Radium™

Topical Report

Hurricane Hood Systems

Report No.: TP-HHS23-01NP

February 5, 2008

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February 5, 2008

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

Subject: Topical Report on Radium Incorporated's Hurricane Hood™ Systems

Enclosures: [1] Topical Report TP-HHS23-01NP; Radium Incorporated's Hurricane Hood™ Systems

Ladies and Gentlemen:

Pursuant to Title 10 of the Code of Federal Regulations (10 CFR), Section 20.1703 (b), Radium is submitting the enclosed nonproprietary Topical Report TP-HHS23-01NP for Nuclear Regulatory Commission review and approval for referencing in licensing actions. The intent of the review is to obtain approval for use of the Hurricane Hood™ Systems at various nuclear facilities where the licensee can reference this Topical Report review for various applications. This review and approval process will increase the efficiency for the licensing process and reduce the NRC work load by avoiding repetitive reviews for each facility's request.

Radium Incorporated (Radium) provides services and manufactures products for the nuclear power industry. Radium has designed the Hurricane Hood™ Systems (patent pending) as a solution to the limitations of current anti-contamination devices such as powered air visors, air supplied suits, respirators, and other respiratory equipment used in the nuclear power industry. Hurricane Hoods™ are a proven device that has increased worker productivity by reducing heat stress illnesses and by minimizing physiological stress. The result: lower dose accumulations, a reduction in the number of personnel contamination events, as well as heat stress incidents.

This report contains information that demonstrates the effectiveness of the Hurricane Hood™ Systems in a myriad of applications.

In addition to various test reports and information about the Hurricane Hoods, a comparison of Hurricane Hoods to the NIOSH *Proposed Powered Air Purifying Respirator (PAPR) Standard* is included. The comparison details performance characteristics of the Hurricane Hood™ and how the Hurricane Hood™ meets these proposed standards for air purifying devices, even though Hurricane Hoods™ are suit type system.

Radium requests completion of this review process by June 1, 2008, to provide sufficient time for Licensee requests to support the fall 2008 refueling outage season.

We look forward to working with the Nuclear Regulatory Commission on this very important matter. Please feel free to contact me (information below) to discuss an acceptable schedule, establish costs, and to answer any questions. Thank you for your time and consideration.

Sincerely,

Cam Abernethy
President
Radium Incorporated

Add: Vanice Perin
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1/3 2 copies forwarded to PM V. Perin

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Please Note:

An identical copy of the enclosed Topical Report was sent to the

Assigned NRC Project Manager: Vanice Perin (415-8143)

Radium™

Topical Report TP-HHS23-01NP

Radium Incorporated's

Hurricane Hood™ Systems

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C. Test Report T3657-01-1 Issue 1; NIOSH 42 CFR Part 84.1139 Air Velocity & Noise Level on Radium's Hurricane Hood Category 2 (CAT-2)

D. Test Report T3657-01-2 Issue 1; NIOSH 42 CFR Part 84.1139 Air Velocity & Noise Level on Radium's Hurricane Hood Category 3 (CAT-3)
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K. Hurricane Hood™ Category-2 (CAT-2) Owner's Manual

TOPICAL REPORT ACCEPTANCE DISCUSSION

The Case for Hurricane Hoods™

Today's nuclear workers face more workplace challenges than ever before. They are expected to perform at peak mental and physical states, to work efficiently, save dose, and prevent mental errors. The best way to ensure nuclear workers are performing at peak levels is to ensure that they work in a "personal" environment that promotes this high level of productivity while increasing their safety.

Radium Incorporated (Radium) developed the Hurricane Hood (patent pending) line of products as a solution to the limitations of current anti-contamination devices such as powered air visors, bubble suits, and respiratory protection equipment used in the nuclear power industry. Radium's personnel have many years of work experience providing Steam Generator Nozzle Dam Services and other services in the nuclear power industry. For decades, Radium personnel and other nuclear workers had no choice but to use respiratory protection and anti-contamination devices that made it difficult to breath, were obstructive to use, and created an extremely hot and stressful environment in which to work. It has been well documented that this older equipment creates safety issues with heat stress, limited vision, mental stress, physical stress, etc. Any one of these issues can create a serious safety problem, as well as contribute to poor worker productivity and higher man-rem exposure. Combine these issues and you multiply your risks and man-rem exposure.

Air supplied suits used in the industry today have numerous limitations. The time spent on setup, testing, maintaining, and monitoring these air supplied systems contribute to increased man-rem exposure, safety risks, and costs. Issues such as low air pressure, loss of air, low air quality, and limited mobility can be avoided.

Hurricane Hood™ Systems

Hurricane Hoods are an anti-contamination and personal cooling system. A high volume of filtered air is blown into a clear vinyl hood and suit at 33 CFM to provide the user with ample air for ease of breathing, anti-fogging, and full-body cooling without any hoses or breathing air system. The cooling effect is from the large volume air entering the suit and displacing the moist warm air. The high capacity blower quickly evaporates perspiration and pushes it out of the suit, keeping the nuclear worker cooler, safer, and more productive.

It is called a "system" because it provides much more functionality than just providing an encapsulating suit with a blower that provides high volume of filtered air. It also is a platform for the nuclear worker to add Radium's in-suit hydration unit called HydroPack, wireless cameras, LED lighting, wireless communication systems, and other accessories. Everything is powered through our very thin high capacity power belt. These added components offer several advantages that save man-rem exposure by increasing work efficiency and safety.

Hurricane Hoods can be used as an anti-contamination and personal cooling system in any non-IDLH (Immediately Dangerous to Life or Health) environments where the objective is to keep nuclear worker's dose ALARA and/or the individual cooler.

Radium currently offers two different models of Hurricane Hood Systems. Both use the identical blower and HEPA filter module. Radium only offers one type of HEPA Filter supplied by 3M. The HEPA Filter is rated at 99.97% efficiency at 0.3 micron and is manufactured to NIOSH standards.

Category-3 (CAT-3)

The Category-3 model is configured with a thin power belt that supplies power to a blower positioned on the head of the wearer by the head harness assembly (refer to the enclosed operation manual for pictures). The blower assembly has a filter adaptor that protrudes through the filter opening hole on top of the clear vinyl hood. A filter securing ring is placed on top of the filter adaptor and a HEPA filter is screwed onto the filter adaptor securing the filter and sealing the hood in place.

Because of the very compact design, the Category-3 model can be used for any potential high heat stress areas that have limited access such as accessing through a 16" primary manway to enter inside a steam generator to install nozzle dams. This design has a more direct air flow path from above the head to the user for cooling, ease of breathing, and great defogging capabilities.

The Category-3 model uses our 2-piece PVC suits. The single use suit is configured similar to a bubble hood/suit with one piece hood with 2 bibs and a bag type suit. They are designed specifically for the Hurricane Hoods and have reinforced knee areas, special exhaust vents, and with additional exhaust vents in the arms. Refer to enclosed operations manual for more information about the Category-3.

Category-2 (CAT-2)

Category-2 model uses the same blower and filter assembly used in the Category-3, but relocates it to the upper back for a lightweight backpack design that provides filtered air from the upper back to the clear vinyl hood.

The Category-2 utilizes a Radium-designed, 2-piece PVC protective suit consisting of a jacket with integrated clear vinyl hood and a pair of PVC pants. The jacket has the filter adaptor opening on the back panel to allow attachment of the filter (refer to the enclosed operation manual for pictures). The hood is oversized to accommodate hardhats, communication systems, and various other head gear.

The Category-2 model is a multipurpose system that can be used for a variety of applications including steam generator support work, cavity decontamination, control rod drive maintenance, fuel transfer canal work, and various other applications.

Refer to enclosed brochure and operations manual for more information about the Category-2 model.

Both models can be used with various accessories.

Optional Hydropack System

Radium's Hydropack is a one-of-a-kind device (patent pending) that provides in-suit hands-free hydration as well as an integrated Hurricane Hood blower mount. The Hydropack can take the place of the backpack harness for the Category 2 model or can be used as a standalone system.

Features:

- Holds 1.5 liters of water
- Very compact size
- Reservoir is guaranteed not to leak
- Every Hydropack has features to mount a Hurricane Hood CAT-2 blower at any time.
- If hydration is not needed, it can be used without the reservoir and only as a Hurricane Hood CAT-2 backpack
- Easily laundered
- No spill bite valve - users simply drink by biting down on the bite valve. The valve closes when released.
- Economical bite valves can be changed easily for different users.

For workers to perform at their peak ability, proper hydration is of the utmost importance. During physical work, the heart increases the blood flow to a worker's muscles and skin to cool the body. Through perspiration, the body loses about 1 liter of water per hour based on moderate activity. If fluids are not replaced the body starts to become dehydrated. At a higher heart rate and core temperature, the body can't produce more energy, leaving the worker weak and much more vulnerable to heat-related illnesses. Also worker productivity is reduced, resulting in a longer time to complete tasks, which can cause high accumulated doses.

The best defense against dehydration is a good offense - - replenish the body's fluids by drinking often - - at least 1 liter per hour for moderate activity in moderate conditions. It is best to drink continuously (6-8 ounces every 15-20 minutes as recommended by the American College of Sports Medicine). Thirst is a delayed response, and by the time you are thirsty, your body is dehydrated.

For optimal cooling, a Hydropack reservoir can be frozen. Unlike an ice vest, when the Hydropack melts, you have a ready source of water for hydration – not dead weight.

There were times in the nuclear power industry when having water in the containment building, in a radioactive contaminated zone, or any other contaminated area was not allowed due to the possibility of internal intake of radioactive contaminates. Times have changed. We are now seeing water fountains and "cool rooms" for workers to cool off and hydrate themselves. Better worker anti-contamination methods and procedures have proven that workers can hydrate themselves and NOT become internally contaminated.

Water fountains and cool rooms take a good deal of time and dose to setup, maintain, monitor, and replenish. They also contribute to generating a high level of radwaste with constant glove changes. An ideal solution would be a hydration system that did not have these disadvantages and would increase a worker's productivity, safety, and quality of work.

The Hydropack is the ideal solution that can provide today's nuclear workers with a ready source of cold water for hydration and keep the user cooler when used with the Hurricane Hood Systems at his/her work area.

Operational Experience and Applications

Hurricane Hoods™ have been used successfully as anti-contamination devices in the following applications:

Plant Vogtle 2R11; Fall 2005 Outage

Installed and removed steam generator nozzle dams in record low dose for Unit 2 and with no personal contamination events, heat stress issues, or injuries using Hurricane Hoods CAT-3 model.

Installing and removing steam generator nozzle dams is one of the most physically and mentally demanding jobs that a nuclear worker can perform. It is imperative that the nozzle dam technician be in top performance condition to quickly move heavy nozzle dam sections and accurately assemble the dam inside this Locked High Radiation Area within a couple of minutes. By using the Hurricane Hood, typical issues such as heat stress, fogging visor, obstructive equipment, crimped breathing air supply hose, and the psychological stress that these conditions create, can be minimized, if not eliminated.

During nozzle dam removal, steam generator primary platform workers used WetPro Suits with exhaust vents cut into the suit calves rather than the PVC suit with installed vents for generator jumpers. This helped with additional cooling and freedom of movement with no personal contamination events and contributed to the record low dose received for this project.

Diablo Canyon Fall 2005 Outage

Installed and removed steam generator nozzle dams in near record low dose for that unit and with no personal contamination events, heat stress issues, or injuries using Hurricane Hoods CAT-3 model.

The Category-3 model was also successfully used for cavity decontamination activities during this outage.

Diablo Canyon Spring 2006 Outage

Installed and removed steam generator nozzle dams in near-record low dose for that unit, with no personal contamination events, heat stress issues, or injuries using Hurricane Hoods CAT-3 model.

The Category-2 model was successfully used for seal table work, cavity decontamination, and other activities during this outage.

Shearon Harris Spring 2006 Outage

The Category 2 model was used for sponge basting operations on the upper internals lifting rig. Sponge blasting is an abrasive blasting process using grit-impregnated foam and non-abrasive blasting media using foam without grit. Sponge blasting systems incorporate various grades of water-based urethane-foam cleaning media used to clean and prepare surfaces. The non-abrasive media grades are used to clean delicate substrates. The abrasive media grades are used to remove surface contaminants, paints, protective coatings, and rust from a variety of surfaces.

The sponge blasting was performed in the lower cavity inside a tent with the workers wearing a Category 2 model. Fifteen minutes into the process, the blasting material started to escape the tent enclosure. Radiation Protection personnel stopped the job to evaluate the situation. Air samples, taken

during the process, read 1.8 E-6 and the HEPA filter on the Hurricane Hood read 2.5 mrem/hr. Plant management stopped the job since it was determined the scope of the job was expanding due to the shortcomings of the sponge blasting process. The worker wearing the Hurricane Hood CAT-2 exited the area clean and his body count was negative.

Vogtle 1R13 Fall 2006 Outage

Successfully installed steam generator nozzle dams using the Category-3 model with no personal contamination, or heat stress issues due to the Hurricane Hoods.

During platform work, an issue occurred when a Hurricane Hood power cable got entangled with a wearer's knee inside his suit. The cable broke at the connector when it was pulled inside the suit and the blower lost power. As directed by the Health Physics and Job Supervisor monitoring the job, the individual left the primary platform immediately and was removed from the suit without incident. As a result from this experience: 1) the cable has been shortened on new models, 2) the operations manual has been revised to include wrapping the power cable around the belt to prevent this incident again, 3) other Licensees that use Hurricane Hoods have received the new operations manual, notifying them of this change.

Hurricane Hood™ System Recognitions

INPO oversaw the use of the Hurricane Hoods at Vogtle for steam generator nozzle dam operations in the fall of 2005 during 2R11. They gave plant Vogtle a rating of "Beneficial Practice" for the use of the Hurricane Hoods.

Diablo Canyon's Health Physics Department has labeled the Hurricane Hood as one of their "Golden Nuggets" at the PWR Conference due to the overall performance of the equipment and proven dose saving capabilities.

Radium Incorporated Quality Assurance Program

Radium's QA Program is based on ASME NQA-1; 10CFR21, and 10CFR50, Appendix B. Our utility approved program provides controls that ensure our respiratory protection equipment is properly designed, procured, manufactured, assembled, inspected and tested to meet customer and regulatory requirements.

Documentation is generated during the above processes and filed to capture program compliance. The program is complimented by a Hurricane Hood Assembly and Test Instructions to ensure each system is assembled, inspected and tested in accordance with design document requirements. Hurricane Hoods are serialized for traceability purposes.

Controls are in place for identifying and controlling nonconforming parts, materials, or components which ensure they are identified, documented, evaluated, dispositioned, and segregated from acceptable items. Controls include notification to affected parties.

REGULATORY REQUIREMENTS

The following regulatory requirements are applicable to our request:

10 CFR Part 20; *Standards for Protection Against Radiation*; Section 20.1703 (b) permits licensees to apply to the NRC for authorization to use respiratory equipment that has not been tested and certified by National Institute for Occupational Safety and Health (NIOSH):

> *10 CFR 20.1703 Use of individual respiratory protection equipment. If the 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 the National Institute for Occupational Safety and Health (NIOSH) except as otherwise noted in this part.*
> >
> > *(b) 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 except as provided in this part.*
>
> *10CFR20.1750, Application for Use of higher assigned protection factors. The licensee shall obtain authorization from the Commission before using assigned protection factors in excess of those specified in Appendix A to Part 20.*

Based on the regulatory requirements mentioned above, Radium and licensees must obtain approval for the use Hurricane Hood Systems and requests an assigned protection factor of 2000 for each system.

TECHNICAL JUSTIFICATION

The following information is provided as technical evidence that the Hurricane Hood Systems are a safe alternative to existing anti-contamination and respiratory equipment currently used in the industry.

Safety Features

The Hurricane Hood Systems have the following safety features:

1. Hoods and suits are manufactured from fire retardant materials and are tested to federal specifications that verify each batch/roll of material.
2. High capacity blower that provides over 33 CFM of filter air for head and body cooling.
3. The air flow path on the Category 3 Model immediately directs airflow down the inside front surface of the hood. Combine this with the high air flow and you have virtually fog free operation.
4. No hoses or suit channels to kink or crimp are incorporated in the design.
5. No On and OFF switch to inadvertently turn OFF during use.
6. Blowers are positioned to ensure air velocity and noise levels do not exceed NIOSH standards of 80 dBa. The enclosed independent tests have verified these results.

7. Systems are equipment with a Low Battery audio alarm and LED light alarm (Cat-3 only) to allow for approximately 15 minutes of continued operation so the individual can safely leave the area and remove the system. The enclosed independent tests have verified these results.
8. Systems are equipped with a Low Air Flow audio alarm and LED light alarm (CAT-3 only) warning the wearer of low air flow. The enclosed independent tests have verified these results.
9. The power circuit does not turn itself OFF to protect batteries when they reach a low capacity unlike other systems.
10. Double pressed clear vinyl hoods that are oversized to allow for use of communication systems, cameras, and hardhats (CAT-2 only).
11. System can be used as a platform for other safety equipment such as Radium's HydroPack (hydration pack), cameras, and lighting.

Testing

Please refer to the enclosed test reports.

Testing was performed in general accordance with current PAPR standards or with NIOSH draft Document "Concept: Proposed Industrial Powered Air-Purifying Respirator Standard" dated September 19, 2006. This proposed NIOSH draft standard will replace Subpart KK of 42 CFR Part 84 and all other applicable requirements for powered air purifying respirators (PAPR).

Most of the test results were performed by a third party provider called ICS Laboratories Incorporated (ICS), located in Brunswick, Ohio. ICS was recommended by personnel in The National Institute of Occupational Safety and Health (NIOSH) as the best place to provide testing for our equipment. ICS is an internationally accredited laboratory and that provides NIOSH product certification testing as well as CE, UL, FDA, CPSC, and NFPA testing.

The following enclosed tests are provided as evidence to the performance of the Hurricane Hood Systems.

2. Test Report T3657-04-1 Issue 1; NIOSH draft Document "Concept: Proposed Industrial Powered Air-Purifying Respirator Standard":, Section 4.2.10 TIL on Radium's Hurricane Hood Category 3 (CAT-3)
3. Test Report T3657-04-2 Issue 1; NIOSH draft Document "Concept: Proposed Industrial Powered Air-Purifying Respirator Standard":, Section 4.2.10 TIL on Radium's Hurricane Hood Category 2 (CAT-2)
4. Test Report T3657-01-1 Issue 1; NIOSH 42 CFR Part 84.1139 Air Velocity & Noise Level on Radium's Hurricane Hood Category 2 (CAT-2)
5. Test Report T3657-01-2 Issue 1; NIOSH 42 CFR Part 84.1139 Air Velocity & Noise Level on Radium's Hurricane Hood Category 3 (CAT-3)
6. Test Report HH122007-01 Hurricane Hoods Category 2 and 3 Models; NIOSH draft document "Concept: Proposed Industrial Powered Air-Purifying Respirator Standard", Section 4.2.9, Breathing Gas - Human Testing

7. Test Report T3657-03-1 Issue 1; NIOSH draft document "Concept: Proposed Industrial Powered Air-Purifying Respirator Standard" , Section 4.1.10 Power Indicator on Radium's Hurricane Hood Category-3 (CAT-3)
8. Test Report T3657-02-1 Issue 1; NIOSH draft document "Concept: Proposed Industrial Powered Air-Purifying Respirator Standard", Section 4.1.9 Low Flow Indicator on Radium's Hurricane Hood Category-3 (CAT-3)

Our suits and hoods are provided by Lancs Industries (Lancs), located In Kirkland, Washington. Lancs Industries manufactures protective clothing, containments, enclosures, lead shielding, and other supplies used for reducing risk and increasing safety of workers in potentially hazardous environments. Their customers include numerous nuclear power plants in the United States and abroad. They also supply their various products to the Department of Energy sites.

Lancs manufactures Hurricane Hood suits to our design requirements. All of their PVC suit material are tested and meet the requirements specified in LP-375D; Federal Specification for Plastic Film, Flexible, Vinyl Chloride and the NFPA-701; Standard Methods of Fire Test for Flame Propagation of Textiles and Films.

The referenced testing includes, but is not limited to:

1. Flame and Fire
2. Thickness
3. Bondability
4. Tensile Strength
5. Ultimate Elongation
6. Elmendorf Tear
7. Pinholes
8. Clarks Stiffness
9. Extraction in Soapy Water
10. Blocking
11. Volatility
12. Weather Resistance
13. Cold Cracks
14. Lacquer Lifting
15. Crocking
16. Dimensional Stability

Other tests are performed as detailed in the enclosed document; Product Information Sheet and Material Specifications for all Hurricane Hood Suits. Sample reports are also provided.

All tests resulted in a PASSING grade and some exceeded the requirements by multiple times.

Considering the design of the system, containment suit with hood and unaffected by facial fit testing, and based on information and test data contained in this report, Radium requests an assigned protection factor for each Hurricane Hood System to be assigned at 2000.

Implementation

The Hurricane Hoods should be integrated into the licensee's existing 10CFR20 Respiratory Protection Program. Requirements such as training, procedures, inventory control, etc. should be implemented.

Radium requests the following options be considered for the unlikely event of a total system failure. These options would replace any requirement for a standby rescue worker.

Due to the type of work and environment a Hurricane Hood user will be working, personnel are typically under constant surveillance by Radiation Protection personnel using video cameras and/or communication systems. The camera and communications systems have proven very effective at reducing safety issues and keep personnel dose ALARA. These systems provide a very quick response to an emergency condition if these were to occur.

In addition to surveillance, other steps can be taken to ensure their safety in an emergency event.

Pre-job ALARA Briefing

The ALARA briefing could review steps to take in case of a total system failure. These steps can be as follows:

1. Typically, more than one worker is located at the work location and they are in identical protection equipment. In the event one of workers experiences an emergency of total system failure, the other worker can assist the individual who needs help. This work practice offers the fastest assistance for a worker in need of help. This type of assistance has been used successfully in other hazardous environments such a scuba diving.
2. Staging of a safety utility knife that is typically used to cut-out a person wearing a bubble suit can be located at the work location. The briefing can review where this knife is staged and steps that can be taken for self rescue. In case of emergency, where the air in the suit has been totally exhausted, the safety knife can be used to create an opening in the hood for breathing. This self rescue technique is very similar to the tear-off mouth strip and emergency tear-off strip on the Mururao BLU suit and requires the same motions.

Implementing any or all of the above steps vs. requiring a rescue standby person, increases the level of safety and decreases response time for emergencies. Eliminating the recue standby person is also an ALARA consideration since the rescue personnel are typically located in close proximity to the work area.

Conclusion

This report contains comprehensive information on the performance of the Hurricane Hoods and how they have been implemented safely in the actual work environments with proven results. The test results confirm that each system performs safely and exceeds the requirements as specified by NIOSH. Compared to other personal protection equipment used in the industry such as air powered visors, bubble suits, and powered air-purifying hoods, the patent pending Hurricane Hood Systems minimize heat stress events by providing full body cooling without the requirements of an air-supplied system.

Per the requirements of 10CFR20.1703(b) and 10CFR20.1705 and based on the information contained in this report, Radium requests that the Hurricane Hood Systems receive approval and are assigned a protection factor of 2000.

ENCLOSURES

A. Test Report T3657-04-1 Issue 1; NIOSH draft Document "Concept: Proposed Industrial Powered Air-Purifying Respirator Standard:, Section 4.2.10 TIL on Radium's Hurricane Hood Category 3 (CAT-3)
B. Test Report T3657-04-2 Issue 1; NIOSH draft Document "Concept: Proposed Industrial Powered Air-Purifying Respirator Standard:, Section 4.2.10 TIL on Radium's Hurricane Hood Category 2 (CAT-2)
C. Test Report T3657-01-1 Issue 1; NIOSH 42 CFR Part 84.1139 Air Velocity & Noise Level on Radium's Hurricane Hood Category 2 (CAT-2)
D. Test Report T3657-01-2 Issue 1; NIOSH 42 CFR Part 84.1139 Air Velocity & Noise Level on Radium's Hurricane Hood Category 3 (CAT-3)
E. Test Report No.: HH122007-01 Hurricane Hoods Category 3 and 2 Models NIOSH draft Document "Concept: Proposed Industrial Powered Air-Purifying Respirator Standard:, Section 4.2.9, Breathing Gas – Human Testing
F. Test Report T3657-03-1 Issue 1; NIOSH draft document "Concept: Proposed Industrial Powered Air-Purifying Respirator Standard" , Section 4.1.10 Power Indicator on Radium's Hurricane Hood Category-3 (CAT-3)
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    i. Typical Test Reports and Certificates for suit materials that meet LP-375D; Federal Specification for Plastic Film, Flexible, Vinyl Chloride
    ii. Typical Test Reports for suit materials that meet NFPA-701; Standard Methods of Fire Tests for Flame Propagation of Textiles and Films
    iii. Typical Test Report for Leachable Halogens
K. Hurricane Hood™ Category-3 (CAT-3) Owner's Manual
L. Hurricane Hood™ Category-2 (CAT-2) Owner's Manual

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Test Report T3657-04-1 Issue 1
NIOSH draft document "Concept: Proposed Industrial Powered Air-Purifying Respirator Standard", Section 4.2.10 TIL
Radium, Inc.
Hurricane Hood Category-3 (CAT-3)
11 October 2007

Authorized and Performed by:

Michael G. Gergel
Manager - Physical & Analytical Chemistry

Reviewed by:

Prabodh K. Patnaik
Physical / Aanalytical Scientist

a) Reports are issued pursuant to the ICS standard Terms and Conditions agreement.

b) The contents of this test report are confidential. Reproduction of the report is prohibited except in full, unless approved in writing by ICS Laboratories, Inc.

c) Unless otherwise indicated, the test results contained in this report apply only to the samples tested and not to lots or batches from which they were taken.

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Issued to: Radium Inc.
435 Essex Ave.; Suit 7
Waynesboro, VA 22980
USA

Date: 11 October 2007
Report: T3657-04-1
Issue: 1

Summary:

Samples of the containment suit, "Hurricane Hood Category-3 (CAT-3)", submitted by Radium Inc. were evaluated against Section 4.2.10 Total Inward Leakage (TIL) of the NIOSH draft document "Concept: Proposed Industrial Powered, Air-Purifying Respirator (PAPR) Standard", dated September 19, 2006. This was an experimental evaluation utilizing six subjects with medium to large face sizes performing a single trial. An average overall TIL value of 1900 was calculated from the six tests.

Objectives:

Testing in general accordance with: NIOSH draft document "Concept: Proposed Industrial Powered, Air-Purifying Respirator (PAPR) Standard", Section 4.2.10 Total Inward Leakage (TIL), dated September 19, 2006. For reference the following was used: NIOSH Procedure No. CET-PAPR-STP-CBRN-0552, "Determination of Laboratory Respirator Protection Level (LRPL) Quantitative, Medium Flow, Deep Probe, Corn Oil Fit Factor Performance Test For Chemical, Biological, Radiological And Nuclear (CBRN) Powered Air Purifying Respirator (PAPR) Standard Testing Procedure (STP)" Draft, Date: 17 November, 2006.

Materials:

Component	*P/N*	*Description*	*Qty*
Hurricane Hood CAT-3 Test System	CAT-3-1 CAT-3-2 CAT-3-3	Headpiece with blower and belt with battery compartments, black	3
Hurricane Hood CAT-3 Suits – Size XL	NA	Body suit, yellow	7
Hurricane Hood CAT-3 Hood	NA	Hood, clear with double bib, yellow	7
Rubber Boots, L, XL	NA	Rubber Boots, yellow, pr	12
Rubber Gloves, L, XL	NA	Rubber Gloves, orange, pr	12
Cotton Glove Liners	NA	Cotton Glove Liners, white	20
Shoe Covers	NA	PVC Shoe Covers, yellow, pr	14
Filter	NA	HE cartridge, black	6
Batteries	NA	Energizer 2500 NiMH AA Batteries	30
Battery Charger	NA	Energizer 15 Minute Battery Charger for NiMH	1

Date provided by the Client: 20 July 2007
Date Testing Authorized: 20 July 2007
Dates of tests: 8 – 10 October 2007
Manufacturer(s) / Supplier: Radium Inc.

Equipment:

Fit Test Chamber, ICS Custom LRPL, (EQ#0086)
Aerosol Generation System, (EQ#0366)
Laser Photometers, TSI 8520, quantity 3, (EQ#0372, 0373, & 0374)
Computer Control System
Stopwatch, Fisher Scientific, Calibrated 4 October 2005, (EQ#0313)

Issued to: Radium Inc.
435 Essex Ave.; Suit 7
Waynesboro, VA 22980
USA

Procedure:

Testing protocols in accord with good laboratory practice were employed for all tests. The equipment and instrument calibrations were verified current and within specification prior to use. All testing procedures with the exception of those identified in the following paragraphs were in general accordance with, NIOSH draft document "Concept: Proposed Industrial Powered, Air-Purifying Respirator (PAPR) Standard", Section 4.2.10 Total Inward Leakage (TIL), dated September 19, 2006, with reference to NIOSH Procedure No. CET-PAPR-STP-CBRN-0552. The materials for assessment were inventoried, numbered (if needed) and logged upon receipt (re. Materials).

A 384 cubic-foot custom configured fit test chamber complete with all required exercise apparatus was used for the evaluation. The chamber is equipped with viewing windows to allow observation of the subjects and non-verbal communication between the test administrator and subjects throughout the test.

The challenge vapor introduced into the chamber is corn oil aerosol. The ambient aerosol concentration is continuously monitored in real time and maintained throughout the test period at a concentration of 20 to 40 mg/m^3 with a Mass Median Aerodynamic Diameter (MMAD) between 0.4 and 0.7 µm and geometric standard deviation less than 2.0 mg/m^3. The oxygen level is maintained at minimum 20% by the constant addition of fresh air into the chamber. Temperature and humidity are controlled at standard laboratory conditions of 23±5°C and 50± 20%RH.

The respirators were normalized to standard laboratory conditions of temperature and humidity, for at least 8 hours prior to test. The air inside each hood was monitored with a TSI 8520 Laser Photometer. This was accomplished by punching a hole in the clear bubble top hood and installing a bulkhead tube adapter positioned to sample air from a point corresponding to the user's central oral-nasal breathing zone. A 6-foot length of ¼" ID plastic tubing was connected to the tube adapter. The tubing linked the hood to the aerosol monitor.

The aerosol monitors, TSI 8520 Laser Photometers, used in these tests have a sensitivity such that they are capable of determining a maximum LRPL value of 40,000 at an oil concentration of 40 mg/m^3 in the test chamber.

Six test subjects with medium to large face sizes were selected from the ICS data base in agreement with the LRPL respirator test panel matrix component of NIOSH Procedure No. CET-PAPR-STP-CBRN-0552. Prior to the test, subjects were provided with a copy of the manufacturer's user instructions. The subjects were allowed time to read the instructions, then verbally instructed in the proper fitting, adjusting, donning, and doffing of the containment suit. Subjects were then trained on how to couple their respirator probe tube to the chamber sampling ports and were familiarized with the LRPL 11-exercise protocol.

Subjects participated in groups of two. They were assisted in suit donning as per manufacturer's instructions by the test administer. They entered the test chamber coupled their respirator probes to the sampling ports on the interior chamber wall. The integrity of the coupling was confirmed by the test administrator and the respirator allowed to stabilize on the monitoring instrument, prior to starting the test sequence (approx. 1 minute). After completing the eleven exercise test protocol, subjects exited the chamber and doffed the suit.

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Date: 11 October 2007
Report: T3657-04-1
Issue: 1

Results:

The data and results for the fit test of the Hurricane Hood Category-3 (CAT-3) are summarized in Tables I and II. A passing result was based on Table 5 in Section 4.2.10 of the NIOSH draft document, which requires a TIL minimum value of 250 for a loose-fitting facepiece.

Table I

TIL Results for Hurricane Hood Category-3 (CAT-3)

Subject No.	*Subject ID*	*Face Size*	*LRPL Cell Letters*	*TRIAL 1*	
				Total Inward Leakage (TIL)	Result (TIL ≥ 250)
1	AS2	5	C, D, F, G	1800	pass
2	DL1	7	D, G, H, I	2100	pass
3	RP1	8	D, F, G, I	620	pass
4	JS1	6	C, D, F, G	4600	pass
5	MG1	7	D, G, H, I	1900	pass
6	DA1	9	G, H, I	600	pass

Note: Maximum TIL Value attainable with equipment used is 40,000 if chamber concentration is maintained at 40 mg/m^3.

Table II

TIL Test Summary for Hurricane Hood CAT-3

Passes	*Failures*	*Overall Average TIL Value*	*Overall Pass Percentage*	*Overall Test Result*
6	**0**	**1900**	**100**	**Pass**

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Photographs:

Figure 1: Subjects with Hurricane Hood Category-3 donned in staging area.

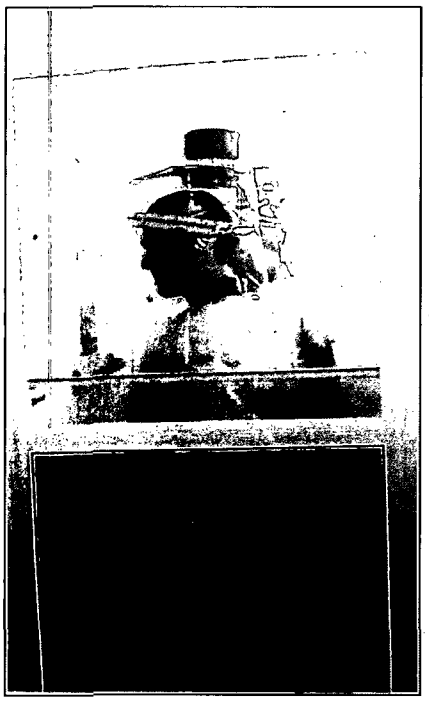

Figure 2: Subjects in fit test chamber.

Figure 3: Subject performing rifle sighting exercise

Photographs:

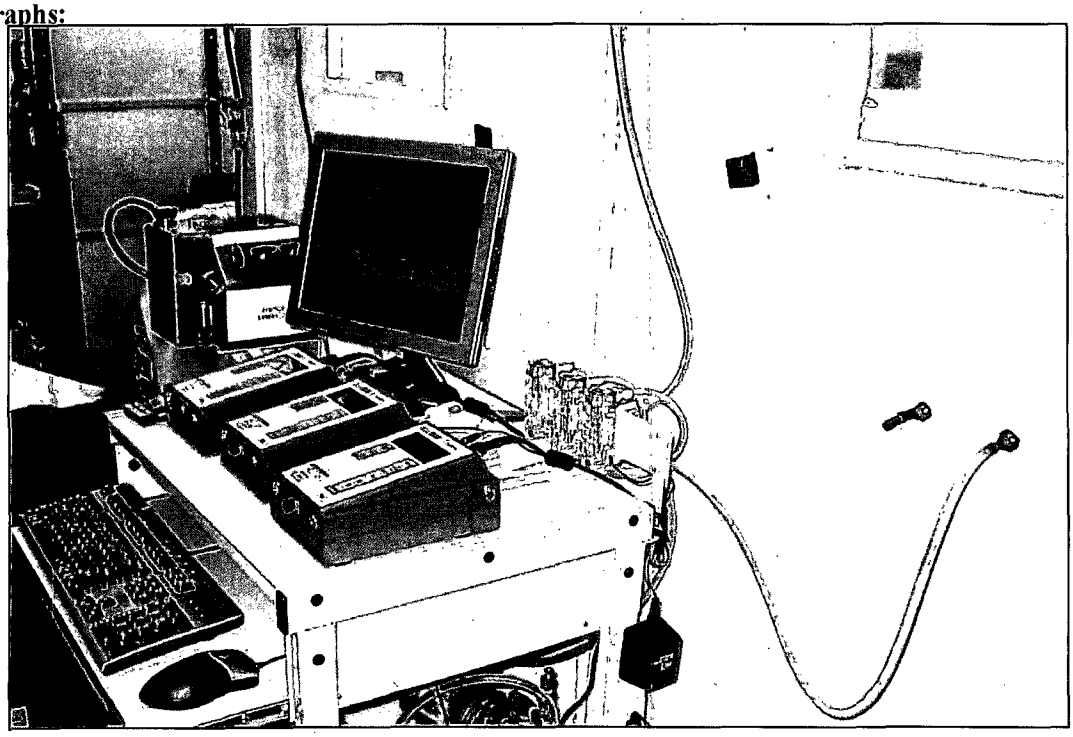

Figure 4: Test chamber monitoring and control equipment.

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Test Report T3657-04-2 Issue 1
NIOSH draft document "Concept: Proposed Industrial Powered Air-Purifying Respirator Standard", Section 4.2.10 TIL
Radium, Inc.
Hurricane Hood Category-2 (CAT-2)
11 October 2007

Authorized and Performed by:

Michael G. Gergel
Manager - Physical & Analytical Chemistry

Reviewed by:

Prabodh K. Patnaik
Physical / Aanalytical Scientist

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ICS Laboratories, Inc. •1072 Industrial Parkway North • Brunswick, Ohio 44212 USA
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Issued to: Radium Inc.
435 Essex Ave.; Suit 7
Waynesboro, VA 22980
USA

Date: 11 October 2007
Report: T3657-04-2
Issue: 1

Summary:

Samples of the containment suit, "Hurricane Hood Category-2 (CAT-2)", submitted by Radium Inc. were evaluated against Section 4.2.10 Total Inward Leakage (TIL) of the NIOSH draft document "Concept: Proposed Industrial Powered, Air-Purifying Respirator (PAPR) Standard", dated September 19, 2006. This was an experimental evaluation utilizing six subjects with medium to large face sizes performing a single trial. An average overall TIL value of 1500 was calculated from the six tests.

Objectives:

Testing in general accordance with: NIOSH draft document "Concept: Proposed Industrial Powered, Air-Purifying Respirator (PAPR) Standard", Section 4.2.10 Total Inward Leakage (TIL), dated September 19, 2006. For reference the following was used: NIOSH Procedure No. CET-PAPR-STP-CBRN-0552, "Determination of Laboratory Respirator Protection Level (LRPL) Quantitative, Medium Flow, Deep Probe, Corn Oil Fit Factor Performance Test For Chemical, Biological, Radiological And Nuclear (CBRN) Powered Air Purifying Respirator (PAPR) Standard Testing Procedure (STP)" Draft, Date: 17 November, 2006.

Materials:

Component	*P/N*	*Description*	*Qty*
Hurricane Hood CAT-2 Test System	CAT-2-1 CAT-2-2 CAT-2-3	Backpack with blower and belt with battery compartments, black	3
Hurricane Hood CAT-2 Suits – Size XL	NA	Hood, clear, vest yellow and pants, yellow	5
Hurricane Hood CAT-2 Suits – Size XXL	NA	Hood, clear, vest yellow and pants, yellow	2
Rubber Boots, L, XL	NA	Rubber Boots, yellow, pr	12
Rubber Gloves, L, XL	NA	Rubber Gloves, orange, pr	12
Cotton Glove Liners	NA	Cotton Glove Liners, white	20
Shoe Covers	NA	PVC Shoe Covers, yellow, pr	14
Filter	NA	HE cartridge, black	6
Batteries	NA	Energizer 2500 NiMH AA Batteries	30
Battery Charger	NA	Energizer 15 Minute Battery Charger for NiMH	1

Date provided by the Client: 20 July 2007
Date Testing Authorized: 20 July 2007
Dates of tests: 8 – 10 October 2007
Manufacturer(s) / Supplier: Radium Inc.

Equipment:

Fit Test Chamber, ICS Custom LRPL, (EQ#0086)
Aerosol Generation System, (EQ#0366)
Laser Photometers, TSI 8520, quantity 3, (EQ#0372, 0373, & 0374)
Computer Control System
Stopwatch, Fisher Scientific, Calibrated 4 October 2005, (EQ#0313)

Procedure:

Testing protocols in accord with good laboratory practice were employed for all tests. The equipment and instrument calibrations were verified current and within specification prior to use. All testing procedures with the exception of those identified in the following paragraphs were in general accordance with, NIOSH draft document "Concept: Proposed Industrial Powered, Air-Purifying Respirator (PAPR) Standard", Section 4.2.10 Total Inward Leakage (TIL), dated September 19, 2006, with reference to NIOSH Procedure No. CET-PAPR-STP-CBRN-0552. The materials for assessment were inventoried, numbered (if needed) and logged upon receipt (re. Materials).

A 384 cubic-foot custom configured fit test chamber complete with all required exercise apparatus was used for the evaluation. The chamber is equipped with viewing windows to allow observation of the subjects and non-verbal communication between the test administrator and subjects throughout the test.

The challenge vapor introduced into the chamber is corn oil aerosol. The ambient aerosol concentration is continuously monitored in real time and maintained throughout the test period at a concentration of 20 to 40 mg/m^3 with a Mass Median Aerodynamic Diameter (MMAD) between 0.4 and 0.7 µm and geometric standard deviation less than 2.0 mg/m^3. The oxygen level is maintained at minimum 20% by the constant addition of fresh air into the chamber. Temperature and humidity are controlled at standard laboratory conditions of 23±5°C and 50± 20%RH.

The respirators were normalized to standard laboratory conditions of temperature and humidity, for at least 8 hours prior to test. The air inside each hood was monitored with a TSI 8520 Laser Photometer. This was accomplished by punching a hole in the clear bubble top hood and installing a bulkhead tube adapter positioned to sample air from a point corresponding to the user's central oral-nasal breathing zone. A 6-foot length of ¼" ID plastic tubing was connected to the tube adapter. The tubing linked the hood to the aerosol monitor.

The aerosol monitors, TSI 8520 Laser Photometers, used in these tests have a sensitivity such that they are capable of determining a maximum LRPL value of 40,000 at an oil concentration of 40 mg/m^3 in the test chamber.

Six test subjects with medium to large face sizes were selected from the ICS data base in agreement with the LRPL respirator test panel matrix component of NIOSH Procedure No. CET-PAPR-STP-CBRN-0552. Prior to the test, subjects were provided with a copy of the manufacturer's user instructions. The subjects were allowed time to read the instructions, then verbally instructed in the proper fitting, adjusting, donning, and doffing of the containment suit. Subjects were then trained on how to couple their respirator probe tube to the chamber sampling ports and were familiarized with the LRPL 11-exercise protocol.

Subjects participated in groups of two. They were assisted in suit donning as per manufacturer's instructions by the test administer. They entered the test chamber coupled their respirator probes to the sampling ports on the interior chamber wall. The integrity of the coupling was confirmed by the test administrator and the respirator allowed to stabilize on the monitoring instrument, prior to starting the test sequence (approx. 1 minute). After completing the eleven exercise test protocol, subjects exited the chamber and doffed the suit.

Issued to: Radium Inc.
435 Essex Ave.; Suit 7
Waynesboro, VA 22980
USA

Date: 11 October 2007
Report: T3657-04-2
Issue: 1

Results:

The data and results for the fit test of the Hurricane Hood Category-2 (CAT-2) are summarized in Tables I and II. A passing result was based on Table 5 in Section 4.2.10 of the NIOSH draft document, which requires a TIL minimum value of 250 for a loose-fitting facepiece.

Table I

TIL Results for Hurricane Hood Category-2 (CAT-2)

Subject No.	*Subject ID*	*Face Size*	*LRPL Cell Letters*	*TRIAL 1*	
				Total Inward Leakage (TIL)	Result (TIL ≥ 250)
1	AS2	5	C, D, F, G	1500	pass
2	DL1	7	D, G, H, I	400	pass
3	RP1	8	D, F, G, I	490	pass
4	JS1	6	C, D, F, G	2900	pass
5	MG1	7	D, G, H, I	2900	pass
6	DA1	9	G, H, I	750	pass

Note: Maximum TIL Value attainable with equipment used is 40,000 if chamber concentration is maintained at 40 mg/m^3.

Table II

TIL Test Summary for Hurricane Hood CAT-2

Passes	*Failures*	*Overall Average TIL Value*	*Overall Pass Percentage*	*Overall Test Result*
6	**0**	**1500**	**100**	**Pass**

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Report: T3657-04-2
Issue: 1
Page: 4 of 5

Photographs:

Figure 1: Subject in staging area.

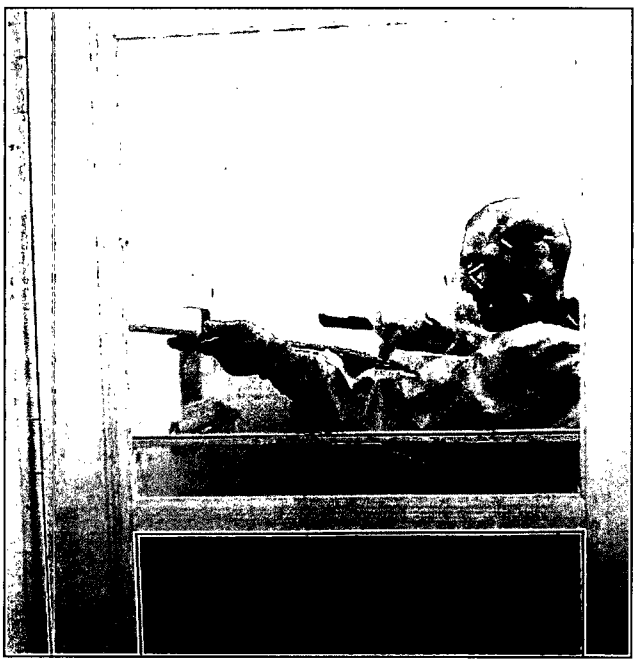

Figure 2: Subject performing rifle sighting exercise.

Photographs:

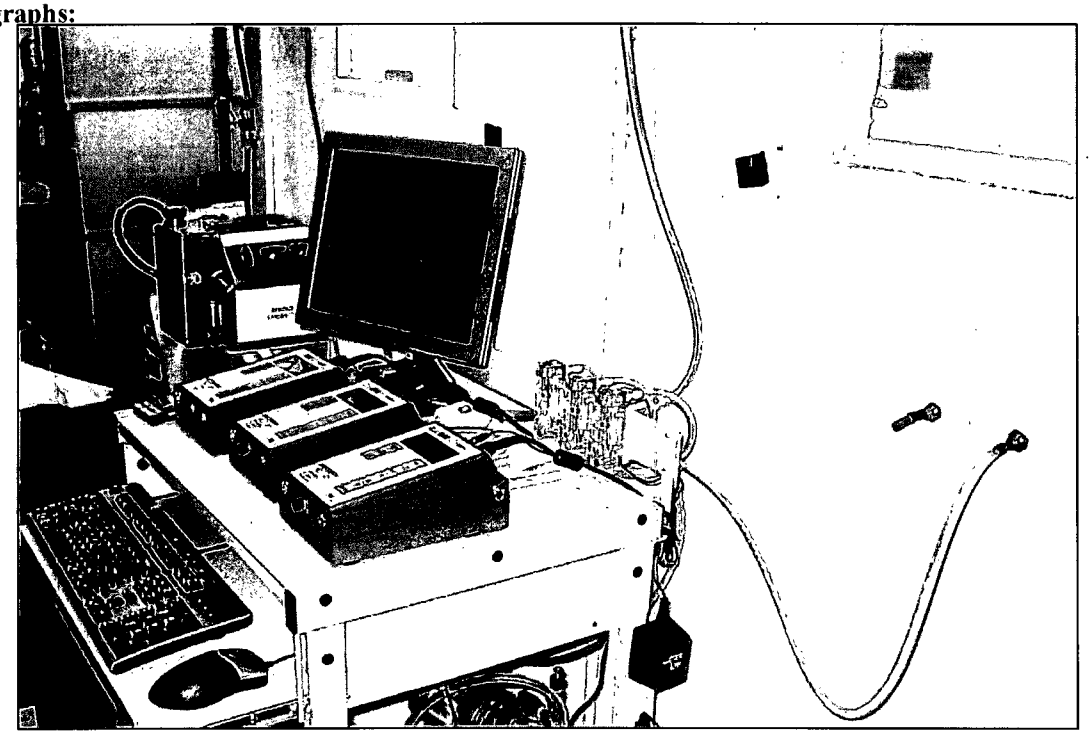

Figure 3: Test chamber monitoring and control equipment.

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Test Report # T3657-01-1 Issue 1
NIOSH 42 CFR Part 84.1139 Air Velocity & Noise Level
Radium, Inc.
Hurricane Hood Category-2 (CAT-2)
11 October 2007

ACCREDITED
Certificate 1722.01

Authorized and Performed by:

Michael G. Gergel
Manager – Physical & Analytical Chemistry

Reviewed by:

Prabodh K Patnaik
Physical / Analytical Scientist

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Issued to: Radium, Inc.
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Date: 11 October 2007
Report: T3657-01-1
Issue: 1

Summary:

Based on the attached data, the samples of the containment suit, "Hurricane Hood Category-2 (CAT-2)", submitted by Radium, Inc., **successfully conformed** to the required criteria as found in 42 CFR Part 84.1139 (subpart KK); Air Velocity & Noise Level.

Objective:

Contract testing to: 42 CFR Part 84.1139 (subpart KK); Air Velocity & Noise Level
NIOSH Procedure No. RCT-APR-STP-0030 "Determination of Noise Level Test, Powered Air- Purifying Respirator with Hoods or Helmets (STP)

Materials:

Component	*P/N*	*Description*	*Qty*
Hurricane Hood CAT-2 Test System	CAT-2-1 CAT-2-2 CAT-2-3	Backpack with blower and belt with battery compartments, black	3
Hurricane Hood CAT-2 Suits – Size XL	NA	Hood, clear, vest yellow and pants, yellow	5
Hurricane Hood CAT-2 Suits – Size XXL	NA	Hood, clear, vest yellow and pants, yellow	2
Rubber Boots, L, XL	NA	Rubber Boots, yellow, pr	12
Rubber Gloves, L, XL	NA	Rubber Gloves, orange, pr	12
Cotton Glove Liners	NA	Cotton Glove Liners, white	20
Shoe Covers	NA	PVC Shoe Covers, yellow, pr	14
Filter	NA	HE cartridge, black	6
Batteries	NA	Energizer 2500 NiMH AA Batteries	30
Battery Charger	NA	Energizer 15 Minute Battery Charger for NiMH	1

Date provided by the Client: 20 July 2007
Date Testing Authorized: 20 July 2007
Dates of tests: 3 October 2007
Manufacturer (s): Radium Inc.

Equipment:

Noise Dosimeter; Quest Electronics. ICS# EQ0367
Sound level calibrator; Quest electronics. ICS# EQ0368
Manikin, dressed in typical work attire, ICS# EQ0370
Three human test subjects

Procedures:

Testing protocols in accord with good laboratory practice were employed for all tests. All tests were conducted in a standard laboratory atmosphere unless otherwise specified. Equipment and instrument calibrations were verified current and within specification prior to use. Materials for assessment were inventoried, numbered (if needed) and logged upon receipt (re. Materials). Testing procedures in general accordance with NIOSH procedure no. RCT-APR-STP-0030 "Determination of Noise Level Test, Powered Air- Purifying Respirator with Hoods or Helmets (STP)", were followed.

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Issued to: Radium, Inc.
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Date: 11 October 2007
Report: T3657-01-1
Issue: 1

Procedures Continued:

The noise assessment was initially performed on a manikin to determine if the sound level was less than the 85 dBa specified by NIOSH as a "screening level". Following a successful "screening" test, the PAPR was evaluated by three human test subjects. A maximum of 80 dBa is allowable for the human test to be considered a "pass". In all tests, noise emissions data was collected over a period of approximately 30 seconds. The Dosimeter was configured to the following protocol per OSHA 29 CFR 1910.95 Subpart G.

Instrument Protocol:

Exchange Rate:	5 dBa
Response:	Slow
Threshold Gate:	90 dBa
Criterion Level:	90 dBa

All three samples of the Hurricane Hood Category-2 Test System were used for the evaluation.

Results:

The data and results for the noise measurements on the Hurricane Hood Category-2 are provided in Table I.

Table I
Results for Noise Level Test of Hurricane Hood Category-2

Subject	Trial 1 (dBa)		Trial 2 (dBa)		Trial 3 (dBa)		Max Allowable (dBa)	Results
	Left Ear	Right Ear	Left Ear	Right Ear	Left Ear	Right Ear		
Manikin	73.2	74.5	73.3	74.3	73.2	74.3	85	**Pass**
DA1	75.9	76.5	76.2	76.8	75.6	75.9	80	**Pass**
VP1	73.6	72.7	71.3	72.2	71.0	71.6	80	**Pass**
AS2	74.0	74.0	73.4	73.9	73.5	73.8	80	**Pass**

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Date: 11 October 2007
Report: T3657-01-1
Issue: 1

Photographs:

Figure 1: Manikin noise level test

Figure 2: Subject prepared for noise test

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Test Report # T3657-01-2 Issue 1
NIOSH 42 CFR Part 84.1139 Air Velocity & Noise Level
Radium, Inc.
Hurricane Hood Category-3 (CAT-3)
11 October 2007

ACCREDITED
Certificate 1722.01

Authorized and Performed by:

Michael G. Gergel
Manager – Physical & Analytical Chemistry

Reviewed by:

Prabodh K Patnaik
Physical / Analytical Scientist

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Date: 11 October 2007
Report: T3657-01-2
Issue: 1
Page: 1 of 3

Summary:

Based on the attached data, the samples of the containment suit, "Hurricane Hood Category-3 (CAT-3)", submitted by Radium, Inc., **successfully conformed** to the required criteria as found in 42 CFR Part 84.1139 (subpart KK); Air Velocity & Noise Level.

Objective:

Contract testing to: 42 CFR Part 84.1139 (subpart KK); Air Velocity & Noise Level
NIOSH Procedure No. RCT-APR-STP-0030 "Determination of Noise Level Test, Powered Air- Purifying Respirator with Hoods or Helmets (STP)

Materials:

Component	*P/N*	*Description*	*Qty*
Hurricane Hood CAT-3 Test System	CAT-3-1 CAT-3-2 CAT-3-3	Headpiece with blower and belt with battery compartments, black	3
Hurricane Hood CAT-3 Suits – Size XL	NA	Body suit, yellow	7
Hurricane Hood CAT-3 Hood	NA	Hood, clear with double bib, yellow	7
Rubber Boots, L, XL	NA	Rubber Boots, yellow, pr	12
Rubber Gloves, L, XL	NA	Rubber Gloves, orange, pr	12
Cotton Glove Liners	NA	Cotton Glove Liners, white	20
Shoe Covers	NA	PVC Shoe Covers, yellow, pr	14
Filter	NA	HE cartridge, black	6
Batteries	NA	Energizer 2500 NiMH AA Batteries	30
Battery Charger	NA	Energizer 15 Minute Battery Charger for NiMH	1

Date provided by the Client: 20 July 2007
Date Testing Authorized: 20 July 2007
Dates of tests: 3 October 2007
Manufacturer (s): Radium, Inc.

Equipment:

Noise Dosimeter; Quest Electronics. ICS# EQ0367
Sound level calibrator; Quest electronics. ICS# EQ0368
Manikin, dressed in typical work attire, ICS# EQ0370
Three human test subjects

Procedures:

Testing protocols in accord with good laboratory practice were employed for all tests. All tests were conducted in a standard laboratory atmosphere unless otherwise specified. Equipment and instrument calibrations were verified current and within specification prior to use. Materials for assessment were inventoried, numbered (if needed) and logged upon receipt (re. Materials). Testing procedures in general accordance with NIOSH procedure no. RCT-APR-STP-0030 "Determination of Noise Level Test, Powered Air- Purifying Respirator with Hoods or Helmets (STP)", were followed.

Procedures Continued:

The noise assessment was initially performed on a manikin to determine if the sound level was less than the 85 dBa specified by NIOSH as a "screening level". Following a successful "screening" test, the PAPR was evaluated by three human test subjects. A maximum of 80 dBa is allowable for the human test to be considered a "pass". In all tests, noise emissions data was collected over a period of approximately 30 seconds. The Dosimeter was configured to the following protocol per OSHA 29 CFR 1910.95 Subpart G.

Instrument Protocol:

Exchange Rate:	5 dBa
Response:	Slow
Threshold Gate:	90 dBa
Criterion Level:	90 dBa

All three samples of the Hurricane Hood Category-3 Test System were used for the evaluation.

Results:

The data and results for the noise measurements on the Hurricane Hood Category-3 are provided in Table I.

Table I
Results for Noise Level Test of Hurricane Hood Category-3

Subject	Trial 1 (dBa)		Trial 2 (dBa)		Trial 3 (dBa)		Max Allowable (dBa)	Results
	Left Ear	Right Ear	Left Ear	Right Ear	Left Ear	Right Ear		
Manikin	77.9	78.9	77.9	78.9	77.9	78.9	85	**Pass**
DA1	77.3	77.5	77.0	77.4	76.6	77.8	80	**Pass**
VP1	77.1	74.9	76.8	74.7	76.6	77.8	80	**Pass**
AS2	76.5	77.7	76.5	77.4	76.5	77.2	80	**Pass**

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Issued to: Radium, Inc.
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Waynesboro, VA 22980
USA

Date: 11 October 2007
Report: T3657-01-2
Issue: 1

Photographs:

Figure 1: Manikin noise level test

Figure 2: Subject noise level test

Radium Incorporated
435 Essex Ave.; STE 7
Waynesboro, VA 22980
540-942-5734
803-753-0067 fax

Test Report No.: HH122007-01
Hurricane Hoods Category 3 and 2 Models

NIOSH draft document "Concept: Proposed Industrial Powered Air-Purifying Respirator Standard", Section 4.2.9, Breathing Gas - Human Testing

Performed By:

Signature on File

A. Campbell Abernethy
President

Reviewed By:

Signature on File

Michael D. Mohundro
Quality Assurance Manager

Radium Incorporated
435 Essex Ave.; STE 7
Waynesboro, VA 22980
540-942-5734
803-753-0067 fax

Summary:

The Hurricane Hood Category 3 (CAT-3) and Category (CAT-2) models were evaluated against Section 4.2.9 Breathing Gas Human Subject Testing of the NIOSH draft document "Concept: Proposed Industrial Powered, Air-Purifying Respirator (PAPR) Standard, dated September 19, 2006. Radium completed the testing and the results were within the requirements of less than 2.0% Carbon Dioxide during the inhalation cycle and greater or equal to 19.5% Oxygen in the breathing zone.

Objectives:

Testing in general accordance with NIOSH draft document "Concept: Proposed Industrial Powered, Air-Purifying Respirator (PAPR) Standard, Section 4.2.9 Breathing Gas Human Subject Testing, dated September 19, 2006. Per 4.2.9 – Conduct two 10-minute tests consisting of 1) standing and 2) walking at 3.5 mph. Carbon dioxide levels shall not exceed 2.0% and oxygen levels will be no less than 19.5% during the testing period. Testing temperature shall be between 68°F and 86°F.

Materials:

Component	P/N	Description	QTY
Hurricane Hood CAT-3 System	CAT-3	Head unit with battery belt.	1
Hurricane Hood CAT-2 System	CAT-2	Backpack unit with battery belt.	1
Hurricane Hood CAT-3 Suit	N/A	1 Piece Suit	1
Hurricane Hood CAT-2 Suit	N/A	2 Piece Suit – Jacket/Hood and Pants	1
Hurricane Hood HEPA Filter	N/A	HEPA Filter	1
Gloves	N/A	Gloves	1 pr
Batteries	N/A	Energizer 2500 NiMH AA Batteries	10
Battery Charger	N/A	Energizer 15 Minute Battery Charger for NiMH	1

Date of Testing: December 5, 2006

Test Equipment:

TSI 8705 DPCALC MicromanoMeter, Imperial (S/N 56110344)
Bacharach Carbon Dioxide Gas Analyzer (S/N LX12037)
Industrial Scientific M40 Oxygen Gas Monitor (S/N 0608131-588) with SP40 Sampling Pump
Treadmill

All test instruments have data logging capabilities. Data was logged at the following intervals:

DP Measurements: every 5 Seconds
Oxygen Measurements: every 30 seconds
Carbon Dioxide Measurements: every 60 seconds

Calibrations were verified current and within specification prior to use.

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803-753-0067 fax

Test Process:

The temperature during test administration was approximately 71°F. The following tests were complete with both the Hurricane Hood Category 3 (CAT-3) and the Category 2 (CAT-2) models.

Test 1: Standing

The test participant donned the Hurricane Hood System and sampling tubes (6 foot long each) were placed inside the hood of each system. Using tape, the CO2 and O2 sampling tubes were secured in the breathing zone of the user and the pressure meter tube was located on the side of the hood.

The test participant stood next to the test instruments while data was recorded for a period of 10 minutes.

Test 2: Walking at 3.5 mph

The test participant donned the Hurricane Hood System. The sampling tubes (6 foot long each) were placed inside the hood of each system. Using tape, the CO2 and O2 sampling tubes were secured in the breathing zone of the user and the pressure meter tube was located on the side of the hood.

The test participant walked on a treadmill set at 3.5 mph for a period of 10 minutes while data was taken.

The test data was downloaded and printed for analysis.

Test Results:

The test results confirmed that the carbon dioxide levels did not exceed 2.0% and oxygen levels were greater than 19.5% for the inhaled air in all exercises during the test periods. The walking test results can be considered conservative due to the incline of the treadmill at the time of testing which created more inhalation/exhalation cycles due to the additional work load.

Table 1
Test 1: Standing with Hurricane Hood Category 3 (CAT-3)

Date	Time	In.H2O	O2%	CO2%
12/5/2006	18:59:03	0.0745	20.9	0.26
12/5/2006	19:00:03	0.0765	20.9	0.32
12/5/2006	19:01:03	0.076	20.6	0.33
12/5/2006	19:02:03	0.129	20.7	0.25
12/5/2006	19:03:03	0.0865	20.7	0.23
12/5/2006	19:04:03	0.0835	20.9	0.21
12/5/2006	19:05:03	0.0835	20.9	0.22
12/5/2006	19:06:03	0.0955	20.9	0.08
12/5/2006	19:07:03	0.1355	20.8*	0.14
12/5/2006	19:08:03	0.0765	20.7	0.14
12/5/2006	19:09:03	0.083	20.9	0.09
12/5/2006	19:10:03	0.093	20.9	0.11

*Test data missing – average taken from period before and after data point.

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Table 2
Test 2: Walking at 3.5mph (treadmill) with Hurricane Hood Category 3 (CAT-3)

Date	Time	In.H2O	O2%	CO2%
12/5/2006	19:11:03	0.117	20.9	0.13
12/5/2006	19:12:03	0.08	20.9	0.15
12/5/2006	19:13:03	0.0795	20.9	0.33
12/5/2006	19:14:03	0.075	20.7	0.72
12/5/2006	19:15:03	0.081	20.3	1.13
12/5/2006	19:16:03	0.086	20.2	1.29
12/5/2006	19:17:03	0.078	20.0	1.43
12/5/2006	19:18:03	0.085	19.7	1.44
12/5/2006	19:19:03	0.0595	20.0	1.60
12/5/2006	19:20:03	0.082	19.8	1.63
12/5/2006	19:21:03	0.0865	19.7	1.51
12/5/2006	19:22:03	0.0815	19.6	1.50

Table 3
Test 1: Standing with Hurricane Hood Category 2 (CAT-2)

Date	Time	In.H2O	O2%	CO2%
12/5/2006	19:54:00	0.123	20.9	0.19
12/5/2006	19:55:00	0.1245	20.9	0.31
12/5/2006	19:56:00	0.1295	20.9	0.27
12/5/2006	19:57:00	0.157	20.9	0.30
12/5/2006	19:58:00	0.1405	20.7	0.24
12/5/2006	19:59:00	0.132	20.9	0.41
12/5/2006	20:00:00	0.1175	20.9	0.25
12/5/2006	20:01:00	0.161	20.9*	0.35
12/5/2006	20:02:00	0.1455	20.9	0.25
12/5/2006	20:03:00	0.1795	20.7	0.43
12/5/2006	20:04:00	0.1235	20.9	0.07
12/5/2006	20:05:00	0.1115	20.9	0.14

*Test data missing – average taken from period before and after data point.

Table 4
Test 2: Walking at 3.5mph (treadmill) with Hurricane Hood Category 2 (CAT-2)

Date	Time	In.H2O	O2%	CO2%
12/5/2006	20:06:00	0.132	20.9	0.11
12/5/2006	20:07:00	0.1135	20.9	0.11
12/5/2006	20:08:00	0.112	20.9	0.27
12/5/2006	20:09:00	0.1265	20.2	1.01
12/5/2006	20:10:00	0.1115	20.1	1.27
12/5/2006	20:11:00	0.1175	20.0	1.39
12/5/2006	20:12:00	0.111	19.6	1.39
12/5/2006	20:13:00	0.12	19.7	1.44
12/5/2006	20:14:00	0.1155	19.6	1.38
12/5/2006	20:15:00	0.096	19.7	1.59
12/5/2006	20:16:00	0.119	20.1	1.28

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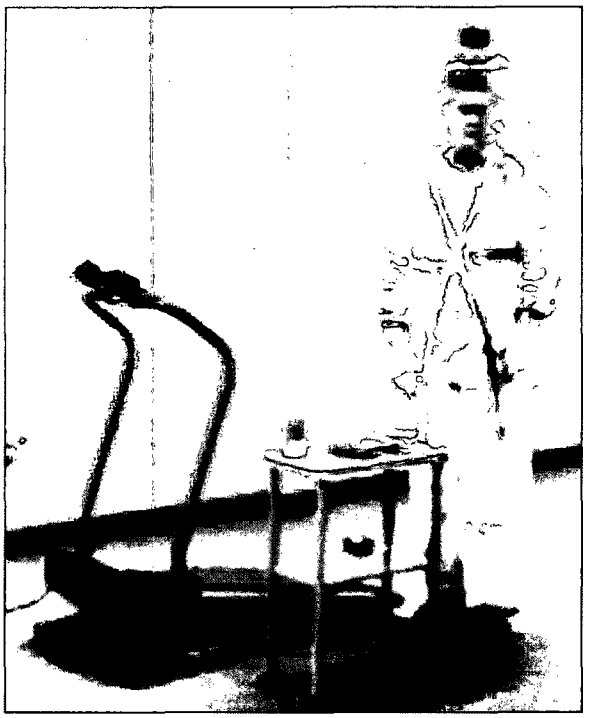
Photographs (taken from video)**:**



TEST 1 - Hurricane Hood CAT-3 Standing

TEST 2 – Hurricane Hood CAT-3 Walking

TEST 1- Hurricane Hood CAT-2 Standing

TEST 2 – Hurricane Hood CAT-2 Walking

Video: This test was videotaped. Contact Radium for more information.

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Test Report T3657-03-1 Issue 1
NIOSH draft document "Concept: Proposed Industrial Powered Air-Purifying Respirator Standard", Section 4.1.10 Power Indicator
Radium, Inc.
Hurricane Hood Category-3 (CAT-3)
1 February 2008

Authorized and Performed by:

Michael G. Gergel
Manager - Physical & Analytical Chemistry

Reviewed by:

Prabodh K. Patnaik
Physical / Aanalytical Scientist

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Issued to: Radium Inc.
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Date: 1 February 2008
Report: T3657-03-1
Issue: 1
Page: 1 of 6

Summary:

Samples of the containment suit, "Hurricane Hood Category-3 (CAT-3)", submitted by Radium Inc. were evaluated against Section 4.1.10 "Power indicator" in the NIOSH draft document "Concept: Proposed Industrial Powered, Air-Purifying Respirator (PAPR) Standard", dated September 19, 2006. In tests with both rechargeable and non-rechargeable battery variants audible and visual alarms indicated the depleted battery state.

Objectives:

Testing in general accordance with: NIOSH draft document "Concept: Proposed Industrial Powered, Air-Purifying Respirator (PAPR) Standard", Section 4.1.10 "Power indicator", dated September 19, 2006.

Materials:

Component	*P/N*	*Description*	*Qty*
Hurricane Hood CAT-3 Test System	CAT-3-1	Headpiece with blower, belt w/ battery case	1
Hurricane Hood CAT-3 Suits – Size XL	NA	Body suit, yellow	1
Hurricane Hood CAT-3 Hood	NA	Hood, clear with double bib, yellow	1
Rubber Boots, L, XL	NA	Rubber Boots, yellow, pr	1
Rubber Gloves, L, XL	NA	Rubber Gloves, orange, pr	1
Shoe Covers	NA	PVC Shoe Covers, yellow, pr	1
Filter	NA	HE cartridge, black	1
Batteries, Rechargeable	NA	Energizer 2500 NiMH AA Batteries	10
Batteries, Alkaline	NA	Energizer AA Alkaline Batteries	10
Battery Charger	NA	Energizer 15 Minute Battery Charger for NiMH	1

Date provided by the Client: 20 July 2007
Date Testing Authorized: 20 July 2007
Dates of tests: 25 January 2008
Manufacturer(s) / Supplier: Radium Inc.

Equipment:

Stopwatch, Fisher Scientific, (EQ#0313)
Airflow meter, 4000 series, TSI, (EQ#0724)
Digital Manometer, Series 477, Dwyer Instruments, (EQ#0269)

Procedure:

Testing protocols in accord with good laboratory practice were employed for all tests. The equipment and instrument calibrations were verified current and within specification prior to use. All testing procedures with the exception of those identified in the following paragraphs were in general accordance with, NIOSH draft document "Concept: Proposed Industrial Powered, Air-Purifying Respirator (PAPR) Standard", Section 4.1.10 "Power indicator", dated September 19, 2006.

At the request of the client two tests were performed, test A: Hurricane hood category-3 system with ten (10) Energizer AA NIMH 2500 mAh rechargeable batteries and test B : Hurricane hood category-3 system with ten (10) Energizer AA Alkaline Batteries.

The suit was placed on a manikin for this test. Flow and pressure values were recorded manually at specific time intervals from the airflow and pressure meters which were connected via probe to the hood.

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Date: 1 February 2008
Report: T3657-03-1
Issue: 1

Results:

The data and results for the low power indicator test on the Hurricane Hood Category-3 (CAT-3) suit are provided in Tables I and II.

Table I

Low Battery Indicator Test

Test A : Hurricsane Hood Category -3 (CAT-3) with 10 Energizer 2500 NiMH AA Batteries

Time	Elasped Time (min)	Airflow (LPM)	Pressure (mm H2O)
7:40 AM	0	25.4	11.5
7:45 AM	5	23.7	10.7
7:50 AM	10	23.2	10.4
8:00 AM	20	22.6	9.9
8:10 AM	30	22.3	9.7
8:20 AM	40	22.1	9.7
8:30 AM	50	21.9	9.7
8:40 AM	60	21.8	9.7
8:50 AM	70	21.6	9.7
9:00 AM	80	21.5	9.7
9:10 AM	90	21.4	9.4
9:20 AM	100	21.3	9.4
9:30 AM	110	21.2	9.4
9:40 AM	120	21.2	9.4
9:50 AM	130	21.1	9.2
10:00 AM	140	21.0	9.2
10:10 AM	150	20.9	9.2
10:20 AM	160	20.8	9.0
10:30 AM	170	20.6	9.0
10:40 AM	180	20.5	9.0
10:50 AM	190	20.3	8.9
11:00 AM	200	20.1	8.9
11:10 AM	210	19.5	8.9
11:20 AM	220	17.1	7.1
11:28 AM	228	14.4	5.4
11:30 AM	230	10.5	3.8
11:40 AM	240	4.7	1.4
11:50 AM	250	2.6	0.8
12:00 PM	260	0.5	0.1
12:10 PM	270	0.0	0.0
12:20 PM	280	0.0	0.0
12:30 PM	290	0.0	0.0

Note: Alarm start time indicated in red

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Results Continued:

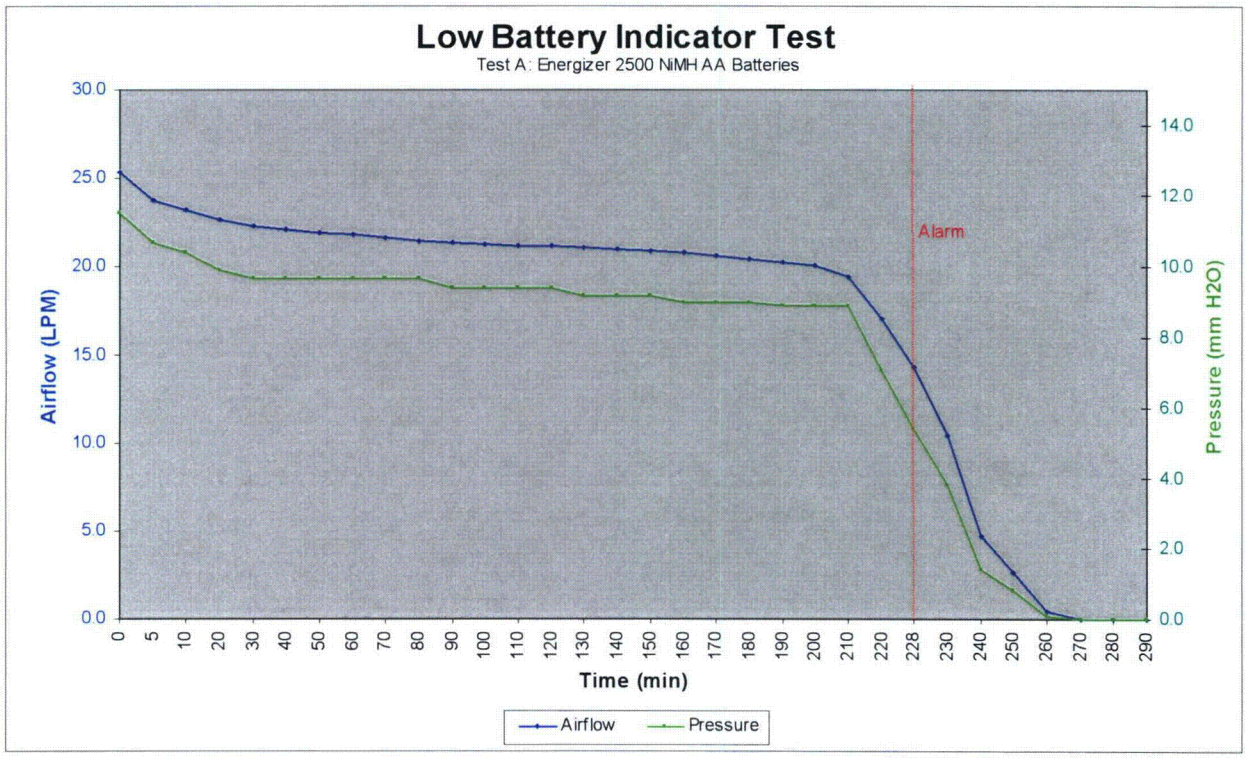

Figure 1: Graph of Low Battery Indicator Test with Energizer 2500 mAh NiMH AA Batteries

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Issue: 1

Results Continued:

Table II

Low Battery Indicator Test

Test B : Hurricsane Hood Category -3 (CAT-3) with 10 Energizer AA Alkaline Batteries

Time	Elasped Time (min)	Airflow (LPM)	Pressure (mm H2O)
10:40 AM	0	23.6	10.4
10:45 AM	5	20.8	8.9
10:50 AM	10	19.7	8.5
11:00 AM	20	18.9	7.9
11:10 AM	30	18.5	7.8
11:20 AM	40	18.1	7.6
11:30 AM	50	17.8	7.4
11:40 AM	60	17.6	7.2
11:50 AM	70	17.3	7.1
12:00 PM	80	17.1	6.7
12:10 PM	90	16.9	6.7
12:20 PM	100	16.6	6.6
12:30 PM	110	16.3	6.6
12:40 PM	120	16.1	6.4
12:50 PM	130	15.7	6.4
1:00 PM	140	15.3	6.1
1:10 PM	150	14.9	5.9
1:20 PM	160	14.3	5.6
1:30 PM	170	13.5	5.1
1:39 PM	179	12.9	4.6
1:40 PM	180	8.0	1.4
1:50 PM	190	3.2	1.0
2:00 PM	200	3.1	1.0
2:10 PM	210	3.0	1.0
2:20 PM	220	2.9	1.0
2:30 PM	230	2.6	0.8
2:40 PM	240	2.0	0.8
2:50 PM	250	1.7	0.4
3:00 PM	260	1.0	0.1
3:10 PM	270	0.4	0.1
3:20 PM	280	0.0	0.0
3:30 PM	290	0.0	0.0
3:40 PM	300	0.0	0.0

Note: Alarm start time indicated in red

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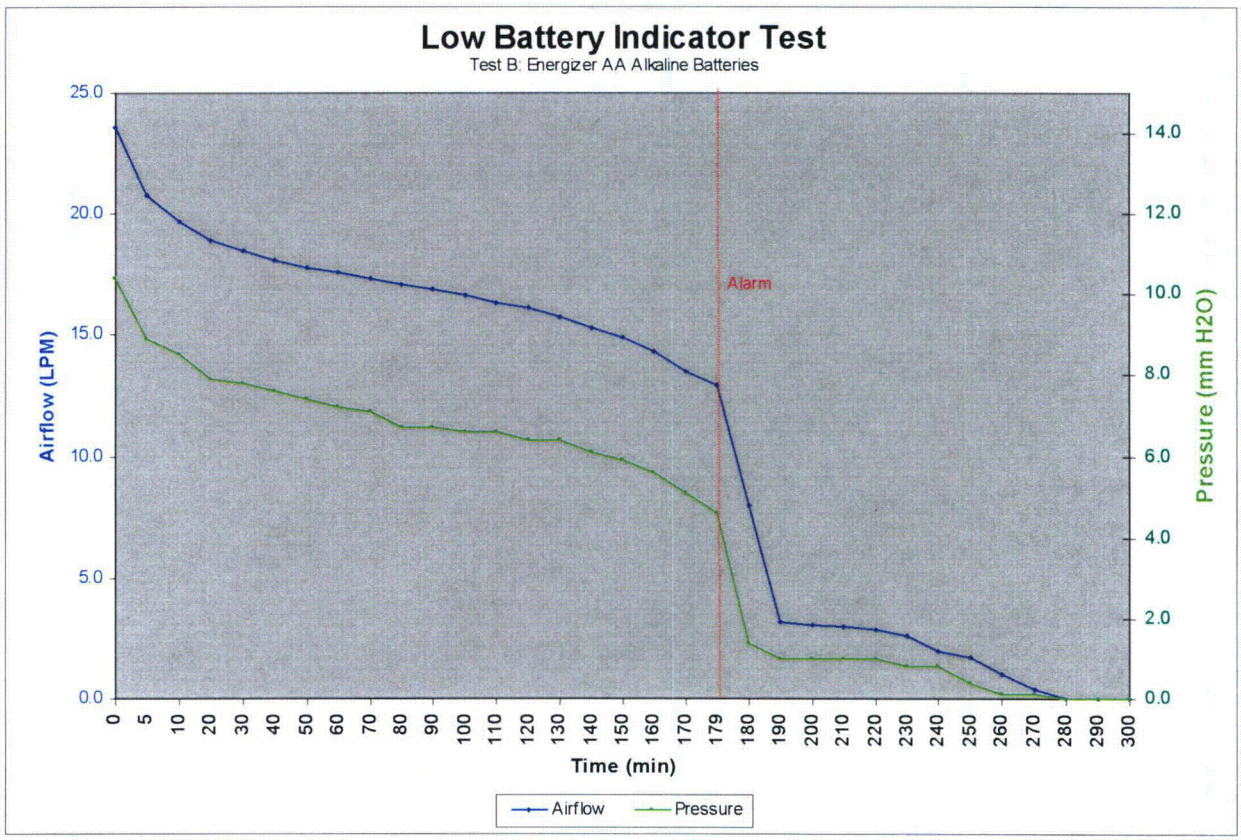

Figure 2: Graph of Low Battery Indicator Test with Energizer AA Alkaline Batteries

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Date: 1 February 2008
Report: T3657-03-1
Issue: 1

Photographs:

Figure 3: Low Battery Indicator test in progress

Figure 4: Alarm activated by depleted battery state

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Test Report T3657-02-1 Issue 1
NIOSH draft document "Concept: Proposed Industrial Powered Air-Purifying Respirator Standard", Section 4.1.9 Low flow indicator
Radium, Inc.
Hurricane Hood Category-3 (CAT-3)
1 February 2008

Authorized and Performed by:

Michael G. Gergel
Manager - Physical & Analytical Chemistry

Reviewed by:

Prabodh K. Patnaik
Physical / Aanalytical Scientist

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Date: 1 February 2008
Report: T3657-02-1
Issue: 1

Summary:

Samples of the containment suit, "Hurricane Hood Category-3 (CAT-3)", submitted by Radium Inc. were evaluated against Section 4.1.9 "Low flow indicator" in the NIOSH draft document "Concept: Proposed Industrial Powered, Air-Purifying Respirator (PAPR) Standard", dated September 19, 2006. In a test with rechargeable batteries audible and visual alarms successfully indicated the low flow state as the filter was loaded with silica dust.

Objectives:

Testing in general accordance with: NIOSH draft document "Concept: Proposed Industrial Powered, Air-Purifying Respirator (PAPR) Standard", Section 4.1.9 "Low flow indicator", dated September 19, 2006.

Materials:

Component	*P/N*	*Description*	*Qty*
Hurricane Hood CAT-3 Test System	CAT-3-1	Headpiece with blower, belt w/ battery case	1
Hurricane Hood CAT-3 Suits – Size XL	NA	Body suit, yellow	1
Hurricane Hood CAT-3 Hood	NA	Hood, clear with double bib, yellow	1
Rubber Boots, L, XL	NA	Rubber Boots, yellow, pr	1
Rubber Gloves, L, XL	NA	Rubber Gloves, orange, pr	1
Shoe Covers	NA	PVC Shoe Covers, yellow, pr	1
Filter	NA	HE cartridge, black	1
Batteries, Rechargeable	NA	Energizer 2500 NiMH AA Batteries	10
Battery Charger	NA	Energizer 15 Minute Battery Charger for NiMH	1

Date provided by the Client: 20 July 2007
Date Testing Authorized: 20 July 2007
Dates of tests: 31 January 2008
Manufacturer(s) / Supplier: Radium Inc.

Equipment:

Stopwatch, Fisher Scientific, (EQ#0313)
Airflow meter, 4000 series, TSI, (EQ#0724)
Digital Manometer, Series 477, Dwyer Instruments, (EQ#0269)
Silica dust, Silicon Dioxide / Crystalline Silica; Ottawa Industrial Sand Co.

Procedure:

Testing protocols in accord with good laboratory practice were employed for all tests. The equipment and instrument calibrations were verified current and within specification prior to use. All testing procedures with the exception of those identified in the following paragraphs were in general accordance with, NIOSH draft document "Concept: Proposed Industrial Powered, Air-Purifying Respirator (PAPR) Standard", Section 4.1.10 "Power indicator", dated September 19, 2006.

At the request of the client the test was performed with a Hurricane Hood Category-3 system with ten (10) Energizer AA NIMH 2500 mAh rechargeable batteries.

The suit was placed on a manikin for this test. Flow and pressure values were recorded manually at specific time intervals from the airflow and pressure meters which were connected via probe to the hood. Silica dust was added manually to the filter.

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Date: 1 February 2008
Report: T3657-02-1
Issue: 1

Results:

The data and results for the low flow indicator test on the Hurricane Hood Category-3 (CAT-3) suit are provided in Table I.

Table I

Low Flow Indicator Test

Hurricsane Hood Category -3 (CAT-3) with 10 Energizer 2500 mAh NiMH AA Batteries

Elasped Time (min)	Airflow (LPM)	Pressure (mm H2O)
0	22.9	10.5
2	22.5	10.0
4	22.1	9.7
6	21.6	9.5
8	21.1	9.2
10	20.6	8.8
12	19.8	8.4
14	19.3	8.2
16	18.7	8.1
18	18.0	7.7
20	17.2	7.2
22	16.3	6.7
24	15.2	5.9
26	14.0	5.4
28	12.9	4.6
30	11.5	4.2
32	10.4	3.9
34	9.1	3.4
36	8.3	3.1
38	7.3	2.6
40	6.8	2.3
42	6.4	2.1
44	6.2	2.0

Note: Alarm start time indicated in red

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Results Continued:

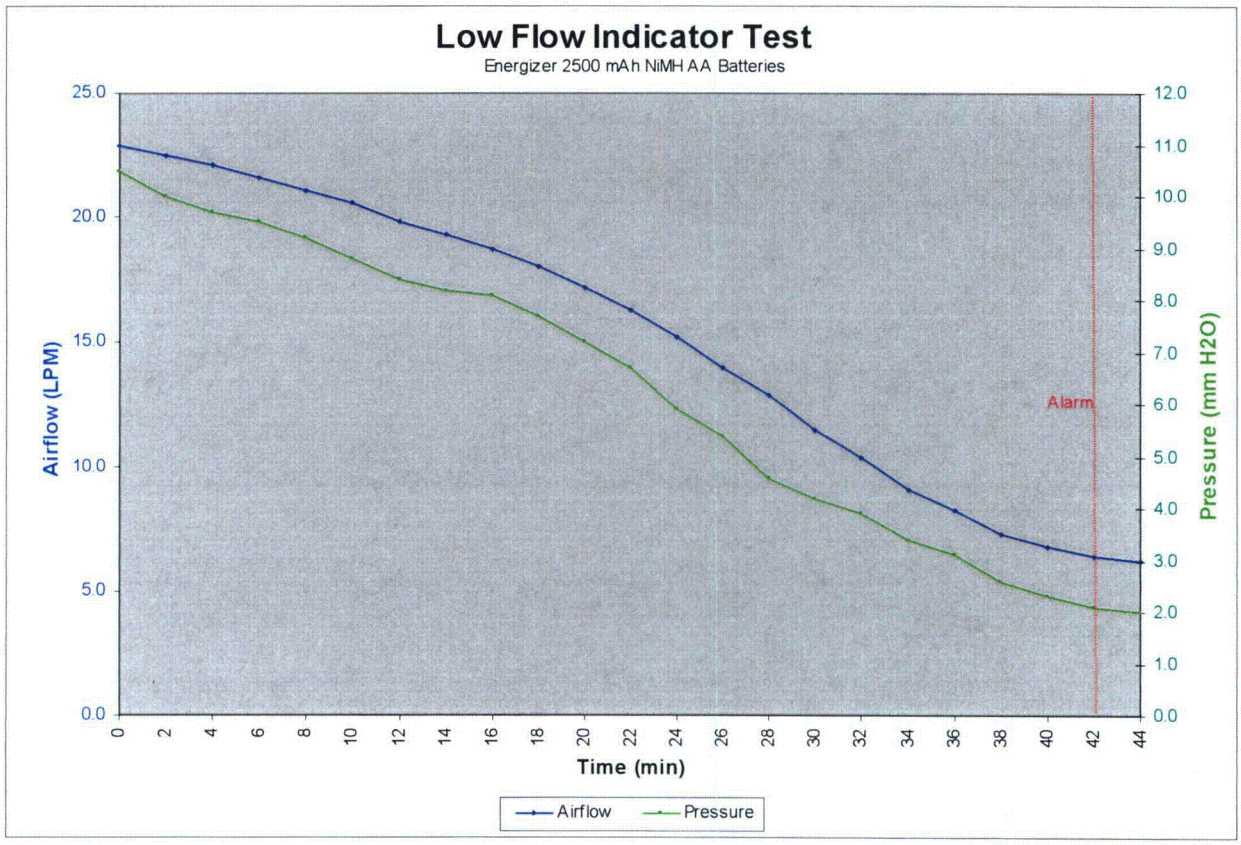

Figure 1: Graph of Low Flow Indicator Test with Energizer 2500 mAh NiMH AA Batteries

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Date: 1 February 2008
Report: T3657-02-1
Issue: 1

Photographs:

Figure 3: Low Flow Indicator test in progress

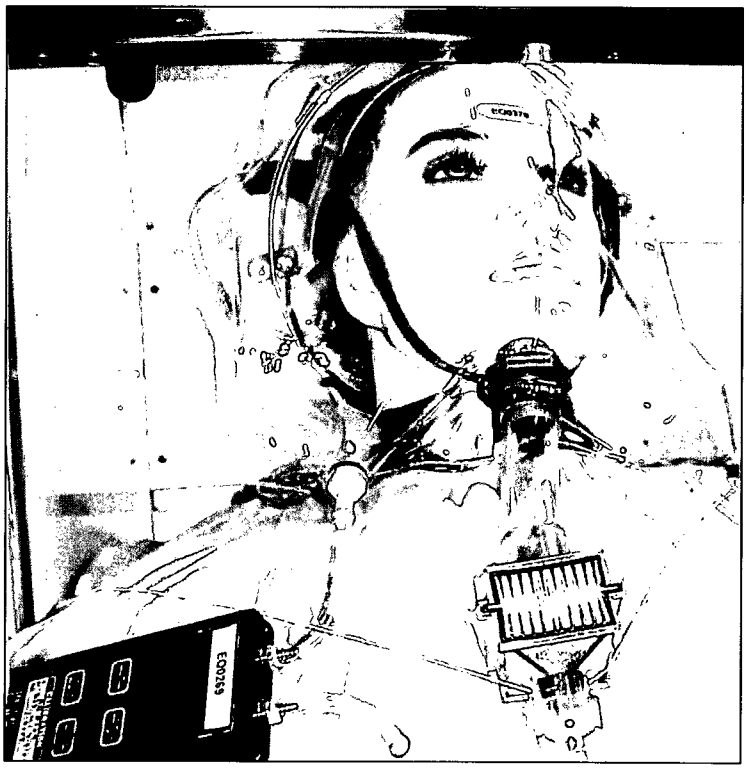

Figure 4: Alarm activated by Low Flow State

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Comparison of Radium's Hurricane Hoods and the Proposed NIOSH PAPR Standard

The following information summarizes the Hurricane Hood System's performance and how it meets or exceeds the requirements in the latest proposed NIOSH PAPR Standard. This proposed standard will replace Subpart KK of 42 CFR Part 84 and all other applicable requirements for powered air purifying respirators (PAPR).

The following information is provided for evaluation purposes and provides a detailed comparison with the proposed NIOSH PAPR standard. Because the Hurricane Hood Systems incorporate a positive pressure suit and a powered air purifying blower, a direct comparison cannot be drawn. However, these comparisons can assist the evaluator to draw conclusions about the performance of the Hurricane Hood Systems.

The standard used in this comparison is *Concept: Proposed Industrial Powered, Air-purifying Respirator (PAPR) Standard* (September 19, 2006).

4.1.1 Required Components

Depending on the model, the Hurricane Hood Systems contain many of the listed components. The Hurricane Hood's unique design (patent pending) does not use a breathing tube. The incorporation of a breathing tube is a limitation to other designs due to the tube's susceptibility to kink and poor air flow characteristics of a tube incorporated in a PAPR design. Also, the Hurricane Hood does not have an operational switch which could be turned off by mistake. Instead, it uses a locking electrical connector to ensure power always remains "ON".

4.1.2 General Construction

Hurricane Hoods incorporate a low-power alarm that notifies the wearer visually by a red LED light (CAT-3 model only) and by an audible alarm (constant tone type) that power is low. This alarm indicates that the user has approximately 15 minutes of blower operation to safely leave the area.

4.1.3 Breathing Tubes

Hurricane Hoods do not incorporate breathing tubes in the design due to their obvious disadvantages.

4.14 Body Harnesses

The Hurricane Hood Category 2 model uses an adjustable backpack type harness that can be released from outside the suit to allow quick removal of the jacket part of the suit in case of emergency. Category 3 models do not use a body harness.

4.1.5 Head Harness

The Hurricane Hood Category 3 model uses a fully-adjustable head harness to quickly and easily secure the blower unit to the head.

4.1.6 Respiratory Inlet Coverings

Hurricane Hoods are designed to fit every individual without limitations to head size or if eyeglasses are worn by the wearer. It does not restrict movement of the head for vision.

4.1.7 Eyepieces/Lens of Respiratory Inlet Coverings

Not applicable. The clear vinyl hood that is part of the Hurricane Hood does not include any eyepieces or lenses.

Radium Incorporated
435 Essex Ave.; STE 7
Waynesboro, VA 22980
540-942-5734
803-753-0067 fax

4.1.8 Noise Levels

Hurricane Hoods have been noise tested (Test Reports T3657-01-1 & T3657-01-2) and do not exceed the 80 dBA limit.

4.1.9 Low Flow Indicator

Hurricane Hoods incorporate a low-flow indicator. A red LED light (CAT 3 model only) and audible alarm (intermittent type) notifies the wearer that flow has decreased significantly and that the wearer should exit the area. These alarms have been independently verified by the enclosed Test Report T3657-02-1.

4.1.10 Power Indicator

Hurricane Hoods have a low-power, visual (CAT-3 model only) and audible alarm that gives the wearer approximately 15 minutes to safely exit the area. Radium tested two types of batteries, Energizer Alkaline AA Batteries and Energizer 2500 NiMH AA Batteries. Radium recommends that the rechargeable batteries be fully charged prior to use. These alarms have been independently verified by the enclosed Test Report T3657-03-1.

4.1.11 Battery Life

Battery life is 3 to 6 hours depending on how many battery banks are filled on the power belt, type of batteries used, and the capacity of the batteries used. In addition to the stated battery life, the wearer has an additional 15 minutes (minimum) to safely leave the area. These times have been independently verified by the enclosed Test Report T3657-03-1.

4.1.12 End-of-Service-Life (ESLI)

Not applicable. Filters, suits, and hoods are recommended for single use only.

4.1.13 Shelf Life Limitations

Shelf life is addressed in the owner's manuals.

4.1.14 Labeling Requirements

Not specified in this draft version of the standard.

4.1.15 Failure Mode and Effects Analysis (FMEA)

FMEA has been addressed in each owner's manual. Cautions, warnings, recommendations, etc. are stated in the manual to ensure the highest confidence in operating the equipment safely and with minimal risks.

4.2.1 Inhalation and exhalation valves

There are no inhalation valves on Hurricane Hoods. The exhalation valves on the suit are designed to protect from inward leakage.

4.2.3 Breathing Resistance

Hurricane Hoods are designed to allow for high airflow in and out of the suit at low pressures. The Hurricane Hood Breathing Gas Test results have proven that they meet the exhalation breathing resistance requirement of less than 1 in.H2O above static pressure inside the suit.

Radium Incorporated
435 Essex Ave.; STE 7
Waynesboro, VA 22980
540-942-5734
803-753-0067 fax

4.2.4 Air Flow Determination

To ensure cooling and ease of breathing during all workloads (low, medium or high), Hurricane Hoods are designed to provide the user with a very high flow of filter air (33 cfm initially then gradual reduction until low battery or low flow alarm), exceeding the requirement of 170 Lpm (6 cfm) during all work load conditions.

4.2.5 Breathing Gas, Carbon Dioxide Machine Tests

Radium has performed successful human breathing gas testing (CO2 and O2) on the Hurricane Hoods. See Test Report HH122007-01.

4.2.6 Service Time Limitations

All battery service recommendations are detailed in the owner's manuals. Battery packs last for a period of 3 to 6 hours depending on how many battery banks are filled, types of batteries, and the age/capacity of the batteries. This capacity exceeds the 2-hour minimum requirement as shown in Test Report T3657-03-1.

4.2.7 Chemical Cartridge/Canister Gas/Vapor Removing Effectiveness

Not applicable. Currently, Radium only offers one high efficiency particulate air (HEPA) filter.

4.2.8 PAPR P95 and PAPR P100 Particulate Filter Efficiency Level Determination

Hurricane Hood's high efficiency particulate air (HEPA) filters are manufactured per NIOSH regulations. The filter meets the following requirements for materials, construction and assembly, flow testing, particulate penetration, and other requirements governed by NIOSH and 42 CFR 84, Subpart KK for HEPA filters. They are rated at 99.97% efficiency, 0.3 micron.

4.2.9 Breathing Gas: Oxygen (O2) and Carbon Dioxide (CO2) Human Subject Generated

Hurricane Hoods have been tested per the requirements of this section. The test results confirm that carbon dioxide levels did not exceed 2.0% and oxygen levels were no less than 19.5% in the air inhaled in all exercises. See Test Report HH122007-01.

4.2.10 Total Inward Leakage (TIL)

Total Inward Leakage Testing is calculated by performing Laboratory Respiratory Protection Level Tests (LRPL) in a controlled atmosphere. This proposed standard uses a corn oil aerosol environment and sampling inside the respirator to determine the total inward leakage (TIL). The TIL minimum value for a loose-fitting face piece (closest class to the Hurricane Hoods) is 250.

Per the enclosed Test Reports T3657-04-1 and T3657-04-2, Hurricane Hoods exceed this requirement with an average TIL of 1900 for the CAT-3 Model and 1500 for the CAT-2 Model.

Radium Incorporated
435 Essex Ave.; STE 7
Waynesboro, VA 22980
540-942-5734
803-753-0067 fax

Product Information Sheet

Product: Hurricane Hood High Efficiency Particulate Air Filter (HEPA)

Product No.: HH-HEPA Filter

Filter Type: HEPA Filter 99.97% efficiency; 0.3 micron

Application: HEPA Filter for all models of the Hurricane Hood Systems.
To be used in accordance with the Hurricane Hood Systems Manuals

Manufacturer: 3M; St. Paul, Minnesota
Manufactured per NIOSH regulations.

3M Provided Information:

This filter meets the following requirements for materials, construction and assembly, flow testing, particle penetration, and other requirements governed by NIOSH and 42 CFR 84, Subpart KK for HEPA filters.

Radium Incorporated
435 Essex Ave.; STE 7
Waynesboro, VA 22980
540-942-5734
803-753-0067 fax

Product Information Sheet

Product: Hurricane Hood Suits (all PVC Suits)

Product No(s).: CAT-3S (Hurricane Hood Category 3 Suit)
CAT-2S (Hurricane Hood Category 2 Suit)

Material: Polyvinyl Chloride (PVC) Film/Sheet

Manufacturer: Lancs Industries, Kirkland WA

Testing Information:

The material was extensively tested to ensure it met or exceeded requirements outlined in LP-375D; *Federal Specification for Plastic Film, Flexible, and Vinyl Chloride* for:

- Thickness
- Bondability
- Tensile strength
- Ultimate elongation
- Elmendorf tear
- Pinholes
- Clarks stiffness
- Extraction in soapy water
- Blocking
- Volatility
- Weather resistance
- Cold cracks
- Lacquer lifting
- Crocking
- Dimensional stability

Flammability testing of the material was also performed to ensure it met/exceeded requirements outlined in MVSS-302; *Federal Flammability Test Procedure* and NFPA-701; *Standard Methods of Fire Tests for Flame Propagation of Textiles and Films*..

A chemical analysis for water extractable halogens such as fluorides, chlorides, bromides, and sulfur was also performed on the material.

LANCS INDUSTRIES

1/5/05

Mr. Graham Hollingsworth
Lanc's Industries
12704 NE 124th St. #36
Kirkland, WA 98034

Test Report

Identification:	0.004 in. Translucent Yellow
Grade:	EMS028
Customer PO:	15638N
Lot ID	108311
Specification:	LP375D Type I Class 2

Test	Sample 1	Sample 2	Sample 3	Requirements
Thickness (LP375D); Inches	0.00480	0.00480	0.00483	.004 ± .0004
	0.00467	0.00458	0.00482	
	0.00486	0.00496	0.00481	
	0.00477	0.00496	0.00470	
	0.00498	0.00498	0.00472	
Average	0.00482	0.00486	0.00478	
Bondability (ASTM D-882) % of psi Machine Direction	3286(143)	2409(105)	2932(127)	65.0 Minimum
	2279(99)	2068(90)	2395(104)	
	3186(139)	1956(85)	2500(109)	
	2810(122)	2227(97)	2140(93)	
	2238(97)	2386(104)	2477(108)	
Average	2760(120)	2209(96)	2489(108)	
Bondability (ASTM D-882) % of psi Transverse Direction	2795(122)	2622(114)	2477(108)	65.0 Minimum
	1659(72)	2267(99)	2659(116)	
	2136(93)	2841(124)	2864(125)	
	2233(97)	2432(106)	1682(73)	
	2523(110)	2250(98)	2500(109)	
Average	2269(99)	2482(108)	2436(106)	

NOTE: This information is, to the best of the company's knowledge, accurate under numerous conditions; however, it does not apply in all cases. The summary chart is intended only as a guideline and all recommendations are made without guarantee since conditions of use are beyond our control.

Lot ID: 108311 1/5/05

	Sample 1	Sample 2	Sample 3	Requirements
Tensile Strength:	3659	3304	3455	2300 Minimum
(ASTM D-882) psi	3178	3091	3156	
Machine Direction	3065	3133	3178	
	2935	3200	3065	
	3065	3209	2844	
Average	3180	3187	3140	
Tensile Strength:	3395	3071	2956	2300 Minimum
(ASTM D-882) psi	2952	2844	2952	
Transverse Direction	3163	2955	2841	
	2977	3333	2976	
	3022	2523	2643	
Average	3102	2945	2874	
Ultimate Elongation:	282	276	262	150 Minimum
ASTM D-882) %	252	241	248	
Machine Direction	241	243	260	
	229	242	248	
	244	250	206	
Average	250	250	245	
Ultimate Elongation:	325	278	260	200 Minimum
ASTM D-882) %	235	276	262	
Transverse Direction	283	279	267	
	252	297	264	
	299	210	218	
Average	279	268	254	
Elmendorf Tear	352	528	352	240 Minimum
(ASTM D-1922) gm/mil	400	464	368	
Machine Direction	320	448	400	
	448	480	384	
	352	400	400	
Average	374	464	381	

1/5/05

Lot ID: 108311

	Sample 1	Sample 2	Sample 3	Requirements
Elmendorf Tear	816	896	800	240 Minimum
(IASTM D-1922) gm/mil	816	880	768	
Transverse Direction	752	880	800	
	784	768	784	
	752	880	752	
Average	784	861	781	
Pinholes	None	None	None	2.0 Maximum
(LP-375D) sq. yd.	None	None	None	
	None	None	None	
Clarks Stiffness	6.9	7.1	6.9	8.0 Maximum
(FTMS 191 5204) cm	6.9	7.0	6.8	
	6.8	7.0	6.9	
	6.8	7.0	6.8	
	6.8	6.8	6.8	
Average	6.8	7.0	6.8	
Extraction in Soapy Water	0.48	0.42	0.52	4.0 Maximum
(LP-375D) %	0.49	0.45	0.51	
	0.37	0.50	0.48	
Average	0.45	0.46	0.50	
Blocking	No. 2	No. 2	No. 2	No.2
(FTMS 191 5872)	No. 2	No. 2	No. 2	
	No. 2	No. 2	No. 2	
Volatility	1.59	1.15	1.15	8.0 Maximun
(ASTM D-1203) %	1.22	1.12	1.32	
Average	1.41	1.14	1.24	
Weather Resistance				No appreciable change
(FTMS 191 5671)	Pass	Pass	Pass	
	Pass	Pass	Pass	
	Pass	Pass	Pass	

1/5/05

Lot ID: 108311

	Sample 1	Sample 2	Sample 3	Requirements
Cold Crack	Pass	Pass	Pass	No evidence of
(FTMS 191 5874)	Pass	Pass	Pass	cracking
0°F +/- 2°F	Pass	Pass	Pass	
Lacquer Lifting (LP-375D)	Pass	Pass	Pass	No appreciable
	Pass	Pass	Pass	change
Crocking (FTMS 191 5651)				
Dry	Good	Good	Good	Good
	Good	Good	Good	
	Good	Good	Good	
Wet	Good	Good	Good	
	Good	Good	Good	
	Good	Good	Good	
Dimensional Stability (Machine)				7.0 Maximum
(LP-375D) %	5.1	5.5	5.1	
	5.1	5.5	5.5	
Average	5.1	5.5	5.3	
Dimensional Stability (Transverse)				7.0 Maximum
(LP-375D) %	1.6	1.6	1.6	
	1.2	1.2	1.6	
Average	1.4	1.4	1.6	

We certify that the material reported above is in compliance with LP-375D.

Bach Nguyen
Technical Manager

LANCS INDUSTRIES

January 5, 2005

Mr. Graham Hollingsworth
Lanc's Industries
12704 NE 124th St. #36
Kirkland, WA 98034

The following data are submitted for your information:

Customer P.O.:	15638N
Lot #:	108311
Grade:	EMS028
Gauge:	.004 in.
Hand:	1.5S
Color:	Yellow
Finish:	Matte

Test Results

Sample No.	Flame Time	Length of Burn (ins.)	Burn Rate (In/Min).
1	0.0	0.00	0
2	0.0	0.00	0
3	0.0	0.00	0
4	0.0	0.00	0

Conclusion: No specimen burned for more than 60 seconds after start of timing.
No specimen burned for more than 2 inches after start of timing.
This film meets the requirements of MVSS-302 Flammability test.

Bach Nguyen
Technical Manager

NOTE: This information is, to the best of the company's knowledge, accurate under numerous conditions; however, it does not apply in all cases. The summary chart is intended only as a guideline and all recommendations are made without guarantee since conditions of use are beyond our control.

PLANT: 12704 NE 124th Street #36, Kirkland, WA 98034-8379
PH: 425-823-6634 FAX: 425-820-6764
E-mail: lancsind@msn.com

FIELD OFFICE: 3890 Post Rd., Suite 6, Warick, RI 02886
PH: 401-828-9392 FAX: 401-884-2341
Web Page: www.lancsindustries.com

LANCS INDUSTRIES

3/16/05

Mr. Graham Hollingsworth
Lanc's Industries
12704 NE 124th St. #36
Kirkland, WA 98034

Test Report

Identification:	0.008 in. Opaque Yellow
Grade:	EMO050
Customer PO:	16006
Lot ID	109602
Specification:	LP-375D Type I Class 2

Test	Sample 1	Sample 2	Sample 3	Requirements
Thickness (LP375D); Inches				.008 ± .0008
	0.00814	0.00821	0.00820	
	0.00814	0.00819	0.00831	
	0.00814	0.00814	0.00833	
	0.00820	0.00820	0.00826	
	0.00847	0.00837	0.00839	
Average	0.00822	0.00822	0.00830	
Bondability (ASTM D-882) % of 2300 psi Machine Direction	3139(136)	3000(130)	2846(124)	65.0 Minimum
	2825(123)	3316(144)	2727(119)	
	2468(107)	3165(138)	3192(139)	
	2418(105)	2924(127)	3025(132)	
	2861(124)	3228(140)	2615(114)	
Average	2742(119)	3127(136)	2881(126)	
Bondability (ASTM D-882) % of 2300 psi Transverse Direction	3179(138)	2247(98)	2468(107)	65.0 Minimum
	3063(133)	2366(103)	2500(109)	
	2438(106)	2914(127)	3154(137)	
	2911(127)	2963(129)	2962(129)	
	2468(107)	2877(125)	2833(123)	
Average	2812(122)	2673(116)	2783(121)	

NOTE: This information is, to the best of the company's knowledge, accurate under numerous conditions; however, it does not apply in all cases. The summary chart is intended only as a guideline and all recommendations are made without guarantee since conditions of use are beyond our control.

Lot ID: 109602 3/16/05

	Sample 1	Sample 2	Sample 3	Requirements
Tensile Strength:	3219	3310	3030	2300 Minimum
(ASTM D-882) psi	3415	3393	3060	
Machine Direction	3311	3336	3237	
	3235	3094	3212	
	3293	3189	3306	
Average	3295	3264	3169	
Tensile Strength:	2985	3125	3034	2300 Minimum
(ASTM D-882) psi	2985	3090	2920	
Transverse Direction	2830	2923	3006	
	3038	2893	2870	
	2944	2764	2911	
Average	2956	2959	2948	
Ultimate Elongation:	311	330	307	200 Minimum
(ASTM D-882) %	336	360	344	
Machine Direction	328	344	365	
	319	318	361	
	334	318	359	
Average	326	334	347	
Ultimate Elongation:	337	371	356	200 Minimum
(ASTM D-882) %	350	373	344	
Transverse Direction	326	343	363	
	356	336	334	
	333	310	346	
Average	340	347	349	
Elmendorf Tear	1216	1216	1280	800 Minimum
(ASTM D-1922) gm	1280	1216	1408	
Machine Direction	1408	1408	1344	
	1216	1216	1408	
	1280	1408	1408	
Average	1280	1293	1370	

Lot ID: 109602 3/16/05

	Sample 1	Sample 2	Sample 3	Requirements
Elmendorf Tear (ASTM D-1922) gm Transverse Direction	1664	1792	1920	800 Minimum
	1728	1792	1984	
	1664	1856	1984	
	1792	1856	1984	
	1664	1856	1920	
Average	1702	1830	1958	
Pinholes (LP-375D) sq. yd.	None	None	None	2 per sq. yard
	None	None	None	
	None	None	None	
Clarks Stiffness (FTMS 191 5204) cm	7.3	8.2	8.2	11.0 Maximum
	7.4	8.3	8.2	
	7.4	8.5	8.2	
	7.4	8.5	8.2	
	7.6	8.5	8.4	
Average	7.4	8.4	8.2	
Extraction in Soapy Water (LP-375D) %	0.41	0.38	0.42	2.0 Maximum
	0.37	0.34	0.41	
	0.38	0.36	0.38	
Average	0.39	0.36	0.40	
Blocking (FTMS 191 5872)	No. 2	No. 2	No. 2	No. 2
	No. 2	No. 2	No. 2	
	No. 2	No. 2	No. 2	
Volatility (ASTM D-1203) %	0.65	0.75	0.66	4.0 Maximun
	0.73	0.56	0.77	
Average	0.69	0.66	0.72	
Weather Resistance (FTMS 191 5671)	Pass	Pass	Pass	No appreciable change
	Pass	Pass	Pass	
	Pass	Pass	Pass	

3/16/05

Lot ID: 109602

	Sample 1	Sample 2	Sample 3	Requirements
Cold Crack (FTMS 191 5874) 0°F +/- 2°F	Pass Pass Pass	Pass Pass Pass	Pass Pass Pass	No evidence of cracking
Lacquer Lifting (LP-375D)	Pass Pass	Pass Pass	Pass Pass	No appreciable change
Crocking (FTMS 191 5651) Dry	Good Good Good	Good Good Good	Good Good Good	Good
Wet	Good Good Good	Good Good Good	Good Good Good	Good
Dimensional Stability (Machine) (LP-375D) %	3.9 3.1	4.3 3.9	3.1 3.9	7.0 Maximum
Average	3.5	4.1	3.5	
Dimensional Stability (Transverse) (LP-375D) %	1.6 2.0	2.0 1.6	1.6 2.0	7.0 Maximum
Average	1.8	1.8	1.8	
Odor (LP-375D)	Pass Pass Pass	Pass Pass Pass	Pass Pass Pass	No objectionable odor

We certify that the material reported above is in compliance with LP-375D.

Bach Nguyen
Technical Manager

LANCS INDUSTRIES

10/25/06

Lancs Industries, Inc
12704 N.E. 124th St. #36
Kitkland WA 98034

Test Report

Identification:	O.020 in. Transparent Clear
Grade:	KGT244
Customer PO:	17206
Lot ID	121684
Specification:	LP-375D Type I Class 2

Test

	Sample 1	Sample 2	Sample 3	Requirements
Thickness (LP375D); Inches	0.01892	0.01906	0.01906	.020 ± .002
	0.01896	0.01893	0.01887	
	0.01905	0.01898	0.01913	
	0.01896	0.01883	0.01898	
	0.01891	0.01876	0.01925	
Average	0.01896	0.01891	0.01906	
Bondability (ASTM D-882) % of 2200 psi Machine Direction	3521(160)	3436(156)	3500(159)	65.0 Minimum
	3351(152)	3556(162)	3268(149)	
	3534(161)	3265(148)	3416(155)	
	3238(147)	3640(165)	3309(150)	
	3566(162)	3388(154)	3379(154)	
Average	3442(156)	3457(157)	3374(153)	
Bondability (ASTM D-882) % of 2200 psi Transverse Direction	3378(154)	3311(151)	2910(132)	65.0 Minimum
	3303(150)	3300(150)	3286(149)	
	3243(147)	3311(151)	3280(149)	
	3335(152)	3367(153)	3356(153)	
	3218(146)	3421(156)	3392(154)	
Average	3295(150)	3342(152)	3245(148)	

NOTE: This information is, to the best of the company's knowledge, accurate under numerous conditions; however, it does not apply in all cases. The summary chart is intended only as a guideline and all recommendations are made without guarantee since conditions of use are beyond our control.

Lot ID: 121684 10/25/06

	Sample 1	Sample 2	Sample 3	Requirements
Tensile Strength:	3405	3521	3174	2200 Minimum
(ASTM D-882) psi	3300	3417	3568	
Machine Direction	3351	3396	3440	
	3435	3330	3346	
	3225	3398	3377	
Average	3343	3412	3381	
Tensile Strength:	2995	3125	3026	2200 Minimum
(ASTM D-882) psi	3199	3283	3178	
Transverse Direction	3047	3203	3153	
	3016	3328	3031	
	3120	3141	3068	
Average	3075	3216	3091	
Ultimate Elongation:	360	357	306	200 Minimum
(ASTM D-882) %	329	347	367	
Machine Direction	343	342	359	
	363	321	338	
	324	330	354	
Average	344	339	345	
Ultimate Elongation:	325	344	339	250 Minimum
(ASTM D-882) %	369	384	361	
Transverse Direction	329	367	358	
	328	395	333	
	353	371	339	
Average	341	372	346	
Graves Tear	8.7	8.8	9.4	7.5 Minimum
(ASTM D-1004) lb	9.2	9.1	8.8	
Machine Direction	9.5	9.4	9.4	
	9.2	9.3	9.1	
	9.2	9.4	8.7	
Average	9.2	9.2	9.1	

Lot ID: 121684

10/25/06

	Sample 1	Sample 2	Sample 3	Requirements
Graves Tear (ASTM D-1004) lb Transverse Direction	9.0	9.3	9.7	7.5 Minimum
	9.7	9.7	9.4	
	9.4	9.6	8.9	
	8.9	9.8	9.7	
	9.7	9.2	9.4	
Average	9.3	9.5	9.4	
Pinholes (LP-375D) sq. yd.	None	None	None	None
	None	None	None	
	None	None	None	
Clarks Stiffness (FTMS 191 5204) cm	17	16.7	16.8	22.0 Maximum
	17	16.7	16.8	
	16.8	16.7	16.7	
	16.8	16.8	16.7	
	16.7	16.8	16.7	
Average	16.9	16.7	16.7	
Extraction in Soapy Water (LP-375D) %	0.30	0.14	0.14	2.0 Maximum
	0.18	0.13	0.15	
	0.28	0.14	0.15	
Average	0.25	0.14	0.15	
Blocking (FTMS 191 5872)	No. 2	No. 2	No. 2	No .2
	No. 2	No. 2	No. 2	
	No. 2	No. 2	No. 2	
Volatility (ASTM D-1203) %	1.00	0.81	0.95	2.0 Maximun
	0.86	0.80	0.84	
Average	0.93	0.81	0.90	
Weather Resistance (FTMS 191 5671)	Pass	Pass	Pass	No appreciable change
	Pass	Pass	Pass	
	Pass	Pass	Pass	

10/25/06

Lot ID: 121684

	Sample 1	Sample 2	Sample 3	Requirements
Cold Crack	Pass	Pass	Pass	No evidence of
(FTMS 191 5874)	Pass	Pass	Pass	cracking
0°F +/- 2°F	Pass	Pass	Pass	
Lacquer Lifting (LP-375D)	Pass	Pass	Pass	No appreciable
	Pass	Pass	Pass	change
Crocking (FTMS 191 5651)	Good	Good	Good	Good
Dry	Good	Good	Good	
	Good	Good	Good	
	Good	Good	Good	Good
Wet	Good	Good	Good	
	Good	Good	Good	
Dimensional Stability (Machine)				7.0 Maximum
(LP-375D) %	3.5	3.9	3.5	
	3.5	3.5	3.5	
Average	3.5	3.7	3.5	
Dimensional Stability (Transverse)				7.0 Maximum
(LP-375D) %	1.2	1.6	1.2	
	1.2	1.6	1.2	
Average	1.2	1.6	1.2	
Odor	Pass	Pass	Pass	No objectionable
LP-375D	Pass	Pass	Pass	odor
	Pass	Pass	Pass	

We certify that the material reported above is in compliance with LP-375D.

Bach Nguyen
Technical Manager

LANCS INDUSTRIES

SS-481
Rev. 2 27 June 1995
CERTIFICATE OF QUALITY CONFORMANCE

1. Manufacturer or Supplier Achilles USA Inc.

2. Customer Lanc's Industries

3. Address 12704 NE 124th St.
Kirkland, WA 98034

4. Contract Number 17206/Lot 121684 5. Date October 25, 2006

6. Form Roll 7. Thickness .020"(lt) 8. Size 54" Width

9 Level of Packaging Commercial 10. Quantity 52 rolls. 11. Feet/Roll 171

12. Physical Properties from LP-375D

Test	Requirement	Actual Values
Tensile strength	MD 2200 psi Min. TD 2200 psi Min.	3379 3127
Elongation	MD 200 % Min. TD 250 % Min.	343 353
Bondability	65% of Tensile Min.	153
Tear resistance	MD. 7.5 lbs Min. TD. 7.5 lbs Min.	9.2 9.5
Pinholes and cracks	None	None
Stiffness	22 cm Max.	16.8
Extraction in soapy water	2.0 % Max.	0.18
Volatility	2.0 % Max.	0.88
Blocking	NO. 2	NO. 2

NOTE: This information is, to the best of the company's knowledge, accurate under numerous conditions; however, it does not apply in all cases. The summary chart is intended only as a guideline and all recommendations are made without guarantee since conditions of use are beyond our control.

PLANT: 12704 NE 124th Street #36, Kirkland, WA 98034-8379
PH: 425-823-6634 FAX: 425-820-6784
E-mail: lancsind@msn.com

FIELD OFFICE: 3890 Post Rd., Suite 6, Warick, RI 02888
PH: 401-828-9392 FAX: 401-884-2341
Web Page: www.lancsindustries.com

SS-481
CERTIFICATE OF QUALITY CONFORMANCE
ADDITIONAL TESTS TO LP-375

Resistance to weathering	Certify	Cold cracking	Certify
Lacquer lifting	Certify	Crocking	Certify
Dimensional Stability	Certify	Odor	Certify

13. Prohibited Materials

A. Water-leachable chloride	MIL-STD 2041 250 ppm max Method D4327	See attached report.
B. Water-leachable fluoride	MIL-STD 2041 250 ppm max Method D4327	See attached report.
C. Water-leachable bromide	MIL-STD 2041 250 ppm max Method D4327	See attached report.
D. Water-leachable Sulfur	MIL-STD 2041 250 ppm max Method D4327	See attached report

E. Mercury: The product did not come in direct contact with mercury or any of its compounds during the manufacturing process, tests, and inspections.
Certify

14. Visual examination

Test	Requirement	Actual Values
Dimensions	54" -0" +.5"	54"
Thickness	.020 "± .0020"	.01898
Construction and workmanship		Certify

15. Physical test from this specification

Test	Requirement	Actual Values
Bottom Seam strength	1495 psi minimum	Not applicable
Longitudinal Seam Strength	1495 psi minimum	Not applicable

SS-481
CERTIFICATE OF QUALITY CONFORMANCE

16. Color and Transparency

Color	Certify
Transparency	Certify
Visibility in water	Certify

17. Preparation for delivery Certify

We hereby certify that the above material has been inspected and tested in accordance with the listed specification and is conformance with all requirements.

Bach Nguyen
Technical Manager

Date 10/26/06

CCI
ANALYTICAL
LABORATORIES, INC.

CERTIFICATE OF ANALYSIS

CLIENT: ACHILLES USA, INC
1407 80TH STREET SW
EVERETT, WA 98203

DATE: 10/25/2006
CCIL JOB #: 610069
CCIL SAMPLE #: 1
DATE RECEIVED: 10/12/2006
WDOE ACCREDITATION #: C142

CLIENT CONTACT: GEORGE WOOD

CLIENT PROJECT ID: NONE GIVEN
CLIENT SAMPLE ID: LOT# 121684.020" TRANSPARENT YELLOW

DATA RESULTS

ANALYTE	EXTRACTION METHOD	ANALYSIS METHOD	RESULTS*	UNITS**	ANALYSIS DATE	ANALYSIS BY
WATER EXTRACTABLE FLUORIDE	MIL-STD-2041	ASTM D-4327	7	MG/KG	10/25/2006	CEO
WATER EXTRACTABLE CHLORIDE	MIL-STD-2041	ASTM D-4327	16	MG/KG	10/25/2006	CEO
WATER EXTRACTABLE BROMIDE	MIL-STD-2041	ASTM D-4327	ND(<4)	MG/KG	10/25/2006	CEO
WATER EXTRACTABLE SULFUR	MIL-STD-2041	ASTM D-4327	ND(<1)	MG/KG	10/25/2006	CEO

* "ND" INDICATES ANALYTE NOT DETECTED AT LEVEL ABOVE REPORTING LIMIT. REPORTING LIMIT IS GIVEN IN PARENTHESES

** UNITS FOR ALL NON LIQUID SAMPLES ARE REPORTED ON A DRY WEIGHT BASIS

APPROVED BY: LABORATORY DIRECTOR

8620 Holly Drive • Everett, WA 98208 • 425 356-2600 • FAX 425 356-2626 • Seattle 206 292-9059
RECEIVED TIME OCT.25. 3:51PM

LANCS INDUSTRIES

October 10, 2006

Lanc's Industries
12704 NE 124th St #36
Kirkland, WA 98034

This material was tested under Test #2 NFPA-701 1999 Edition. Test results are as shown below.

Material Identification

Customer P.O. No. 17206		Lot No.	121684
Grade KGT244		Gauge	.020"
Hand 3S		Color	Transparent Yellow

Test Results

Sample #	Flame Time	Char Length	Drip Burn time Seconds
1	0.00	400.0	0.00
2	0.00	380.0	0.00
3	0.00	330.0	0.00
4	0.00	390.0	0.00
5	0.00	370.0	0.00
6	0.00	390.0	0.00
7	0.00	380.0	0.00
8	0.00	360.0	0.00
9	0.00	320.0	0.00
10	0.00	340.0	0.00
Maximum	0.00	400.0	0.00

Maximum after flame time 2.0 Seconds
Maximum char length 435 Millimeters
Maximum drip flame time 2.0 Seconds.

Material meets the requirements of NFPA-701.

Bach Nguyen
Technical Manager

NOTE: This information is, to the best of the company's knowledge, accurate under numerous conditions; however, it does not apply in all cases. The summary chart is intended only as a guideline and all recommendations are made without guarantee since conditions of use are beyond our control.

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FIELD OFFICE: 3890 Post Rd., Suite 6, Warick, RI 02886
PH: 401-828-9392 FAX: 401-884-2341
Web Page: www.lancsindustries.com

Radium™

HURRICANE HOOD™

CATEGORY-3 (CAT-3)

Version 2-
OWNERS MANUAL

Radium Incorporated, 435 Essex Ave., STE 7, Waynesboro, VA 22980 803.414.4445

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103107

Introduction to Radium's Hurricane Hood Cat-3 Model

Thank you for purchasing Radium's Hurricane Hood Cat-3. The Hurricane Hood Cat-3 was designed as a containment and personal cooling system that provides ample air without hoses or airlines for today's nuclear power workers. For decades, nuclear workers had no choice but to use personal protection products that made it difficult to breathe, were obstructive to use, and created an extremely hot and stressful environment to work. The Hurricane Hood Cat-3 gives you the mobility of a powered air visor with the air flow better than a bubble suit...the best of both worlds!

Radium's Hurricane Hood Cat-3 is more than just a personal containment system that provides ample air. The Hurricane Hood line of products provides options such as miniature wireless color cameras, wireless communications, and LED lights. When you purchased a Hurricane Hood, you have purchased a modular platform that can be configured for numerous jobs. Typical uses include Steam Generator Nozzle Dam Installation, Steam Generator Platform Support Workers, and Reactor Cavity Decontamination Workers. Virtually any job that requires personal protection from radioactive particulates and added cooling will benefit from using a Hurricane Hood. This model is not recommended for very wet environments where liquids can enter into the filter openings such as Control Rod Drives maintenance. The Cat-2 model with filter splash cover is recommend for wet environments.

Contact Radium at (803) 414-4445 for additional details on other models of the Hurricane Hood and the various options.

NOTE: ALL USERS SHOULD READ THESE INSTRUCTIONS PRIOR TO USING THIS EQUIPMENT.

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Safety Guidelines

General Description and Limitations

The Radium Hurricane Hood Cat-3 is a containment and personal cooling system that offers protection from particulates while providing cool flowing air to the head and body. The Hurricane Hood Cat-3 includes the blower assembly, halo assembly with ratchet suspension, filter, filter cap, hood securing ring, hood sealing gasket, power belt, hood, and suit.

A minimum of 10 (AA) size batteries are required for operation. See Sections 3 and 5 for additional information on battery requirements. The proper batteries can be purchased from Radium.

The Hurricane Hood Cat-3 suit is a two piece suit that has a hood and suit sections. It can be manufactured from several materials but is most often provided in PVC. The outer protective suit has reinforced knees and special exhaust vents. It also provides an anchoring surface to secure the Hurricane Hood and helps direct the air from the Hurricane Hood blower to parts of the body for cooling. Contact Radium for more information on their suits.

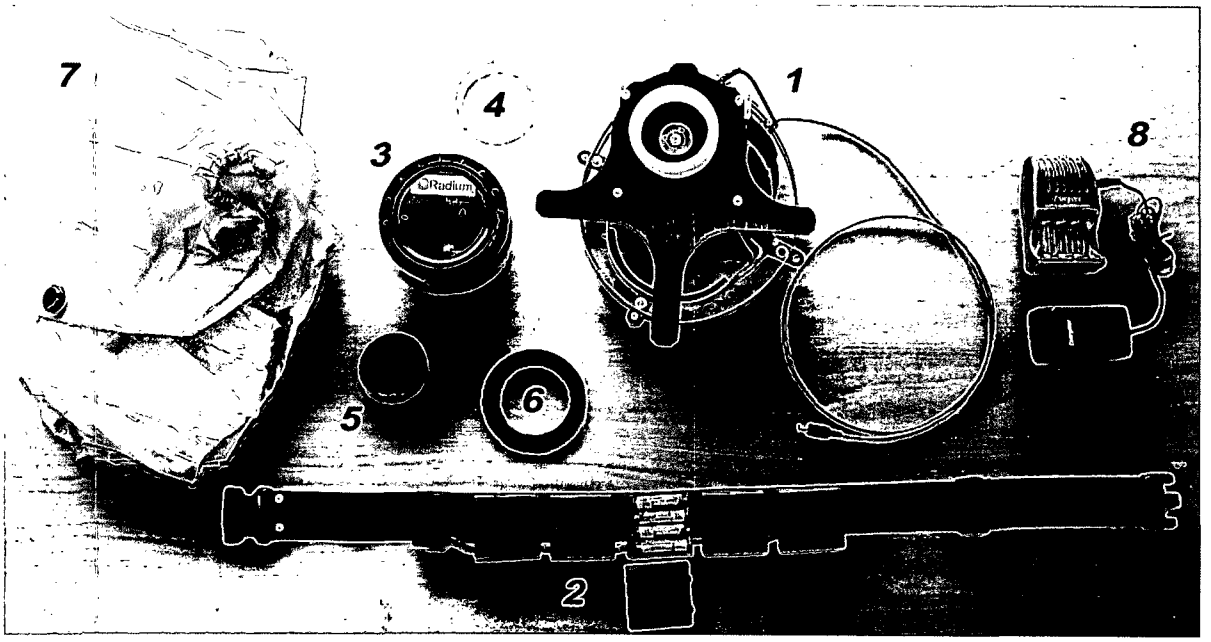
A blower located within the top of the hood assembly draws ambient air through the filter. The air is directed to the front surface of the hood and down into the protective suit where it then exits through the vents in the arms and legs of the suit.

WARNING

Radium's Hurricane Hood Cat-3 helps protect against certain airborne contaminants, such as particulates. DO NOT USE this in atmospheres where the oxygen concentration is below 19.5% or concentrations of contaminants that are unknown; Immediately Dangerous to Life or Health (IDLH). This system has not been evaluated by NIOSH/MSHA as a potential ignition source in flammable or explosive atmospheres. This system has not been tested or approved for intrinsic safety. Misuse of this product may result in sickness or death.

Equipment

Parts Identification



List of Components

1. Blower Assembly
2. Power Belt with NiMH AA Batteries (10 Minimum)
3. HEPA Filter
4. Hood Securing Ring
5. Filter Cap
6. Hood Sealing Gasket
7. Hurricane Hood CAT-3 Containment Suit
8. Optional- 15 Minute AA Battery Charger Shown (other chargers can be used; refer to battery manufacturer recommendations.)
9. Hurricane Hood Cat-3 Bubble Hood (Not shown for clarity)

Additional Equipment Needed for Operation

1. Duct Tape
2. Small Phillips Head Screwdriver
3. Other protective clothing such as rubber gloves, shoe covers, rubber boots, etc.

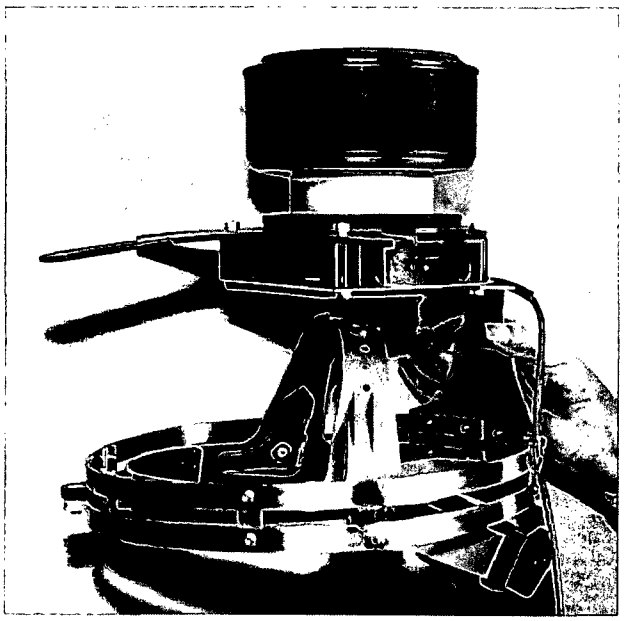
Equipment Inspection and Preparation

Pre-Operation Inspection and Checks

Before each use, examine all components of the Hurricane Hood system for incorrectly fitting parts, damage, or missing fasteners or parts. If any components are missing or damaged, replace them prior to use.

Other checks:

• Test Hurricane Hood Operation by assembling the system with the same components that will be used in the actual operation without the hood and hood securing ring. (Refer to picture below.) Radium recommends that a new filter be used for each use. Power the system ON by connecting the blower power connector to the power belt power port. Ensure the flow is adequate for use and that no flow or low power alarms have been activated.



Testing Configuration

- Examine the hood for any rips or other type of damage.
- Examine the hood sealing gasket and ensure it is not deformed or damaged.
- Examine the blue clevis blocks and ensure they are parallel with the rails. (They rotate)
- Ensure all hardware is tight and secured in place.
- Examine power belt for damage.
- Repair or replace any damaged components.

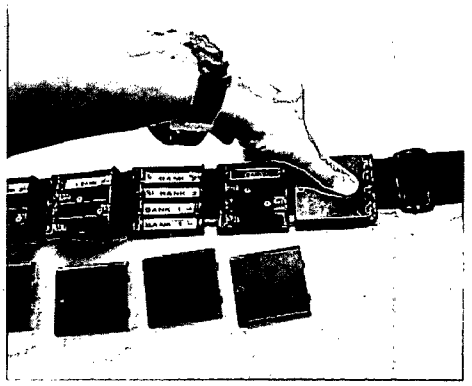
Charging Batteries

Radium provided NiMH batteries are not charged when shipped. Charging could take 15 minutes to 12 hours depending on the type of battery charger purchased. NiMH do not have a battery memory therefore, they can be charged prior to use in any capacity (drained to full) to ensure batteries are fully charged and ready for use.

Equipment Inspection and Preparation

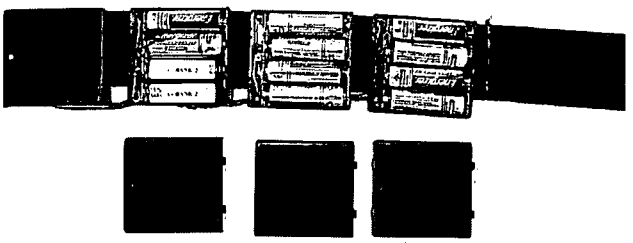
Install Batteries (See Section 5 for information on the type of batteries)

Place the power belt on a table with battery compartments facing up. If installed, remove cover locking screws and place them aside. Look for the thumb ridges on the battery compartment covers and push the cover to the left at the thumb ridges as shown below.



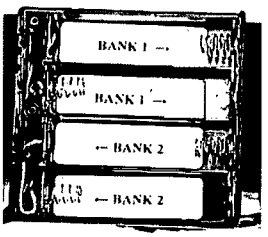
Removing Battery Compartment Cover

Install the fully charged NiMH batteries in Bank 1 or Bank 2 or both depending on the desired operation duration. Ensure batteries are seated properly in each slot and that the electrical conductors make contact with the battery end. Each bank takes 10 batteries.



Batteries Installed in Bank 1

The center battery compartment is used for BOTH Banks 1 and 2. Install batteries as indicated inside the battery compartment (picture shows typical configuration).



Center Battery Compartment

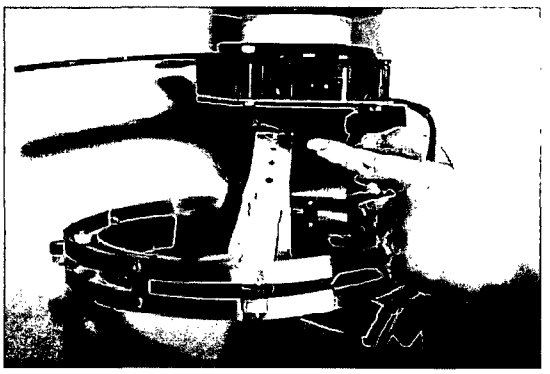
Reinstall battery covers by sliding them into place. If desired, secure the covers in place but reinstalling the locking cover screws. Installing the locking cover screw is recommended to ensure the cover does not come off during rough operations.

Assembly And Donning

Note: Donning of equipment requires a minimum of 2 people, the user and the assistant.

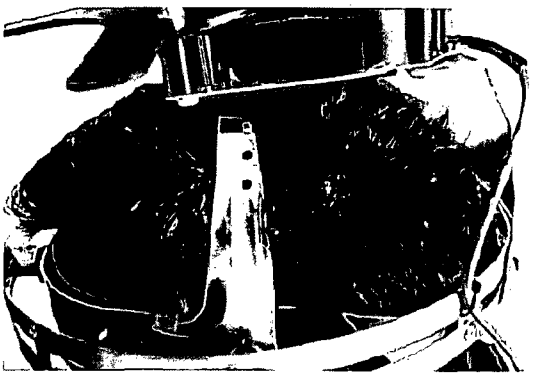
Head Height Adjustment

The head height should be adjusted to the users head to ensure the Hurricane Hood properly sits on the user's head.



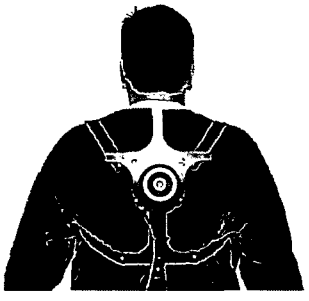
Adjustment Strap

NOTE: If the user is going to wear an under-the-hard-hat type intercom headset, then the user should first install the headset and adjust it so it does not interfere with the Hurricane Hood position. The Velcro strap on the headset can be actually be used to assist in securing the Hurricane Hood into position by installing it as shown in this picture.



Headset Strap over the Adjustment Strap

It is not recommended to use any other type of intercom headset than an under-the-hard-hat type headset, as it could interfere with the Hurricane Hood operation and placement on the head. As shown below, the Hurricane Hood Cat-2 can be used with any type of intercom headset since it is mounted to your back. Contact Radium for a CAT-2 conversion kit or for more information.



For Information Only

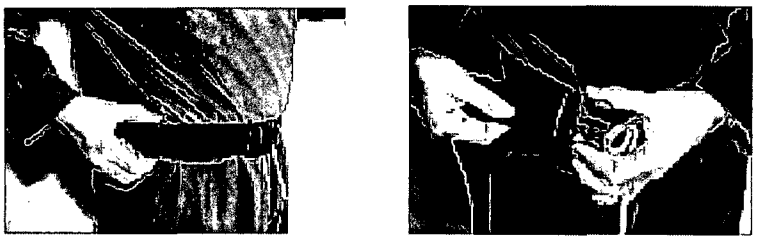
Cat-2 Model

Assembly And Donning

Donning the System

With charged batteries installed, adjust the power belt to fit securely around the waist.

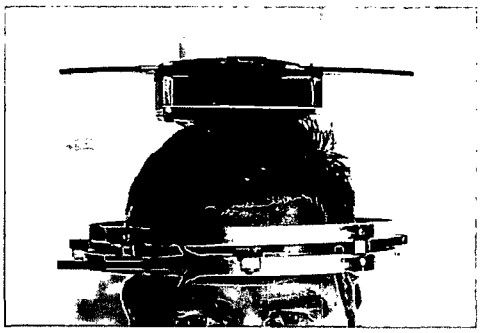
NOTE: If desired, the power belt can be sleeved in 4" poly to protect it from any contaminates and secured around the waist of the OUTER protective suit. This also provides an easy method of changing out power belts without undressing.



Power Belt Adjustment (Type 1 and 2 Belts)

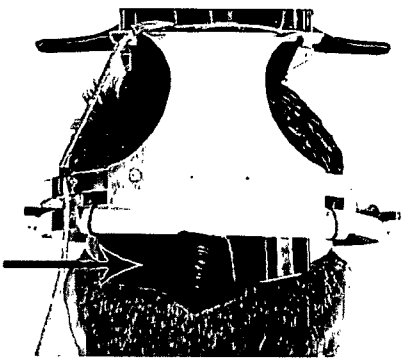
Don the outer protective suit up to the waist and put on any protective foot protection.

Place the blower and halo band assembly on the head and position it with the front halo band roller in the center front of the head as shown below.



Center Roller Location

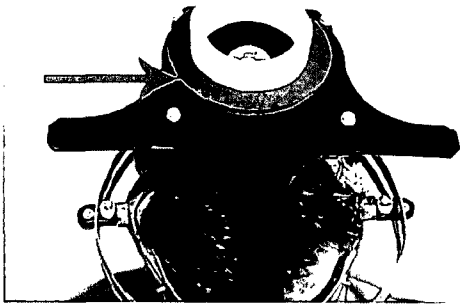
Adjust the ratchet strap to ensure snug fit on the user's head.



Ratchet Adjustment

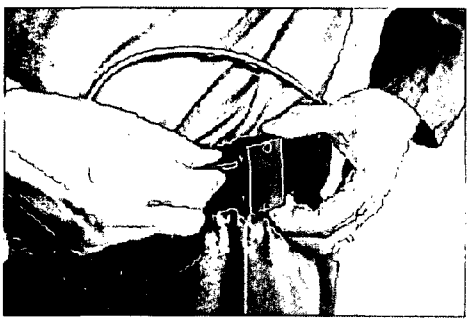
Assembly And Donning

If not already installed, install the hood sealing gasket.



Installed Hood Sealing Gasket

Connect the blower power connector to the power belt by inserting the connector into the power jack and **align the two keys on the connector then turn the connector a quarter turn to lock** the connector in place. Take the slack cable and wrap it around the power belt. The blower should be running. If not, go to the Equipment Inspection and Preparation Section to troubleshoot problem.



Align Connector - Twist to Lock

Suit Size Selection

When selecting a suit size, it is important to have the correct size suit. The Hurricane Hood CAT-3 relies on the suit to anchor the hood and blower in place by applying tape from the outer hood bib to the suit. If you are using a CAT-3 suit without integrated shoe covers, it is also important that the suit ankle area is securely taped to the shoe covers. A loose fitting suit or poorly secured hood could allow for excess movement (wobbling) of the blower unit.

Assembly And Donning

Unfold and open up the hood. Install the hood with the clear PVC seam facing the back of the head. Align hood cutout with the filter adaptor hole. Complete dress-out of the user by inserting the inner hood bib in the protective suit and apply tape to the areas shown here:

Securing the hood in place as shown above is VERY IMPORTANT! Besides acting as containment for the user, the hood also anchors the Hurricane Hood to the top of the users head by applying duct tape around the outer bib and from the outer bib to the protective suit. An alternate way to secure the hood to the suit, is to tape an "X" from the thighs, over the shoulders to the back of the opposite leg. Also, applying tape to the outer bib on the shoulders is helpful. DO NOT APPLY excess tape on suit that may restrict exhaust vents!

Complete the dress-out process.

Install the Hood Securing Ring around the filter adaptor. Screw the filter in place until it is fully seated on the filter adaptor. **DO NOT OVERTIGHTEN!** The Hood Securing Ring is clear to provide the inspection of the sealing surfaces.

Screw Filter in place until it is snug and fully seated.

The user is ready to go to work.

Operation

Normal Operation - Battery Capacity Alarm

The Hurricane Hood blower will operate normally until the battery bank(s) capacity drops to a low level (See chart below). At approximately the levels indicated below, a constant tone alarm with the red warning light on the halo band will activate warning the user that he or she has approximately 15 minutes of operation remaining to safely leave the work area and remove the hood/suit.

If at **anytime** during operation of the Hurricane Hood, the user feels that the blower is not providing enough air, the user should leave the area immediately and remove the hood/suit.

NOTE: DO NOT leave a user in a hood without power!

Operation duration has been tested using the following batteries: (Note: Age of batteries and the number of cycles the batteries have been used can affect the durations noted below.)

* Battery Type	1 Battery Bank	2 Battery Banks
Energizer NiMH 2500 mAh AA Batteries	3 Hours	6 Hours
Energizer NiMH 2300 mAh AA Batteries	2.75 Hours	5.5 Hours
Energizer NiMH 2000 mAh AA Batteries	2.5 Hours	5 Hours

*Radium recommends the batteries listed above. Other batteries such as NiCads, alkaline, other NiMH batteries should be tested prior to use to know duration limitations. Our testing has determined that not all same capacity NiMH batteries will operate as well as the Energizer brand and some brands operate at LESS THAN 50% the duration of the Energizer brand.

Note: Added options such as Radium's wireless cameras and LED lights will reduce operation durations. Contact Radium for more information.

Filter - Low Flow Alarm

Hurricane Hoods are equipped with a low air flow alarm. If during operation an intermittent alarm is sounded with the flashing red warning light on the halo band, leave the area immediately and remove the suit. The intermittent alarm warns the user a significant obstruction of air flow has occurred (possible high particulate loading of the HEPA filter) and the user should take immediate steps to remove the suit.

WARNING

Wearing the Hurricane Hood with little or no blower operation could result in sickness or death. Ensure the user has a means of removing the hood such as using a safety razor knife staged in the work area to cut a large hole in the hood if the need should arise and/or personnel should have established continuous communication with the user where he or she could be assisted immediately if need should arrive to remove the hood quickly.

Undressing and Equipment Removal

Undressing the Hurricane Hood user is very similar to undressing a bubble hood user.

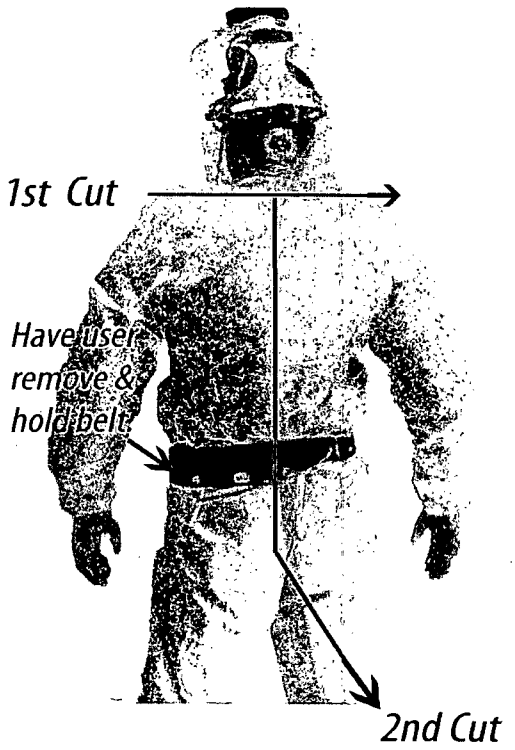
OPTION 1: With the power belt worn underneath the outer plastic protective suit, follow these steps:

1. The person who will be removing the suit should face the wearer's back.
2. Take a cutting utensil such as a safety razor knife and start a horizontal cut at the top of the back outer bib of the hood.
3. Make a second cut vertically starting at the middle of the horizontal cut down to one of the user's feet.
4. Preferably with clean gloves, open up the suit at the cut area and disconnect the power at the power belt and peel the suit off the user while also removing the Hurricane Hood assembly.
5. The user exits the area.
6. Radiation Protection can now go in the radioactive contamination zone and unscrew filter from the blower unit.
7. Remove the hood securing ring and set it aside for decontamination.
8. Preferably with clean gloves, open up the hood and remove the blower unit.

OPTION 2: With the power belt worn over the outer plastic protective suit, follow these steps:

Follow the same procedure above except have the wearer hold the power belt **with power still connected** until the suit is removed.

All equipment is reusable if in good working order except for the PVC hood. Equipment should be decontaminated as necessary.



Equipment Decontamination and Storage

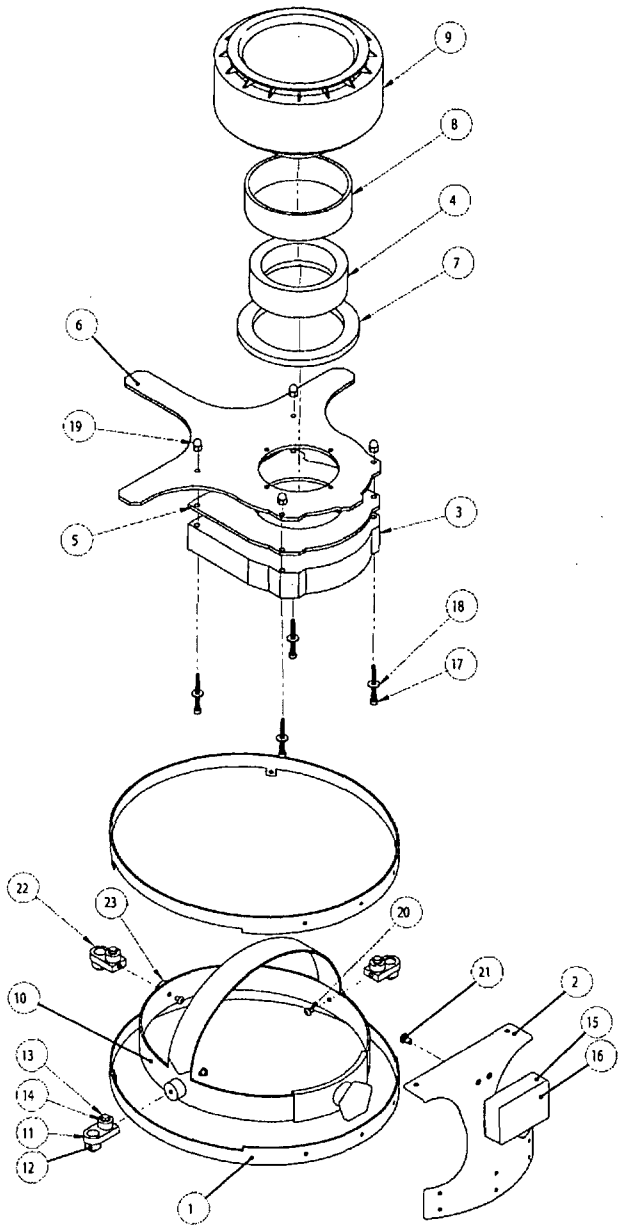
Equipment can be wiped down with a water and mild soap using a towel or rag. Do not spray any cleaning fluid directly on any electrical components or filters.

Storage and Shelf Life:

Store all equipment in an environmentally controlled area for a long serviceable life.

PVC suits shelf life range from 2-3 years depending on temperature stored. If you feel a residue on any suits, this could be an indication that the plasticizers are breaking down and the suit should be discarded.

Replacement Parts



Note: Some fasteners are not shown for clarity.

ID	Part Description	Part No.	QTY
1	Halo Band Support	5006023-1	2
2	Blower Support	5006023-2	1
3	Blower	5006023-3	1
4	Filter Adaptor	5006023-4	1
5	Blower Gasket	5006023-5	1
6	Spider Ring	5006023-6	1
7	Hood Seal	5006023-7	1
8	Filter Adaptor Sleeve	5006023-8	1
9	HEPA Filter	5006023-9	1
10	Head Harness	5006023-10	1
11	Clevis Block - Side Type	5006023-11	2
12	Roller	5006023-12	6
13	Roller Pin	5006023-13	6
14	C Clip	5006023-14	6
15	J-Box	5006023-15	1
16	PCB (internal)	5006023-16	1
17	#6-32 SHCS Nylon	5006023-17	4
18	#6 SS Washer	5006023-18	4
19	Acorn Nut #6-32	5006023-19	4
20	#6-32 PHCS	5006023-20	3
21	#6-32 PHCS	5006023-21	1
22	Clevis Block -Front Type	5006023-22	1
23	Rubber Washer	5006023-23	1
NS	Power Belt	5006023-1	1
NS	CAT-3 Hood	5006001	A/R
NS	Cat-3 Suits	Contact Radium	A/R
NS	NiNH Battery Charger - 15 Min	Contact Radium	A/R

NS- Not Shown; A/R - As Required

Troubleshooting

Troubleshooting

Use the following guide to help to identify and remedy possible problems:

Problem	Probable Cause	Corrective Action
Reduced airflow	Discharged batteries	Replace batteries with fully charged batteries
	Filter clogged	Replace filter
	Blower motor failure	Contact Radium Technical Service
No Airflow	Batteries discharged	Replace batteries with fully charged batteries
	Missing batteries in power belt	Check battery compartments
	Batteries not installed properly or not seating properly with metal contacts in battery holder	Check battery compartments and battery seating
	Electrical connector is damaged	Inspect connector for damage
	Blower motor failure	Contact Radium Technical Service
Rotation of the suspension system is not smooth	Ensure the blue clevis blocks are NOT rotated out of position in the rail	Rotate the clevis blocks back into parallel position with the rail and tighten securing screw, if necessary.
Short operation duration	Batteries are not charged fully	Charge batteries
	Low capacity batteries	Replace batteries with high capacity batteries
	Rechargeable batteries are at end of life	Test batteries and replace batteries that do not hold a stored charge > 1 VDC

Technical Support

Technical Support

For Technical Support, Spare and Replacement Parts, contact Radium:

Phone: 1-803-414-4445
Fax: 1-803-753-0067
Email: TechnicalSupport@radiuminc.com

Radium Incorporated
Attn: HH Technical Support
435 Essex Ave. STE 7
Waynesboro, VA 22980

Radium™

HURRICANE HOOD™

CATEGORY-2 (CAT-2)

Version 2 -
OWNERS MANUAL

Radium Incorporated, 435 Essex Ave., STE 7, Waynesboro, VA 22980; 803.414.4445

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103107

Introduction to Radium's Hurricane Hood Cat-2 Model

Thank you for purchasing Radium's Hurricane Hood Cat-2. The Hurricane Hood Cat-2 was designed as a personal cooling and containment system that provides ample air without hoses or airlines for today's nuclear power workers. For decades, nuclear workers had no choice but to use personal protection products that made it difficult to breathe, were obstructive to use, and created an extremely hot and stressful environment to work. The Hurricane Hood Cat-2 gives you the mobility of a powered air visor with better air flow than a bubble suit...the best of both worlds!

Radium's Hurricane Hood Cat-2 is more than just a personal containment system that provides ample air. The Hurricane Hood line of products provides options such as miniature wireless color cameras, wireless communications, LED lights, and a new Hydration Pack. When you purchased a Hurricane Hood, you have purchased a modular platform that can be configured for numerous jobs. Typical uses include Control Rod Drive Maintenance, Steam Generator Platform Support Workers, and Reactor Cavity Decontamination Workers. Virtually any job that requires personal protection from radioactive contamination and added cooling and/or hydration will benefit from using a Hurricane Hood.

Contact Radium at (803) 414-4445 for additional details on other models of the Hurricane Hood and the various options.

NOTE: ALL USERS SHOULD READ THESE INSTRUCTIONS PRIOR TO USING THIS EQUIPMENT.

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Safety Guidelines

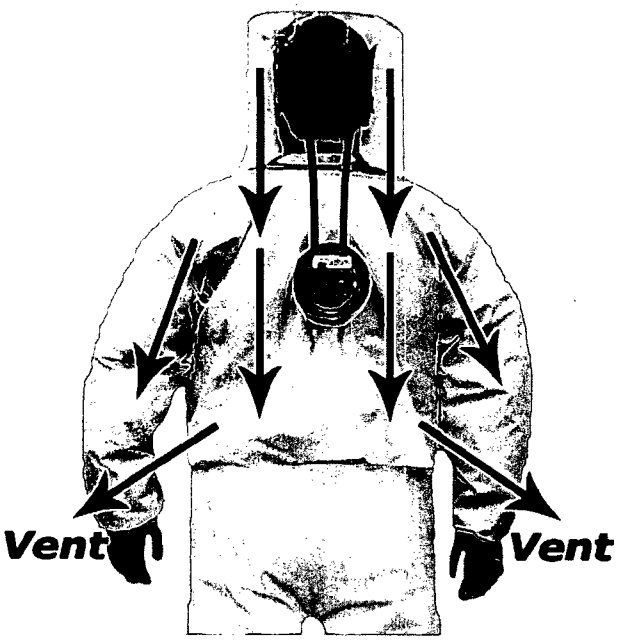
General Description and Limitations

The Radium Hurricane Hood Cat-2 is a containment and personal cooling system that offers some protection from particulates while providing cool flowing air to the head and body. The Hurricane Hood Cat-2 includes the blower assembly, back pack, filter, filter cap, suit securing ring, suit sealing gasket, power belt, and Hurricane Hood Cat-2 suit with integrated bubble hood.

The Hurricane Hood Cat-2 suit is a two piece suit that has a top (or jacket) and bottom (or pants) sections. It can be manufactured from several materials but is most often provided in PVC. The vinyl hood is attached to the top section and has the filter access hole for the blower on the back. The pants are provided with each suit but are optional to wear.

A minimum of 10 (AA) size batteries are required for operation. See Sections 3 and 5 for additional information on battery requirements. The proper batteries can be purchased from Radium.

A blower located on the wearer's back draws ambient air through the filter. The air is directed into the hood from the back and down into the suit where it exits through vents located on the sides of the top section of the suit.

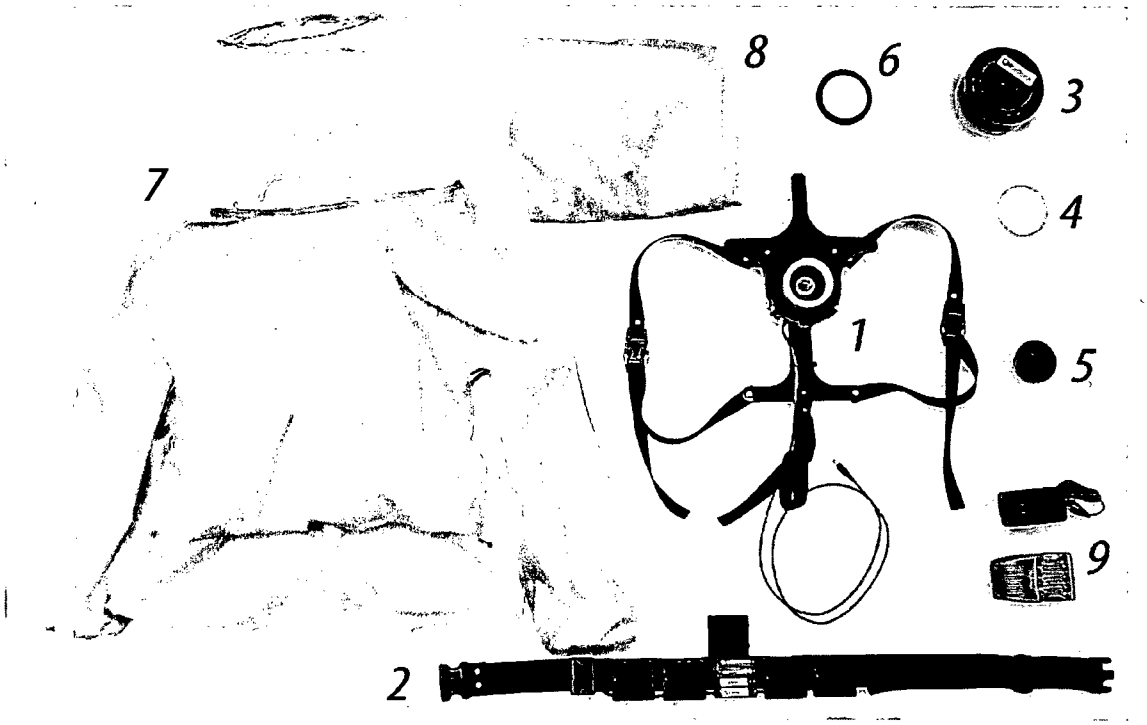


WARNING

Radium's Hurricane Hood Cat-2 helps protect against certain airborne contaminants, such as particulates. DO NOT USE this in atmospheres where the oxygen concentration is below 19.5% or concentrations of contaminants that are unknown; Immediately Dangerous to Life or Health (IDLH). This system has not been evaluated by NIOSH/MSHA as a potential ignition source in flammable or explosive atmospheres. This system has not been tested or approved for intrinsic safety. Misuse of this product may result in sickness or death.

Equipment

Parts Identification



List of Components

1. Blower Assembly with Back Pack
2. Power Belt with NiMH AA Batteries (10 Minimum)
3. HEPA Filter
4. Suit Securing Ring
5. Filter Cap
6. Suit Sealing Gasket
7. Hurricane Hood CAT-2 Suit - Jacket
8. Hurricane Hood CAT-2 Suit - Pants
9. Optional - 15 Minute AA Battery Charger Shown (other chargers can be used; refer to battery manufacturer recommendations.)
10. Optional Sternum Strap not shown.

Additional Equipment Needed for Operation

1. Duct Tape
2. Small Phillips Head Screwdriver
3. Other protective clothing such as rubber gloves, shoe covers, rubber boots, etc.

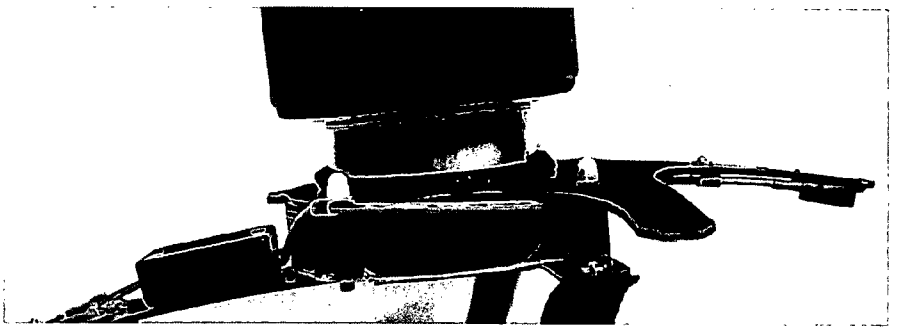
Equipment Inspection and Preparation

Pre-Operation Inspection and Checks

Before each use, examine all components of the Hurricane Hood system for incorrectly fitting parts, damage, or missing fasteners or parts. If any components are missing or damaged, replace them prior to use.

Other checks:

• Test Hurricane Hood Operation by assembling the system with the same components that will be used in the actual operation without the suit and suit securing ring. (Refer to picture below) Radium recommends that a new HEPA filter be used each time the system is donned to ensure optimal performance. Power the system ON by connecting the blower power connector to the power belt power port. Monitor the system for a minimum of 1 minute. Ensure the air flow is adequate for use and no audible alarms have triggered.



Testing Configuration

- Examine the suit for any rips or other type of damage.
- Examine the suit sealing gasket and ensure it is not deformed or damaged.
- Ensure all hardware is tight and secured in place.
- Examine power belt for damage.
- Repair or replace any damaged components.

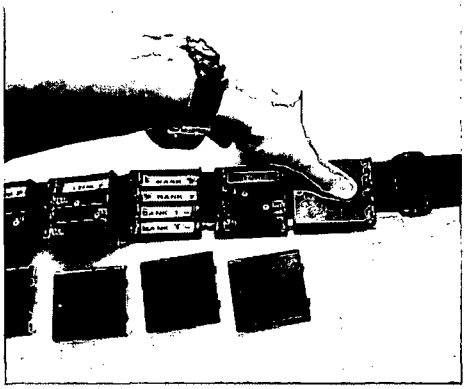
Charging Batteries

Radium provided NiMH batteries are not charged when shipped. Charging could take 15 minutes to 12 hours depending on the type of battery charger purchased. NiMH do not have a battery memory therefore, they can be charged prior to use in any capacity (drained to full) to ensure batteries are fully charged and ready for use.

Equipment Inspection and Preparation

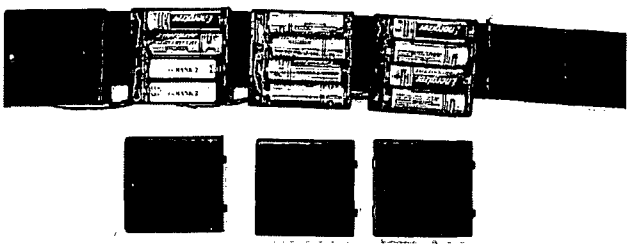
Install Batteries (See Section 5 for information on the type of batteries)

Place the power belt on a table with battery compartments facing up. If installed, remove cover locking screws and place them aside. Look for the thumb ridges on the battery compartment covers and push the cover to the left at the thumb ridges as shown below.



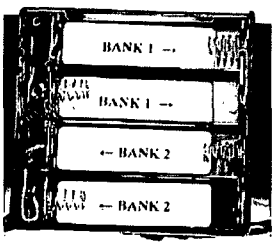
Removing Battery Compartment Cover

Install the fully charged NiMH batteries in Bank 1 or Bank 2 or both depending on the desired operation duration. Ensure batteries are seated properly in each slot and that the electrical conductors make contact with the battery end. Each bank takes 10 batteries.



Batteries Installed in Bank 1

The center battery compartment is used for BOTH Banks 1 and 2. Install batteries as indicated inside the battery compartment (picture shows typical configuration).



Center Battery Compartment

Reinstall battery covers by sliding them into place. If desired, secure the covers in place but reinstalling the locking cover screws. Installing the locking cover screw is recommended to ensure the cover does not come off during rough operations.

Assembly And Donning

Note: Donning of equipment requires a minimum of 2 people, the user and the assistant.

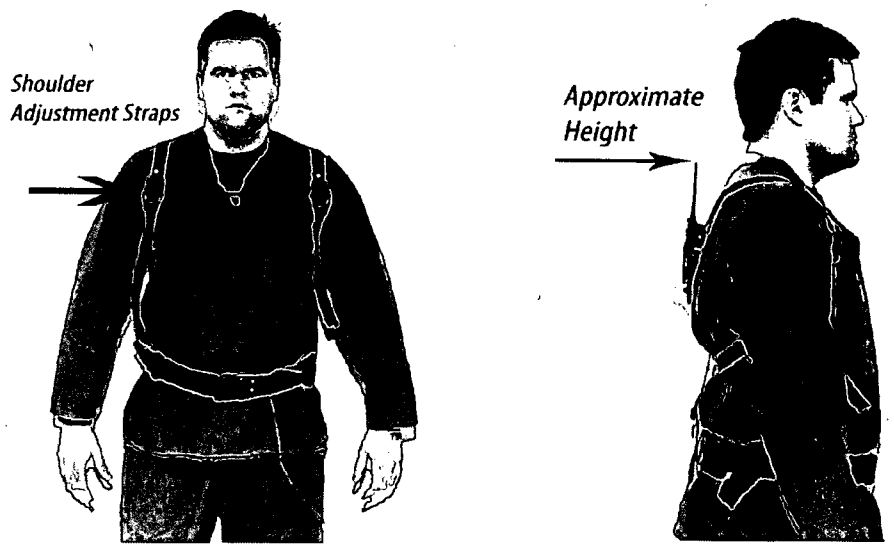
Donning the System

With charged batteries installed, adjust the power belt to fit securely around the waist.

Power Belt Adjustment

Back Pack Adjustment

The back pack blower unit is positioned on the upper back. Use the adjustable shoulder straps to position the unit as shown. Note the height of the blower guard. The top guard should be at the top of the shoulders as shown. The blower guard is used to protect the blower opening. An optional sternum strap can also help with securing the unit in place. Contact Radium for this strap.



Adjustable Shoulder Straps

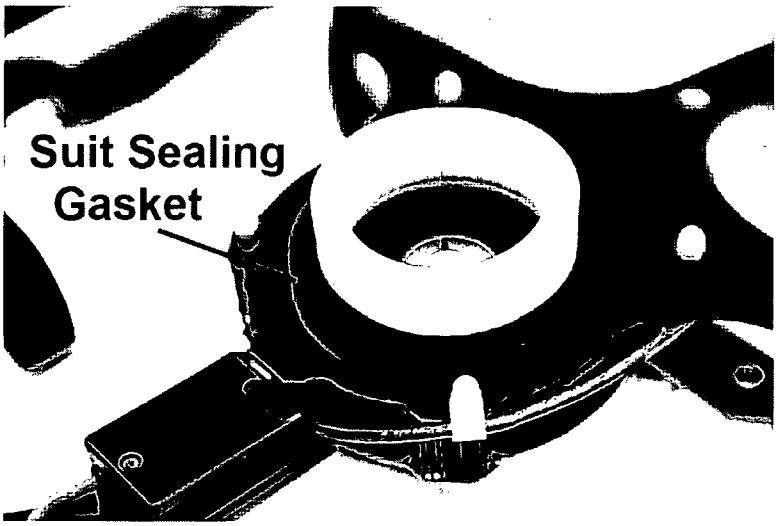
Assembly And Donning

Back Pack Adjustment (continued)

The lower back strap secures the back pack to the power belt. This will ensure that the blower does not move higher on the back when the wear bends over. The strap loops around the belt and clips in place as shown.

Lower Strap Adjustment

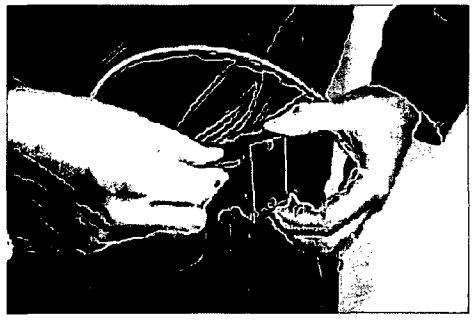
If not already installed, install the suit sealing gasket.



Installed Suit Sealing Gasket

Assembly And Donning

Wrap slack power cable around the power belt. Connect the blower power connector to the power belt by inserting the connector into the power jack and align the two keys on the connector then turn the connector a quarter turn to lock the connector in place. Pull straight back on the connector. The connector should be locked in place and the blower should be running. If not, go to the Equipment Inspection and Preparation Section to troubleshoot problem.

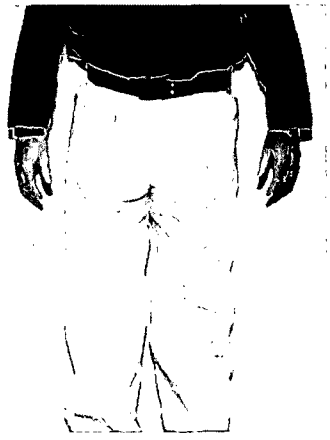


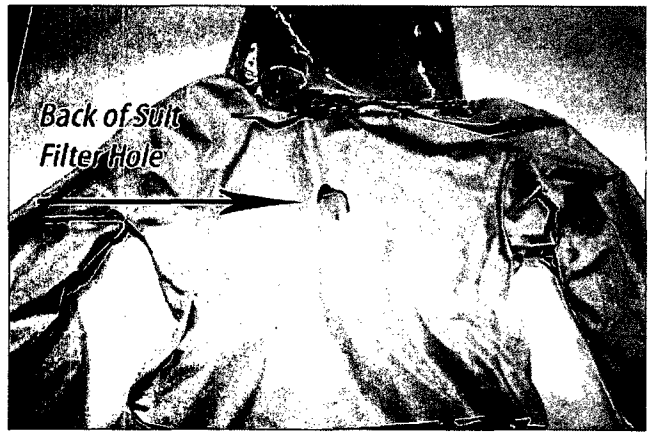
Align Connector - Twist to Lock

Donning the two piece Hurricane Hood CAT-2 suit

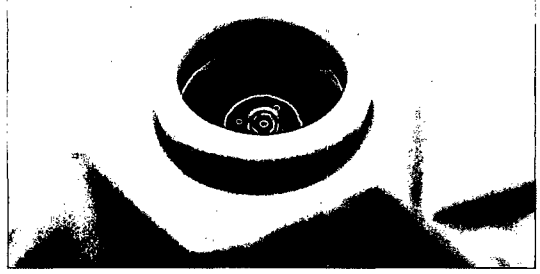
If utilizing the pants, unfold them and put them on as shown below.

Unfold the Hurricane Hood and locate the side with the filter hole. The filter hole is on the back of the hood. Confirm blower is still operating from previous steps. With assistance, place your arms in the sleeves of the hood and lift the hood over your head. Have the assistant help with fitting the hood over the back pack and with locating the hole in the back of the suit to align it with the blower unit as shown.



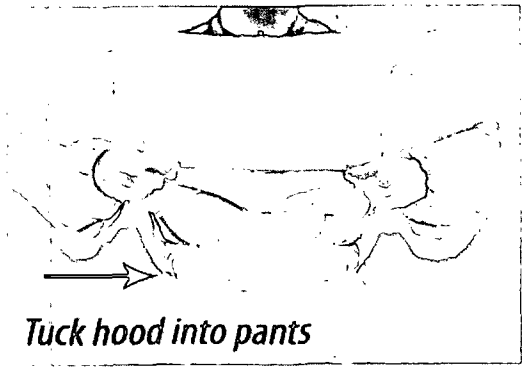


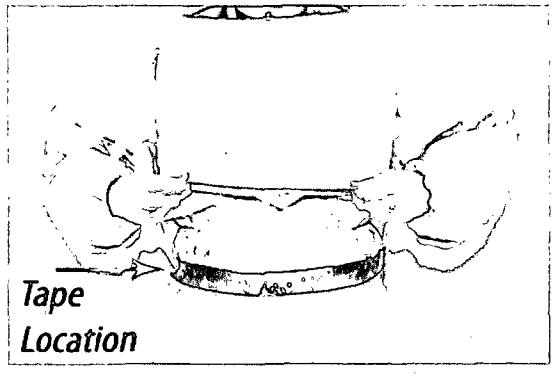
Align filter hole with filter adaptor



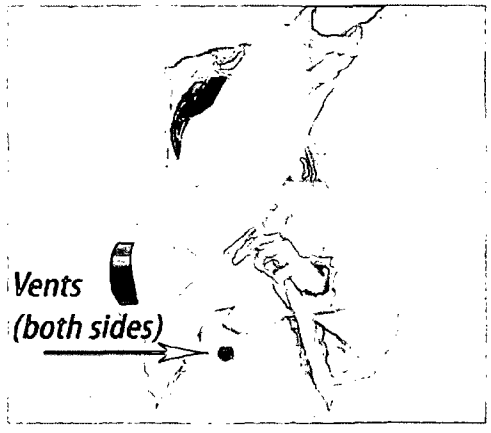
Assembly And Donning

Tuck the inner bib of the hood into the pants and apply tape to the pants and inner bib as shown below. Do not tape the outer hood bib to the pants.

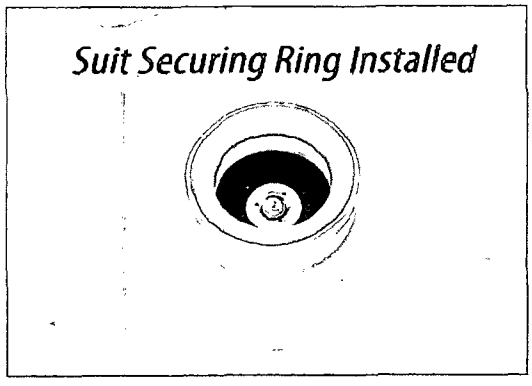


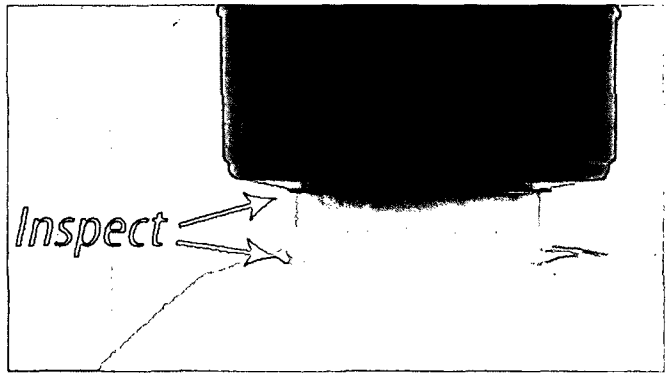


Ensure vents under both arms for the hood are completely open and are not obstructed.



Install the Suit Securing Ring around the filter adaptor. Screw the filter in place until it is fully seated on the filter adaptor. DO NOT OVERTIGHTEN! The Hood Securing Ring is clear to provide the inspection of the sealing surface.





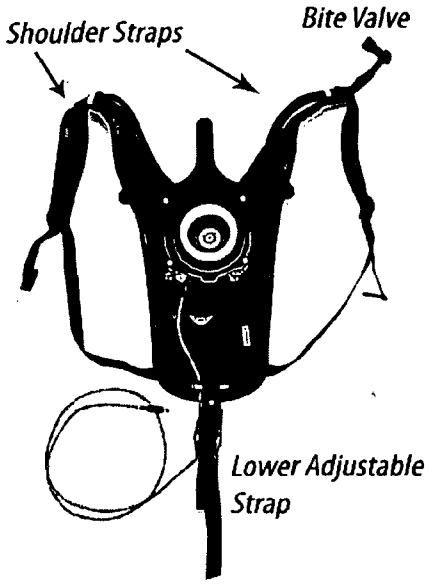
The user is ready to go to work.

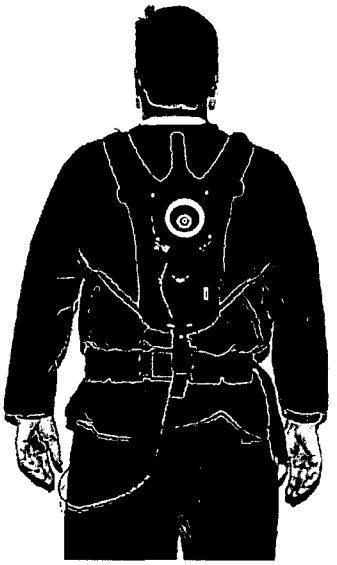
Optional Equipment

Hydration Pack

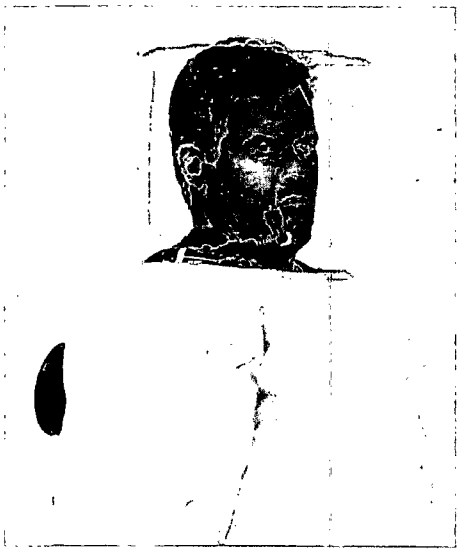
Radium has teamed with Camelbak® to provide the Hydration Pack for the Hurricane Hood CAT-2 model. The Hurricane Hood CAT-2 blower mounts directly to the Hydration Pack. It holds 1.5 liters of water and allows for in-suit hands-free operation.

The Hydration Pack has two adjustable straps for the shoulders and a adjustable strap that loops under the power belt to secure the unit on the wearer. Installation of the pack should be performed as shown.





The Hydration Pack has a special hose that can be formed into a convenient position for the user to drink inside the hood. There is a bite valve that allows the user to drink without using their hands and without spilling water by simply biting on the mouthpiece. Contact Radium for additional details and information on the Hydration Pack.



Operation

Normal Operation - Battery Capacity Alarm

The Hurricane Hood blower will operate normally until the battery bank(s) capacity drops to a low level (See chart below). At approximately the levels indicated below, a constant tone alarm will occur warning the user that he or she has approximately 15 minutes of operation remaining to safely leave the work area and remove the suit.

If at **anytime** during operation the Hurricane Hood, the user feels that the blower is not providing enough air, the user should leave the area immediately and remove the suit.

NOTE: DO NOT leave a user in a hood without power!

Operation duration has been tested using the following batteries: (Note: Age of batteries and the number of cycles the batteries have been used can affect the durations noted below.)

* Battery Type	1 Battery Bank	2 Battery Banks
Energizer NiMH 2500 mAh AA Batteries	3 Hours	6 Hours
Energizer NiMH 2300 mAh AA Batteries	2.75 Hours	5.5 Hours
Energizer NiMH 2000 mAh AA Batteries	2.30 Hours	5 Hours

*Radium recommends the batteries listed above. Other batteries such as NiCads, alkaline, other NiMH batteries should be tested prior to use to know duration limitations. Our testing has determined that not all same capacity NiMH batteries will operate as well as the Energizer brand and some brands operate at LESS THAN 50% the duration of the Energizer brand.

Note: Added options such as Radium's wireless cameras and LED lights will reduce operation durations. Contact Radium for more information.

Filter - Low Flow Alarm

Hurricane Hoods are equipped with a low air flow alarm. If during operation an intermittent alarm is sounded, leave the area immediately and remove the suit. The intermittent alarm warns the user a significant obstruction of air flow has occurred (possible high particulate loading of the HEPA filter) and the user should take immediate steps to remove the suit.

WARNING

Wearing the Hurricane Hood with little or no blower operation could result in sickness or death. Ensure the user has a means of removing the hood such as using a safety razor knife staged in the work area to cut a large hole in the hood if the need should arise and/or personnel should have established continuous communication with the user where he or she could be assisted immediately if need should arrive to remove the hood quickly.

Undressing and Equipment Removal

Undressing the Hurricane Hood user is very similar to undressing a bubble hood user.

Recommended steps:

1. The person who will be removing the suit should face the wearer's back.
2. Loosen the filter one turn but **do not remove it**.
3. Take a cutting utensil such as a safety razor knife and start a vertical cut at the bottom of the filter down to one of the user's feet.
4. With clean gloves, open up the suit at the cut area and peel the suit off the user.
5. Remove the filter and suit securing ring.
6. The user exits the area.

All equipment is reusable if in good working order except for the hood/suit and filter. Equipment should be decontaminated as necessary.

Equipment Decontamination and Storage

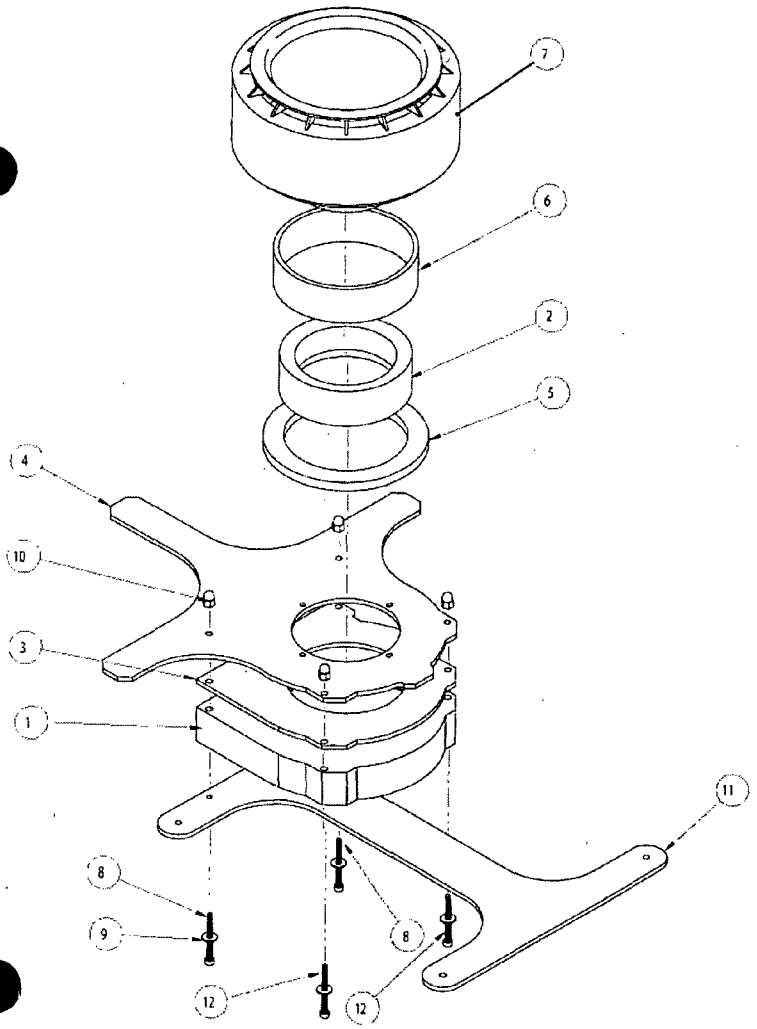
Equipment can be wiped down with water and mild soap using a towel or rag. Do not spray any cleaning fluid directly on any electrical components or filters.

Storage and Shelf Life:

Store all equipment in an environmentally controlled area for a long serviceable life.

PVC suits shelf life range from 2-3 years depending on temperature stored. If you feel a residue on any suits, this could be an indication that the plasticizers are breaking down and the suit should be discarded.

Replacement Parts



Note: Some fasteners and straps are not shown for clarity.

ID	Part Description	Part No.	QTY
1	Blower	5006024-01	1
2	Filter Adaptor	5006024-02	1
3	Blower Gasket	5006024-03	1
4	Spider Ring	5006024-04	1
5	Suit Seal	5006024-05	1
6	Filter Adaptor Sleeve	5006024-06	1
7	HEPA Filter	5006024-07	1
8	Top #6-32 SHCS	5006024-08	2
9	#6 Washers	5006024-09	4
10	Acorn Nut	5006024-10	4
11	CAT-Support	5006024-11	1
12	Bottom #6-32 SHCS	5006024-12	2
NS	Power Belt	5006002	1
NS	CAT-2 Suit	Contact Radium	A/R
NS	NiMH Battery Charger	Contact Radium	A/R

NS- Not Shown; A/R - As Required

Troubleshooting

Troubleshooting

Use the following guide to help to identify and remedy possible problems:

Problem	Probable Cause	Corrective Action
Reduced airflow	Discharged batteries	Replace batteries with fully charged batteries
	Filter clogged	Replace filter
	Blower motor failure	Contact Radium Technical Service
No Airflow	Batteries discharged	Replace batteries with fully charged batteries
	Missing batteries in power belt	Check battery compartments
	Batteries not installed properly or not seating properly with metal contacts in battery holder	Check battery compartments and battery seating
	Electrical connector is damaged	Inspect connector for damage
	Blower motor failure	Contact Radium Technical Service
Short operation duration	Batteries are not charged fully	Charge batteries
	Low capacity batteries	Replace batteries with high capacity batteries
	Rechargeable batteries are at end of life	Test batteries and replace batteries that do not hold a stored charge > 1 VDC

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Technical Support

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