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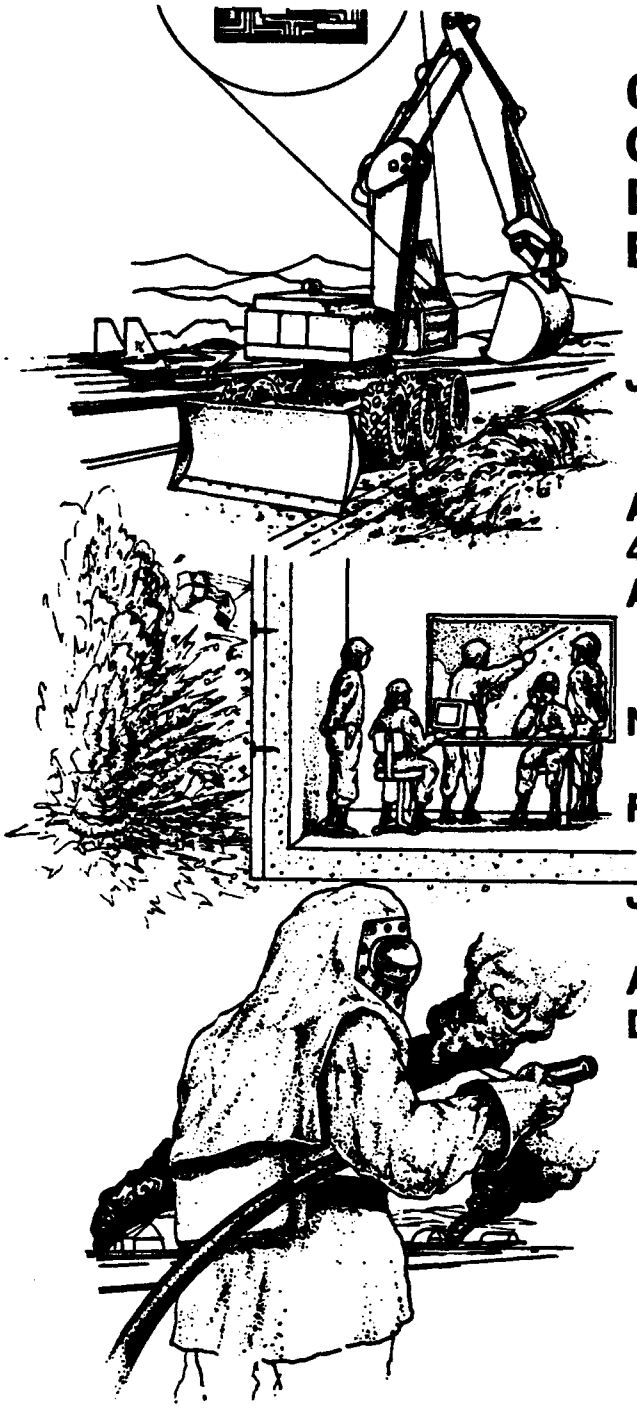

COMBINATION STRUCTURAL/ CRASH FIREFIGHTER HEAD PROTECTION OPERATIONAL EVALUATION

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NOVEMBER 1992

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ENGINEERING RESEARCH DIVISION
Air Force Civil Engineering Support Agency
Civil Engineering Laboratory
Tyndall Air Force Base, Florida 32403

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13. ABSTRACT *(Maximum 200 words)*

This project evaluated a combination structural/crash firefighter head protection system. The system utilized standard structural firefighter helmets, modified with a heat resistant face shield and full head heat shield, similar to crash hoods. The program evaluated these modified helmets for their ability to provide protection against the high radiant heat of a large hydrocarbon fire. Five firefighters, each with a different modified helmet, conducted firefighting operations. Relative heat and comfort were evaluated by the firefighter/evaluators. This program evaluated the firefighter interface and the operational effectiveness and suitability of the system.

Evaluation scores showed that all modified helmets were acceptable, with some improvements required. Overall, these helmets are a big improvement over the Air Force standard crash hood in comfort, weight, visibility, and interface with the SCBA. By incorporating the above recommendation, the Air Force firefighter will have a much improved head protection system, usable in both the structural and crash firefighting scenarios.

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EXECUTIVE SUMMARY

A. OBJECTIVE

The overall objective of this evaluation was to evaluate the comfort and degree of protection afforded by the combination helmet when exposed to the high radiant heat of a large hydrocarbon fuel fire during firefighting operations.

B. BACKGROUND

The Air Force has historically used a structural firefighter's helmet with face shield for structural firefighting and the crash/rescue firefighter ensemble with crash hood for aircraft and fuel fires. Each firefighter therefore has two separate helmets or hoods and uses one or the other as a function of the type fire. A modified face shield and hood have been designed and manufactured to fit the standard structural helmet, that may make it suitable for aircraft and fuel firefighting operations. The shield modification was developed by the U.S. Navy Clothing and Textile Research Facility at Natick, Massachusetts. The helmets evaluated are currently in the Air Force inventory. This program evaluated seven structural helmets, modified by the manufacturers with the new face and hood shields, for suitability in crash firefighting operations.

C. SCOPE

This project evaluated a combination structural/crash firefighter head protection system. The system utilized standard structural firefighter helmets, modified with a heat resistant face shield and full head heat shield, similar to crash hoods. The program evaluated these modified helmets for their ability to provide protection against the high radiant heat of a large hydrocarbon fire. Large hydrocarbon fuel fires of 300 gallons each were conducted in the 100-foot fire test facility. Four firefighters, each with a different modified helmet, conducted firefighting operations. Relative heat and comfort were evaluated by the firefighter/evaluators. One helmet during each fire was instrumented with thermocouples on the forward inside and outside sections to measure and record the temperatures encountered during the exposure. Laboratory tests were previously conducted to confirm the radiant heat protection afforded by the new shields. This program evaluated the firefighter interface and the operational effectiveness and suitability of the system.

D. CONCLUSION

While Helmet # 2, Lite Force IV Helmet by Morning Pride was the high-scoring unit, the scores showed that all modified helmets were acceptable, with some improvements required. Overall, these helmets are a big improvement over the Air Force standard crash hood in comfort, weight, visibility, and interface with the SCBA. By incorporating the above recommendations, the Air Force firefighter will have a much improved head protection system, usable in both the structural and crash firefighting scenarios.

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PREFACE

This report was prepared by the Air Force Civil Engineering Laboratory, Air Force Civil Engineering Support Agency, Tyndall Air Force Base, Florida 32403.

SMSgt Freddie Thompson, AFCESA/DF, was the Project Officer. This evaluation program was completed in support of the USAF Chief of Fire Protection, AFCESA/DF. This report presents the results of the Combination Structural/ Crash Firefighter Head Protection Operational Evaluation Program conducted on 3 June 1992 at Tyndall AFB, Florida.

This report has been reviewed and is approved.

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AFCESA/DFO

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SECTION I

INTRODUCTION

A. OBJECTIVE

The overall objective of this evaluation was to evaluate the comfort and degree of protection afforded by the combination helmet when exposed to the radiant heat of a large hydrocarbon fuel fire during firefighting operations.

Specific objectives are listed in Appendix A.

B. BACKGROUND

The Air Force has historically used a structural firefighter's helmet with face shield for structural firefighting and the crash/rescue firefighter ensemble with crash hood for aircraft and fuel fires. Each firefighter therefore has two separate helmets or hoods and uses one or the other as a function of the type fire. A modified face shield and hood have been designed and manufactured to fit the standard structural helmet, that may make it suitable for aircraft and fuel firefighting operations. The shield modification was developed by the U.S. Navy Clothing and Textile Research Facility at Natick, Massachusetts. The helmets evaluated are currently in the Air Force inventory. This program evaluated seven structural helmets, modified by the manufacturers with the new face and hood shields, for suitability in crash firefighting operations.

C. MEASURES OF MERIT

The measures of merit were the relative comfort and protection afforded an experienced firefighter during actual firefighting operations with a large hydrocarbon fuel fire. Firefighter/evaluators compared the comfort and protection afforded by the combination helmet to their experience base, the crash/rescue hood, normally worn during large fuel firefighting operations.

D. SCOPE

This project evaluated a combination structural/crash firefighter head protection system. The system utilized standard structural firefighter helmets, modified with a heat resistant face shield and full head heat shield, similar to crash hoods. The program evaluated these modified helmets for their ability to provide protection against the radiant heat of a large hydrocarbon fire. Large hydrocarbon fuel fires of 300 gallons each were conducted in the 100-foot fire test facility. Four firefighters, each with a different model helmet, conducted firefighting operations. Relative heat and comfort were evaluated by the firefighter/evaluators. During each fire one helmet was instrumented with thermocouples on the forward inside and outside sections to measure and record the temperatures encountered during the exposure. Laboratory tests were previously conducted to confirm the radiant heat protection afforded by the new shields. This program evaluated the firefighter interface and the operational effectiveness and suitability of the system.

E. AUTHORITY

HQ USAF Program Management Directive (PMD) Number 8028 (9) 64708F (2505), 10 May 1991, Firefighting, Suppression, and Rescue, was the authority for this program. This program was conducted as directed in the PMD and AFR 80-14.

F. ITEM DESCRIPTION

The combination structural/crash firefighter head protection system utilizes standard structural firefighter helmets, modified with heat resistant face shields and radiant heat protection for the back of the head and the side of the face and neck. Seven different models from three manufacturers were evaluated under this evaluation program.

SECTION II

EVALUATION DESCRIPTION

A. INTRODUCTION

This program evaluated combination structural/crash helmets, consisting of standard structural firefighting helmets modified with heat resistant face shields and full head heat protection. Three separate 300 gallon fires were conducted at the AFCESA 100-foot fire test facility in support of this program. A list of the seven modified structural helmet models evaluated are shown in Table 1. Firefighter/evaluators were current operational Air Force Firefighters provided by the Eglin AFB, Florida Fire Department. During each fire, two handline teams, consisting of two firefighters each, a lead firefighter operating the handline and a back-up, attacked the fire using handlines from P-4 and P-19 firefighting vehicles. Each firefighter/evaluator wore the crash/rescue firefighter ensemble (silver suit) and a helmet of a different model. In addition, the Senior Fire Officer (SFO), who directed firefighting operations, also wore a prototype helmet and provided additional evaluation data. One helmet in each fire event was equipped with two thermocouples on the forward interior and exterior sections to measure the representative temperatures encountered.

B. HELMET PERFORMANCE EVALUATION

When all systems were ready, 300 gallons of fuel were pumped into the pit and ignited. After a pre-burn period, the four firefighters attacked the fire with the objective of gaining heat exposure experience, rather than extinguishing the fire. The AFCESA/DF Senior Fire Officer (SFO) directed firefighting operations and functioned as the safety back-up for all fires. The two firefighter teams, wearing helmets of different models, fought the fire using P-4 and P-19 handlines dispensing AFFF. After a suitable evaluation period (3-5 minutes) firefighters withdrew and interviews were completed to record the evaluators subjective impressions of helmet performance.

C. INSTRUMENTATION AND DATA COLLECTION

Instrumentation for this evaluation was limited to one helmet per fire event. Two thermocouples were placed on the forward interior and exterior part of the helmet to record the representative temperatures encountered. A portable data recording unit was attached to the firefighter's back to record the data. These thermocouples measured ambient temperature at the thermocouple location, but did not give an accurate indication of radiant heat present at the helmet. Video cameras recorded evaluation activities. Still photographs were taken of selected events.

Table 1. Prototype Helmets Evaluated

#	Company	Style #
1, 1.1	Cairns & Brother	N660C Metro
2, 2.1	Morning Pride	Lite Force IV Helmet
3	Cairns & Brother	Style 692
4, 4.1	Morning Pride	Lite Force V Helmet
5, 5.1	Safeco	911 - certified model
6, 6.1	Cairns & Brother	Style N660DD
7, 7.1	Cairns & Brother	660CN-Mark/2

SECTION III

EVALUATION RESULTS

A. GENERAL

This evaluation program was conducted as described in Section II, Evaluation description. Three 300-gallon JP-4 fires were conducted in the AFCESA 100-foot fire test facility in support of this evaluation. Weather conditions during these fires were as follows:

FIRE EVENT	WIND	COMMENTS
1	East/5 mph	
2	South/10 mph	Rain
3	Southeast/8 mph	Light rain

The results of this evaluation are presented in the following paragraphs. Evaluation data are contained in Table 2.

B. HELMET PERFORMANCE EVALUATION

After each fire event was completed, firefighter/evaluators completed questionnaires answering the following questions:

1. Was the helmet comfortable to wear all during the test?
2. Did the helmet provide the necessary heat protection?
3. Did the helmet restrict your forward vision?
4. Did the helmet restrict your total field of vision or ability to conduct firefighting operations?
5. Did the helmet interfere with your SCBA mask or breathing capability?
6. Did the helmet unnecessarily interfere with your hearing?
7. What is your overall opinion of the helmet for use in general firefighter operations?

Each question was scored on a 1-10 scale with 10 depicting the perfect helmet and a score of 5 being the nominal score, based on the firefighter's experience. Each helmet was evaluated by one to three evaluators. The results of this numerical evaluation are contained in Table 2. Subjective comments were also recorded with these questionnaires. These comments are summarized in the recommendations paragraph of the following section.

Temperature profiles on the lead firefighter for fire events one and two are contained in Figures 1 and 2. The peak temperature encountered was approximately 190°F.

Table 2. Structural/Crash Helmet Performance Data

EVALUATION DATE: June 3, 1992

			QUESTIONS								
			1	2	3	4	5	6	7		
HELMET NUMBER	EVALUATOR	FIRE EVENT	COMFORT	HEAT PROTECT	VISION FWD	VISION FIELD	SCBA	HEARING	OVERALL	TOTAL SCORE	AVG. SCORE
2	PAVLIK	2	9	8	9	9	5	8	8	8.0	8.21
2	SMITH	3	8	10	9	7	10	7	8	8.4	
1.1	ARBUCKLE	1	6	5	8	8	8	8	8	7.3	7.43
1	ARBUCKLE	2	7	6	8	8	8	8	8	7.6	
1.1	THOMPSON	3	5	8	8	6	8	8	9	7.4	
7.1	SMITH	1	9	8	8	8	10	6	8	8.1	7.36
7.1	POWELL	3	8	3	5	8	9	5	8	6.6	
3	THOMPSON	2	10	8	10	10	10	8	9	9.3	7.07
3	PAVLIK	3	7	3	6	6	3	5	4	4.9	
4.1	POWELL	2	8	4	7	7	8	5	8	6.7	6.71
5	POWELL	1	7	4	10	7	6	5	8	6.7	6.71
6.1	PAVLIK	1	5	3	8	4	5	5	6	5.1	6.86
6.1	SMITH	2	6	7	8	8	10	7	8	7.7	
6.1	ARBUCKLE	3	9	4	8	8	8	9	8	7.7	

#	Company	Style #
1, 1.1	Cairns & Brother	N660C Metro
2, 2.1	Morning Pride	Lite Force IV Helmet
3	Cairns & Brother	Style 692
4, 4.1	Morning Pride	Lite Force V Helmet
5, 5.1	Safeco	911 - certified model
6, 6.1	Cairns & Brother	Style N660DD
7, 7.1	Cairns & Brother	660CN-Mark/2

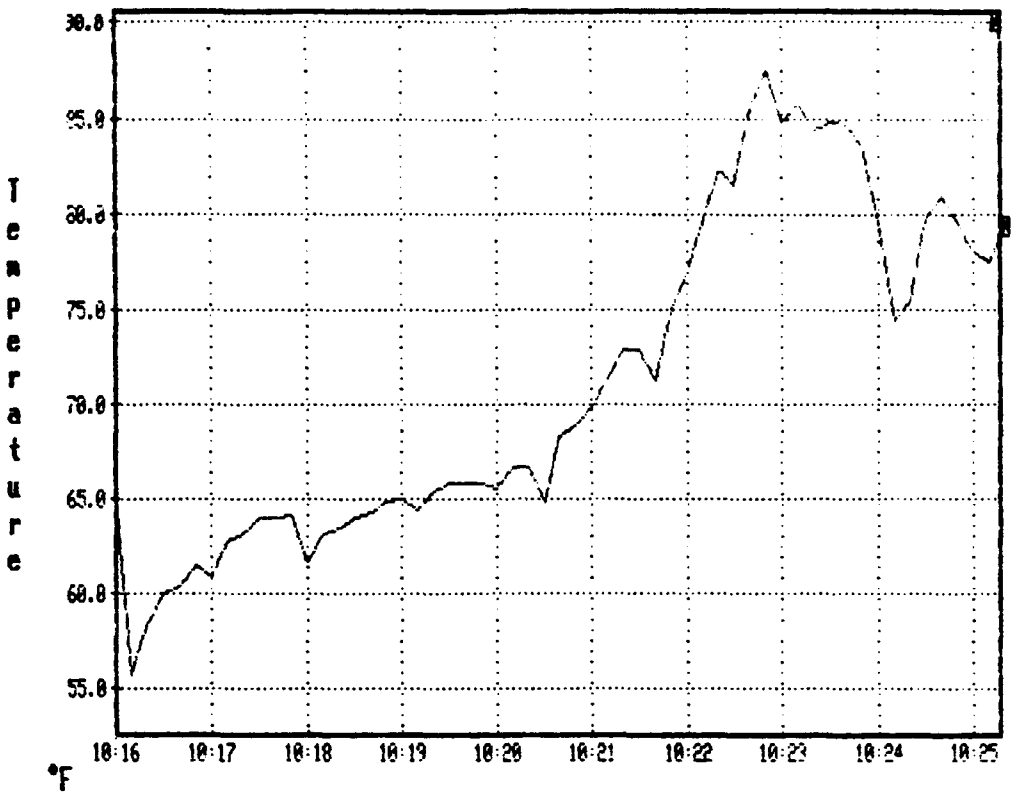

Figure 1. Fire Event 1 - Inside Helmet Temperature

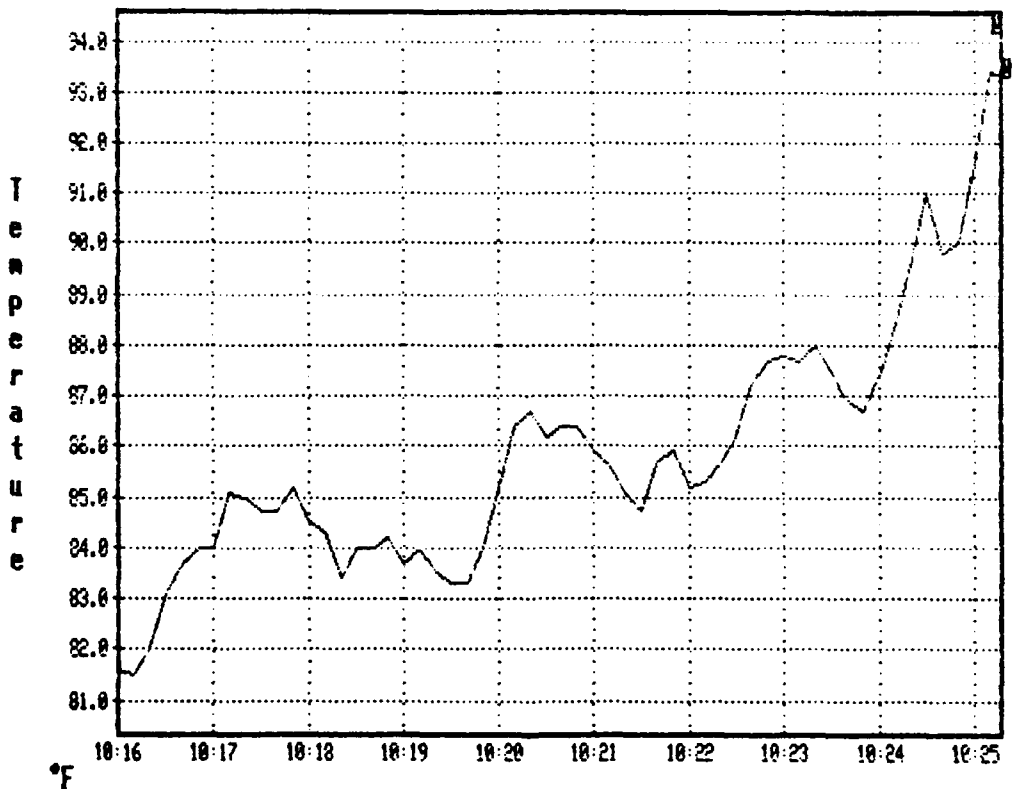

Figure 2. Fire Event 1 - Outside Helmet Temperature

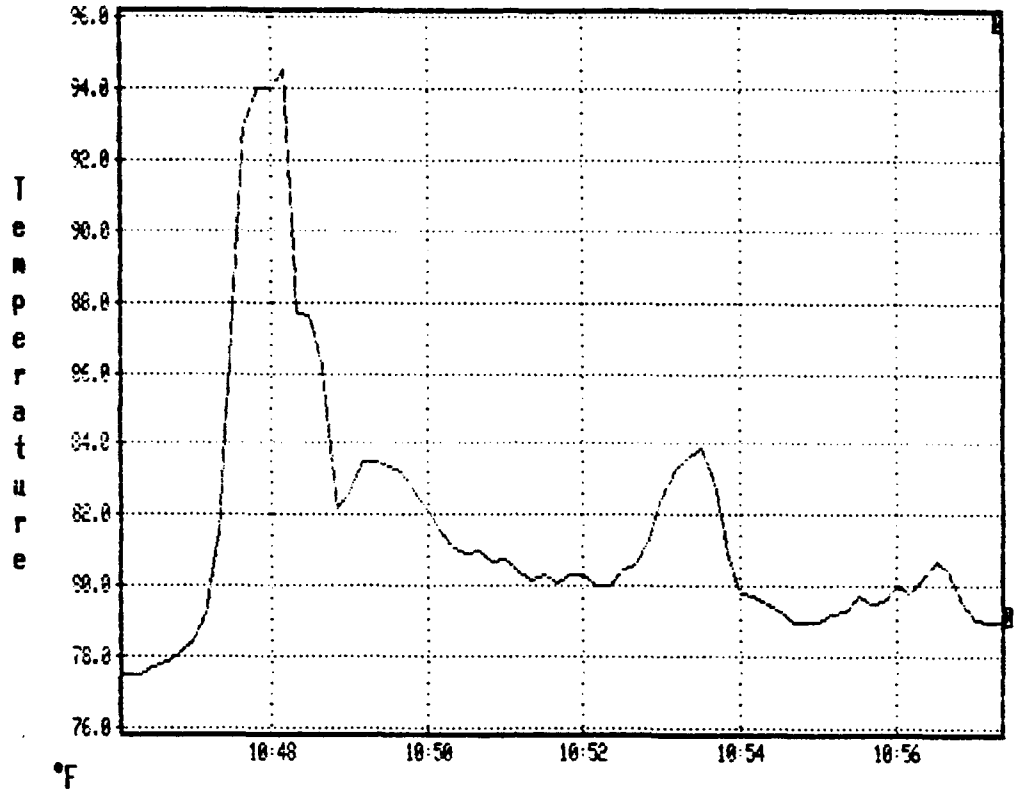

Figure 3. Fire Event 2 - Inside Helmet Temperature

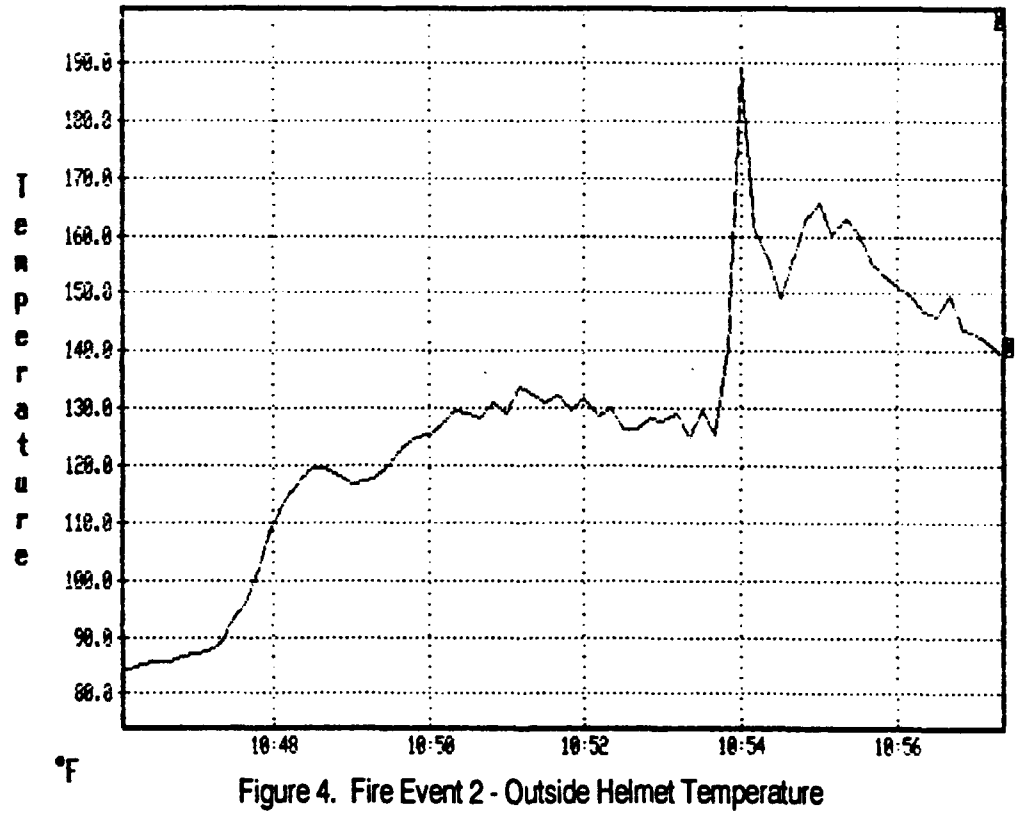

Figure 4. Fire Event 2 - Outside Helmet Temperature

SECTION IV

RECOMMENDATIONS AND CONCLUSIONS

A. RECOMMENDATIONS

Following are the summarized recommendations of the firefighter/evaluators that evaluated the seven modified helmets during these three firefighting events. These comments apply to all models tested and should be incorporated into any combination structural/crash helmet procured for Air Force firefighting operations.

1. Incorporate a longer bubble-shaped face shield to provide better heat shielding from below. Any new shield for the modified helmets must be compatible with the new generation SCBA for CW defense.

2. Use a Kevlar ear protection/chin strap, as used on helmet # 7, model 660CN-Mark/2 from Cairns & Brother.

3. Use a large buckle on the helmet chin strap, as used on helmet # 7, model 660CN-Mark/2 from Cairns & Brother.

4. Use a Dial-a-size head band adjuster.

5. The gold plating on the face shield flakes off on all models evaluated. If this cannot be corrected, recommend that an easily replaceable throw-away gold shield cover be provided.

6. Provide a close-fitting/no-gap fit for the silver shield around the SCBA mask. An elastic or velcro band may provide a closer fit.

7. Attach the wrap-around silver shield (rain cover) to the under side of the helmet. There is no need to cover the top of the structural helmet with this silver shield. This rain cover is an optional item.

B. CONCLUSIONS

While Helmet # 2, Lite Force IV Helmet by Morning Pride was the high-scoring unit, the scores showed that all modified helmets were acceptable, with some improvements required (see rank-ordered scores in Table 2). Overall, these helmets are a big improvement over the Air Force standard crash hood in comfort, weight, visibility, and interface with the SCBA. By incorporating the above recommendations, the Air Force firefighter will have a much improved head protection system, usable in both the structural and crash firefighting scenarios.

APPENDIX A

COMBINATION STRUCTURAL/CRASH FIREFIGHTER HEAD PROTECTION OPERATIONAL EVALUATION TEST PLAN

AIR FORCE CIVIL ENGINEERING SUPPORT AGENCY
Tyndall Air Force Base, Florida 32403

COMBINATION STRUCTURAL/CRASH FIREFIGHTER HEAD PROTECTION OPERATIONAL EVALUATION

29 May 1992

TEST PLAN

This test plan has been reviewed and approved by:

WADE GRIMM
Acquisition Project Officer

RICHARD REID, Capt, USAF
AFCESA SAFETY OFFICER

FREDDIE THOMPSON, SMSgt, USAF
Fire Protection Project Manager

RICHARD N. VICKERS
Chief, Air Base Fire Protection
and Crash Rescue Systems Branch

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SECTION I

INTRODUCTION

A. SCOPE

This project will evaluate a combination structural/crash firefighter head protection system. The system utilizes standard structural firefighter helmets, modified with a heat resistant face shield and full head heat shield, similar to crash hoods. The test program will evaluate these modified helmets for their ability to provide protection against the high radiant heat of a large hydrocarbon fire. Large hydrocarbon fuel fires of 300 gallons each will be conducted in the 100-foot fire test facility. Four firefighters, each with a different modified helmet, will conduct firefighting operations. Relative heat and comfort will be evaluated by the firefighter/evaluators. One helmet during each fire will be instrumented with thermocouples on the forward inside and outside sections to measure and record the temperatures encountered during the exposure. Laboratory tests were previously conducted to confirm the radiant heat protection afforded by the new shields. This test will evaluate the firefighter interface and the operational effectiveness and suitability of the system.

B. BACKGROUND

The Air Force has historically used a structural firefighter's helmet with face shield for structural firefighting and the crash/rescue firefighter ensemble with crash hood for aircraft and fuel fires. Each firefighter therefore has two separate helmets or hoods and uses one or the other as a function of the type fire. A modified face shield and hood have been designed and manufactured to fit the standard structural helmet, that may make it suitable for aircraft and fuel firefighting operations. The shield modification was developed by the U.S. Navy Clothing and Textile Research Facility at Natick, Massachusetts. The helmets being tested are currently in the Air Force inventory. This test program will evaluate seven structural helmets, modified by the manufacturers with the new face and hood shields, for suitability in crash firefighting operations.

C. AUTHORITY

HQ USAF Program Management Directive (PMD) Number 63723F (2104), dated March 1985, provides the authority for this test. This test program will be conducted as directed in the PMD and AFR 80-14.

D. PURPOSE

The purpose of this test series is to evaluate the suitability of combination structural/crash firefighter head protection systems consisting of Air Force structural helmets, modified with high heat resistant face and head shields, for use in crash firefighting operations.

E. TEST ITEM DESCRIPTION

The combination structural/crash firefighter head protection system utilizes standard structural firefighter helmets, modified with heat resistant face shields and radiant heat protection for the back of the head and the side of the face and neck. Seven different models from three manufacturers will be evaluated under this test program.

SECTION II

TEST OBJECTIVES AND MEASURES OF MERIT

A. TEST OBJECTIVES

1. Evaluate the comfort and degree of protection afforded by the combination helmet when exposed to the high radiant heat of a large hydrocarbon fuel fire during firefighting operations.

2. Measure the representative interior and exterior heat experienced at the front of the helmet exposed to a large hydrocarbon fuel fire during firefighting operations.

3. Evaluate the structural integrity of the combination helmet after exposure to high radiant heat.

B. MEASURES OF MERIT

1. The measures of merit are the relative comfort and protection afforded an experienced firefighter during actual firefighting operations with a large hydrocarbon fuel fire. Firefighter/evaluators will compare the comfort and protection afforded by the combination helmet to that provided by the crash/rescue hood, normally worn during large fuel firefighting operations.

2. Specific Measures of Merit are as follows:

a. The helmet shall suffer no deformity when exposed to the high radiant heat levels normally encountered in a large hydrocarbon fire.

b. The aluminum shroud shall suffer no deterioration throughout the test program.

c. The use of the helmet shall have no negative effect on the SCBA or its operation.

C. SPECIFIC QUESTIONS FOR TEST SUBJECTS

1. Was the helmet comfortable to wear all during the test?

2. Did the helmet provide the necessary heat protection?

3. Did the helmet restrict your forward vision?

4. Did the helmet restrict your field of vision or ability to conduct firefighting operations?

5. Did the helmet interfere with your SCBA mask or breathing ability?

6. Did the helmet unnecessarily interfere with your hearing?

7. What is your overall opinion of the helmet for use in general firefighter operations?

SECTION III

MANAGEMENT AND ORGANIZATIONAL RESPONSIBILITIES

A. MANAGEMENT

Overall test responsibility rests with the AFCESA/RACF Test Director. The Test Director will delegate authority, as necessary. Specific responsibilities for safety, instrumentation, photography, and engineering support are listed in the following paragraphs.

B. ORGANIZATIONAL RESPONSIBILITIES

1. HQ AFCESA - The Air Force Civil Engineering Support Agency is responsible for overall test management.

2. AFCESA/RACF will:

   a. Develop, coordinate, and publish a test plan.

   b. Provide the Test Director and Range Safety Officer.

   c. Provide the necessary fire test facilities, fuels, AFFF, instrumentation and data collection systems.

   d. Have overall test authority.

   e. Prepare a test report detailing the test methods and results.

3. AFCESA/RAAE will:

   a. Provide the Acquisition Project Officer.

   b. Provide the test articles.

   c. Coordinate on the test plan.

4. AFCESA/DFO will:

   a. Determine test protocols and temperature limits.

   b. Provide operational firefighters and personal protective equipment to evaluate the helmet.

   c. Provide the Senior Fire Officer to direct the firefighting operations of the test subjects during the program.

   d. Coordinate on the test plan.

SECTION IV

TEST EXECUTION

A. GENERAL

This test program will evaluate combination structural/crash helmets that consist of standard structural firefighting helmets modified with heat resistant face shields and full head heat protection. Two to four separate 300 gallon fires will be conducted at the AFCESA 100-foot fire test facility to support this test program. During each fire, two handline teams consisting of two firefighters each, wearing the crash/rescue firefighter ensemble (silvers) will attack the fire using handlines from P-4 and P-19 firefighting vehicles. All four firefighters will function as evaluators and will be wearing test helmets of different models. The lead firefighter/evaluators will fight the fire using the P-4/P-19 handlines. One helmet in each fire event will be equipped with two thermocouples on the forward interior and exterior sections to measure the representative temperatures encountered.

Firefighters will approach the fire front as close as required to fight the fire within the comfort range of the modified helmets and protective equipment. Firefighter approach and handline operation will be directed by the AFCESA/DF Senior Fire Officer and conducted in accordance with standard firefighting operational procedures. Following each fire exposure, each firefighter will be interviewed by the data collector to record their subjective evaluation of the modified helmet. The temperature profiles encountered will be recorded from the instrumented helmet.

Pretest briefings will be conducted before each fire to evaluate weather conditions, discuss the results of the previous test, verify that all systems are functional, and plan the next fire test. All personnel will be at their assigned locations a minimum of 1 hour before each scheduled ignition time. Individual protective equipment will be worn by all actively involved personnel and will be tested and verified as fully operational before fuel is placed in the pit. All test materials and equipment will be set up and ready for the test a minimum of 1 hour before the scheduled ignition time. Before ignition, the pretest checklist, included at the end of Annex 3, will be completed to ascertain the readiness of all functions. These functions will include, but are not limited to, safety, weather, test pit readiness, and data collections readiness. When all functions are ready, the order to ignite the fuel will be given by the AFCESA Test Director. The fire will not be ignited if the wind exceeds 5 knots.

A backup USAF P-19 or P-4 firefighting vehicle will be manned by AFCESA/RACF personnel and available at the fire test facility for all fires to cover safety contingencies.

Data will be recorded on data sheets provided in Annex 4. All tests will be video recorded.

B. TEST PROCEDURES

Four firefighters will be equipped with firefighter crash ensembles, to include SCBA, for each fire test. Each firefighter will wear a different model of the test combination structural/crash helmet. The AFCESA/DF Senior Fire Officer (SFO), equipped with standard crash firefighter ensemble with crash hood, will direct handline operations and function as the safety back-up for all fires.

When the Test Director confirms that all systems are ready, 300 gallons of fuel will be pumped into the pit. When all systems, personnel, and data recording equipment are ready he will direct ignition. After a 30-second (or less as determined by the SFO) pre-burn period, four fighters will attack the fire from a cross-wind position for a 3 minute period. The two firefighter teams will be wearing test helmets of different models and will fight the fire using P-4 and P-19 handlines dispensing AFFF. After 3 minutes, firefighters will be withdrawn and interviews completed to record helmet performance data. Following data collection firefighter/evaluators will don helmets of different models and evaluate them during a second 300-gallon fire event. The four fighters will again fight the fire for a 3 minute period.

After each fire the test subjects will be interviewed by a data collector to obtain the subjective evaluation of the combination helmet by each firefighter. The temperature profiles encountered will be measured and recorded.

Following the completion of the first two fires, data collection sheets will be scored and helmets will be rank-ordered from best to worst, using the numerical grading criteria shown on the Test Evaluation Sheet contained in Annex 4. If the top scored (best) helmet is not at least 3 points higher that the next best helmet, two additional test fires will be conducted, in accordance with the above test procedures. Firefighters will wear helmets not previously worn during the first two fire tests.

A detailed checklist for large-scale fire pit operations is contained in Annex 3.

C. INSTRUMENTATION AND DATA COLLECTION

1. Instrumentation. During each fire event, one helmet will be instrumented with two thermocouples placed on the forward interior and exterior part of the helmet to record the representative temperatures encountered. The interior thermocouple will be placed on the forward edge of the helmet behind the face shield. A portable data recording unit will be attached to the firefighter's back so as not to encumber his activities. Temperatures from all thermocouples will be recorded with date/time information at 10-second intervals on a portable recording system for later data reduction and analysis. Anticipated temperature ranges are up to 1,500°F for the external thermocouple.

2. Data Collection. All data will be recorded on the data collection sheets contained in Annex 4. Two stationary video cameras will record all test activities. Still camera photographs will be taken of selected events. Test data results do not constitute approval or endorsement for use of the tested product by U.S. Air Force units.

D. TEST LIMITATIONS

1. Fire tests will not be conducted if the wind speed exceed 5 knots.

2. Test firefighters, wearing the combination helmet, will not be exposed to firefighting operations for more than 3 minutes at any one time.

Table 1. Test Helmets

#	Company	Style #
1, 1.1	Cairns & Brother	N660C Metro
2, 2.1	Morning Pride	Lite Force IV Helmet
3	Cairns & Brother	Style 692
4, 4.1	Morning Pride	Lite Force V Helmet
5, 5.1,	Safeco	911 - certified model
6, 6.1	Cairns & Brother	Style N660DD
7, 7.1	Cairns & Brother	660CN-Mark/2

SECTION V

SAFETY

A. GENERAL

Safety is an integral part of the test. The Test Director is responsible for accident prevention. Personnel and equipment safety will take precedence over test execution at all times. Special emphasis will be placed on providing thorough supervision and guidance throughout all test phases. Premission briefings will be conducted daily by the test director detailing the test procedures for the day and emphasizing safety in all test phases.

B. SENIOR FIRE OFFICER

The AFCESA Test Director is ultimately responsible for safety, however, an AFCESA/DF Senior Fire Officer (SFO) will direct all firefighting handline operations associated with this test, and will act as the fire operations Safety Officer. The test will be suspended at any time by the SFO if a safety hazard is observed. Identification of a potential safety hazard will result in test suspension until the hazard can be evaluated and corrected to the satisfaction of the Safety Officer and Test Director.

C. IDENTIFIED HAZARD

An open pit fuel fire, by its very nature, is hazardous. The largest fire planned for this test series will be 300 gallons in the 100-foot fire pit. The approved test plan has been thoroughly examined for safety distance from surrounding objects and found to be well within safe distance limits.

D. SAFETY REPORTING

Accidents, incidents, and serious hazards will be reported in accordance with AFR 127-4 through AFCESA/SEG and HQ 325 FW/SEG. The Safety Officer is responsible for accident/incident reporting.

The Test Director will ensure that all appropriate safety procedures are followed throughout all testing. Testing will be suspended if an event occurs contrary to this checklist. During the actual fire testing, observers will be located a minimum of 300 feet upwind from the edge of the fire pit.

Individual protective equipment will be worn by the test facility operators, the firefighting vehicle operator(s), and the helmet test firefighters.

SECTION VI

ENVIRONMENTAL IMPACT

In accordance with AFR 19-2, Air Force Form 813 has been completed and approved. The determination has been made that this test series qualifies for a Categorical Exclusion 2W. As stated in the Form 813, it is anticipated that all evidence of visible smoke will be dispersed within two hours. Using the Air Quality Assessment Model (AQAM), initial calculations were made for the levels of particulate matter, hydrocarbons, carbon monoxide, and oxides of nitrogen for a 500 gallon fire, typical for this series. The results are contained in Table 1.

Table 1. AIR EMISSION ESTIMATES FOR LARGEST HYDROCARBON FIRES

FIRE SIZE		AIR POLLUTANTS*				
GALLONS JP-4	POUNDS JP-4	POUNDS PM	POUNDS CO	POUNDS HC	POUNDS NOx	TOTAL
300	1,950	250	110	629	9	998
APPROXIMATE TOTAL FOR TEST SERIES						
1,200	7,860	1,008	442	2,515	34	4,000

* PM = Particulate Matter
CO = Carbon Monoxide
HC = Hydrocarbons
NOx = Oxides of Nitrogen

Reference: A Generalized Air Quality Assessment Model for Air Force Operations, AFWL-TR-74-304, February 1975.

Any major fuel spills or other unplanned event that may affect the environment will immediately be reported to the AFCESA and Tyndall AFB environmental offices.

ANNEX 1

TEST SCHEDULE

TEST PREPARATION	1 - 2 June 92
FIRE TESTS	3 June 92
DATA ANALYSIS	4 - 5 June 92
REPORT PREPARATION	8 - 12 June 92

ANNEX 2

LOGISTICS SUPPORT

A. FACILITY REQUIREMENTS

The test facility for this test is the 100 foot AFCESA Fire Research Facility #1, located approximately 7 miles southeast of the main gate at Tyndall AFB, Florida. This test site will be used for all fires conducted in this series.

B. PERSONNEL REQUIREMENTS

Personnel to support this test will be provided by AFCESA/RACF, AFCESA/RAAE, and AFCESA/DFO.

Agency/Organization	Personnel Required
AFCESA/RACF	Test Director Range Safety Officer Fire Pit Operator (2 ea) Data collector (1 ea) Video Operator (1 ea) Still Photographer (1 ea)
AFCESA/RAAE	Project Officer
AFCESA/DFO	Fire Protection Project Manager Senior Fire Officer Helmet Evaluators (4 ea)
USAF HOSPITAL - TYNDALL AFB	Emergency Medical Care

C. MATERIAL REQUIREMENTS

Material requirements are as follows:

ITEM	QUANTITY	SOURCE
JP-4	1,200 gal.	AFCESA/RACF
AFFF	30 gal.	AFCESA/RACF
Video tape	6 cassettes	AFCESA/RACF
35 mm film	6 rolls	AFCESA/RACF

D. EQUIPMENT REQUIREMENTS

ITEM	QUANTITY	SOURCE
P-19/P-4 Fire Fighting Vehicle	2 ea	AFCESA/RACF
Portable Fire Extinguishers	4 ea	AFCESA/RACF
Protective Clothing (sets)	4 sets	AFCESA/RACF
First Aid Kit	1 kit	AFCESA/RACF
Hand Held Radios	2 ea	AFCESA/RACF
Electric Ignition System	1 ea	AFCESA/RACF
35mm Still Frame Cameras	1 ea	AFCESA/RACF
VHS 1/2" Video Cameras	2 ea	AFCESA/RACF
Stopwatches	2 ea	AFCESA/RACF
Wind Direction Instrument	1 set	AFCESA/RACF
SCBA	6 units	AFCESA/DFO
Proximity Clothing	6 sets	AFCESA/DFO
Spare cylinders	6 ea	AFCESA/DFO

ANNEX 3

LARGE-SCALE FIRE TEST PIT OPERATIONAL PROCEDURES

The following are general procedures to be used during the operation of the 100 foot fire test pit.

1. Insure all agencies are notified of test events.
2. Conduct Safety Briefing/site orientation.
3. Verify all data collection equipment in place and operational.
4. Insure downrange/fire pit area clear.
5. Verify amount of fuel to be used; flow fuel in test area.
6. Start data collection.
7. Ignite fire.
8. 30-second pre-burn.
9. Conduct fire event/test.
10. Secure fire burn area/downrange.
11. Check test results.
12. Conduct post-test and facility shutdown procedures.
13. Notify all agencies that test complete & facility secure.
14. Conduct critique.
15. Document test results.

PRETEST CHECK LIST

TO BE USED BEFORE CONDUCTING FIRE TESTS AT

FIRE RESEARCH FACILITIES NO. 1

DATE:_____ TIME:_____

VERIFIED	PROCEDURES
___	Brief all personnel on proper safety procedures.
___	All personnel at the test site are required for the test or are an approved visitor?
___	Brief all personnel on accident and fire reporting procedures.
___	Radio or telephone communications available?
___	Post telephone numbers for the ambulance and fire department by the telephone or radio.
___	Ensure that adequate first aid kit is available.
___	Ensure that an emergency eye wash apparatus is available.
___	Ensure that all fuel valves are closed and that there are no fuel leaks prior to fuel ignition.
___	Ensure Individual Protective Equipment is fully charged and operational.
___	Secure area prior to igniting fire.

ANNEX 4

COMBINATION STRUCTURAL/CRASH

FIREFIGHTER HEAD PROTECTION

TEST CONDUCT CHECKLIST AND DATA COLLECTION SHEET

TEST NO:____ DATE:_____ TIME:_____ FUEL:_____ QTY:_____ gal.

HELMET # ____ MODEL: _____ EVALUATOR: _____

HELMET # ____ MODEL: _____ EVALUATOR: _____

HELMET # ____ MODEL: _____ EVALUATOR: _____

HELMET # ____ MODEL: _____ EVALUATOR: _____

METEOROLOGICAL DATA:

TEMPERATURE: _____ WIND: _____

TEST READINESS:

_____	Weather within limits	_____	Communications check
_____	Fire vehicles ready	_____	Ignition system ready
_____	Video cameras ready	_____	Fuel in pit
_____	Emer. Medical notified	_____	Access gate secured

CLEARANCE FOR IGNITION:

_____	Safety Officer	_____	Fire Department

IGNITION TIME: _____ AGENT APPLICATION: START: _____ END: _____

EXTINGUISH TIME: _____

GENERAL COMMENTS:

COMBINATION STRUCTURAL/CRASH
FIREFIGHTER HEAD PROTECTION
TEST EVALUATION SHEET

HELMET # _____ MODEL:_____ EVALUATOR:_____

DATE:_____ TIME:_____ MAXIMUM TEMPERATURE:_____°F

SPECIFIC QUESTIONS:

1. Was the helmet comfortable to wear all during the test?

   Comments:

2. Did the helmet provide the necessary heat protection?

   a. Score (0-10): Adequate heat protection = 5

   b. Comments:

3. Did the helmet restrict your forward vision?

   a. Score (0-10): Adequate forward vision capability = 5

   b. Comments:

4. Did the helmet restrict your total field of vision or ability to conduct firefighting operations?

   a. Score (0-10): Adequate total field of vision to conduct firefighting operations = 5

   b. Comments:

5. Did the helmet interfere with your SCBA mask or breathing capability?

   a. Score (0-10): Nominal interference with SCBA or breathing = 5

   b. Comments:

6. Did the helmet unnecessarily interfere with your hearing?

   a. Score (0-10): Adequate hearing ability = 5

   b. Comments:

7. What is your overall opinion of the helmet for use in general firefighter operations?

   a. Score (0-10): Adequate protection and applicability to firefighting operations= 5

   b. Comments:

COMBINATION STRUCTURAL/CRASH
FIREFIGHTER HEAD PROTECTION
EVALUATION SCORING MATRIX

TEST DATE: _____

QUESTIONS

HELMET NUMBER	EVALUATOR	1 COMFORT	2 HEAT PROTECT	3 VISION FWD	4 VISION FIELD	5 SCBA	6 HEARING	7 OVERALL	TOTAL SCORE
1									
2									
3									
4									
5									
6									
7									

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