Tennessee Valley Authority, 1101 Market Street, Chattanooga, Tennessee 37402-2801

May 13, 2005

10 CFR 20.1705
10 CFR 20.1703

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D.C. 20555-0001

Gentlemen:

In the Matter of	)	Docket Nos.	50-259	50-260
Tennessee Valley Authority	)		50-296	50-327
			50-328	50-390

BROWNS FERRY NUCLEAR PLANT (BFN) UNITS 1, 2, AND 3; SEQUOYAH NUCLEAR PLANT (SQN) UNITS 1 AND 2; AND WATTS BAR NUCLEAR PLANT (WBN) UNIT 1 – DELTA PROTECTION MURUROA SINGLE USE SUPPLIED AIR SUITS - REQUEST FOR APPROVAL

Pursuant to Title 10 of the Code of Federal Regulations (CFR) Part 20, TVA requests approval to use "Delta Protection Mururoa Single Use Supplied Air Suits," Model V4 MTH2, at BFN, SQN, and WBN in accordance with the following specific regulations:

1. §20.1703(b) requires prior authorization from the Nuclear Regulatory Commission (NRC) for the use of equipment that has not been tested or certified by National Institute for Occupational Safety and Health (NIOSH).

2. §20.1705 requires prior authorization from NRC before using assigned protection factors in excess of those specified in §20, Appendix A.

Model V4 MTH2 provides for better worker protection in areas of airborne radioactivity and in areas of high potential for facial or skin contamination from hot particles. Other benefits include improved contamination control, reductions in heat stress, and better respiratory protection over existing equipment. Model V4 MTH2 has no current NIOSH approval for use as a respirator in the United States; therefore, TVA requests that the NRC review this special equipment for approval for respiratory protection and also assign a protection factor for its use. The enclosure to this letter provides TVA's detailed "Request for Approval."

D030

The subject air-supplied suits were accepted for use by the NRC safety evaluation report (SER) for Duke Energy with transmittal letter dated June 30, 2003, and more recently accepted for use for Entergy Operations with SER transmittal letter dated February 1, 2005.

TVA requests approval by September 1, 2005, to allow time to make process procedure changes and complete training for TVA's spring 2006 outages.

There are no new regulatory commitments in this letter. If you have any questions, please call Rob Brown at (423) 751-7228.

Sincerely,

Fredrick C. Mashburn
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ENCLOSURE

TENNESSEE VALLEY AUTHORITY
BROWNS FERRY NUCLEAR PLANT (BFN) UNITS 1, 2, AND 3, SEQUOYAH NUCLEAR PLANT (SQN) UNITS 1 AND 2, AND WATTS BAR NUCLEAR PLANT (WBN) UNIT 1

DELTA PROTECTION MURUROA SINGLE USE SUPPLIED AIR SUITS

REQUEST FOR APPROVAL

APPROVAL REQUEST FOR DELTA PROTECTION MURUROA SINGLE USE ENCLOSED SUITS

1.0 INTRODUCTION

1.1 PURPOSE

10CFR20, Appendix A, "Assigned Protection Factors for Respirators," states that an air-supplied suit may be used in a continuous-flow mode; however, an Assigned Protection Factor (APF) has not been designated. A footnote (g) to this equipment application indicates that the suit can be used in a respiratory protection program if the minimum program requirements are met (e.g., 10CFR20.1703, "Use of Individual Respiratory Protection Equipment). 10CFR20.1703 states that use of non-National Institute for Occupation Safety and Health (NIOSH) equipment is acceptable only if approved for use by the Nuclear Regulatory Commission (NRC). Since 10CFR20, Appendix A does not specify an APF for these air-supplied suits, 10CFR20.1705, "Application for Use of Higher Assigned Protection Factors," would have to be exercised in order to obtain NRC approval for exceeding the requirements of 10CFR20, Appendix A.

Tennessee Valley Authority (TVA) proposes the use of the Mururoa "fully enclosed suit" model V4 MTH2 manufactured by Delta Protection, France. The purpose of this submittal is to request approval for the use of these particular suits and for authorization to use an APF of 2,000 when using the suits. Additionally, due to the advanced safety features for emergency breathing and emergency escape built into these suit models, TVA may choose to use the Mururoa suits without dedicated rescue personnel being assigned.

The Mururoa suit was accepted by the NRC in June 2003 for use by the Duke Energy Corporation as a respiratory device with a protection factor of 2,000 (TAC NOS. MB 7952, MB7953, MB7954, MB7955, MB7956, MB7957, and MB7958). The Mururoa suits have been widely used in Western European nuclear power plants (the manufacturer indicates that approximately 60,000 Mururoa garments/suits are used by these plants each year). The suits received certification for use by the Institute for Nuclear Protection and Security in 1996.

1.2 BACKGROUND

1.2.1 Regulatory Requirements

The following regulatory requirements are relevant to this request.

10CFR20.1703, "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.

10CFR20.1703(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 to authorize use of the equipment.

10CFR20.1705, "Application for Use of Higher Assigned Protection Factors," requires that a licensee shall obtain authorization from the NRC before using assigned protection factors in excess of those specified in 10CFR20, Appendix A.

10CFR20, Appendix A, "Assigned Protection Factors for Respirators," Item II, "Atmosphere Supplying Respirators (particulate, gases and vapors)," indicates that for a suit in a continuous flow operating mode, no APF is assigned nor is a NIOSH approval schedule currently available for the evaluation of such 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., 10CFR20.1703).

Based on these regulatory requirements, TVA is required to obtain NRC approval for both the use of and a protection factor for the Mururoa model V4 MTH2 suit.

1.2.2 Suit Construction

The Mururoa Model V4 MTH2 suit meets ISO 8194 and the European Standard EN.NF 1073-1. The manufacturer is ISO 9002 certified.

The Mururoa single use suits have the following features that are not typically available in the "bubblehoods" and "rain suits" manufactured in the United States and currently in use at TVA:

1) One piece single use suit that includes welded gloves and booties with tie straps

2) Made of polyethylene (Ethyfuge 2000) with reinforced elbows, knees and crotch areas

3) Dual zippers - metal zipper inside and plastic zipper outside

4) Helmet made of clear Poly Vinyl Chloride (PVC) material that provides distortion-free vision and large enough for wearing a headset

5) Welded sleeve to insert communication cable

6) A removable strip near the mouth that could be used for emergency breathing in case of loss of supplied air

7) 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

8) Air intake located at the waist with a built-in regulator that can adjust airflow (but not block it).

9) Two exhaust valves that provide ventilation and protect from overpressure

10) Very low noise level at maximum air flow

11) Air flow distributed to the arms, legs, and face

Air hoses of any length can be used, but air shall be supplied to the Mururoa suits between 40-85 psig as measured at the inlet.

A regulator at the inlet can adjust the airflow from 43 CFM maximum to 9 CFM at the minimum. To ensure user safety, the regulator cannot shut off the air supply. Noise level is kept between 76 dB at maximum airflow to 58 dB at minimum airflow. Air flows through manifolds to the chest, hands and feet. 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 aspiration of contaminants if supplied air is lost. The Mururoa is approved for use with different fittings in Europe and can be fitted with Schrader, Foster or CEJN type fittings used at the TVA facilities. The Mururoa Model V4 MTH2 suit is made of Ethyfuge material, which is incinerable. Examination of the suit shows there are two air vents near the chin for cooling the face, as well as a distribution network for air to go to the arms and the legs.

1.2.3 Safety Features of the Mururoa Model V4 MTH2 Suit

The Mururoa suit is lightweight (2.5 lbs), made of fire-retardant material and can be used in temperatures up to 140° F., as per EN 1073-1. The suits have built-in gloves, booties with binding ties, and have reinforced elbows, knees and crotch. A transparent helmet with 6-inch X 8-inch clear faceplate provides distortion-free view. Dual magnetic ventilation valves provide needed ventilation and relief of excess pressure in case suit is squeezed/pinched unexpectedly. Noise level at maximum airflow is less than 80 dB. Airflow can be adjusted by the user for his/her comfort, but cannot be shut off. 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's design **does not permit** its use in an Immediately Dangerous to Life and Health (IDLH) atmosphere. TVA plans to use this suit for protection against radioactive particulate contamination only. The Mururoa suit is 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.

1.2.4 Implementation

TVA sites have well developed respiratory programs in full compliance with 10CFR20. The Mururoa V4 MTH2 suits will be integrated into the TVA respiratory program using the information provided by the manufacturer. New lesson plans will be developed to train workers on the Mururoa's features, donning, use and removal, 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 the Mururoa suit. The Mururoa suit's safety features, namely the tear-off mouth strip and the emergency tear-off strip, make it unnecessary for any standby rescue personnel. Additionally, in many cases, workers are in direct contact with Radiation Protection or support personnel via audio headsets. The ability to eliminate the rescue worker is an ALARA consideration since the work areas where air-supplied suits are used are typically areas with higher radiation and contamination levels. Steam generator platform work, reactor cavity decontamination, and equipment decontamination are specifically targeted for the use of the Mururoa suit.

TVA will use the Corrective Action Program (CAP) to document and evaluate any unexpected problems with the suits. In addition, TVA will advise Delta Protection of any unexpected problems with the suits, if they arise. The manufacturer is subjected to checks from the IPSN (Institute for Nuclear Protection and Security) to insure the product has no risk of injury to the user. A second organization called ASQUAL (an advisory group to regulators) performs annual inspections of the factory to certify that the manufactured product is of the same quality approved by the IPSN. 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 by Delta Protection, and are reported to licensees using our suits on a quarterly basis. Customers are notified of significant problems and products are recalled if necessary. This information is made available to ASQUAL for their annual inspections.

TVA currently uses air-supplied hoods, (commonly known as the bubble hood) for jobs involving overhead contamination, contaminated water, high potential for skin contamination from discrete radioactive particles, and to prevent intake of airborne contaminates. Because the bubble hoods do not cover the hands and the feet, workers have to wear additional protective clothing, including multiple pairs of gloves, rubber shoes and booties and tape for sealing. Chances of cross contamination during undressing/exit from the 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 2,000 for the Mururoa suits would allow use of the Mururoa suits in TVA's efforts to control contamination incidents and prevent intakes during operational activities at the TVA's nuclear facilities.

2.0 TECHNICAL JUSTIFICATION

2.1 EVALUATION

TVA reviewed the following documents obtained from Delta Protection:

- General Description of the Mururoa Model V4 MTH2 Ventilated Suits (Attachment 1)
- European Standard EN 1073-1:1998 for Ventilated Protective Clothing (Attachment 2)
- Certificate No. 0073/197/162/01/96/0001 for Mururoa Model V4 MTH2 Issued by the Institute for Nuclear Protection and Security (Attachment 3)
- Protection Factor Determined During Fit Test Exercises for Mururoa Model V4 MTH2 (Attachment 4)
- Donning and Removal Instructions for Mururoa V4 MTH2 (Attachment 5)

Based on a review of this documentation and physical examination of the Mururoa Model V4 MTH2 suit, the 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 2,000.

A key element of this review was the application of the European Standard and the Certificate issued by the Institute for Nuclear Protection and Security for the Mururoa suits. The European Standard (Attachment 2) requires that the 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, two 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. Certificate No. 0073/197/162/01/96/0001 (Attachment 3) states that the Mururoa Model V4 MTH2 passed in all categories tested and provided a protection factor greater than 50,000. It should be noted that the term 'protection factor' used in the European Standard is equivalent to the 'fit factor' used 10CFR20.1003 and is not the same as the Assigned Protection Factor used in 10CFR20 Appendix A.

TVA also conducted an in-house inspection and demonstration of the suits. This inspection/demonstration indicated that the Mururoa suits are an improvement over the currently used suits due to their ease in donning and removal.

Additionally, the NRC approved the use of the Mururoa Model V4 MTH2 suit with an APF of 2,000 for the Duke Energy Corporation in June 2003 (TAC NOS. MB 7952, MB7953, MB7954, MB7955, MB7956, MB7957, and MB7958).

3.0 CONCLUSION

TVA requests the approval for the use of the suits as per 10CFR20.1703(a), which requires use of respiratory protection equipment that is tested and certified by NIOSH or alternatively which is approved for use by the NRC. Based on in-house inspection of suits and review of industry and manufacturer test documentation, TVA has determined that the Mururoa V4 MTH2 model air supplied suits offer a safer and more efficient means to protect workers in areas of either high radiological contamination and/or high potential for airborne contamination. The existing rain suits and bubble hoods provide cooling only to the head and force workers to wear the ensemble in a manner that makes self-rescue very difficult, thus requiring a rescue worker to be stationed nearby. Ease of removal of the Mururoa suit provides for more desirable self-rescue features. Additionally, the Mururoa suits provide a means to undress that minimize the potential for personnel contamination events.

4.0 REFERENCES

1. 10CFR20.1703, "Use of Individual Respiratory Protection Equipment"

2. 10CFR20.1705, "Application for Use of Higher Assigned Protection Factors"

3. 10CFR20, Appendix A, "Assigned Protection Factors for Respirators"

4. Regulatory Guide 8.15 (Revision 1), "Acceptable Programs for Respiratory Protection"

5. NUREG-0041, "Manual of Respiratory Protection Against Airborne Radioactive Materials"

6. European Standard CEN/TC 162 N 738 (July 1996)

7. EC Type Examination Certificate No. 0073/197/162/12/96/0001 for the V4 MTH2 suit dated January 10, 1996

ATTTACHMENT 1 - GENERAL DESCRIPTION OF THE DELTA PROTECTION SUPPLIED AIR SUIT.

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

*ATTTACHMENT 2 - **EUROPEAN STANDARD CEN/TC 162 N 738 FOR VENTILATED PROTECTIVE CLOTHING***

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.

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

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 materials	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 .

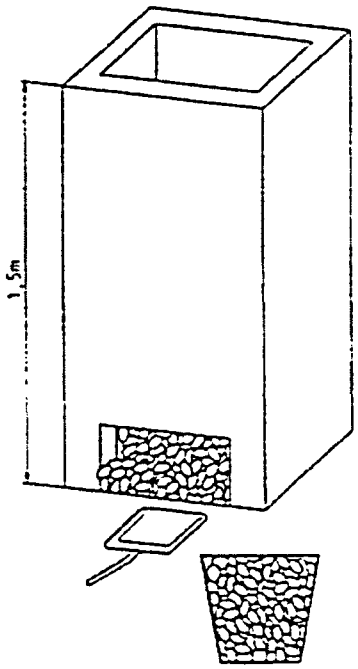


Figure 1: Hopper and basket

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).

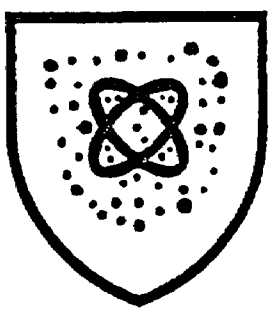


Figure 2: Pictogram

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.

ATTTACHMENT 3 - CERTIFICATE NO. 0073/197/162/01/96/0001 FOR MURUROA V4 MTH2 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 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

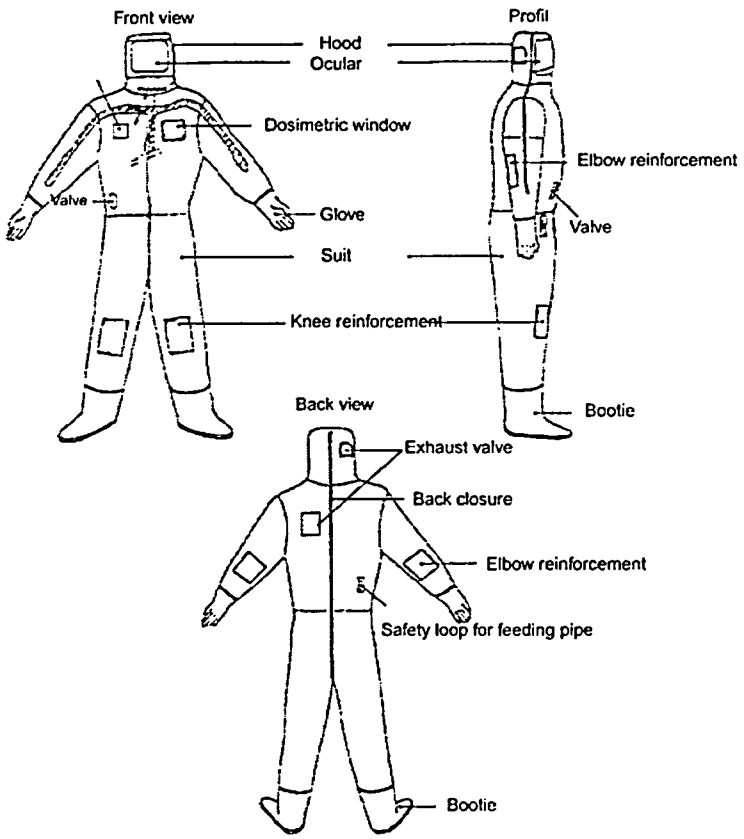
It is a Ventilated Protective Suit against Radioactive Contamination ventilated type – pressurised for a single use only, its name is:

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 $l.min^{-1}$)**

ATTTACHMENT 4 PROTECTION FACTOR DETERMINED DURING FIT TEST EXERCISES FOR MURUROA 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.

*ATTTACHMENT 5 - **DONNING AND REMOVAL INSTRUCTIONS FOR MURUROA V4 MTH2***

M.T.H.2

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 ,a communication device, if applicable, 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.