyl-t-butyl ether	AX
Methyl butyl ketone	A
Methyl chloroform (1,1,1-Trichloro-ethane)	A
Methyl 2-cyanoacrylate	A-P3, B-P3
Methylcyclohexane	A
Methylcyclohexanol	A
2-Methylcyclo haxanone	A
Methylene bisphenyl diisocyanate (MDI)	A2B2-P3
4,4'-Methylene-bis (2-chloraniline) MbOCA	A2B2-P3
Methylene bis (4-cyclohexyliso-cyanate)	A2B2-P3
4,4'-Methylene-dianiline (MDA)	A-P3
Methylene chloride	AX
Methyl ethyl ketone peroxideS (MEKP)	A-P3
Methyl formate	AX
Methyl hydrazine	K
Methyl iodide	AX
Methyl isoamyl ketone	A
Methyl isobutyl ketone	A
Methyl isocyanate	A2B2-P3
Methyl methacrylate	A
Methyl parathion	A-P3
Methyl propyl ketone	A
Methyl silicate	A
a-Methylstyrene	A
Mevinphos (ISO)	A-P3
Molybdenum (as Mo)	P3
Monochloroacetic acid	A-P3
Monomethyl aniline	A
Morpholine	A
N	
Naphthalene	A-P3
2-Naphthylamine	A-P3
Neon	Use air-line
Nickel and inorganic compounds	P3
Nickel and organic compounds (as Ni)	A-P3
Nicotine	A-P3
Nitrapyrin	A-P3
Nitric acid	E-P3
4-Nitroaniline	AB-P3
Nitrobenzene	A-P3
4-Nitrobiphenyl	P3
Nitroethane	A-P3, (B-P3)
Nitrogen dioxide	BE
Nitrogen trifluoride	Use air-line
Nitroglycerin	A-P3
Nitromethane	A-P3
1-Nitropropane	A-P3
2-Nitropropane	A-P3
n-Nitrosodimethylamine	A-P3
Nitrotoluene	A-P3
O	
Octachloronaphthalene	A-P3
n-Octane	A
Oil mist, mineral	P3
Osmium tetroxide (as Os)	B-P3
Oxalic acid	P3
Oxygen difluoride	B
Ozone	Reactor-Hg-P3 or A1E1Hg-P3
P	
Paraffin wax fume	A-P3
Paraquat dichloride (ISO)	A-P3
Parathion (ISO)	A-P3
Pentachlorophenol	A-P3
Pentane, all isomers	AX
Perchloroethylene	A
Perchloromethyl mercaptan	B
Perchloryl fluoride	B
Phenacyl chloride	A-P3
Phenol	A-P3
n-Phenyl-ß-Naphthylamine	A-P3
p-Phenylenediamine	P3
Phenyl ether (vapourr)	A
Phenyl ether-Diphenyl mixture (vapor)	A-P3
Phenyl glycidyl ether (PGE)	A
Phenyl hydrazine	A
Phenyl mercaptan	B
Phenyl phosphine	B
Phorate	A-P3
Phosdrin (Mevinphos)	A-P3
Phosgene (carbonyl chloride)	B-P3
Phosphine	B
Phosphoric acid	P3
Phosphorous (yellow)	P3
Phosphorus pentachloride	B-P3
Phosphorus pentasulfide	B-P3
Phosphorus trichloride	B-P3
Phthalic anhydride	A-P3
Picloram (ISO)	AB-P3
Picric acid	P3
Platinum (Soluble salts) (as Pt)	P3
Polychlorinated biphenyls (PCB's)	A-P3
Polyvinyl chloride (PVC)	P3
Potassium hydroxide	P3
n-Propanol	A
Propargyl alcohol	A
Propiolactone	A-P3
Propionic acid	A-P3
n-Propyl acetate	A
Propyl alcohol	A
Propylene	Use air-line

Substance	Filter recommendation
Propylene glycol	A
Propylene glycol dinitrate	A-P3
Propylene oxide	AX
PyrethrINS (ISO)	P3
Pyridine	A-P3
Pyrocategol	A-P3
Q	
Quartz	P3
Quinone	A-P3
R	
Resorcinol	A-P3
Rhodium (as Rh) metal fume and dust	P3
Rosin core solder pyrolysis products (as formaldehyde)	B-P3
S	
Sarin (GB)	ABE-P3
Selenium compounds (as Se)	P3
Silica dust	P3
Silver, metal	P3
Silver soluble compounds (as Ag)	P3
Sodium azide	P3
Sodium bisulfite	E-P3
Sodium fluoroacetate	P3
Sodium hydroxide	P3
Sodium metabisulfite	P3
Soman (GD)	B-P3
Stibine	Use air-line
Stoddard solvent	A
Strychnine	P3
Styrene	A
Subtilisins (Proteolytic enzymes)	P3
Sulfur dioxide	E
Sulfuric acid	E-P3
Sulfur monochloride	B-P3
Sulfur pentafluoride	B-P3
Sulfur tetrafluoride	Use air-line
Sulfuryl difluoride	Use air-line
2,4,5-T (ISO)	P3
T	
Tabun (GA)	B-P3
Tantalum	P3
TEDP	AB-P3
Tellurium & compounds (as Te)	P3
Tellurium hexafluoride (as Te)	Use SCBA
Terphenyls	A-P3
1,1,1,2-Tetrachloro-2, 2-difluoroethane	A
1,1,2,2,-Tetrachloro-1, 2-difluoroethane	A
1,1,2,2,-Tetrachloro, ethane	A
Tetrachloro-naphthalene	A-P3
Tetrahydrofuran	A
Tetramethyl lead (as Pb)	A-P3
Tetramethyl succinonitrile	A-P3
Tetranitromethane	B
Tetrasodium pyrophosphate	P3
Tetryl (2,4,6-trinitro-phenyl-methyl-nitramine)	P3
Thallium, soluble compounds (as Tl)	P3
4,4'-Thiobis (6-tert-butyl-m-cresol)	P3
Thioglycolic acid	A-P3
Toluene (Toluol)	A
Toluene-2, 4-diiso-cyanate (TDI)	A2B2-P3
o-Toluidine	A-P3
Tributyl phosphate	A-P3
Trichloroacetic acid	AE-P3
1,2,4-Trichlorobenzene	A
1,1,1-Trichloroethane	A
Trichloroethylene	A-P3
Trichloromethane	AX
1,2,3-Trichloropropane	A
Tricyclohexyltin hydroxide	A-P3
Triethylamine	A, K
Trimethyl benzene	A
Trimethyl phosphite	A-P3
2,4,6-Trinitrotoluene (TNT)	P
Tri-o-tolyl phosphate	A-P3
Triphenylamine	A-P3
Triphenyl phosphate	A-P3
Tungsten & compounds	P3
Turpentine	A
U	
Uranium compounds, natural, soluble (as U)	P3
Urethane (INN)	A-P3
V	
Vanadium pentoxide	P3
Vinyl acetate	A
Vinyl benzene	A
Vinyl bromide	A
Vinyl chloride	AX
Vinylidene chloride	AX-P3
Vinyl toluene	A
VM & P Naphtha	A
VX	B-P3
W	
Warfarin (ISO)	P3
Welding fume	P3
White spirit	A
X	
Xylene (all isomers)	A
Xylidine, all isomers	AK
Y	
Yttrium	P3
Z	
Zinc chloride, fume	P3
Zinc chromates (inc. zinc potassium chromate)	P3
Zinc oxide fume	P3
Zirconium compounds (as Zr)	P3

Restrictions on use:

- Maximum permitted use time for the mercury filter Hg-P3 is 50 hours (EN 141).
- AX-filter is recommended on a single use basis (EN371).
- Standard filtering respirators do not protect against certain gases, e.g. CO (carbon monoxide), CO_2 (carbon dioxide), N_2 (nitrogen).
- Against radioactive substances, microorganisms and enzymes, particlefilter is recommended on a single use basis.
- If the user can identify the breakthrough of the gas by smell, taste or irritation factor the filter must be replaced.
- When a hazardous gas has an olfactory threshold higher than the occupational exposure limit it produces no clear break through sign. In these cases special directions regarding the calculated lifetime are required. *Such substances include e.g.: Acetonitrile, Aniline, Benzene, Butyl glycidyl ether, Diaminoethane, Dichloromethane, Diethylaminoethanol, Diglycidyl ether, Dimethyl formamide, 1,4-Dioxane, Epichlorhydrin, Ethyl silicate, Hexane, Hydrogen peroxide, Methyl chloride, Methyl cyclohexanol, Methyl silicate, Methyl cellosolve, Methanol, Methylene chloride, Methyl isocyanate, 1-Nitropropane, Sulphur hexafluoride, Trichloroethylene, Trichlorpropane.*
- The particle filter and combined filter must be changed at the latest when breathing resistance is noticeable.
- An opened gas filter must be used within six months. The above mentioned storage times for the Pro2000 filters are for a factory sealed filter package.

Accessories

052691	Prefilter Pro2000 (set of 20)
052692	Prefilter holder Pro2000 (2 pcs + prefilters (6 pcs)
052690	Spark protector Pro2000 (incl. 2 holders + 2 metal spark covers)
052693	Plastic cover Pro2000 (2 pcs)
052694	Screw plug

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ULNRC-05152
Enclosure 1
Attachment 2.5.8

European Standard EN 1073-1 Part 1: Requirements and test methods for ventilated protective clothing against particulate radioactive contamination.

EUROPEAN STANDARD
NORME EUROPEENNE
EUROPEAÏSCHE NORM

EN 1073-1

January 1998

ICS 13.280; 13.340.10

Descriptors: Personal protective equipment, clothing, radioactive contamination.

English version

Protective clothing against radioactive contamination

Part 1: Requirements and test methods for ventilated protective clothing against particulate radioactive contamination

Vêtements de protection contre la contamination radioactive - Partie 1: Exigences et méthodes d'essai des vêtements contre la contamination radioactive sous forme de particules

Schutzkleidung gegen radioaktive Kontamination -Teil 1: Anforderungen und Priifverfahren fur beliiftete Schutzkieidung gegen radioaktive Kontamination durch feste Partikel

This European Standard was approved by CEN on 1997-11-23. CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

The European Standards exist in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

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CEN

European Committee for Standardization

Comite Europeen de Normalisation

Europaisches Komitee fur Normung

Central Secretariat: rue de Stassart 36, B-1050 Brussels

Ref. No. EN 1073-1 : 1998 E

Contents

Foreword

This European Standard has been prepared by Technical Committee CEN/TC 162 "Protective clothing including hand and arm protection and lifejackets", the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by July 1998, and conflicting national standards shall be withdrawn at the latest by July 1998.

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association and supports essential requirements of EU Directive(s).

For relationship with EU Directive(s), see informative Annex ZA, which is an integral part of this standard.

The annex A is normative and contains the activity sequence for the testing of the protection factor.

Further parts of this standard will deal with requirements and test methods for unventilated protective clothing and protection against liquids and gases.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

1 Scope

This European Standard specifies the requirements and test methods for ventilated protective clothing protecting the wearer against particulate radioactive contamination.

This European Standard does not apply for the protection against ionizing radiation and the protection of patients against contamination with radioactive substances by diagnostical and/or therapeutical measures.

2 Normative references

This European standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

EN 146
Respiratory protective devices - Powered filtering devices incorporating helmets or hoods - Requirements, testing, marking

EN 270
Respiratory protective devices - Compressed air line breathing apparatus incorporating a hood - Requirements, testing, marking

EN 340
Protective clothing - General requirements

EN 530
Abrasion resistance of protective clothing material - Test methods

EN 863
Protective clothing - Mechanical properties - Test method: Puncture resistance

prEN 943-1
Protective clothing for use against liquid and gaseous chemicals, including liquid aerosols and solid particles - Performance requirements for ventilated and non-ventilated "gas-tight" (Type 1) and "non-gas-tight" (Type 2) protective clothing

EN1146
Respiratory protective devices for self-rescue - Self-contained open-circuit compressed air breathing apparatus incorporating a hood (compressed air escape apparatus with hood) - Requirements, testing, marking

EN 25978
Rubber- or plastics- coated fabrics - Determination of blocking resistance (ISO 5978 : 1990)

EN 29073-4
Textiles - Test methods for nonwovens - Part 4: Determination of tear resistance

ISO 5082 : 1982
Textiles - woven fabrics - Determination of breaking strength - Grab method

ISO 7854
Rubber- or plastics-coated fabrics - Determination of resistance to damage by flexing

3 Definitions

For the purposes of this standard, the following definitions apply:

3.1 Protective clothing against radioactive contamination

Protective clothing intended to provide protection to the skin and if required to the respiratory tract against radioactive contamination.

3.2 Ventilated protective clothing (against particulate radioactive contamination)

Protective clothing which is supplied with breathable air ensuring internal ventilation and overpressure. This protective clothing provides protection against particulate radioactive contamination for the respiratory tract and the whole body.

3.3 Nominal protection factor (100: inward leakage (IL))

The ratio of the concentration of contaminant in the ambient atmosphere to the concentration of the contaminant in the suit. The concentrations taken into account are the average concentrations recorded during a standardized test.

3.4 Paniculate radioactive contamination

Presence of radioactive substances in or on a material or in a place where they are undesirable or could be harmful.

3.5 Seam

A permanent fastening between two or more pieces of protective clothing material.

3.6 Assemblage

A permanent fastening between two or more different garments, or between protective clothing and accessories, obtained, for example by sewing, welding, vulcanising, gluing.

3.7 Join

A non-permanent fastening between two different garments, or between protective clothing and accessories.

3.8 Closure

A device, for example, zipper, "touch and close" fastener, etc., to close openings for donning or removing the protective clothing.

4 Requirements

4.1 Design

4.1.1 Protective clothing against radioactive contamination shall comply with the general requirements specified in EN 340.
4.1.2 The design of the protective clothing shall be such that the protective clothing is straightforward to put on and take off, and to minimize the risk of contamination. Testing according to "practical performance test" (see 5.2).
4.1.3 The clothing can be designed for single or multiple use.
4.1.4 The ventilated protective clothing (see 3.2) may consist of one or several parts. The clothing may be fitted with a respiratory protective device to enable the wearer to breath in case of failure of the primary air supply.

4.2 Materials

The materials used for protective clothing against particulate radioactive contamination shall meet the requirements according to table 1 after the pretreatment in accordance with 5.1.1 and after the conditioning according to 5.1.2.

Table 1: Requirements for the materials

Requirement	Classification	Test according to	Applicable for reusable	Applicable for single use materials
Abrasion resistance	6 > 2000 Cycles 5 > 1 500 Cycles 4 > 1000 Cycles 3 > 500 Cycles 2 > 100 Cycles 1 > 10 Cycles	EN 530, Method 2 00 abrasive paper according to prEN 943-1 and 9 kPa downward pressure	yes	yes
Flex cracking resistance	6 > 100000 Cycles 5 > 40000 Cycles 4 > 1 5000 Cycles 3 > 5000 Cycles 2 > 2500 Cycles 1 > 1000 Cycles	ISO 7854 Method B	yes	no
Puncture resistance	3 > 100 N 2 > 50 N 1 > 10 N	EN 863	yes	yes
Resistance to blocking (see note 1)	2 no blocking 1 blocking	EN 25978	yes	no
Tear resistance	6 > 150 N 5 > 80 N 4 > 40 N 3 > 20 N 2 > 10 N 1 > 2 N	EN 29073-4	yes	yes
Flammability of materials, visor and ancillary parts	Shall not continue to burn	EN 1146 (single burner test)	yes	yes

NOTE 1: Uncoated materials shall not be tested against resistance to blocking. The test report shall be marked "Not tested against....."
NOTE 2: If protection against hazardous chemicals is required then testing has to be carried out according to the relevant chemical standards.

4.3 Nominal protection factor (100:IL)

Ventilated protective clothing shall be classified according to table 2. Testing according to 5.4 with the necessary activity sequence according to annex A, at the minimum design air flow rate.

Table 2: Leakage

Class	Maximum value of mean inward leakage into the hood during exercise of		Nominal protection factor
	One activity %	All activities %	
5	0,004	0,002	50000
4	0,01	0,005	20000
3	0,02	0,01	10000
2	0,04	0,02	5000
1	0,10	0,05	2000
NOTE 1: Maximum value is calculated as the average performance over all test sequences. NOTE 2: Nominal protection factor is the reciprocal of the IL obtained during all activities (100 : IL)			

4.4 Seam strength, Joins and Assemblages

4.4.1 Seam strength

A sample of each type of straight seam construction shall be tested in accordance with A.2 of ISO 5082 : 1982 (Constant-rate-of-traverse). Three specimens of each type of seam shall be tested and the mean of each set of three samples calculated. The garment seam performance shall be classified according to the levels of performance given in table 3 using the lowest result, i.e. the weakest seam type.

NOTE: The test method described in ISO 5082 : 1982 is only applicable to straight seams joining two pieces of material.

Table 3: Classification of seam strength

Class	Seam strength N
5	>300
4	>125
3	> 75
2	> 50
1	> 30

4.4.2 Joins and assemblages

The joins and assemblages between the suit and detachable parts e.g. between gloves and sleeves, boots and trouser legs, shall be tested in accordance with 5.5 and withstand a pull of 100 N.

4.5 Visor

The visor shall comply with table 4. Where antifogging compounds are used or specified by the manufacturer they shall not have an adverse affect on the health of the wearer, or on the clothing.

Table 4: Requirements for the visor

Properties of the visor	Requirement	Testing
Distortion of vision	the loss of sight shall not exceed two scales on the optometrical chart	to read letters on a chart at a distance of 5 m during the practical performance test according to 5.2
Mechanical strength	shall not be visibly damaged in such a way as to be likely to affect the performance of the suit system	according to EN 146

4.6 Air supply system

Couplings and connections shall comply with EN 270.

The connection between the compressed air supply tube and the suit, including attachments, threaded parts, belt or other parts, or means of stabilising the suit to the body shall withstand a 250 N pull when tested according to 5.5 .

NOTE: The test should be performed before the inward leakage test.

4.7 Breathing hose

The breathing hose shall comply with the requirements of EN 270.

4.8 Air flow rate

Two suit systems shall be tested, one of which has to be preconditioned as specified in 5.1.4. When tested the air flow rate into the suit system shall not be less than the manufacturers' minimum design flow rate. The maximum flow rate shall not exceed the maximum as stated by the manufacturer. Test in accordance with 5.3

The flow rate and the distribution of the air into the suit system shall not cause distress to the wearer by local cooling. The heat stress has to be considered. Test in accordance with 5.2.

4.9 Air flow rate warning device

If an audible warning device is incorporated in the suit system it shall comply to EN 270, except for the sound pressure level which may be in the range 85dB(A) to 90 dB(A) when measured at the ears of the wearer. The frequency range of the warning device shall be between 2 000 Hz to 4 000 Hz.

Five warning devices shall be tested, one of which has to be preconditioned as specified in 5.1.4. Testing according to EN 270.

4.10 Supply valve

If a variable continous flow valve is fitted, it shall comply to EN 270. The valve shall permit to adjust the air flow rate in the range from the minimum to the maximum as specified in 4.8. It shall not be possible to close the valve to restrict the air flow below the minimum design air flow rate.

4.11 Exhaust devices

The suit shall be provided with exhaust devices which shall continue to work correctly after the testing of the pressure in the suit (see 4.1 2), during the practical performance test (see 5.2) and during the determination of the protection factor (see 5.4). Testing in accordance with 5.6.

4.12 Pressure in the suit

The overpressure shall not exceed 1 000 Pa mean and 2 000 Pa peak. A positive pressure shall be maintained. Testing with the maximum air flow rate during the activity sequence as specified in Annex A.

4.13 Carbon dioxide content of the inhalation air

The carbon dioxide content of the inhalation air, determined at the minimum air flow rate, shall not exceed an average of 1,0 % (by volume), tested according to EN 270. Two suits shall be tested, one of which has to be pretreated as specified in 5.1.1.

4.14 Noise associated with the air supply to the suit

The noise measured in the suit at the ears shall not exceed 80 dB(A) at the maximum manufacturers' design flow rate. Testing in accordance with EN 270. Two suits shall be tested, one of which has to be pretreated as specified in 5.1.1.

5 Test methods

5.1 Test preparations

5.1.1 Pretreatment

When the clothing is intended to be reusable the requirements for the materials or the complete clothing shall be proved after five cycles of cleaning and disinfection according to the manufacturer's instructions for use before testing.

5.1.2 Conditioning

All material samples shall be conditioned by storage at (20 ± 2) °C and (65 ± 5) % relative humidity for at least 24 h. Start each of the tests as specified in 5.1.3 and 5.1.4, within 5 min after removal from the conditioning atmosphere.

5.1.3 Visual inspection

A visual inspection shall be carried out by the test house prior to the laboratory or the practical performance test. This may entail a certain amount of dismantling of the components of the protective clothing in accordance with the manufacturer's information for maintenance.

5.1.4 Preconditioning for the practical performance test

If the manufacturer does not state the preconditioning atmosphere for the practical performance test, the complete clothing shall be exposed:

a) for 4 h to a temperature of (-30 ± 3) °C and allowed to return to ambient conditions, followed by

b) for 4 h to an atmosphere of (60 ± 3) °C at 95 % relative humidity. It shall then be allowed to return to ambient temperature.

5.2 Practical performance test

5.2.1 General

The tests shall be carried out by two test persons at (20 ± 5) °C and a relative humidity of less than 60 %. The test temperature and humidity shall be recorded. The background noise shall not be greater than 75 dB(A).

The test persons shall be selected who are familiar with using such or similar protective clothing. The persons will be drawn from those people certified as fit to do so by the medical officer. The necessity of a medical examination before or supervision during the tests shall be at the testing officers discretion.

Prior to the test there shall be an examination that the suit is in working-condition and that it can be used without danger. If more than one size of clothing is manufactured the subjects are asked to select the appropriate size. Ensure that the air supply is within the specified parameters. Two suits shall be tested, each being tested on one test person.

After fitting the suit each test person is asked "Does the suit fit?". If the answer is "Yes", continue the test. If the answer is "No", replace the test person or the suit.

5.2.2 Procedure

During the test the following activities shall be done in simulation of the practical use of the suit:

a) the test shall be completed within a total working time of 20 min

b) walking on the level with regular rate of 5 km/h for 5 min

c) filling a small basket (see figure 1, approximate volume 8 l) with 12 mm chippings (e.g. limestone chippings) or other suitable material from a hopper which stands 1,5 m high and has an opening at the bottom to allow the contents to be shovelled out and a further opening at the top where the chippings may be returned. The person stoops or kneels as he wishes and fills the basket with chippings. He then lifts the basket and empties the contents back into the hopper. This shall be repeated 1 5 to 20 times in 10 min .

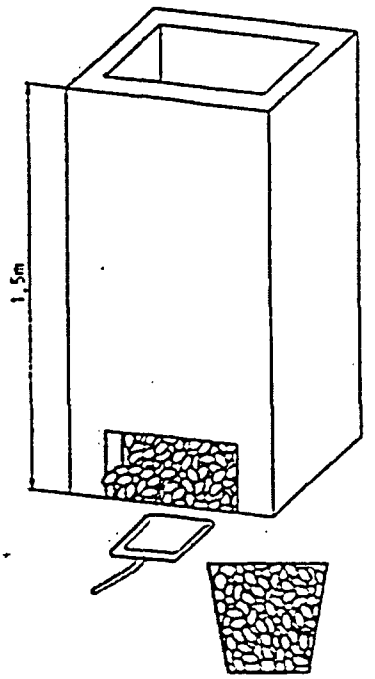

Figure 1: Hopper and basket

5.2.3 Information to be recorded

During the practical performance test the clothing shall be subjectively assessed by the wearer and the following shall be recorded:

a) harness comfort (see 5.6);
b) security of fastening and couplings;
c) accessibility of controls and pressure gauge (if fitted);
d) clarity and field of vision from the facepiece and/or visor;
e) clothing comfort;
f) ease of speech transmission;
g) any other comments volunteered by the wearer.

5.3 Measurement of minimum and maximum air flow rate

Connect the ends of the distribution system collectively to a suitable measuring device. Record the maximum air flow delivered at the manufacturers' specified air supply, if a control valve is fitted, record the maximum delivered air flow and the minimum delivered air flow.

The value of minimum and maximum air flow rate shall be determined under the condition of exercise 6 of Annex A (person standing still).

5.4 Determination of the protection factor

The protection factor shall be determined in accordance with prEN 943-1. Sodium chloride test method shall be used. Activity sequences for testing are given in Annex A of this standard.

The determination has to be done at the minimum design air flow rate (see 4.8).

On two test subjects four new suits shall be tested. Two suits per test subject.

For each individual test calculate the arithmetic mean over the time period. Calculate the percentage inward leakage (IL) as follows: -

$$IL = \frac{C_2 \times 100\%}{C_1}$$

where:

C_1 is the challenge concentration in the test chamber,
C_2 is the mean concentration in the breathing zone for each exercise. For classification according to table 2, the average value for the four suits shall be taken.

5.5 Join and assemblage pull test

Assemble the means of attachment according to the manufacturers' information. If the assembled item (e.g. glove or boot) is itself not strong enough to apply the required pull substitute an item that is. Securely attach one part to a fixed clamp. Apply the required force longitudinally. Record at which force it parts or state that at the required force it was still complete.

5.6 Exhaust device pull test

Mount the suit on to a dummy torso which can be adjusted so that the load can be applied axialiy to the exhaust device. A system of retaining straps or bands is fitted over the suit around the exhaust device so that the load is applied as directly as possible to the fitting of the exhaust device in the suit.

Exert a force of (50 ± 2,5) N to the exhaust device and hold for 10 s. Repeat 10 times.

Examine the exhaust device for signs of damage or failure.

6 Marking

The marking shall comply with the specifications of EN 340 with the pictogram as given in figure 2.

The level of performance of the inward leakage (IL) shall be marked as:

IL : class x (x = class number according to table 2).

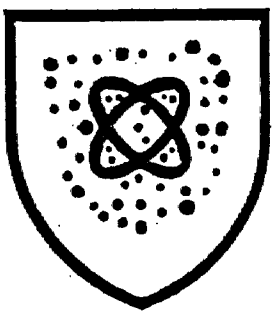

Figure 2: Pictogram

7 Information supplied by the manufacturer

The information supplied shall be at least in the official language(s) of the country or region of application. The manufacturers' information shall comply with the specifications of EN 340. The following information shall be supplied additionally:

- instructions for donning, using, fitting, removing and storing;
- application, limitations of use (classification, temperature range etc.);
- tests to be carried out by the wearer before use (if required);
- maintenance and cleaning and decontamination by e.g. showering (if required).

The manufacturers shall specify the required supply pressure and flow range necessary to maintain protection.

Warnings (if appropriate) shall be given against problems likely to be encountered, as e.g. heat stress, depending on the air flow rate, work load, environmental atmosphere etc.

Annex A (normative)

Activity sequence for the testing of the protection factor

Table A.1: Activity sequence for the testing of the protection factor

No	Activity sequence for the testing	Time of activities min
1	dress person in the suit	
2	don boots, gloves etc. as required according to the manufacturers instructions	-
3	person to enter test chamber, connect tubing to the sample point - no test agent	3
4	establish background reading at sample point with person standing still - no test agent	3
5	start test agent and allow to stabilize	3
6	record leakage and pressure at sample point with the person standing still	3
7	start treadmill	-
8	walk	3
9	record leakage and pressure at sample point with the person walking at about 5 km/h	-
10	stop treadmill	-
11	record leakage and pressure at sample point, person moving arms up and down above head height and looking upward, e.g. lifting object (half brick) from desk to shelf level	3
12	record leakage and pressure at sample point, person doing continuous squats	3
13	stop test agent and allow to desperse with person in chamber	3
14	disconnect sample tubes and remove person from test chamber and undress subject	-

NOTE: The total trial may vary, all times are approximate and are to stable conditions. When doing squats, a slow deliberate action is required, say continuously during about 3 s.

Analyse results over final 2 min of each exercise period to avoid carry over of result from one exercise to the other.

Record challenge chemical continuously using a separate detector (if possible). Record the pressure inside the suit over the whole time.

Annex ZA (informative)

Clauses of this European Standard addressing essential requirements or other provisions of EU Directives

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association and supports essential requirements of EU Directive 89/686/EEC.

WARNING: Other requirements and other EU Directives may be applicable to the product(s) falling within the scope of this standard.

The following clauses of this standard are likely to support requirements of Directive 89/686/EEC, Annex II:

EU-Directive 89/686/EEC, Annex II	clauses of this standard
1.1 Design principles	4.1, 4.2, 4.3, 5.5.1 to 5.6
1.2 Innocuousness of PPE	4.1, 4.5, 4.14, 5.2
1.3 Comfort and efficiency	4.1, 4.3, 5.2, 5.4, annex A
1.4 Information supplied by the manufacturer	clause 7
2.2 PPE 'enclosing' the parts of the body to be protected	4.1.4, 4.5, 4.8, 5.2
2.3. PPE for the face, eyes and respiratory tracts	4.5, 5.2
2.1 2 PPE bearing one or more identification or recognition marks directly or indirectly relating to health and safety	clause 6
3.9.2.1 Protection against external radioactive contamination	clause 4, 5, 6, 7

Compliance with the clauses of this standard provides one means of conforming with the specific essential requirements of the Directive concerned and associated EFTA regulations.

ULNRC-05152
Enclosure 1
Attachment 2.5.9

Technical information on Mururoa V4 model ventilated suits

MURUROA SUIT

The Mururoa suit is a single use garment designed to be used in radioactively contaminated environments. It has been widely used in western European Nuclear Power Plants for more than 20 years, without any major problem (the French state company: Electricité de France use 60,000 garments each year).

The Mururoa suit is a fully enclosed PVC plastic, supplied-air and pressurized suit, that offers excellent protection factor (~100,000) against any solid, liquid, or gas pollutant, minimizing discomfort and heat stress and increasing the worker's efficiency.

The Mururoa suit is C.E. approved and complies with CE standard EN:1073-1 "Protective clothing against Radioactive Contamination"
It also fulfils the requirements of the I.S.O. 8194 standard "Radiation Protection-Clothing for protection against Radioactive contamination-Design selection ,testing and use"

VENTILATION / EXHAUST

In the supplied-air Mururoa suit, the ventilation system is composed of

- An airflow control valve, preset to a minimum flow of 250 litres/minute (9 CFM) at 3 bar (42 PSIG), located on the right hip and covered with a protection flap. This flow can be adjusted, from 250 to 1150 litres (9 CFM to 41 CFM) per minute. 1150 litres is obtained with the tap fully opened at the feeding pressure of 6 bar (85 PSIG) (refer to graph in annex 11).

- A silencer bag which attenuates the noise level less than 58 dBa at 250 litres/minutes to 76 dBa at 1150 litres/minute.

- A manifold system welded to the suit and distributing the air to the helmet, the legs and the arms.

- An exhaust by two world patented valves placed in the helmet and in the back. These valves ensure a remarkable airtight seal in case of accidental air-feed cut off, or when putting the suit in under pressure through abrupt movements. The valves regulate the overpressure in the garment between 3 mbar (0.042 PSIG) and 10 mbar (0. 142 PSIG) for supply air pressure between 3 bar (42 PSIG) and 6 bar (85 PSIG)

- The benefits of this system are

    - High heat removal through superior airflow
    - Non irritating diffuse ventilation
    - Resistance free breathing
    - High level of comfort for long and strenuous jobs in contaminated areas
    - Very low noise level

DESIGN CHARACTERISTICS

- One piece PVC, fire proof suit. (Thickness 20/100mm for technical data concerning the material, refer Annex I of this document)
- Welded PVC gloves
- Incorporated overboots with strengthened sole
- Binding ties on the overboots
- Reinforced elbows, knees and crotch
- Dual zipper system: - metal zipper for mechanical strength
  - PVC zipper for air and gas tightness (0.30 PVC thickness)
- Supple transparent PVC helmet, fitted with a transparent distortion free, PVC face plate 6"x 8" giving almost the same optical quality as glass.
- Quick release strip from forearm, overhead to forearm, for easy removal. This is used both for undressing or emergency egress. (Emergency egress takes less than 3 seconds).
- Quick release strip for access to the mouth.
- Welded sleeve for communication cable.

GENERALCONSIDERATIONS

THE MURUROA SUIT IS AVAILABLE IN SIX SIZES

Size 0	1,55 m	→	1,62 meter	5 feet I inch	→	5 feet 4 inches
Size 1	1,60	→	1,68 meter	5'3"	→	5'6"
Size 2	1,68	→	1,74 meter	5'6"	→	5'8"
Size 3	1,74	→	1,82 meter	5'8"	→	6'0"
Size 4	1,82	→	1,92 meter	6'0"	→	6'3"
Size 5	1,92	→	2,05 meter	6'3"	→	6'8"

But if any individual selects a suit size different from the recommended size, the operating and safety characteristics will not change.

WEIGHT	1200 grams (2.64 LBS)
FEEDING PRESSURE	6 bar (85 PSIG)
FLOW	450 up to 1150 Lit/minute (16 - 41 CFM)

STORAGE

- The suit should be used by the third year from the date of manufacture.
- It must be stored in its original packaging.
- The storage temperature has to stay between 0°C and 60°C (32°F - 140°F)
- If the storage temperature was below 5°C (41°F) the suit must be stored approximately 3 hours at a room temperature until the suit become flexible.
- The usage temperature range + 5° C and + 55°C (41° - 13l°F) depends on air fed temperature

MATERIAL PROPERTIES

Technical characteristic of PVC material 20/100 mm using French standards, which would correspond to ANSI standards.

Characteristic	*Standards*	*Results*	*Units*
Density	NFT 51063	1.38	gm/cm3
Traction Resistance	NFT 54102	≥ 143	N/cm²
Stretch before tear	NFT 54102	≥ 178	%
Tear resistance	NFT 46007	≥ 45	N/cm²
Weld resistance than material resistance	NFT 54122	Peel 50 | Tear 65	%
Resistance to cold	NFT 51102	-10	°C
Vapour permeability	NFH 00030	34.1	g/m²/24h
Volatility on activated charcoal	NFT 51167	≤ 6	%
Spark perforation	NFC 26225	9.2	KV

ULNRC-05152
Enclosure 1
Attachment 2.5.10

European Standard CEN/TC 162 N 738 for ventilated protective clothing

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

FINAL DRAFT
prEN 1073-1
CEN/TC 162 N 738
(1996-05-07)
(July 1996)

ICS 13.280; 13.340.10
Descriptors:

English version

Protective clothing against radioactive contamination
Part 1: Requirements and test methods for ventilated protective clothing against particulate radioactive contamination

Vêtements de protection contre la contamination radioactive - Partie 1: Exigences et méthodes d'essai pour vêtement de protection ventilé contre la contamination radioactive sous forme de particules

Schutzkleidung gegen radioaktive Kontamination - Teil 1: Anforderungen und Prüfverfahren für belüftete Schutzkleidung gegen radioaktive Kontamination durch feste Partikel

This draft European Standard is submitted to CEN members for formal vote.

It has been drawn up by Technical Committee CEN/TC 162.

If this draft becomes a European Standard, CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

This draft European Standard was established by CEN in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

CEN

European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

Central Secretariat: rue de Stassart 36, B-1050 Brussels

Contents

Foreword

This European Standard has been prepared by the Technical Committee CEN/TC 162 "Protective clothing including hand and arm protection and lifejackets" the secretariat of which is held by DIN.

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association and supports essential requirements of EU Directive 89/686/EEC.

For relationship with EU Directive(s), see informative Annex ZA, which is an integral part of this standard.

The annex A is normative and contains the activity sequence for the testing of the protection factor.

Further parts of this standard will deal with requirements for unventilated protective clothing and protection against liquids and gases.

In accordance with the CEN/CENELEC Rules, the following countries are bound to implement this European Standard:

1 Scope

This European Standard specifies the characteristics of ventilated clothing protecting the wearer against particulate radioactive contamination.

This European Standard does not apply for the protection against ionizing radiation and the protection of patients against contamination with radioactive substances by diagnostical and/or therapeutical measures.

2 Normative references

This European standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

EN 146
Respiratory protective devices - Powered filtering devices incorporating helmets or hoods - Requirements, testing, marking

EN 270
Respiratory protective devices - Compressed air line breathing apparatus incorporating a hood - Requirements, testing, marking

EN 340
Protective clothing - General requirements

EN 530
Abrasion resistance of protective clothing material - Test method

EN 863
Protective clothing - Mechanical properties - Test method: Puncture resistance

prEN 943-1
Protective clothing for use against liquid and gaseous chemicals, including liquid aerosols and solid particles - Performance requirements for ventilated and non-ventilated "gas-tight" (Type 1) and "non-gas-tight" (Type 2) protective clothing

prEN 1146
Respiratory protective devices for self-rescue - Self-contained open-circuit compressed air breathing apparatus incorporating a hood (compressed air escape apparatus with hood) - Requirements, testing, marking

EN 25978
Rubber or plastics coated fabrics - Determination of blocking resistance

EN 29073-4
Textiles - Test methods for nonwovens - Part 4: Determination of tear resistance

ISO 5082
Textiles - woven fabrics - Determination of breaking strength - Grab method

ISO 7854
Rubber or plastics coated fabrics - Determination of resistance to damage by flexing (dynamic method)

3 Definitions

For the purposes of this standard the following definitions apply:

3.1 Protective clothing against radioactive contamination

Protective clothing intended to provide protection to the skin and if required to the respiratory tract against radioactive contamination.

3.2 Ventilated protective clothing

Protective clothing which is supplied with breathable air ensuring internal ventilation and overpressure. This protective clothing provides protection against radioactive contamination for the respiratory tract and the whole

body.

3.3 Nominal protection factor (inward leakage, IL)

The ratio of the average concentrations of a test aerosol or gas measured in the ambient atmosphere and inside the hood of the protective clothing at the point where the wearer draws breath. The concentrations taken into account are the average concentrations recorded during a standardized test.

3.4 Radioactive contamination

Presence of radioactive substances in or on a material or in a place where they are undesirable or could be harmful.

3.5 Seams

A permanent fastening between two or more pieces of protective clothing material.

3.6 Assemblages

A permanent fastening between two or more different garments, or between protective clothing and accessories, obtained, for example by sewing, welding, vulcanising, gluing.

3.7 Join

A non-permanent fastening between two different garments, or between protective clothing and accessories.

3.8 Closure

A device, for example, zipper, "touch and close" fastener, etc., to close openings for donning or removing the protective clothing.

4 Design

4.1 Protective clothing against radioactive contamination shall comply with the general requirements specified in EN 340.

4.2 The design of the protective clothing shall be such that the protective clothing is straightforward to put on and take off, and to minimize the risk of contamination, testing according to "practical performance test" (see 6.2).

4.3 The clothing can be designed for single or multiple use.

4.4 The protective clothing (see 3.2) may consist of one or several parts. The clothing may be fitted with a respiratory protective device to enable the wearer to breath in case of failure of the primary air supply.

5 Requirements

5.1 Materials

The materials used for protective clothing against radioactive contamination shall meet the requirements according to table 1 after the pretreatment in accordance with 6.1.1 and 6.1.2.

Table 1: Requirements for the materials

Requirement	Classification	Test according to	applicable for reusable materials	applicable for single use materials
Abrasion resistance	6 > 2000 Cycles 5 > 1500 Cycles 4 > 1000 Cycles 3 > 500 Cycles 2 > 100 Cycles 1 > 10 Cycles	EN 530, Method 2 00 abrasiv paper according to prEN 943-1 and 9 kPa downward pressure	yes	yes
Flex cracking resistance	6 > 100000 Cycles 5 > 40000 Cycles 4 > 15000 Cycles 3 > 5000 Cycles 2 > 2500 Cycles 1 > 1000 Cycles	ISO 7854 Method B	yes	no
Puncture resistance	3 > 100 N 2 > 50 N 1 > 10 N	EN 863	yes	yes
Resistance to blocking (see note 1)	2 no blocking 1 blocking	ISO 5978	yes	no
Tear resistance	6 > 150 N 5 > 80 N 4 > 40 N 3 > 20 N 2 > 10 N 1 > 2 N	ISO 9073-4	yes	yes
Flammability of materials, visor and ancillary parts	shall not continue to burn	prEN 1145 (single burner test)	yes	yes

NOTE 1: Uncoated materials shall not be tested against resistance to blocking. The test report shall be marked "Not tested against .... ."

NOTE 2: If protection against hazardous chemicals is required then testing has to be carried out according to the relevant chemical standards.

5.2 Ventilated protective clothing

5.2.1 General

The design of the protective clothing has to be tested in the practical performance test, specified in 6.2.

5.2.2 Requirements for the nominal protection factor (N)

Ventilated protective clothing shall be classified according to table 2. Testing according to E.4 with the necessary activity sequence according to annex A, at the minimum design air flow rate.

Table 2: Leakage

Class	Maximum value of mean leakage into the hood during exercise of		Nominal protection factor
	one activity %	all activities %	
5	0.004	0.002	50000
4	0.01	0.005	20000
3	0.02	0.01	10000
2	0.04	0.02	5000
1	0.10	0.05	2000

NOTE 1: Maximum value is calculated as the average performance over all test sequences.

NOTE 2: Nominal protection factor is the reciprocal of the IL obtained during all activities

5.2.3 Strength of Seams, Joins and Assemblages

5.2.3.1 Seams

A sample of each type of seam shall be tested in accordance with ISO 5082 Annex A2 (Constant-rate-of traverse). Three specimens of each type of seam shall be tested and the mean of each set of three samples calculated. The garment seam performance shall be classified according to the levels of performance given in table 3, using the worst mean result, i.e. the weakest seam type.

If the test is not applicable because the strength of the material is lower than the strength of the seams, the value of material tear resistance should be used for classification of the seams.

NOTE: The test method described in ISO 5082 is only applicable to straight seams joining two pieces of material.

Table 3: Classification of seam strength

Class	Seam strength in N
6	> 300
5	> 250
4	> 200
3	> 150
2	> 100
1	> 50

5.2.3.2 Joins and assemblages

The joins and assemblages between the suit and detachable parts e.g. between gloves and sleeves, boots and trouser legs, shall be tested in accordance with 6.5 and withstand a pull of 100 N.

5.2.4 Visor

The visor shall comply with table 4. Where antifogging compounds are used or specified by the manufacturer they shall not have an adverse affect on the health of the wearer, or on the clothing.

Table 4: Requirements for the visor

Properties of the visor	Requirement	Testing
Distortion of vision	the loss of sight shall not exceed two scales on the optometrical chart	to read letters on an optometrical chart at a distance of 5 m during the practical performance test according to 6.2
Mechanical strength	shall not be visibly damaged in such a way as to be likely to affect the performance of the suit system	according to EN 168

5.2.5 Air supply system

Couplings and connections shall comply with EN 270.

The connection between the compressed air supply tube and the suit, including attachments, threaded parts, belt or other parts, or means of stabilising the suit to the body shall withstand a 250 N pull when tested according to 6.5 .

NOTE. Should be performed before the inward leakage test.

5.2.6 Breathing hose

The breathing hose shall comply with the requirements of EN 270.

5.2.7 Air flow rate

Two suit systems shall be tested, one of which has to be preconditioned as specified in 6.1.4. When tested, the air flow rate into the suit system shall not be less than the manufacturers' minimum design flow rate. The maximum flow rate shall not exceed the maximum as stated by the manufacturer. Test in accordance with 6.3 .

The flow rate and the distribution of the air into the suit system shall not cause distress to the wearer by local cooling. The heat stress has to be considered. Test in accordance with 6.2.

NOTE: Heat stress has to be considered.

5.2.8 Air flow rate warning device

If an audible warning device is incorporated in the suit system it shall comply to EN 270, except for the sound pressure level which may be in the range 85dB(A) to 90 dB(A) when measured at the ears of the wearer. The frequency range of the warning device shall be between 2000 Hz to 4000 Hz.

Five warning devices shall be tested, one of which has to be preconditioned as specified in 6.1.4. Testing according to EN 270.

5.2.9 Supply valve

If a variable continous flow valve is fitted, it shall comply to EN 270. The valve shall permit to adjust the air flow rate in the range from the minimum to the maximum as specified in 5.2.7. It shall not be possible to close the valve to restrict the air flow below the minimum design air flow rate.

5.2.10 Exhaust devices

The suit shall be provided with exhaust devices which shall continue to work correctly after the testing of the pressure in the suit (see 5.2.11), during the practical performance test (see 6.2) and during the determination of the protection factor (see 6.4). Testing in accordance with 6.6.

5.2.11 Pressure in the suit

The overpressure shall not exceed 1000 Pa mean and 2000 Pa peak. A positive pressure shall be maintained. Testing with the maximum air flow rate during the activity sequence specified in Annex A

5.2.12 Carbon dioxide content of the inhalation air

The carbon dioxide content of the inhalation air, determined at the minimum air flow rate, shall not exceed an average of 1,0 % (by volume), tested according to EN 270. Two suits shall be tested, one of which has to be pretreated as specified in 6.1.1.

5.2.13 Noise associated with the air supply to the suit

The noise measured in the suit at the ears shall not exceed 80 dB(A) at the maximum manufacturers' design flow rate. To be tested in accordance with EN 270. Two suits shall be tested, one of which has to be pretreated as specified in 6.1.1.

6 Test methods

6.1 Test preparations

6.1.1 Pretreatment

When the clothing is intended to be reusable the requirements for the materials or the complete clothing shall be proved after 5 cycles of cleaning and disinfection according to the manufacturer's instructions for use before testing.

6.1.2 Conditioning

All material samples shall be conditioned by storage at (20 ± 2) °C and (65 ± 5) % relative humidity for at least 24 h. Start each of the tests as specified in 6.1.3 and 6.1.4, within 5 min after removal from the conditioning atmosphere.

6.1.3 Visual inspection

A visual inspection shall be carried out by the test house prior to the laboratory or the practical performance test. This may entail a certain amount of dismantling in accordance with the manufacturers' information for maintenance.

6.1.4 Preconditioning for the practical performance test

If the manufacturer does not state the preconditioning atmosphere for the practical performance test, the complete clothing shall be exposed:

a) for 4 h to a temperature of (-30 ± 3) °C and allowed to return to ambient conditions, followed by
b) for 4 h to an atmosphere of (60 ± 3) °C at 95 % relative humidity. It shall then be allowed to return to ambient temperature.

6.2 Practical performance test

6.2.1 General

The tests shall be carried out by two test persons at (20 ± 5) °C and a relative humidity of less than 60 %. The test temperature and humidity shall be recorded. The background noise shall not be greater than 75 dB(A).

The test persons shall be selected who are familiar with using such or similar protective clothing. The persons will be drawn from those people certified as fit to do so by the medical officer. The necessity of a medical examination before or supervision during the tests shall be at the testing officers discretion.

Prior to the test there is an examination that the suit is in working-condition and that it can be used without danger. If more than one size of a clothing is manufactured the subjects are asked to select the appropriate size. Ensure that the air supply is within the specified parameters. Two suits shall be tested, each being tested on one test person.

After fitting the suit each test person is asked "Does the suit fit?". If the answer is "Yes", continue the test. If the answer is "No", replace the test person or the suit.

6.2.2 Procedure

During the test the following activities shall be done in simulation of the practical use of the suit:

- the test shall be completed within a total working time of 20 min
- walking on the level with regular rate of 5 km h^{-1} for 5 min
- filling a small basket (see figure 1, approximate volume 8 l) with 12 mm chippings (e.g. limestone chippings) or other suitable material from a hopper which stands 1,5 m high and has an opening at the bottom to allow the contents to be shovelled out and a further opening at the top where the chippings may be returned. The person stoops or kneels as he wishes and fills the basket with chippings. He then lifts the basket and empties the contents back into the hopper. This is repeated 15 to 20 times in 10 min .

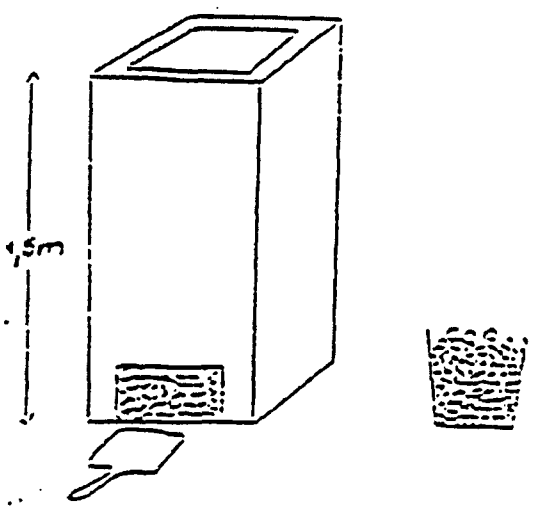

Figure 1: hopper and basket

6.2.3 Information to be recorded

During the practical performance test the clothing shall be subjectively assessed by the wearer and the following shall be recorded:

a) harness comfort (see 6.6);
b) security of fastening and couplings;
c) accessibility of controls and pressure gauge (if fitted);
d) clarity and field of vision from the facepiece and/or visor;
e) clothing comfort;
f) ease of speech transmission;
g) any other comments volunteered by the wearer.

6.3 Measurement of minimum and maximum air flow rate

Connect the ends of the distribution system collectively to a suitable measuring device. Record the maximum air flow delivered at the manufacturers' specified air supply. If a control valve is fitted, record the maximum delivered air flow and the minimum delivered air flow.

The value of minimum and maximum air flow rate shall be determinec under the condition of exercise 6 of Annex A (person standing still).

6.4 Determination of the protection factor

The protection factor shall be determined in accordance with prEN 943-1. Sodium chloride test method shall be used. Activity sequences for testing are given in Annex A of this standard.
The determination has to be done at the minimum design air flow rate (see 5.2.7).

On two test subjects four new suits shall be tested. Two suits per test subject.

For each individual test calculate the arithmetic mean over the time period.
Calculate the percentage inward leakage (IL) as follows:

$$IL = \frac{C_2 \times 100}{C_1}$$

where

C_1 challenge concentration in the test chamber,
C_2 mean concentration in the breathing zone for each exercise. For classification according to table 2, the average value for the four suits shall be taken.

6.5 Join and assemblage pull test

Assemble the means of attachment according to the manufacturers' information. If the assembled item (e.g. glove or boot) is itself not strong enough to apply the required pull substitute an item that is. Securely attach one part to a fixed clamp. Apply the required force longitudinally. Record at which force it parts or state that at the required force it was still complete.

6.6 Exhaust device pull test

Mount the suit on to a dummy torso which can be adjusted so that the load can be applied axially to the exhaust device. A system of retaining straps or bands is fitted over the suit around the exhaust device so that the load is applied as directly as possible to the fitting of the exhaust device in the suit.

Exert a force of (50 ± 2,5) N to the exhaust device and hold for 10 s. Repeat 10 times.

Examine the exhaust device for signs of damage or failure.

7 Marking

The marking shall comply with the specifications of EN 340 with the pictogram as given in figure 2.

The level of performance of the inward leakage (IL) shall be marked as:

IL : class x
(x = class number according to table 2).

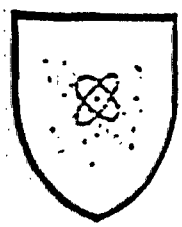

Figure 2: Pictogram

8 Manufacturers' information

The manufacturers' information shall comply with the specifications of EN 340.

The following information shall be supplied additionally:

- instructions for donning, using, fitting, removing and storing,
- application, limitations of use (temperature range etc.)
- tests to be carried out by the wearer before use (if required),
- maintenance and cleaning and decontamination by e.g. showering (if required).

The manufacturers shall specify the required supply pressure and flow range necessary to maintain protection.

Warnings (if appropriate) shall be given against problems likely to be encountered, as e.g. heat stress, depending on the air flow rate, work load, environmental atmosphere, and so on.

Annex A (normativ)

Activity sequence for the testing of the protection factor

Table A.1: Activity sequence for the testing of the protection factor

No	Activity sequence for the testing	time of activities min
1	dress person in the suit	-
2	don boots, gloves etc. as required according to the manufacturers instructions	-
3	person to enter test chamber, connect tubing to the sample point - no test agent	3
4	establish background reading at sample point with person standing still - no test agent	3
5	start test agent and allow to stabilize	3
6	record leakage and pressure at sample point with the person standing still	3
7	start treadmill	-
8	walk	3
9	record leakage and pressure at sample point with the person walking at about 5 km h^{-1}	-
10	stop treadmill	-
11	record leakage and pressure at sample point, person moving arms up and down above head height and looking upward, e.g. lifting object (half brick) from desk to shelf level	3
12	record leakage and pressure at sample point, person doing continuous squats	3
13	stop test agent and allow to decrease with person in chamber	3
14	disconnect sample tubes and remove person from test chamber and undress subject	-

NOTE: The total trial may vary, all times are approximate and are to stable conditions. When doing squats, a slow deliberate action is required, say continuously during about 3 s .

Analyse results over final 2 min of each exercise period to avoid carry over of result from one exercise to the other.

Record challenge chemical continuously using a separate detector (if possible).

Record the pressure inside the suit over the whole time.

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WARNING : Other requirements and other EU Directives may be applicable to the product(s) falling within the scope of this standard.

The following clauses of this standard are likely to support requirements of Directive 89/686/EEC, Annex II:

EU-Directive 89/686/EEC, Annex II	clauses of this standard
1.1 Design principles	4
1.3 Comfort and efficiency	4
1.4 Information supplied by the manufacturer	8
2.2 PPE "enclosing" the parts of the body to be protected	4 and 5
2.12 PPE bearing one or more identification or recognition marks directly or indirectly relating to health and safety	7
3.9 Radiation protection	4 and 5

Compliance with the clauses of this standard provides one means of conforming with the specific essential requirements of the Directive concerned and associated EFTA regulations.

ULNRC-05152
Enclosure 1
Attachment 2.5.11

Protection Factor determined during fit test exercises for V4 F1

Test Results carried out on the full encapsulated suit
MURUROA V4F1 ref. 8481X1T
For the EC Type Examination Certificate
N°0073/197/162/12/97/0028

You will find below the detailed results taken in account for being able to statue on the conformity of this equipment in accordance with the Essential Requirements of the European Standard pr EN 1073-1 . Other results those are non pointed out in this report are already written in the EC TYPE Examination certificate (dated December 10th 1997)

1 – Air Flow entering the suit when connected to a 6 bar feeding pressure (paragraph 2.3.2. of the EC Type Examination Certificate)

Suit number	Minimum air flow(l/mn)	Maximum air flow (l/mn)
1	508	1050
2	516	1070
3	508	1050

2 – Carbon dioxide content of the inhalation air when measured at the minimum air flow of 450 l/mn (paragraph 2.3.12. of the EC Examination Type)

Suit number	Test N°1 CO2 contents(%)	Test N°2 CO2 contents(%)
1	0,86	0,93
2	0,68	0,68
3	0,75	0,82

3 - Noise level associated with the air supply to the suit when tested at the maximum air flow rate at 6 bar (paragraph 2.3.13 of the EC Examination Type)

Suit number	Maximum air flow(l/mn)	Noise level (dB)
1	1050	77,2
2	1070	75,1
3	1050	77,6

4 – Inward leakage average- Fit Factor measured at the minimal air flow of 450l/mn (paragraph 2.3.3. of the CE Examination Type)

Suit n° / Exercise	1	2	3
Standing still	> 120 000	> 120 000	> 120 000
Walking (5 km/h)	76 700	90 900	66 000
Moving arms up and down above head	113 800	> 120 000	113 800
Continuous squats	30 000	41 700	50 000
Bending forward	110 000	103 400	91 700
Person twisting at waist	> 120 000	> 120 000	> 120 000
Person crawling	55 000	> 120 000	31 400

5 - Pressure in the suit when measured at the maximum air flow when suit connected under 6 bar feeding pressure (paragraph 2.3.11.of the EC Examination Type)

Suit n°	1		2		3	
Exercise	P min(Pa)	P Max.	P min(Pa)	P Max.	P min(Pa)	P Max.
Standing still	275	280	295	305	275	280
Walking (5 km/h)	200	800	300	900	600	900
Moving arms up and down above head	150	400	160	420	250	800
Continuous squats	30	900	30	1050	70	1700
Bending forward	80	1550	60	1900	100	1900
Person twisting at waist	140	500	160	420	160	650
Person crawling	160	900	150	850	250	1050

6 Air supply system (paragraph 4- 6 of the pr EN 1073-1)

In accordance with the paragraph 4.6; the connexion between the compressed air supply system and the suit has been tested for a steady pull of 250 N. The three suits have been tested successfully. However, it appears a deformation of the fabric, near the regulation air flow device. A reinforced area could certainly avoid this deformation.

ULNRC-05152
Enclosure 1
Attachment 2.5.12

Certificate No. 0073/197/162/12/97/0028 for Mururoa V4 F1
issued by the Institute for Nuclear Protection and Security

INSTITUTE FOR NUCLEAR PROTECTION AND SECURITY

Technical Center for Nuclear Equipment Certification

In accordance with the directive 89/686/EEC dated December 21th 1989 comparing the laws of the States Members Legislations relative to the Personal Protective Equipments, and the decrees n° 92-765, 766 and 768 dated July 29th 1992 transposing the directive into French Laws.

The organisation herebelow mentioned (IPSN / CTHEN) whose references are as follows:

- Address : B.P. n° 6 – 92265 Fontenay-aux-Roses Cedex (France).
- Empowered by Order of the Ministries of Employement and Agriculture dated December 24th 1996.
- Identified under the n° 0073 (published in the EEC Official Publication dated July 23 th 1994).

Assigns the :

EC TYPE EXAMINATION CERTIFICATE
N° 0073 / 197 / 162 / 12 / 97 / 0028

To the following Personal Protective Equipment model:

- Designation: Ventilated Protective Suit against Radioactive Contamination pressurised for a single use only.
- Commercial reference : ***MURUROA V4 F1 – ref. 848 1X1T.***
- Manufacturer : DELTA PROTECTION / REDI – 69 210 Saint-Germain-Sur-L'Abresle.
- Certificate applicant : DELTA PROTECTION – Z.A. De Berret-30200 Bagnols-Sur-Ceze.
- Essential Requirements Reference : EN 143, pr EN 1073-1 (July 1997), pr EN 943-1 (October 1997), EN 270, EN 1146 (April 1997).

Date : December 10th 1997
J. CORBIERE/ Chief of CTHEN

Nota : According to article R 223-62 of the "Working Law", the empowered organisation should be informed of any modification made to the material subject of this EEC type examination certificate, as well as of any modification made to the contents of this technical file on which the delivered type certificate was based on (address, manufacturer name, quality insurance certificate extract, ...)

This certificate contains 12 pages n° 1/12 to 12/12

1. DESCRIPTION

It is a Ventilated Protective Suit against Radioactive Contamination ventilated type – pressurised for a single use only, its name is:

MURUROA V4 F1 – ref. DELTA: 8481X1T

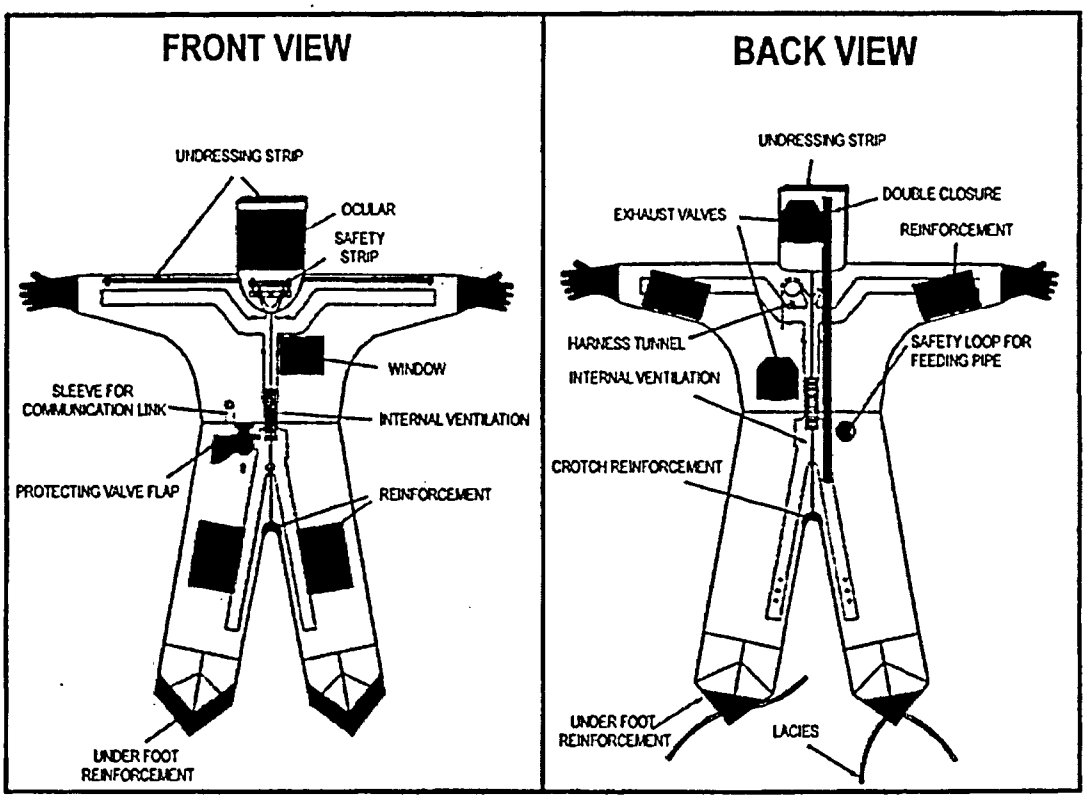
The T values are defined according to the size of the suit.

The X values are defined according to the pipe butt (Staubli or CEJN) allowing to connect the suit to the breathable compressed air supply system.

The attached list – annex 2 – gives all the references defined by this ECEC.

The suit includes:

- A air tight suit with an incorporated hood
- A suit fastening system located on the back of the suit.
- A breathable air flow supply system.
- A air exhaust device.
- A safety strip for emergency opening located on the hood.



1.1. MAIN MATERIALS

- **Skin of the suit :**

  PVC 9013 – Formule 1010, 20/100 mm thickness.

- **Hood:**

  PVC Cristal – 30/100 mm thickness.

- **Visor:**

  PVC (astraglass) 50/100 mm thickness.

- **Gloves:**

  PVC Sempersoft type – Size 9-91/2 for all the sizes of the suits.

- **Boots :**

  PVC 9013 – formulation 1010 – 20/100 mm thickness , reinforced PMI.

1.2. COMPONENTS

- **Internal Ventilation System :**

  It includes a total ventilation V4 fitted with a valve with butt.

- **Exhaust:**

  It includes two exhaust valves located on the head and on the back of the suit.

- **Fastening device:**

  It includes a double zip fastener situated vetically on the back of the suit.

- **Other components:**

  The suit includes:

- A safety strip for an emergency opening located on the hood.
- A acoustic link tunnel.
- A loop for breathable air supply pipe.
- Several internal strengthening pieces for elbows, knees and lmegs.
- A transparent window to visualise the dosimeter.

2. CONFORMITY TO REQUIREMENTS

2.1. REQUIREMENTS FOR THE MATERIALS (except accessories: Gloves, slippers...) (See paragraph 4.2. of the Norm EN 1073-1)

2.1.1. Abrasion Resistance

Test according to the Norm EN 530 – method 2 (abrasive paper 00). The classification is carried out according to the following diagram:

Class	Number of cycles
6	> 2 000 cycles
5	> 1500 cycles
4	> 1 000 cycles
3	> 500 cycles
2	> 100 cycles
1	> 10 cycles

Results: Class 6 for PVC 9013 – formule 1010 – 20/100 mm thickness.
Class 6 for Cristal PVC 30/100 mm thickness.

.1.2. Flexcracking Resistance

Test according to the Norm ISO 7854 – method B. The clasification is carried out according to the following diagram :

Class	Number of cycles
6	> 100 000 cycles
5	> 40 000 cycles
4	> 15 000 cycles
3	> 5 000 cycles
2	> 2 500 cycles
1	> 1 000 cycles

This test is not applicable to suits for one single use only.

2.1.3. Puncture Resistance

Test according to the Norm EN 863. The classification is carried out according to the following diagram :

Class	Puncture resistance
3	> 100 N
2	> 50 N
1	> 10 N

Results: Class 2 for PVC Cristal – 30/100 mm thickness.
Class 1 for PVC 9013 – Formule 1010 -20/100 mm thickness.

2.1.4. Resistance in blocking

Test according to the Norm EN 25978. The classification is carried out according to the following diagram:

Class	Comments
2	non stick
1	sticky

This test is not applicable to non-coated materials.

2.1.5. Tear Resistance

Test according to the Norm EN 29073-4. The classification is according to the following diagram:

Class	Applied strength
6	> 150 N
5	> 80 N
4	> 40 N
3	> 20 N
2	> 10 N
1	> 2 N

Results :. Class 3 for PVC 9013 – Formule 1010 – 20/100 mm thickness.
Class 4 for Cristal PVC – 30/100 mm thickness.

2.1.6. Flammability of materials, visors, and ancillary parts

Tests are carried out according to the Norms EN 1146 – single burner test (paragraph 7.5.3).
Results: Test requirements entirely fulfilled.

2.2. REQUIREMENTS FOR THE ACCESSORIES

2.2.1. Gloves

The gloves set on the MURUROA V4 F1 ref. 8481X1T comply with the specific requirements for this type of Individual Protection Equipment, mainly to the Norm EN 421 "Protective Gloves against ionizer radiation and radioactive contamination".

They have Special EC Examination Certificates (ECEC) based on contracted tests.

2.2.2. Boots

The boots are part and parcel of the suit and are made of the same constituted material.

Consequently they comply with the requirements.

2.3. REQUIREMENTS FOR THE PROTECTIVE SUIT

2.3.1. Suit Design: Practical Performance Test

The Practical Performance Test is carried out according to the Norm 1073-1 (paragraph 5.2.). The conditioning is according to the manufacturer directions for use.

Parameters	Valuations
a) Hood comfort	Aimless
b) Security of fastenings & couplings	Good
c) Accessibility of adjusting devices	Good
d) Clarity of vision through visor	Good
e) Suit comfort	Good
f) Speaking transmission facility	Aimless
g) Other parameters	No particular notice

2.3.3. Air flow supply system (project Norm pr EN 1073-1 – paragraph 4.8.)

The manufacturer estimated air flow rates, for a relative air flow supply pressure of 6 bar, with a tolerance of +/- 10%, are:

- Minimal flow rate : 30,0 $m^3.h^{-1}$ (500 $l.min^{-1}$)
- Maximum flow rate : 58,4 $m^3 h^{-1}$ (973 $l.min^{-1}$)

Notice: In order to take into account the manufacturer indicated tolerances, this ECEC tests have been carried out under the following conditions:

Dmin = 27,0 $m^3.h^{-1}$ (450 $l.min^{-1}$)
Dmax = 64,2 $m^3.h^{-1}$ (1070 $l.min^{-1}$)

The test concerning the air flow rates of the suit has been realised according to the Norm EN 1073-1 (paragraph 5.3); For an air supply pressure of 6 bar, the air flow rate inside the suit must not be : :

- Below the minimum value estimated by the manufacturer (Dmin), when the valve is on the "stop" closed position.
- Superior to the maximum value esitimated by the manufacturer (Dmax), when the valve is on the "on" opened position.

Results : Requirements entirely fulfilled.

2.3.3. Inward leakage average – Fit Factor (paragraph 4.3. of the project Norm pr EN 1073-1)

The ratio of the average inward leakage (or its contrary : Fit Factor) has been measured according to the draft Norm pr EN 943-1 (annex A). According to the Sodium Chloride Method.

Measurements have been performed under the following conditions:

- Quantity of tested suits : 3
- Air flow rate: Adjusted and maintained on minimum flow rate (D min) as indicated in paragraph 2.3.2.
- Trainings sequence: According to the Norm EN 1073-1 Annex A list.
- Suit preliminary conditioning: According to the advice of the user manual

The ratio of the average inward leakage (or Fit Factor) gives the following classification :

Ventilated pressurised Suit classification	Maximum accepted values, in %, of the ratio of the average Inward Leakage inside the hood, calculated on the whole lot of suits		FIT FACTOR
	For One activity	For all activities	
5	0.004	0.002	50 000
4	0.010	0.005	20 000
3	0.020	0.010	10 000
2	0.040	0.020	5 000
1	0.100	0.050	2 000

Results : The suit is classified 5.

2.3.4.1. Seams / Welds (paragraph 4.4.1 of the project Norm pr EN 1073-1)

A sample of each type of seam/weld is tested according to the Norm ISO 5082 (annex 2). The seam performance level is according to the following classification:

Class	Seam resistance (N)
5	> 300
4	> 125
3	> 75
2	> 50
1	> 30

The tests have been applied to the folllowing welds:

- Assemblage hood/suit
- Assemblage hood/visor
- Assemblage hood level
- Assemblage belt level
- Assemblage of the strengthening pieces (elbow and knees)
- Assemblage at the level of the arms, back and sides

Results : All the welds are classified 4.

2.3.4.2. Joins and Assemblages (paragraph 4.4.2. – project Norm pr EN 1073-1)

This suit has no removable parts. This paragraph is aimless.

2.3.4.3. Visors (paragraph 4.5. – project Norm pr EN 1073-1)

The distorsion of vision is measured, during the Practical Performance Test, by reading letters on an optometrical chart placed at a distance of 5 m; The loss of vision must not exced 2 degrees.

The mechanical resistance test of the visor is according to the Norm EN 146 (paragraph 6.7.).

Results : Distortion of vision : Up to requirement.
Mechanical resistance : up to requirement.

2.3.6. Air supply system (paragraph 4.6. of the project Norm pr EN 1073-1)

The couplings and connections must comply with the requirements of the paragraphs 6.7.1., 6.7.2., and 6.11.7. of the Norm EN 270. The connection between the compressed air supply system and the suit must resist to a 250 N pull.

Result: requirement entirely fulfilled.

2.3.7. Breathing Hose (paragraph 4.7. of the project Norm pr EN 1073-1)

Tests are performed according to the Norm 270 (paragraph 7.2. and 7.6). The pipes must not block the movements nor cause a rupture of the air supply during the Practical Performance Test.

Result: No constraint.

2.3.8. Air flow rate warning device (paragraph 4.9. of the project Norm pr EN 1073-1)

If a warning is fitted, it must comply to the Norm EN 270 (paragraph 6.13.3). The test must be carried out according to the Norm EN 270 (paragraph 7.12). The sound level must be between 85 dB(A) and 90 dB(A).

Result: Aimless (there is no warning device).

2.3.9. Air supply valve (paragraph 4.10 of the project Norm pr EN 1073-1)

For the air supply pressure specified by the manufacturer, the air supply valve must be able to adjust the air flow between the minimum and maximum values as indicated in the technical manual. It must be impossible to close the valve in order to reduce the air flow supply below the minimum flow rate as specified by the manufacturer.

Result: Requirements entirely fulfilled.

Notice: The MURUROA does not include low air flow indicator.

2.3.10. Exhaust devices (paragraph 4.11. of the project Norm pr EN 1073-1)

The exhaust devices must work correctly after the testing of the pressure in the suit, during the Practical Performance Test and during the determination of the Fit Factor. Test in accordance with the Norm 1073-1 (paragraph 5.6.).

Results : Good valves working.
Pull resistance superior to the fixed limit.

2.3.11. Pressure in the suit (Paragraph 4.12. of the project Norm pr EN 1073-1)

During the activity sequence as specified, the overpressure shall not exceed 1000 Pa mean and 2000 Pa peak. A positive pressure shall be maintained.
Test is performed with maximum air flow rate D max, as stipulated in paragraph 2.3.2. on three different suits.

Result : Requirements entirely fulfilled.

2.3.12. Carbon dioxide content of the inhalation air (paragraph 4.13.-project Norm pr EN 1073-1)

The CO2 content of the inhalation air, determined at the minimum air flow rate, shall not exceed an average of 1 % (by volume), tested according to the Norm 270 (paragraph 7.15) with the minimum air flow rate D min indicated in paragraph 2.3.2, on three diffeent suits.

Result: Requirement entirely fulfilled.

2.3.13. Noise associated with the air supply to the suit (paragraph 4.14 - project Norm pr EN 1073-1)

Test according to the Norm 270 (paragraph 7.16). The noise measured in the suit at the ears shall not exceed 80 dB(A) at the maximum air flow rate as indicated by the manufacturer.Tested at the maximum air flow rate D max as stipulated in paragraph 2.3.2, on three different suits.

Result: Requirement entirely fulfilled.

3. CHECKINGS

3.1. MARKING (paragraph 6 of the Norm project pr EN 1073-1)

The marking complies with the requirements of the Norms EN 340 and EN 1073-1. According to the Decree dated February 7TH 1997 "relative to EEC marking of the working equipment and of the Personal Protective Equipment", it includes the distinctive number of the entitled organisation for the procedure of controls of the manufactured PPE (article 11 of the EEC Directive 89/686/EEC).

The symbol "i" is included in the pictogram, in order to show that the manufacturer instructions should be read by the user..

3.2. MANUFACTURER INFORMATION (Paragraph 7 of the project Norm pr 1073-1)

Information comply with the specifications of the project of Norm pr 1073-1. They include the Directions for use, the conditions of use, the specific limits and restraints.
Thes documents will be corrected in order to take into account the tests results as mentionned in this ECEC.

3.3. MAINTENANCE MARKING

This is aimless, the suit being for one single use only.

4. CONCLUSIONS

Upon presentation of the tests results, the Ventilated – pressurised for a single use only, **MURUROA V4 F1 – ref. 8481X1T** is certified to ensure a protection against radioactive contamination **according the following specified limits :**

- **Minimum air flow rate:** **27,0 $m^3.h^{-1}$.**
- **Maximum air flow rate:** **64,2 $m^3.h^{-1}$.**

The **MURUROA V4 F1** is delivered without low air flow rate indicator.

Before using it, the user will have at his disposal the necessary devices to check that the minimum air flow rate, as specified by the manufacturer is reached or over reached before and during the use of the suit.

ANNEX 1

Description and references of the equipment certified in the EC Type Examination Certificate

The different models of equipment, whose generic appellation is MURUROA V4 F1 ref. 8481X1T, and which are the subject of this EEC type examination certificate (ECEC), are only different on the following points:

- The type of pipe butt connecting the equipment to the breathable compressed air supply system.
- The size.

X indicates the type of pipe butt according to the following values:

References	Type of butt for connection to the compressed air supply system	References of MURUROA V4 F1 associated
X=2	Staubli RBE 06 6150	848121 T
X=3	Staubli RBE 06 "détrompeur"	848131 T
X=4	CEJN 342	848141 T
X=8	Staubli RBE 06 QR	848181 T

T indicates the size of the suit according to the following values:

REFERENCE	Height (cm)	Waist measurement (cm)
T=0	152-164	56-64
T=1	164-170	64-68
T=2	170-176	68-72
T=3	176-182	72-76
T=4	182-188	76-80
T=5	188-200	80-88

ULNRC-05152
Enclosure 1
Attachment 2.5.13

User Instructions for Mururoa V4 F1 and V4 MTH2.

NO/841442T

INDICE : e

DATE : 12/00

PAGE : 1/1

M.T.H.2 And MUROROA V4F1

INSTRUCTIONS FOR USE

Preliminary remarks : This clothing is to be used under the authority of the person responsible for issuing the equipment for its dedicated use :

- the clothing offers the necessary protection for it's intended use.
- Breathable air *network, hoses with connectors compatible with that of the clothing, are actually available on site and that they are capable of supplying a sufficient quantity of air :

minimum flow rate	500 liters/min. +/- 10% at 6 Bars ; (17 cfm at 85 psig)
maximum flow rate	1100 liters/min. +/- 10% at 6 Bars ; (38cfm at 85 psig)

DRESSING

- The wearer, with a helper, visually inspects the condition of the garment and its components, then removes the shipping protection (cardboard on the visor and inside the garment, and removable "plastic protection" from the visor).
- He enters through the rear opening of the garment and insures that his legs are in the garment.
- Connects to the breathable air network by passing the supply line through the loop at the rear of the garment, at the same height as the supply valve.
- Connects , if used, the MURUPHONE system, or other communication device through the safety loop and communication loop and finishes dressing.
- The helper zips up the dual zipper system and applies a large strip of adhesive tape to the upper extremity of the second zipper at the top to ensure air tightness. He then, ties the over boot laces around the ankles.
- The wearer can control the air supply by turning the adjustment knob. The correct functioning of the supply flow valve and the over pressure valves can be verified by crouching down rapidly a few times.
- He then is free to enter the work zone.

UNDRESSING

- Undressing may be done in the following manner. While the garment is still being supplied with air , the helper pulls on the orange undressing strip, which runs from one wrist to the other over the hood. Once the undressing strip is removed, the helper can split the suit shell by pulling on the hooded area and separating the suit into two identical pieces. The helper rolls up the front and rear parts in a way that traps the contamination and avoids all contact with the wearer of the garment. (Please consult our video for detailed undressing techniques).

IMPORTANT

- Leave the work zone immediately if the clothing deflates during the work phase evolution .If the helmet fogs, or if the person has a feeling of excessive warmth.
- Remember that the clothing remains pressurised for a few minutes in case of an air supply failure

STORAGE

In the original packaging; out of the light; between + 5°C and + 45°C.(41°F and 113°F)

USAGE

The air supply should be between + 15°C and + 45°C. (59°F and 113°F)

EXPIRY DATE

The clothing should be used by the third year from the date of manufacture.

CLEANING

Not necessary for this type of equipment which is for a single use only.

EMERGENCY FEATURES

- Air outside of the garment can be breathed by removing the safety strip at the front of the helmet/hood.
- The undressing strip, removed by the wearer, enables the wearer to self escape t in less than 5 seconds.

* Breathable air : see the EN 132 standard.

ULNRC-05152
Enclosure 1
Attachment 2.5.14

Certificate No. 0073/197/162/01/96/0001 issued for Mururoa V4 MTH2
by the Institute for Nuclear Protection and Security

INSTITUTE FOR NUCLEAR PROTECTION AND SECURITY

Technical Center for Nuclear Equipment Certification

In accordance with the directive 89/686/EEC dated December 21 th 1989 comparing the laws of the States Members Legislations relative to the Personal Protective Equipments, and the decrees n° 92-765, 766 and 768 dated July 29th 1992 transposing the directive into French Laws.

The organisation here below mentioned (IPSN / CTHEN) whose references are as follows:

- Address : B.P. n° 6 – 92265 Fontenay-aux-Roses Cedex (France).
- Empowered by Order of the Ministries of Employment and Agriculture dated December 24th 1996.
- Identified under the n° 0073 (published in the EEC Official Publication dated July 23 th 1994).

Assigns the :

EC TYPE EXAMINATION CERTIFICATE
N° 0073 / 197 / 162 / 01 / 96 / 0001

To the following Personal Protective Equipment model:

- Designation: Ventilated Protective Suit against Radioactive Contamination pressurised for a single use only.
- Commercial reference : ***MTH 2 – ref. 841 442 T.***
- Manufacturer : DELTA PROTECTION / REDI – 69 210 Saint-Germain-Sur-L'Abresle.
- Certificate applicant : DELTA PROTECTION – Z.A. De Berret-30200 Bagnols-Sur-Ceze.
- Essential Requirements Reference : EN 143, pr EN 1073 (nov. 1995), pr EN 943 (august 1995), EN 270, EN 146.

Date : January 10th 1996
G.BRUHL / Chief of CTHEN

Nota : According to article R 223-62 of the "Working Law", the empowered organisation should be informed of any modification made to the material subject of this EEC type examination certificate, as well as of any modification made to the contents of this technical file on which the delivered type certificate was based on (address, manufacturer name, quality insurance certificate extract, ...)

This certificate contains 12 pages n° 1/9 to 9/9

1. DESCRIPTION

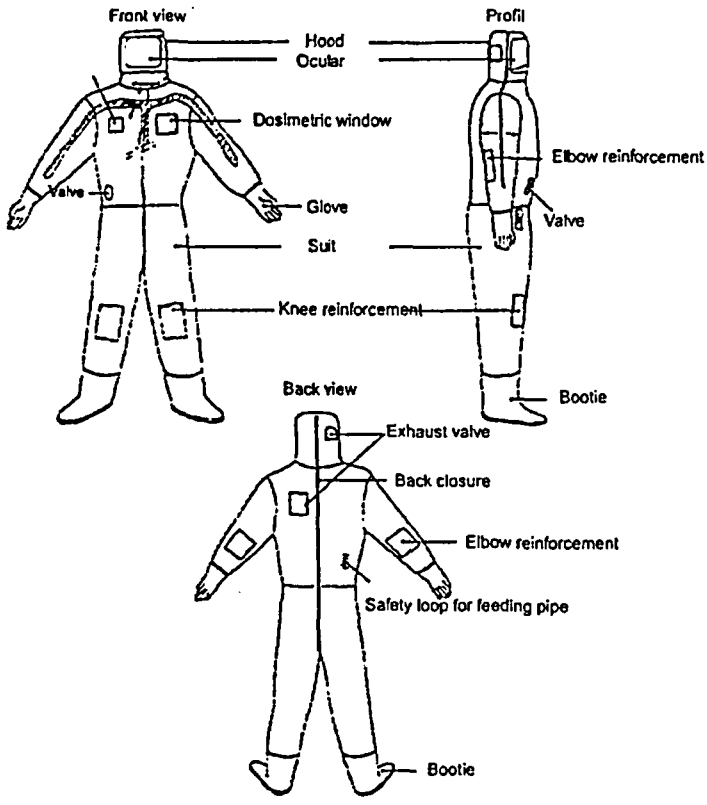
It is a Ventilated Protective Suit against Radioactive Contamination ventilated type – pressurised for a single use only, its name is:

MTH2 – ref. DELTA: 841 442 T

The T values are defined according to the size of the suit.

The suit includes:

- A air tight suit with an incorporated hood
- A suit fastening system located on the back of the suit.
- A breathable air flow supply system.
- A air exhaust device.
- A safety strip for emergency opening located on the hood.



1.1. MAIN MATERIALS

- **Skin of the suit :**

  White polyethylene: Ethyfuge 2000 Thickness: 24/100 mm

- **Hood:**

  PE Cristal – 30/100 mm thickness.

- **Visor:**

  PVC (astraglass) 50/100 mm thickness.

- **Gloves:**

  PVC Sempersoft type – Size 9-91/2, and Semperstar type – size 10-10 ½..

- **Boots :**

  Polyethylene – 24/100 mm thickness , reinforced with PE cristal.

1.2. COMPONENTS

- **Internal Ventilation System :**

  It includes a total ventilation V4 fitted with a valve with CEJN (réf:342) butt.

- **Exhaust:**

  It includes two exhaust valves located on the head and on the back of the suit.

- **Fastening device:**

  It includes a double zip fastener located vertically on the back of the suit.

- **Other components:**

  The suit includes:

- A safety strip for an emergency opening located on the hood.
- A acoustic link tunnel.
- A loop for breathable air supply pipe.
- Several internal strengthening pieces for elbows, knees and legs.
- A transparent window to visualise the dosimeter.

2. CONFORMITY TO REQUIREMENTS

2.1. REQUIREMENTS FOR THE MATERIALS (except accessories: Gloves, slippers...) (See paragraph 5.1. of the prEN 1073)

2.1.1. Abrasion Resistance

Test according to the Norm EN 530 – method 2 (abrasive paper 00). The classification is carried out according to the following diagram:

Class	Number of cycles
6	> 2 000 cycles
5	> 1500 cycles
4	> 1 000 cycles
3	> 500 cycles
2	> 100 cycles
1	> 10 cycles

Results: Class 6 for Ethyfuge 2000 – 24/100 mm thickness.
Class 6 for PVC.

.1.2. Flex cracking Resistance

Test according to the Norm ISO 7854 – method B. The classification is carried out according to the following diagram :

Class	Number of cycles
6	> 100 000 cycles
5	> 40 000 cycles
4	> 15 000 cycles
3	> 5 000 cycles
2	> 2 500 cycles
1	> 1 000 cycles

This test is not applicable to suits for one single use only.

2.1.3. Puncture Resistance

Test according to the Norm EN 863. The classification is carried out according to the following diagram :

Class	Puncture resistance
3	> 100 N
2	> 50 N
1	> 10 N

Results: Class 1 for Ethyfuge 2000 – 24/100 mm thickness.
Class 2 for PE cristal.

2.1.4. Resistance in blocking

Test according to the Norm ISO 5978. The classification is carried out according to the following diagram:

Class	Comments
2	non stick
1	sticky

This test is not applicable to non-coated materials.

2.1.5. Tear Resistance

Test according to the Norm ISO 9073-4. The classification is according to the following diagram:

Class	Applied strength
6	> 150 N
5	> 80 N
4	> 40 N
3	> 20 N
2	> 10 N
1	> 2 N

Results :. Class 4 for Ethyfuge 2000 – 24/100 mm thickness.

Class 3 for PE Cristal.

2.1.6. Flammability of materials, visors, and ancillary parts

Tests are carried out according to the Norms EN 1146 – single burner test (paragraph 7.5.3).

Results: Test requirements entirely fulfilled.

2.2. REQUIREMENTS FOR THE ACCESSORIES

2.2.1. Gloves

The gloves set on the MTH2 ref. 841 442 T comply with the specific requirements for this type of Individual Protection Equipment, mainly to the Norm EN 421 "Protective Gloves against Ionizer radiation and radioactive contamination".

They have Special EC Examination Certificates (ECEC) based on contracted tests.

2.2.2.Boots

The boots are part and parcel of the suit and are made of the same constituted material.

Consequently they comply with the requirements.

2.3. REQUIREMENTS FOR THE PROTECTIVE SUIT

2.3.1. Suit Design: Practical Performance Test

The Practical Performance Test is carried out according to the prEN 1073 (paragraph 6.2.). The conditioning is according to the manufacturer directions for use.

Parameters	Valuations
a) Harness comfort	Aimless
b) Security of fastenings & couplings	Good
c) Accessibility of adjusting devices	Good
d) Clarity of vision through visor	Good
e) Suit comfort	Good
g) Other parameters	No particular notice

2.3.2. Fit Factor (paragraph 5.2.2. of the pr EN 1073)

The protection factor is determined according to the PrEN 944 standard (paragraph 8.9) by respecting the sequences indicated in Annex A of the PrEN 1073.
The mean leakage value (or inversely, the protection factor) enables a clothing classification according to the following table. The preconditioning according to the instructions for use recommendations.

Ventilated pressurised Suit classification	Maximum accepted values, in %, of the ratio of the average Inward Leakage inside the hood, calculated on the whole lot of suits		FIT FACTOR
	For One activity	For all activities	
5	0.004	0.002	50 000
4	0.010	0.005	20 000
3	0.020	0.010	10 000
2	0.040	0.020	5 000
1	0.100	0.050	2 000

Results : The suit is classified 5.

2.3.3.1. Seams, Joins and Assemblages pull test resistance

2.3.3.1. Seams / Welds (paragraph 5.2.3.1 of the pr EN 1073)

A sample of each type of seam/weld is tested according to the Norm ISO 5082 (annex 2). The seam performance level is according to the following classification:

Class	Seam resistance (N)
5	> 300
4	> 125
3	> 75
2	> 50
1	> 30

The tests have been applied to the following welds:

- Elbow and knee reinforcement
- Crotch assembly
- Belt assembly
- Booties assembly
-

Results : All the welds are classified 3.

2.3.3.2. Joins and Assemblages (paragraph 5.2.3.2. – prEN 1073)

This suit has no removable parts. This paragraph is aimless.

2.3.4 Gas tight (paragraph 5.2.4. of prEN 1073.

The test was carried out according to the EN 464 standard . The loss of pressure shall not be greater than 4 mbar in 6 minutes.

Results : Test not undertaken as the clothing is not considered as an gastight suit.

2.3.5. Visors (paragraph 5.2.5. of prEN 1073)

The distortion of vision is measured, during the Practical Performance. The mechanical resistance test of the visor is according to the Norm EN 146 (paragraph 6.6 and 6.7.).

Results : Distortion of vision : Up to requirement.
Mechanical resistance : up to requirement.

2.3.6. Air supply system (paragraph 5.2.6. of the pr EN 1073)

The couplings and connections must comply with the requirements of the paragraphs 6.7.1., 6.7.2., and 6.11.7. of the EN 270. The connection between the compressed air supply system and the suit must resist to a 250 N pull.

Result: requirement entirely fulfilled.

2.3.6. Breathing Hose (paragraph 5.2.7. of the pr EN 1073)

Tests are performed according to the EN 270 (paragraph 7.2. and 7.6). The pipes must not block the movements nor cause a rupture of the air supply during the Practical Performance Test.

Result: No constraint.

2.3.7. Air supply flow rate (paragraph 5.2.8. of the PrEN 1073)

The test is carried out according to the PrEN 1073 standard (paragraph 6.3).

Result:

Minimal flow rate:30 $m^3.h^{-1}$ (500 l/min^{-1}) for a 6 Bar supply pressure

Maximal flow rate:66 $m^3.h^{-1}$ (1100 l/min^{-1}) for a 5.5 Bar supply pressure

2.3.8. Air flow rate warning device (paragraph 5.2.9. of the pr EN 1073)

If a warning is fitted, it must comply to the EN 270 (paragraph 6.13.3). The test must be carried out according to the EN 270 (paragraph 7.12). The sound level must be higher than 85 dB(A).

Result: Aimless (there is no sonic warning device).

2.3.9. Air supply valve (paragraph 5.2.10 of the pr EN 1073)

Where present, the control valve should enable a variation of flow rate between the minimum and maximum specified values without the possibility of closure.

Result: Requirements entirely fulfilled.

2.3.11. Exhaust devices (paragraph 5.2.11. of the pr EN 1073)

The exhaust devices must work correctly after the testing of the pressure in the suit, during the Practical Performance Test and during the determination of the Fit Factor. Test in accordance with the EN 1073 (paragraph 6.6.).

Results : Good valves working.
Pull resistance superior to the fixed limit.

2.3.12. Pressure in the suit

During the activity sequence as specified, the overpressure shall not exceed 1000 Pa mean and 2000 Pa peak. A positive pressure shall be maintained.

Result: Requirements entirely fulfilled.

2.3.13. Carbon dioxide content of the inhalation air

The CO_2 content of the inhalation air, determined at the minimum air flow rate, shall not exceed an average of 1 % (by volume), tested according to the EN 270 (paragraph 7.15).

Result: Requirement entirely fulfilled.

2.3.14. Noise associated with the air supply to the suit (paragraph 5.2.14 - pr EN 1073)

Test according to the EN 270 (paragraph 7.16). The noise measured in the suit at the ears shall not exceed 80 dB(A) at the maximum air flow rate as indicated by the manufacturer.

Result: Requirement entirely fulfilled.

3. CHECKINGS

3.1. MARKING (paragraph 7 of the pr EN 1073)

The marking is satisfies the requirements of article 7 in the EN 340.

3.2. MANUFACTURER INFORMATION (Paragraph 8 of the pr 1073)

The manufacturers information complies with the specifications in paragraph 8 of the EN 340. They contain the instructions for use, the usage conditions and the specific limits and restraints.

3.3. MAINTENANCE MARKING

This is aimless, the suit being for one single use only.

4. CONCLUSIONS

Upon presentation of the tests results, the Ventilated suit – pressurised for a single use only, **MTH 2 – ref. 841 442 T** is certified to ensure a protection against radioactive contamination **according the following specified limits :**

- **Minimum air flow rate:** **30 $m^3.h^{-1}$ (500 $l.min^{-1}$)**
- **Maximum air flow rate:** **66 $m^3.h^{-1}$.(1100 $l.min^{-1}$)**

ULNRC-05152
Enclosure 1
Attachment 2.5.15

Protection Factor determined during fit test exercises for V4 MTH2

Test Results carried out on the full encapsulated suit
MTH2 ref. 841442T
For the EC Type Examination Certificate
N°0073/197/162/01/96/0001

You will find below the detailed results for this equipment in accordance with the Essential Requirements of the European Standard pr EN 1073-1 (revision Nov 1995). Other results that are not pointed out in this report are already written in the EC TYPE Examination certificate (dated December 10th 1997)

1 – Air Flow entering the suit when connected to a 6 bar feeding pressure (paragraph .5.2.8. of the EC Type Examination Certificate)

Suit number	Entrance valve position	Air flow feeding pressure Bar / *psig*	air flow (m3/h / l/mn/ *cfm*)
1	Fully open	5,5 / *77*	66/1100/ *38*
1	Closed	6,0 / *87*	30 / 500 / *17*
2	Fully open	5,5 / *77*	65 / 1080 / *37,8*
2	closed	6,0 / *87*	31 / 516 / *18*

2 – Carbon dioxide content of the inhalation air when measured at the minimum air flow (paragraph 5.2.13. of the EC Examination Type)

Suit number	Feeding pressure Bar / *psig*	Air flow M3/h / *cfm*	CO2 contents(%)
1	6 / *87*	30 / *17*	0,85
2	6 / *87*	31 / *18*	0,80

3 - Noise level associated with the air supply to the suit when tested at the maximum air flow rate (paragraph 5.2.14 of the EC Examination Type)

Suit number	Feeding pressure Bar / *psig*	Air flow M3/h; *cfm*	Noise level (dB)
1	5,5 / *77*	66 / *38*	76,8
2	5,5 / *77*	65 / *37,8*	78,5

4 – Inward leakage average- Fit Factor measured at the minimal air flow of 450l/mn (paragraph 2.3.3. of the CE Examination Type)

Suit n° / Exercise	1	2
Air flow m3/h/ l/mn / *cfm*	30 / 500 / *17*	31 / 516 / *18*
Standing still	130 000	130 000
Walking (5 km/h)	59 500	50 000
Moving arms up and down above head	125 000	125 000
Continuous squats	65 000	81 250
Bending forward	100 000	92 850
Person twisting at waist	115 000	130 000
Standing still	130 000	130 000
Average	103 500	103 440

5 - Pressure in the suit when measured at the maximum air flow when suit connected under 5,5 bar (77psig) feeding pressure (paragraph 4.12.of the EC Examination Type)

Suit n° / Exercise	1 P ave/ P min/ Pmax daPa.			2 P ave; P min, P Max. daPa		
Standing still	40	-	-	38	-	-
Walking (5 km/h)	40	23	74	100	61	128
Moving arms up and down above head	40	17	62	46	18	72
Continuous squats	42	4	86	56	3	110
Bending forward	52	3	104	74	0	162
Person twisting at waist	38	18	58	46	20	110
Person crawling	37	-	-	40	-	-

For Information: Both overboots are breaked at the end of the test

6 **Over pressure and fit factor when person crawling on the floof as indicated in paragraph 4.12 and 5.2.2 of the pr EN 1073-1dated 1995**

Suit number	Crawling exercise			
	Average DP daPa	Minimum DP daPa	Maximum DP daPa	Fit Factor
1	52	12	90	110 000
2	65	3	102	105 000

7 **Screen:(paragraph 5.2.5)**

- **Distortion of the vision**: none
- **Mechanical resistance :** no incidence on the screen.

LIST OF COMMITMENTS

The following table identifies those actions committed to by AmerenUE in this document. Any other statements in this document are provided for information purposes and are not considered commitments. Please direct questions regarding these commitments to Mr. David E. Shafer at (314) 554-3104.

COMMITMENT	Due Date/Event
The Delta Protection Mururoa model BLU, V4 F1, and V4 MTH2 single use suits will be integrated into AmerenUE station respiratory program using the information provided by the manufacturer.	Within 45 days of NRC approval
New lesson plans will be developed to train workers on BLU, V4 F1, and V4 MTH2 features, donning, use and removal, cautions and use of mouth strip and tear off strips for routine and emergency egress, as well as the maintenance of the "powered air purifying system" that forms an integral part of the product.	Within 45 days of NRC approval
Radiation Protection personnel will be provided additional training for selection, approval, issue, equipment set-up, operation and maintenance instructions for the BLU, V4 F1, and V4 MTH2 suit.	Within 45 days of NRC approval
Procedural guidance will be developed to ensure single use only and appropriate suit disposal after each use.	Within 45 days of NRC approval
Procedural guidance will be established to ensure AmerenUE identified defects and usage problems are reported to the suit manufacturer.	Within 45 days of NRC approval