AMENDMENT OF SOLICITATION/MODIFICATION OF CONTRACT

1. CONTRACT ID CODE

2. AMENDMENT/MODIFICATION NO.	3. EFFECTIVE DATE	4. REQUISITION/PURCHASE REQ. NO.	5. PROJECT NO. *(If applicable)*
0001	28 Aug 2002		

6. ISSUED BY CODE N00173

CONTRACTING OFFICER
NAVAL RESEARCH LABORATORY
4555 OVERLOOK AVENUE SW
WASHINGTON, DC 20375-5326
ATTN: CODE 3230.CB

7. ADMINISTERED BY *(If other than Item 6)* CODE

8. NAME AND ADDRESS OF CONTRACTOR *(No., street, county, State and ZIP Code)*

TO ALL OFFERORS

CODE | FACILITY CODE

(X) X 9A. AMENDMENT OF SOLICITATION NO. N00173-02-R-CB04

9B. DATED *(SEE ITEM 11)* 05 Aug 2002

10A. MODIFICATION OF CONTRACT/ORDER NO.

10B. DATED *(SEE ITEM 11)*

11. THIS ITEM ONLY APPLIES TO AMENDMENTS OF SOLICITATIONS

[X] The above numbered solicitation is amended as set forth in Item 14. The hour and date specified for receipt of Offers [X] is extended, [ ] is not extended.

Offers must acknowledge receipt of this amendment prior to the hour and date specified in the solicitation or as amended, by one of the following methods:

(a)By completing items 8 and 15, and returning _______ copies of the amendment; (b) By acknowledging receipt of this amendment on each copy of the offer submitted; or (c) By separate letter or telegram which includes a reference to the solicitation and amendment numbers. FAILURE OF YOUR ACKNOWLEDGMENT TO BE RECEIVED AT THE PLACE DESIGNATED FOR THE RECEIPT OF OFFERS PRIOR TO THE HOUR AND DATE SPECIFIED MAY RESULT IN REJECTION OF YOUR OFFER. If by virtue of this amendment your desire to change an offer already submitted, such change may be made by telegram or letter, provided each telegram or letter makes reference to the solicitation and this amendment, and is received prior to the opening hour and date specified.

12. ACCOUNTING AND APPROPRIATION DATA *(If required)*

13. THIS ITEM ONLY APPLIES TO MODIFICATION OF CONTRACTS/ORDERS. IT MODIFIES THE CONTRACT/ORDER NO. AS DESCRIBED IN ITEM 14.

CHECK ONE	
	A. THIS CHANGE ORDER IS ISSUED PURSUANT TO: *(Specify authority)* THE CHANGES SET FORTH IN ITEM 14 ARE MADE IN THE CONTRACT ORDER NO. IN ITEM 10A.
	B. THE ABOVE NUMBERED CONTRACT/ORDER IS MODIFIED TO REFLECT THE ADMINISTRATIVE CHANGES *(such as changes in paying office, appropriation date, etc.)* SET FORTH IN ITEM 14, PURSUANT TO THE AUTHORITY OF FAR 43.103(b).
	C. THIS SUPPLEMENTAL AGREEMENT IS ENTERED INTO PURSUANT TO AUTHORITY OF:
	D. OTHER *(Specify type of modification and authority)*

E. IMPORTANT: Contractor [ ] is not, [ ] is required to sign this document and return ——— copies to the issuing office.

14. DESCRIPTION OF AMENDMENT/MODIFICATION (*Organized by UCF section headings, including solicitation/contract subject matter where feasible.*)

See Page 2

Except as provided herein, all terms and conditions of the document referenced in Item 9A or 10A, as heretofore changed, remains unchanged and in full force and effect.

15A. NAME AND TITLE OF SIGNER *(Type or print)*		16A. NAME AND TITLE OF CONTRACTING OFFICER *(Type or print)*	
15B. CONTRACTOR/OFFEROR *(Signature of person authorized to sign)*	15C. DATE SIGNED	16B. UNITED STATES OF AMERICA *(Signature of Contracting Officer)*	16C. DATE SIGNED

The purpose of this amendment is to provide answers to questions from prospective offerors in regards to the Statement of Work (SOW) and the site visit. The date specified for receipt of offers has been revised accordingly.

1) Is this a prevailing wage (Davis-Bacon) project? If so, are wage rates available?

Answer to No. 1:

This is not considered to be a construction contract.

2) How do we obtain a copy of NRL Report 8093 " Modified Smoldering Test of Urethane Foams Used in Anechoic Chambers"?

Answer to No. 2:

See Attachment No. 1

3) How do we obtain a copy of NRL Instruction 5101.3C Fire Safety in Anechoic Chamber Operations 7/13/98?

Answer to No. 3:

See Attachment No. 2

4) What is the sequence of construction at the SCIF and Mezzanine? Which is to be built first? Can the mezzanine be used as a platform during construction of the SCIF?

Answer to No. 4:

The Mezzanine steel structure will precede the construction of the SCIF/Anechoic chamber facility. The mezzanine cannot be used as a platform during construction of the SCIF.

5) What is the height from concrete floor to underside of structure within the parent building in the area of the SCIF?

Answer to No. 5:

From page 16 (drawing S5) of the PDF drawing package; The floor to ceiling distance at its shortest (along the south wall of the building) is approximately 21'

6) What is the intended overall height of the SCIF?

Answer to No. 6:

Enough to totally enclose the tapered chamber and any required mechanical / utility infrastructure.

7) Is the roof of the SCIF required to be rated for material storage?

Answer to No. 7:

The roof of the structure should provide for the storage of lightweight antennas.

8) We assume that the contractor is responsible for running the SCIF sprinkler lines to the outside wall of the SCIF and terminating there. The facility will tie into our lines at that point. Is this correct?

Answer to No. 8:

This is correct.

9) We assume that the contractor is responsible for running the SCIF electrical conduit and wiring to the outside wall of the SCIF and terminating there. The facility will tie into our lines at that point. Is this correct?

Answer to No. 9:

This is correct.

10) We assume that the contractor is responsible for running the SCIF steam lines to the outside wall and terminating there. The facility will tie into our lines at that point. Is this correct?

Answer to No. 10:

This is correct.

11) Will a list of site visit attendees be made available.

Answer to No. 11:

Yes, the following attendees were at the site visit:

EMS Technologies
ETS-Lindgren
Emerson Cuming Microwave Products
Panashield Inc.
Advanced Electro Magnetics
Project Developers Inc.
Lehman Chambers
Vitatech Engineering Inc.
Global Partners in Shielding Inc.

12) Para 4.1 - define the SCI level required.

Answer to No. 12:

From DCID 1/21: This is a CONUS SCIF requirement, on a US Government controlled compound, and having armed immediate response forces; assume the specifications indicated in Chapter 4 – Drywall construction.

13) Para 6.2.1 Is the (Par. 4.1) referenced pertaining to the Statement of Work or to the DCID 1/21 called for.

Answer to No. 13:

A full DCID 1/21 review is required; the reference in 4.1 provides a quick overview of the requirements.

14) It is unclear whether or not the Chamber is RF Shielded as para. 6.2.1 calls for drywall construction yet 6.2.3 calls for a shielded enclosure.

Answer to No. 14:

The SOW paragraph 6.2.3 is in error; should read "The finished floor of the chamber facility…"

15) We presume that the Tapered Anechoic Chamber is RF shielded but do not find any performance criteria.

Answer to No. 15:

A minimum of 60 dB shielding over the entire band down to 100 MHz.

16) Does NRL have a list of NRL approved subcontractors for HVAC, Fire Detection and Suppression, Carpentry and Electrical?

Answer to No. 16:

NRL does not have an NRL approved subcontractors list.

17) In reference to the HVAC system, where will the steam lines come in relative to the chamber location?

Answer to No. 17:

Assume that all utility connections will be made on the north-west corner of the chamber facility.

18) In reference to the HVAC system, may we assume installation of roof top units is acceptable?

Answer to No. 18:

"Roof Top" relative to the chamber facility would be acceptable. However, "roof-top" to mean the roof of the A59 building, is unacceptable. No equipment shall be placed on the roof of building A59. Keep in mind that the HVAC must not exhaust waste heat into the Building A59 volume.

19) In reference to the HVAC system, if we are to mount the units on the rooftop, should we assume the need to include price for structural engineering to provide load calculations for the existing roof?

Answer to No. 19:

Equipment may not be placed on the roof of building A59.

20). Will silencers on the HVAC be required?

Answer to No. 20:

The HVAC system should produce nominal sound output within the chamber facility, similar to a typical office environment. However, if silencers provide the physical security protection needed to meet DCID 1/21, they may be installed.

21) Will man bars on the waveguide vents and connectors panels and other facility penetrations be required?

Answer to No. 21:

If the waveguide vents and connector panels are sturdy and will not easily admit access (or the opening is less than 96 sq inches [see DCID 1/21]) then no additional security measures would be required.

22) What is the distance between where the power to the building comes in and the location of the chamber?

Answer to No. 22:

The contractor will provide power entry to the chamber facility on the north-west corner of the facility. NRL R&D services will bring power to that location and make the final hook-ups.

23) Is the common wall for the chamber facility and anechoic tapered chamber required in light of the fact that one is shielded and the other is not?

Answer to No. 23:

A common wall is possible, but not required.

24) Due to the varying levels of SCIF, may we get a better definition of the SCIF requirements that pertain to solicitation?

Answer to No. 24:

The purpose of this requirement is to make the facility easily SCIF-able, if necessary during the life of the new chamber. Since this facility will be located in the Continental US, and on a Military installation, the requirements are somewhat relaxed in DCID 1/21. The key issues that we are concerned about in the construction of the facility such that it meets DCID 1/21 (this explanation is not designed to be a replacement for understanding the DCID 1/21 requirements, nor is it complete):

Security the SCIF perimeter: in this case it is the walls, doors, and any other penetrations through the chamber facility envelope.

Wall construction: two layers of drywall on side of wall, constructed using a staggered frame, filling the interior with sound insulation, and the method of attaching the drywall to the frame. True (not false) Ceiling / roof must be handled similarly.

Ventilation ducts: If these penetrate through the SCIF perimeter (and are in excess of 96 sq inches), then bars, or commercial sound baffles / wave forms provide physical protection. Also, sound attenuation would be required for ducts that penetrate through the SCIF perimeter; these security devices must be installed in such a way that offers visual inspection of the devices within the duct.

All penetrations through the SCIF perimeter must have gaps and holes sealed with materials of equal or greater strength than the surrounding surface. TEMPEST requirements are not required.

Doors: Must be 1-3/4” solid wood core, wood composite with 16 gauge metal wrap, or a metal fire or acoustical door. Ensuring that the hinges are properly protected, sound gasketing around the door frame, and providing a door sweep to cover the gap between the door and floor are required.

The contractor is not required to provide any alarm equipment or combination locksets that are required for SCIF use.

25) What level of shielding effectiveness is required for the anechoic tapered chamber?

Answer to No. 25:

A minimum of 60 dB shielding over the entire band down to 100 MHz.

26) Define ``consumable'' components as referred to on page 12, section 6.1.7, Remedial Maintenance.

Answer to No. 26:

"Consumable" components are any components that require replacing at regular intervals as part of their standard maintenance. An example would be air-filters for the HVAC system; these typically require replacement every 1-3 months.

27) Clarify the number and size of the doors required in both the chamber facility and the anechoic tapered chamber.

Answer to No. 27:

The tapered chamber itself should have one personnel entrance door, 4'x7'. (§6.3.11) The chamber also has a split in the vertical plane with one side that opens for the installation of source antennas. (§6.3.3). For the chamber facility, double-door should be located on the north side of the chamber facility, (§6.3.11 calls this the "east" door).

28) Clarify the references to ``see C5'' and ``see C8'' as stated on page 15, section 6.3.3, Tapered Anechoic Chamber Physical Specifications. We believe the solicitation is referring to the picture labeled A1 through A7 at the end of Attachment 1.

Answer to No. 28:

Correct. Page 15 of the SOW (40 of the solication) should reference A5 rather than C5, and A8, rather than C8.

29) In reference to the CCTV camera located in the tapered anechoic chamber, what field intensity does the system need to withstand (e.g. 200 v/m)?

Answer to No. 29:

The system needs to be able to withstand a maximum field intensity of 5.5 V/meter without damage. Operation field intensity required is approximately 1 V/meter.

30) Will the hinged tapered section of the tapered anechoic chamber be identical to figure A4 of the solicitation?

Answer to No. 30:

Figures A1..A6 are provided for reference only. The contractor need not propose an exact duplicate of the existing chamber. Electrical performance must be balanced with convenience and ease-of-operation when proposing a design.

31) Please provide a list of qualified NRL vendors for electric, fire, foundation excavation and any other items within the solicitation that you may have already qualified vendors to perform.

Answer to No. 31:

NRL does not have a list of qualified vendors.

32) We are assuming by the reference to FAR clause 52.215-5 that we may provide e-mail in response to the solicitation..

Answer to No. 32:

This is correct.

33) In light of the number of clarifications we are asking for, may we have a due date extension?

Answer to No. 33:

The closing date will be extended to September 9, 2002 4:00 PM local time

34) Can the rectangular "Chamber Facility" be stand alone modular construction with a stick built tapered chamber. Since it will serve as a control room it will keep interfering signals out and all power coming in will be filtered. We would also provide some shielding for the tapered chamber.

Answer to No. 34:

The contractor may propose a construction technique for the Chamber Facility that exceeds the requirements for a drywall and stud construction technique. The key is however to meet the specifications for anechoic chamber performance, as well as meeting the security requirements for the SCIF space.

35) The shielding standard calls for IEEE-299, but it does not say what level of shielding is required.

Answer to No. 35:

A minimum of 60 dB shielding over the entire band down to 100 MHz.

36) If the "Chamber Facility" is shielded. Does the tapered chamber have to be shielded?

Answer to No. 36:

The contractor must meet the technical performance requirements in the “quiet zone” of the anechoic chamber facility for making proper antenna measurements. If the contractor proposes to shield the entire facility, they should also consider the effects of electronic equipment within the facility and outside of the anechoic chamber when determining the requirements on the tapered chamber itself. The 60 dB shielding requirement is the requirements inside of the tapered chamber. If the contractor can show that an unshielded taper-chamber inside of the larger shielded room meets this requirement, then this would be acceptable.

37) Is there an adequate water supply to support the FM 1-53 as described in Para. 6.1.5.1?

Answer to No. 37:

Assume that adequate water supplies will be made available.

38) Telescoping sprinkler heads are required in the tapered chamber. A newly developed retractable telescoping head is available and we will list that as an option for your consideration. This new development eliminates the need to reset the heads after testing.

Answer to No. 38:

> The sprinkler heads required have been approved by the cognizant authorities. Other variations that are currently not approved will not be considered at this time.

39) Is 240 days calendar days or work days?

Answer to No. 39:

> It is 240 calendar days.

40) "Chamber Facility" will use NFPA-13 (wet pipe), and the tapered chamber will use FM 1-53 (pre-action) standards for sprinkler protection.

Answer to No. 40:

> This is correct.

41) Must we provide for tie in to a base fire alarm system, and who will perform the tie-in?

Answer to No. 41:

> Yes. Grouped with the other utilities, the file alarm system building-trigger should be made available via terminal block with other appropriate connection. Connection into the building file alarm system will be the responsibility of the NRL R&D services. The contractor’s responsibility ends at the terminal block.

42) Will the HVAC system be tied-in to a central control system and who's system are you using (e.g. Johnson Controls METASYS)?

Answer to No. 42:

> The chamber facility HVAC will be tied into the central system by use of steam and chilled water lines only. No other “building-wide” control system tie-in will be required.

43) Is there a location convenient to the project site for a scrap container?

Answer to No. 43:

> Space will be made available as close to the job site as possible for a refuse container by the Laboratory. It is anticipated that the Laboratory R&D services will allow the refuse container to be placed in the "rail-road tracks" section of the A59 area, as close to the job site as possible. This area would be identified in the drawing package, page 3, drawing A1, near the top right hand side of the page as "EXIST TRENCH".

44) Indicate the pipe connection size, location and available capacity for the steam system for use on this project.

Answer to No. 44:

> Design the facility with the HVAC sized appropriately. New steam connections will be provided by NRL R&D Services.

45) Indicate the pipe connection size, location and available capacity for the chilled water system for use on this project.

Answer to No. 45:

> Design the facility with the HVAC sized appropriately. New chilled water connections will be provided by NRL R&D Services.

46) Indicate the design drawing submissions that will be required by this solicitation, if any.

Answer to No. 46:

> The proposal should include as much information as possible to allow the selection team to understand the design proposed by the contractor. The more technical detail possible, in general, the better. Given these requirements, draft drawings of the facility and the anechoic chamber facility would be helpful to the selection team.

47) Clarify the scope of work for the new electrical service. Will it be the contractor's responsibility to provide tie in only? Indicate the location of the new service entrance.

Answer to No. 47:

> Assume that the contractor's responsibility include everything within the facility up to the exterior tie-in point. NRL R&D Services will design power feed and equipment needed to complete the tie-in, and actually perform the tie in. The service entrance nominally will be located on the north-west corner of the chamber facility.

48) Please clarify if the contractor is to be responsible for the tie in only of the phone, data, power, Fire Protection, and chilled water.

Answer to No. 48:

> The contractor is responsible for all of the plumbing, wiring, and other equipment *within the chamber facility*. Utility connections should terminate on the exterior of the facility, north-west corner, for tie-in to the building utility capability. NRL R&D services will perform the final tie-in for phone, data, power, fire-suppression, and chilled water.

49) Clarify the entrance route for large equipment to the construction area.

Answer to No. 49:

> Personnel doors on the west side of the "chamber location" (see page 3 of drawing package, drawing A1) will provide the best access via a driveway to the west of the new facility. Access is also available through a personnel door on the south-west corner of A59 (bottom-left corner of drawing A1), through the "FIRE PUMP RM" An access path through building 240's roll-up door, through a roll-up door on the west side of A59, and south along the west wall of A59 may be possible, but will necessitate the relocation of an air-compressor system which currently blocks access south of the personnel doors.

50) Indicate if Performance and Payment Bonds will be required.

Answer to No. 50:

> This is <u>not</u> considered a construction contract.

51) What frequencies does the Navy want cross polarization tested at (para 6.3.2)? Will the Navy provide a pair of antennas that can provide 40 db cross polarization for measurement purposes?

Answer to No. 51:

> See §6.3.8. Cross polarization performance should be tested with the same list of frequencies as for the rest of the performance tests.

52) Is the source positioner to be supported off the chamber support steel or can it be supported by the building steel.

Answer to No. 52:

> The chamber must be a completely self-sufficient facility except for utility connections and support from the ground. Source positioner should be supported independently of the tapered chamber, and therefore supported by the chamber facility structure.

53) Within the RFP it is indicated that the tapered chamber is to be modular panel shielded chamber; however, the level of shielding effectiveness that is required is not specified. What level of shielding effectiveness is required? (i.e., 60dB, 100dB, etc.).

Answer to No. 53:

> The bidders should specify the shielding effectiveness for the construction technique they propose to provide for the chamber and the construction technique shown in option 1 -- modular to fully welded. Nominally, RF attenuation should exceed 60 dB above 10 MHz.

54) It is unclear how the chamber and the Chamber facility can share a common wall if one is a modular panel system and the other is stud and drywall construction? What is the intent? (ref. para. 6.1.2 of RFP)

Answer to No. 54:

> "Share a common wall" is meant to mean that the tapered chamber abuts directly against the chamber facility wall.

55) Paragraph 6.2.6.2 of the RFP identifies two doors ((1) 6' x 7' double door at the east location and (1) 42" x 7' single door at the southeast *location)* for the CHAMBER FACILITY (Exterior Room); however, three doors are depicted in Figure 1. Clarification.

Answer to No. 55:

> The drawing erroneously shows (but does not identify) a symbol for a third door, on the south-east corner.

The Statement of Work (SOW) will be modified to reflect any changes that were discussed in the above Questions and Answers.

Attachment No. 1

NRL Report 8093

Modified Smoldering Test of Urethane Foams Used in Anechoic Chambers

P. A. TATEM, P. D. MARSHALL, AND F. W. WILLIAMS

Combustion and Fuels Branch
Chemistry Division

March 9, 1977

NAVAL RESEARCH LABORATORY
Washington, D.C.

SECURITY CLASSIFICATION OF THIS PAGE (*When Data Entered*)

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER: NRL Report 8093	2. GOVT ACCESSION NO.
3. RECIPIENT'S CATALOG NUMBER	
4. TITLE (*and Subtitle*): MODIFIED SMOLDERING TEST OF URETHANE FOAMS USED IN ANECHOIC CHAMBERS	5. TYPE OF REPORT & PERIOD COVERED: Interim report on one phase of a continuing NRL Problem.
	6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(*s*): P. A. Tatem, P. D. Marshall, and F. W. Williams	8. CONTRACT OR GRANT NUMBER(*s*)
9. PERFORMING ORGANIZATION NAME AND ADDRESS: Naval Research Laboratory, Washington, D.C. 20375	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS: NRL Problem C08-36D
11. CONTROLLING OFFICE NAME AND ADDRESS: Department of the Navy, Naval Facilities Engineering Command, Alexandria, Va. 22332	12. REPORT DATE: March 9, 1977
	13. NUMBER OF PAGES: 16
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16. DISTRIBUTION STATEMENT (*of this Report*)

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (*of the abstract entered in Block 20, if different from Report*)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (*Continue on reverse side if necessary and identify by block number*)

Flammability
Flashover
Polyurethane foams
Scaling

20. ABSTRACT (*Continue on reverse side if necessary and identify by block number*)

A program is under way at the Naval Research Laboratory to develop small-scale laboratory fire tests that will predict more accurately the behavior of Class A materials in fires. After development of five small-scale performance specifications for assessing the hazard of carbon-impregnated polyurethane foam, samples of the materials were installed in a large-scale fire test facility to determine the scaling parameters applicable to the foam. The knowledge gained from the large-scale tests under different experimental conditions and with several polyether and polyester foams has been used to scale down to a laboratory test that dynamically measures the expected behavior of the foam in a scaled situation.

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CONTENTS

MODIFIED SMOLDERING TEST OF URETHANE FOAMS USED IN ANECHOIC CHAMBERS

INTRODUCTION

Since the 1973 fire in a Naval Research Laboratory anechoic chamber [1], several other fires involving carbon-impregnated polyurethane foam have occurred at various facilities [2,3]. The hazard of these chambers has been highlighted, and the public finally recognizes this long-existing problem.

The absorber material in these chambers presents several unique problems. First, the least expensive available material with the desired qualities, including required electrical characteristics, is polyurethane foam. The dangers of this base material are its self-smoldering properties and its toxic gas emission under thermal and fire stress [4]. Second, the types of fire retardants that can be used are limited because of restrictions placed on the end product. The end product is heavily loaded with carbon for specific electrical characteristics, and fire retardants used must not interfere with this function.

The Chemistry Division at NRL has been actively involved since 1973 in a research program to improve the fire behavior of the absorber materials on the market, and five fire performance tests have been conceived and developed [4,5]. These have been adopted as performance specifications in procurement contracts for chamber materials used by various governmental, institutional, and commercial agencies. Since the development of the small-scale fire performance tests, a large-scale testing program has been developed to determine scaling parameters applicable to the small-scale test results, for more accurate prediction of real-life performance.

One of the small-scale tests described in Ref. 4 evaluated the smoldering tendency of foams after ignition by a hot surface heater. This was the most severe test conceived, but it did not take into account the effects of heat transfer (heat feedback), fuel load, sample geometry, or other, more subtle scaling parameters encountered in full-scale fires involving this material. The large-scale testing program was to simulate a full-scale chamber so that these factors could be reevaluated. This program produced knowledge that has been used to reassess the small-scale smoldering test procedure and to evolve a redesign that better indicates the material's behavior under fire conditions in actual anechoic chambers.

EXPERIMENTAL SETUP AND PROCEDURE

The seven materials used in the first large-scale testing program were submitted by several of the companies that supplied foams for the program from which the test specifications were developed. The samples will be referred to by the letters A through G.

Manuscript submitted December 10, 1976

Each manufacturer has been deeply involved in improving its product since the performance specifications were developed. Although there may be several foams from the same company, each represents the state-of-the-art material for its company at the time of receipt.

Large-scale tests were carried out in the 1.8 m × 1.8 m × 2.4 m (6 ft × 6 ft × 8 ft) facility shown in Fig. 1. The walls, floor, and ceiling of this chamber were covered with absorber material in the configuration used in actual chambers. Although the entire interior of the chamber was covered with foam, the absorber under test at any time covered only a 0.6 m × 0.6 m (2 ft × 2 ft) area surrounding the location of the ignition source. The ignition source used was an 80-W hot-surface cartridge heater 1.27 cm (0.5 in.) in diameter and 16.5 cm (6 in.) long, as used in Test 3, Ref. 4. In the small-scale tests [4] we had found that the cartridge heater is a more severe form of ignition than the 1900°C methane-air flame required by Test 2 (Table 1). When a flame is played on a sample of the foam, the area in contact with the flame is burned away, creating a cavity, so that the only significant forms of heat transfer are radiative and convective. With the cartridge heater, heat is more efficiently transferred through conduction because of the constant contact between the heater and the foam. Conductive heat transfer is more effective in allowing heat to build up in the foam to the point at which combustion can sustain itself; heat buildup then depends on the ability of the foam to dissipate the energy rapidly.

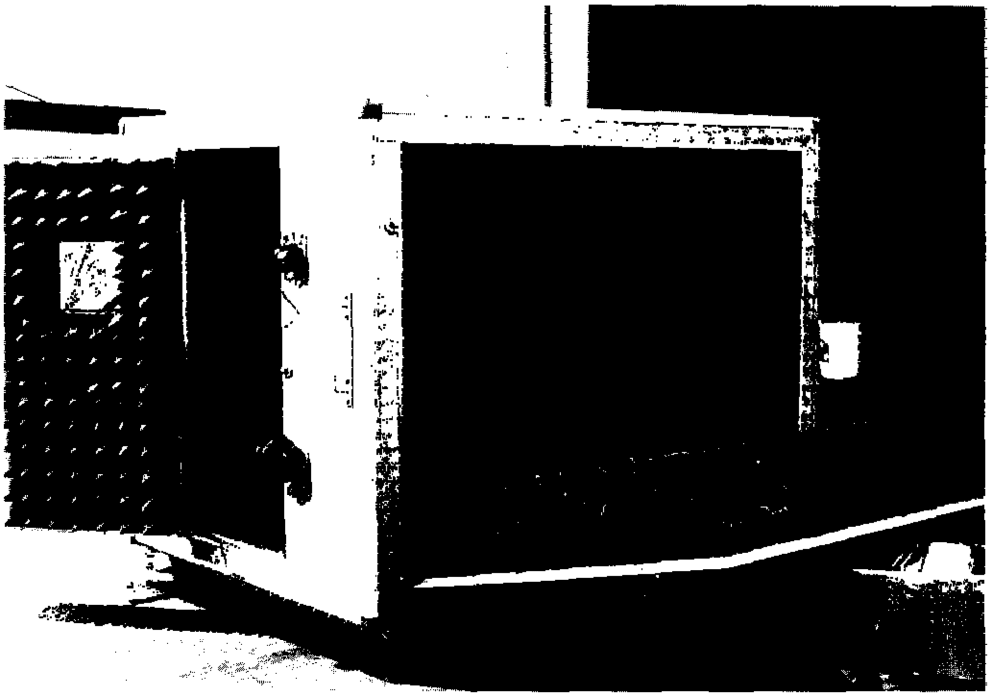

Fig. 1 — Interior view of model anechoic chamber used to conduct large-scale absorber fire tests

Table 1 — Summary of Performance Specification Tests

Test	Equipment for Test	Property Tested	Experimental Conditions	Requirements Under Test Conditions
1. Resistance to electrical stress	Power supply (capable of 240 V ac, 8 A) Test leads located 2.5 cm apart	Ability to withstand electrical overload or short	Exposure to 240 V ac for 60 s	Self-extinguish within 60 s after removal of ignition source. Specimen damage <90%
2. Ease of ignition and flame Propagation	Bunsen burner Support for specimen Timing device	Ignitability and ability to self-extinquish flame (flaming ignition source)	Exposure to flame for 60 s	Self-extinguish within 60 s after removal of ignition source
3. Smoldering	Radiative cartridge heater (capable of 600°C)	Ability to self-extinguish smoldering (flameless ignition source)	Exposure to 600°C radiative heat source for 5 min	Specimen damage <90%
4. Toxic gas emission in a fire environment	Combustion boat H_2/air flame Closed chamber	Toxic gas production Under continuous exposure to flaming ignition source (T = 2400°C)	Exposure to flame for 15 min	HCN conc. <0.3 mg/g HC1 conc. <0.4 mg/g CO conc. <20 mg/g
5. Toxic gas emission due to a hot surface	Combustion boat Radiative cartridge heater Closed chamber	Toxic gas production under continuous exposure to flameless ignition source (T = 350°C)	Exposure to radiative heat source for 15 min	HCN conc. <0.6 mg/g HC1 conc. <0.9 mg/g CO conc. <5 mg/g

The fire spread within the absorber is monitored by a thermocouple array that covers one side of the chamber and extends to cover half of the back (Fig. 2). The thermocouples are spaced on a square grid 30.5 cm (12 in.) apart and extend 7.6 cm (3 in.) into the absorber attached to the wall. Two additional thermocouples are used, one attached to the cartridge heater and the other inserted 2.54 cm (1 in.) away from the cartridge heater. The thermocouples were inserted in the back of the foam through holes drilled through the chamber wall and the foam. The thermocouples were protected during insertion by 0.6 cm × 10.2 cm (0.25 in. × 4 in.) stainless steel tubing. This was removed after the thermocouple was in place, and the hole was repaired with General Electric RTV-112 potting compound.

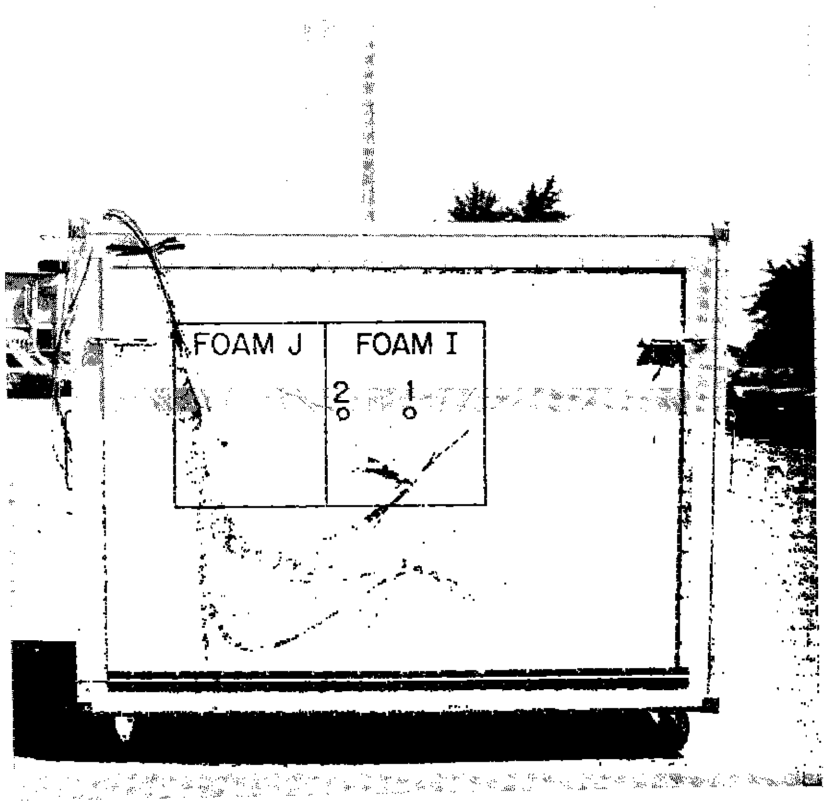

Fig. 2 — Side view of model chamber, showing thermocouple array

A stack located on top of the chamber houses the fire detectors (one photoelectric detector, two ionization detectors, and one toxic product monitor) used for sensing a fire (Fig. 2) and the gas sampling lines through which are continuously monitored, in some tests, oxygen (Beckman Instruments, Model 715) and carbon monoxide and dioxide on two analyzers (Beckman Instruments, Model 315A). Temperatures within the foam are recorded during fire tests by a Hewlett Packard Model 3480 Scanning Digital Voltmeter and output on paper tape at a rate of approximately one reading every 2 s. Subsequent computer plots of the data permit correlation of temperature profiles with the progress of the fire in the chamber.

The cartridge heater was imbedded in the base of the foam that was attached to the wall of the chamber. The heater temperature was then raised to the desired value, either stepwise in 100°C intervals or directly to maximum temperature, and then removed after all fire detectors were in the alarm mode. Monitoring of the temperatures was continued after removal of the ignition source to determine the extent of fire spread and time of extinguishment.

RESULTS AND DISCUSSION

The data from the large-scale fire tests are tabulated in Table 2. A typical computer plot generated during one of these fire tests is shown in Fig. 3. In the upper left-hand corner of the figure is the thermocouple (TC) configuration of the entire side wall on which the fire was initiated. In this particular test, the damper on the stack was 30% open but the blower to circulate air in the chamber was not activated. Thermocouple 39 monitors the temperature of the heater. From this figure we can follow the fire spread, which was negligible as indicated by the minimal responses of thermocouples 12, 13, 17, and 18 in the immediate vicinity of the fire.

Table 2 — Summary of Large-Scale Chamber Fire Tests

Sample	Maximum Temperature of Heater (°C)	Method of Reaching Temp.	Maximum Temperature of TC 2.5 cm Away (°C)	Max. Energy Input (kW)	Fire Test	Outcome
F	600	Stepped	—*	186	23	Smoldered
D	600	Stepped	460	176	11	Smoldered
E	600	Stepped	500	258	21	Smoldered
D	600	Stepped	410	172	16	Self-exting.
G	600	Stepped	550	160	22	Smoldered
C	600	Stepped	260	186	19	Self-exting.
C	600	Stepped	270	204	20	Self-exting.
B	600	Stepped	375	147	9	Self-exting.
D	560	Direct	460	157	13	Self-exting.
D	520	Direct	450	60	12	Self-exting.
C	600	Direct	400	—	18	Self-exting.
B	600	Direct	290	—	10	Self-exting.
B	600	Direct	220	—	14	Self-exting.
B	310	Direct	110	—	8	Self-exting.
A	300	Direct	—	—	3	Self-exting.
A	425	Direct	>550	—	4	Smoldered
A	440	Direct	—	—	1	Smoldered
A&D	600	Direct	630	47	17	Smoldered
A&B	600	Direct	520	—	15	Smoldered

* — Indicates data not available.

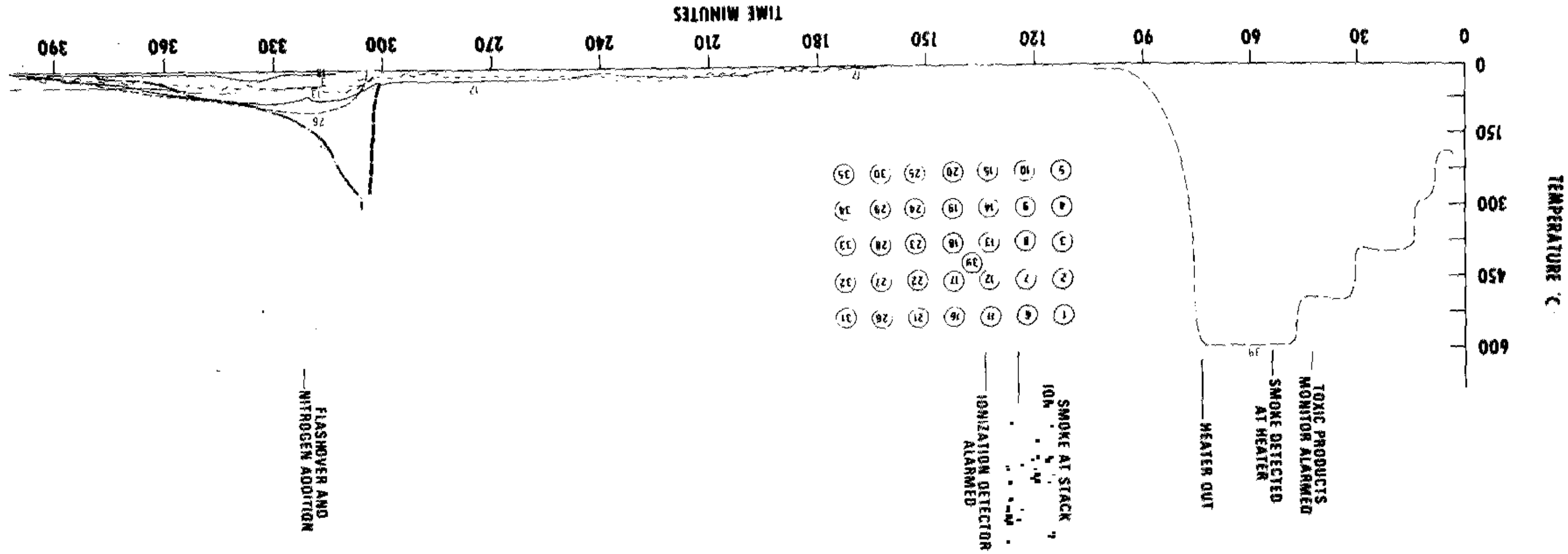

Fig. 3 — Fire scenario depicting the temperatures of several thermocouples during initiation and propagation of a fire that resulted in flashover in the large-scale facility

Under these minimal ventilation conditions, the fire was monitored for an additional 4 h after the heater was removed. At this time the combustible gases from the smoldering foam ignited, and rapid combustion spread throughout the chamber foam. This phenomenon is one form of "flashover" and is evident in the figure at 305 min into the test. This necessitated termination of the test, accomplished by flooding the chamber with nitrogen to suppress the fire. Following flashover, the fire was fought with nitrogen for approximately 1 h before being extinguished. More than 50% of the absorber material lining the chamber walls was destroyed during the later phase of the fire, post flashover (Fig. 4).

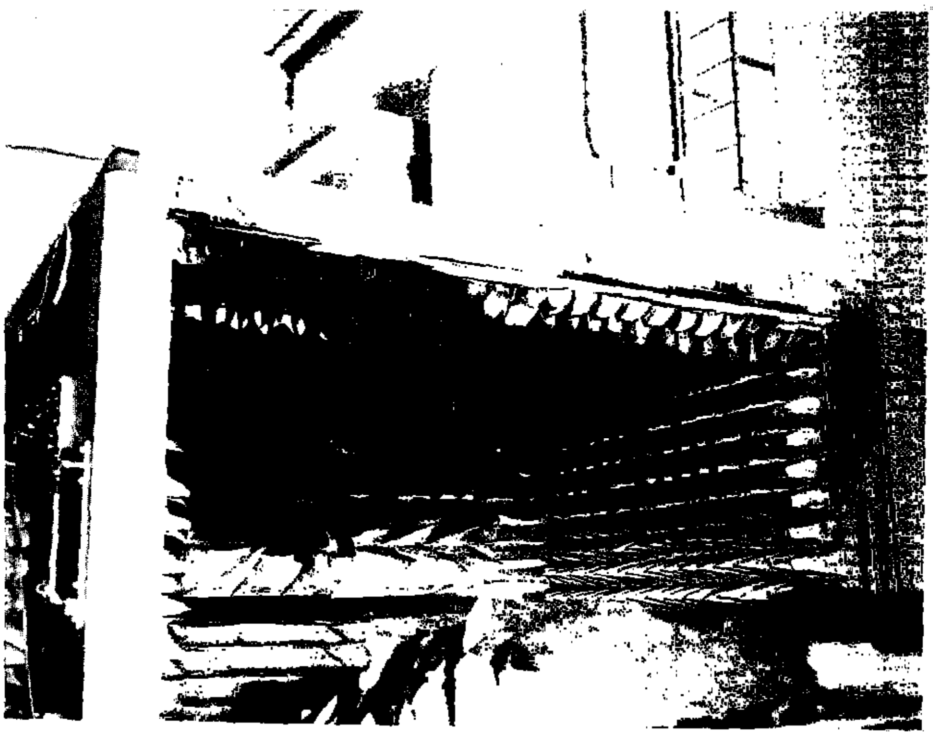

Fig. 4 — Appearance of large-scale facility after flashover fire

The fire was not halted before the 350 min point because the thermocouples indicated that the material was sustaining, rather than suppressing, smoldering. The fundamental characteristic being evaluated in the large-scale tests is the ability of the carbon-impregnated polyurethane foams to suppress smoldering when the heat source is removed. Correlations were attempted between smoldering and several other factors, such as the amount of heat or energy input (maximum temperature), time to reach maximum temperature (heating rate), and method of heat input (stepped or direct).

Attempts to predict the self-extinguishing ability of these foams based on maximum temperature reached or time and method of reaching maximum temperature individually were unsuccessful. The one factor common to each large-scale fire test was the maximum temperature reached by the thermocouple 2.54 cm (1 in.) away from the heat source. In these tests, if this thermocouple failed to exceed the temperature range of 450° ± 10°C, the material could self-extinguish once the heat source was removed. This ability is related to the insulating quality of the char produced by the decomposing foam. Since it is neither very realistic nor practical to run large-scale tests on all materials to determine their smoldering capability, this knowledge can be used in redesigning the small-scale smoldering test to give more reliable results. The essential ingredients of this modified test would be

1. Increased sample size, so that the fuel load represented will minimize heat loss to the exterior. The close packing arrangement of anechoic chambers minimizes heat dissipation in case of ignition.

2. Monitoring of the conductive heat transfer at some distance from the heat source to determine the heat being propagated through the char to the virgin foam. A critical temperature (450°C-460°C at a thermocouple 2.54 cm away) must not be exceeded if the char formed is to protect the remaining foam from being consumed.

This type of information will give specific information on the insulating qualities of the char and its effectiveness in controlling conductive energy transfer. These ideas have been incorporated in the modified Smoldering Test Procedure that appears in Appendix A.

Correlations of Modified Small-Scale and Large-Scale Test Results

Two additional urethane foams (I and J) were subjected to the modified small-scale test. This test uses 20.5 cm × 20.5 cm × 20.5 cm (8 in. × 8 in. × 8 in.) samples and monitors the temperature 2.54 cm (1 in.) from the hot-surface ignition source. The test procedure outlined in Ref. 4 (Test 3) was followed, and the ignition source was removed 5 min after reaching 600°C.

The results with these two samples are shown in Fig. 5. The thermocouple 2.54 cm (1 in.) from the cartridge heater did not exceed 280°C during the test on product I, and smoldering was suppressed within 10 min after the heater was removed. On the other hand, the thermocouple 2.54 cm (1 in.) from the heater exceeded 600°C during the test of foam J. This foam was reduced completely to char before smoldering was suppressed.

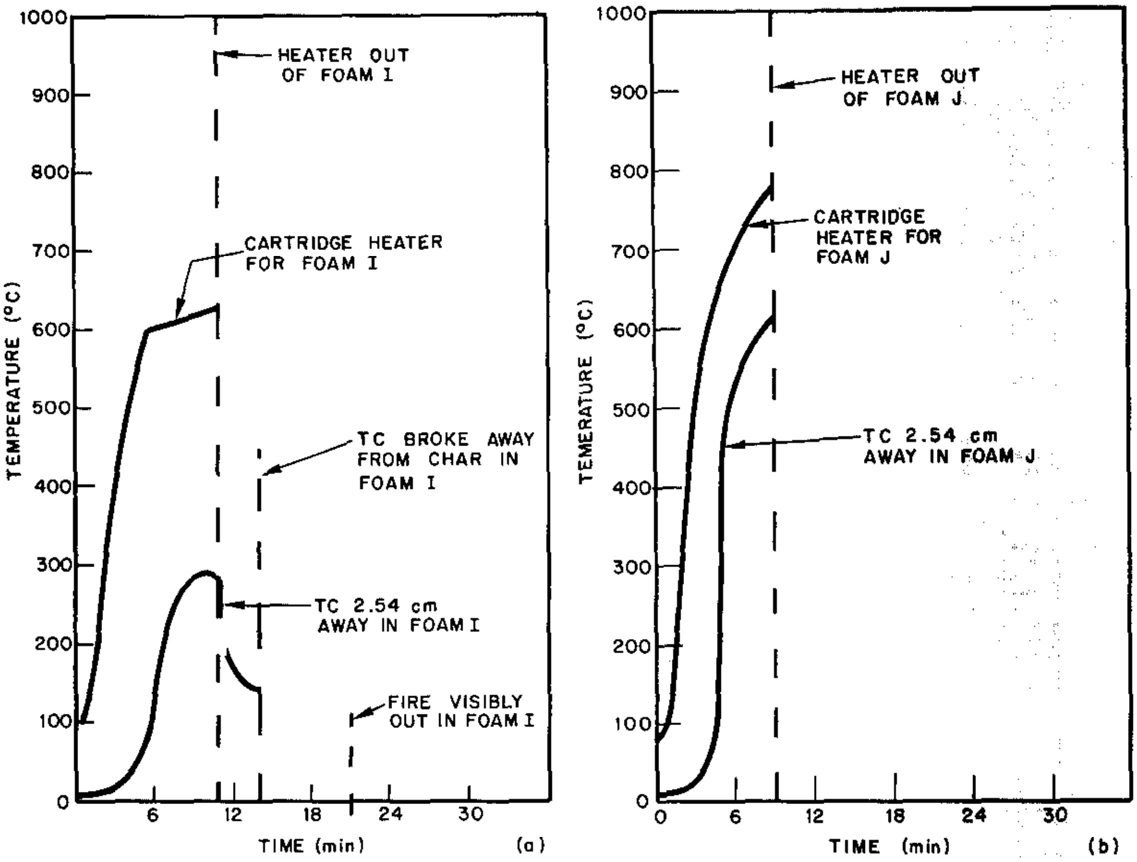

Fig. 5 — Thermocouple responses of Samples I and J during modified small-scale smoldering tests

Based on these measurements, foam I would not be expected to create the smoldering hazard that foam J would. To test this prediction, the same two foams were installed in the large-scale facility, as shown in Fig. 2, and examined under two modified large-scale test procedures. In the first test the hot-surface ignition source was inserted in foam I in position 1 (Fig. 2), and the temperature was increased to 900°C over a 20-min. span. The temperature of the thermocouple 2.54 cm (1 in.) away never exceeded 450°C during the test period, which spanned 25 min. The performance of this foam was satisfactory in that it self-extinguished the smoldering initiated by the heater and prevented additional material from being consumed after the heater was removed.

The hot-surface ignition source was again inserted in foam I in position 2 (Fig. 2), which is bordered by foam J. The temperature of the ignition source was raised to 600°C over 15 min. The ignition source temperature was not increased further, but as the combustion spread into foam J, the temperature of the thermocouple 2.54 cm (1 in.) away began to rise and peaked at 800°C as the fire intensified. Foam J was incapable of suppressing the fire, and special additional measures had to be taken to extinguish the fire.

It is evident from these results that the modified small-scale test provides a qualitative basis for correlation to large-scale tests. It thus provides a simple, inexpensive way of predicting fire performance without engaging in an involved testing program. Many samples tested under both large- and small-scale test procedures have confirmed the usefulness of this modified test.

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4. P.A. Tatem and F.W. Williams, "Flammability and Toxic Gas Production from Urethane Foams Used in Anechoic Chambers," NRL Report 7793, Sept. 13, 1974.

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Appendix A

PERFORMANCE SPECIFICATIONS FOR ANECHOIC-CHAMBER MATERIALS

TEST 1 — RESISTANCE TO ELECTRICAL STRESS

Specimens: — Three 5.2 cm × 15.1 cm × 15.1 cm (2-in. × 6-in. × 6-in.) samples. The surface area of the specimen in which the test leads are inserted shall not be covered with a surface fire retardant.

Equipment: — A 240-V a.c. power supply capable of 8-A output; test leads of AWG copper wire with 90° bends 1.9 cm (0.75 in.) from the ends.

Procedure: — The insulation is removed from the test leads to expose 1.3 cm (0.5 in.) of bare wire. The leads are inserted to a depth of 1.3 cm (0.5 in.) in the foam, 2.54 cm (1 in.) apart. They are horizontally supported so that they do not rest on the specimen. Power shall be applied to the specimen for 60 s. The specimen fails the test if it does not self-extinguish (no visible flame, smoke, or smoldering) within 60 s after the power has been turned off. If it does self-extinguish, the specimen is left undisturbed for 30 min and then reinspected; any specimen that is more than 90% (by weight) destroyed has failed the test. The specimen is then opened to expose its interior and is inspected for any evidence of remaining combustion (hot embers, smoke, or flame); any visible combustion rates the material as unsatisfactory.

TEST 2 — EASE OF IGNITION AND FLAME PROPAGATION

Specimens: — Five cubes, 5.2 cm (2 in.) or larger on each side. The bottom of each specimen shall not be covered with surface fire-retardant paint.

Equipment: — A laboratory ringstand with necessary clamps, suitable for supporting and positioning the specimen; a laboratory Bunsen burner adjusted to a height of 7.6 cm (3 in.) and producing a flame temperature of 1900°C; a time device permitting measurements of intervals of 1 s or less.

Procedure: — The test is conducted in a location free of drafts. The specimen is exposed so that the flame is directed at the bottom center of each specimen for 30 s. If the burning part of the specimen melts or shrinks away from the flame, the burner is moved to keep the specimen continuously in the flame. If the specimen self-extinguishes (no visible flame, smoke, or smoldering) within 60 s after the flame is withdrawn, it has passed the ignition test. For a material to be classified as self-extinguishing by this test, every specimen must self-extinguish within 60 s after flame withdrawal.

TEST 3 — MODIFIED SMOLDERING TEST (REVISED 1976)

Specimens: — Three cubes, 20.1 cm (8 in.) on each side.

Equipment: — A high-density electric cartridge heater 1.3 cm (0.5 in.) in diameter and 15.1 cm (6 in.) long, capable of being inserted snugly into a 7.6-cm (3 in.) deep hole in the specimen and of reaching a maximum temperature of 600°C; two thermocouples, capable of measuring temperatures to 1000°C.

Procedure: — The tests are conducted in a laboratory hood. One thermocouple is physically attached by temperature-resistant tape to the cartridge heater and inserted vertically into a hole in the specimen 7.6-cm (3 in.) deep. The second thermocouple is inserted into the specimen top 2.54 cm (1 in.) from the cartridge heater. Both the thermocouple and cartridge heater/thermocouple pair are supported so that they remain upright and imbedded in the specimen throughout the test. The heater is inserted in the specimen and the temperature is raised to 600°C. The heater is left in the specimen at 600°C for 5 min before being removed. The temperature of the thermocouple 2.54 cm (1 in.) from the heater is monitored throughout the test period. The test is considered over only when all visible smoldering has ceased (no smoke, flame, or hot embers). The specimen has failed if at any time during the test period the temperature of the thermocouple 2.54 cm (1 in.) from the heater exceeds 450°C ± 10°.

TEST 4 — TOXIC GAS EMISSION IN A FIRE ENVIRONMENT

Specimens: — Three 1-g quantities of 0.63-cm (0.25 in.) cubes.

Equipment: — A combustion boat capable of containing 1 g of the specimen; a 2400°C hydrogen-air torch adjusted to a height of 1.3-2.54 cm (0.5-1 in.) (Either the boat or the flame must be movable to allow exposure of the entire sample to the flame during the test — total involvement of the sample is required); a closed chamber capable of containing the boat with the specimen and the torch, equipped to ignite the torch remotely and sample the concentrations of CO, HC1, HCN, and O_2 and large enough that the O_2 concentration does not fall below 20% during the test; detector tubes or other instrumentation for measuring the concentrations of CO, HCN, and HC1 gases at the end of the test.

Procedure: — The combustion boat containing the specimen is placed in the closed system. The torch is remotely ignited and directed at an angle, from above the specimen for 15 min at a distance no greater than 0.63 cm (0.25 in.) from the specimen. During this time, the entire specimen must be exposed to the torch. At the end of the 15-min exposure, the concentrations of HCN, HC1, and CO are measured. Their productions are reported in terms of milligrams of combustion product per gram of specimen. If toxic gas production exceeds the following limits, the specimen has failed the test.

Combustion Product	Milligrams of Product per gram of Specimen
HCN	0.3
HC1	0.4
CO	20.0

Failure of any of the specimens rates the material as unsatisfactory.

TEST 5 — TOXIC GAS EMISSION DUE TO A HOT SURFACE

Specimens: — Three 1-g quantities of 0.63-cm (0.25-in.) cubes.

Equipment: — The combustion boat, closed chamber, and sampling devices used in Test 4; a radiative cartridge heater capable of generating a temperature up to 350°C.

Procedure: — The combustion boat containing the cubes is placed in the closed system with the heater lying on top of the cubes so that it heats all of the sample during the test. The heater is then remotely activated and allowed to heat to 350°C. The specimen is heated at this temperature for 15 min. During this time, the sample must be totally involved. At the end of the 15-min exposure, the concentration of CO, HCN, and HC1 gases are measured and reported in terms of milligrams of combustion product per gram of specimen. If toxic gas production exceeds the following limits, the specimen has failed the test.

Combustion Product	Milligrams of Product per gram of Specimen
HCN	0.6
HC1	0.9
CO	5.0

Failure of any specimen rates the material as unsatisfactory.

NAVAL RESEARCH LABORATORY
Washington, D.C.

NRLINST 5101.3C
Code 1240
13 July 1998

NRL INSTRUCTION 5101.3C

From: Commanding Officer
To: Distribution Lists A and B

Subj: FIRE SAFETY IN ANECHOIC CHAMBER OPERATIONS

1. Purpose. To update guidance regarding fire prevention and procedures to be followed in case of fire during use of anechoic chambers at NRL.

2. Cancellation. This instruction cancels and supersedes NRLINST 5101.3B.

3. Scope. This instruction applies to NRL-DC only.

4. Information

a. Anechoic chambers pose unique fire hazards. They are lined with various polymers, most of which produce dense smoke if ignited. Fires in such materials are very difficult to extinguish. Their smoke contains highly toxic gases such as hydrogen chloride (HCl), carbon monoxide (CO), toluene diisocyanate, and hydrogen cyanide (HCN) (the latter being absorbable through the skin as well as through inhalation). Besides the immediate danger of these gases, there is the possibility of death from pulmonary edema (chemical pneumonia) 24 to 48 hours after exposure to HCl.

b. Following an anechoic chamber fire in 1973 in NRL-DC Building 56, a research project was started in the Navy Technology Center for Safety and Survivability (Code 6180) to determine fire prevention, fire fighting, and hazard control procedures. The measures developed by Code 6180 are contained in this instruction.

5. Policy. All anechoic chambers at NRL shall meet the design requirements and have the safety features and precautions described in this instruction. A fire inspector shall be assigned to each anechoic chamber to carry out fire safety responsibilities. Design specifications for all new anechoic chambers shall be submitted to the Safety Branch (Code 1240), the NDW Fire Department (Code 1250), and the Research and Development Services Division (Code 3500) for review prior to construction.

6. Definitions. For purposes of this instruction, an anechoic chamber is any device or installation in which quantities of polymers (e.g., polyurethane foam, polystyrene, polyvinylchloride, and

nitrile rubber) are used to reduce electromagnetic wave echoes. An anechoic chamber is generally located within a parent room.

7. Responsibilities

a. Code 1240 shall:

(1) Review designs for new anechoic chambers, and for modifications or renovations of existing anechoic chambers.

(2) Review anechoic chamber safety procedures submitted by chamber safety engineers.

(3) Review work requests and service calls involving maintenance or repair work in anechoic chambers and prescribe appropriate precautionary measures.

(4) Conduct evaluations of anechoic chambers during regularly scheduled workplace safety inspections.

(5) Inspect storage areas where bulk quantities of polymer materials are stored to ensure that material is stored properly and that protective measures are in place.

(6) Conduct, on request, evaluations of unusual odors associated with anechoic chambers.

(7) Conduct evaluations of conditions following an anechoic chamber fire before permitting personnel to reenter the area.

b. Division superintendents shall:

(1) Appoint an anechoic chamber safety representative for each anechoic chamber, including the parent room. One safety representative may be appointed for all anechoic chambers in each branch or division. The person(s) appointed must be thoroughly familiar with all anechoic chambers and with the operations conducted under their areas of responsibility.

(2) Review and approve written procedures prepared by the anechoic chamber safety engineers.

(3) Ensure compliance with this instruction and with the specific procedures developed by the anechoic chamber safety engineers.

c. Anechoic Chamber Safety Representatives shall:

(1) Review, within 90 days of assignment, fire safety procedures for all anechoic chambers under their responsibility to ensure compliance with the safety precautions provided in paragraph 8 of this instruction. Include in this review the procedures for handling classified materials in the event of a fire. If any

deviations from paragraph 8 are noted, such as lack of mechanical ventilation, provide the rationale for the deviation. Prepare appropriate amendments to the safety procedures where necessary. Send copies of the proposed amendments via the division superintendent to Codes 1240, 1250, and 6180.

(2) Ensure that all personnel working in their assigned anechoic chamber have been informed of the potential hazards of chamber fires and have received instructions on safe operating procedures and emergency evacuation procedures for the particular chamber.

(3) Monitor the operations in the chamber to ensure compliance with safety procedures and regulations. Report violations to the division superintendent.

(4) Ensure that all visitors are indoctrinated about the hazards associated with anechoic chamber fires prior to entry. This may be accomplished through an oral briefing, furnishing a briefing paper, or posting signs at each entrance.

(5) Review and approve plans for new chamber operations that may pose unusual fire hazards. Develop additional fire safety measures, as necessary, that are consistent with the precautions provided in this instruction.

(6) Correct any hazardous conditions noted by Code 1250 during periodic inspections.

(7) Coordinate with Code 3500 in planning and developing fire safety for new anechoic chambers, and modification/renovation of existing chambers.

(8) Route all work requests and service calls involving maintenance or repair work in anechoic chambers via Code 1240. Code 1240 shall review the type of work to be performed and prescribe appropriate precautionary measures to supervisory personnel.

d. Code 3500 shall:

(1) Review designs for new anechoic chambers, and for modifications or renovations of existing anechoic chambers.

(2) Provide guidance and recommendations for improving the fire safety of new and existing anechoic chambers.

(3) Provide instructions on the hazards of anechoic chamber fires to Code 3500 personnel when maintenance or repair work is to be conducted inside anechoic chambers. Code 1240 shall provide technical guidance on request.

e. Code 1250 shall:

(1) Review safety procedures submitted by anechoic chamber safety engineers and make recommendations for changes or improvements.

(2) Review designs for new anechoic chambers, and for modifications or renovations of existing anechoic chambers, and make recommendations for changes or improvements.

(3) Assign a fire inspector to each anechoic chamber and conduct inspections of anechoic chambers during regularly scheduled building inspections. Provide the chamber safety representative with a written report of any identified discrepancies.

(4) Conduct an annual fire prevention training class and evacuation drill for each anechoic chamber.

8. Safety Precautions. It is essential in preventing anechoic chamber fires to eliminate sources of ignition such as overheating cables or motors, welding, soldering, smoking, or anything that could produce the heat necessary for ignition of anechoic chamber material or of materials used inside the chamber; and to educate anechoic chamber personnel about fire hazards.

a. The following signs shall be posted:

(1) At all entrances to buildings containing anechoic chambers, a Building Fire Bill (NAVFAC-11320/9) and a sign stating:

> "This building contains an anechoic chamber facility that shall produce lethal gases when exposed to fire. In the event of fire, evacuate the entire building."

(2) At all entrances to a chamber, signs stating:

> "No person shall work alone in this anechoic chamber if the operation poses an unusual fire hazard, or if the person is required to work at elevated heights or to perform some other type of work that exposes him/her to unusual safety hazards. In such situations, other personnel shall remain within voice and/or visual contact in order to summon help in the event of an emergency."

> "Warning! This chamber is not designed for high-power density application."

> "This anechoic chamber facility shall produce lethal gases when exposed to fire. In the event of fire, evacuate the entire building."

b. The following safety features and precautions shall apply:

(1) The annunciator panels for the fire protection system and the controls for the ventilation system (see paragraph 8b(3) below) shall be located outside the parent room so that Code 1250 personnel must not pass through heavy smoke to reach the panels or ventilation controls.

(2) All fire locator controls and evacuation pull stations shall be located outside the hazardous area and as close as possible to the emergency exits.

(3) Mechanical ventilation shall be provided to remove smoke in case of fire. The ventilation system should have the capability of removing smoke from the anechoic chamber or the parent room separately or at the same time. The objectives of providing ventilation are to remove smoke so that firefighters can see and to reduce smoke damage to the rest of the building.

(4) If an unusual odor is noticed in the vicinity of the chamber, call Code 1240 on 767-2232 for an evaluation. If smoke or fire is detected, call Code 1250 immediately on 767-3333; do not wait for an evaluation by Code 1240.

(5) Electrically operated doors to chambers should have a remote control switch located outside the parent room.

c. The following safety precautions shall be incorporated into the "Safety Procedures" developed by the anechoic chamber safety representative for each chamber:

(1) Equipment shall not be left operating in the chamber while the chamber is unattended unless required for operational needs. If equipment is required to be left operating, it must be kept at least 3 inches away from the polymer lining, it must be positioned so that air can circulate freely around it, and it must not generate enough heat to feel hot to the touch.

(2) Flammable or combustible liquids shall not be handled or stored inside the chamber unless absolutely required. Before starting repair operations using volatiles or solvents, or tests that involve the use of fuels, the chamber safety representative’s approval must be obtained and Code 1250 must be notified. Alcohol, commonly used to clean electrical components, should be replaced by nonflammable, non-ozone-depleting materials such as Genesolv 2004 or Inonox MC. If the use of flammable liquids is approved, personnel shall wear electrically conductive shoes or grounding straps to bleed off static electricity.

(3) Sources of ignition shall not be permitted inside of or in the vicinity of the chamber except by special approval of the anechoic chamber safety representative. Extreme caution should be used when using soldering guns and high-intensity lights in the

chamber. Portable fluorescent lights are cooler and should be used when portable lights are required. Oxyacetylene and arc welding are prohibited inside anechoic chambers.

(4) All polymer materials (as defined in paragraph 6) that are not installed in anechoic chambers shall be protected from becoming ignited. Such materials shall be stored away from electrical equipment, flammable liquids, welding and soldering operations, and other such conditions that may promote ignition. Preferably, loose polymer materials should be stored in metal cabinets with signs posted reading: "WARNING. This cabinet contains polymer materials that produce lethal gases when ignited or exposed to flames. Keep all ignition sources and flammable liquids away. In the event of a fire involving this material, call the NDW Fire Department on 767-3333 and evacuate entire building." Storage of quantities of bulk polymer materials exceeding two cubic yards, such as new material in cartons awaiting installation, shall be approved by Code 1250.

(5) Polymer materials for new chambers shall be of the highest flame-retardant material available unless operational requirements call for a lower-rated material. Deviations from the design requirements specified in paragraph 8b may be authorized to meet operational requirements; requests for such deviations shall be reviewed carefully by all parties concerned.

(6) Before using electrical equipment in the chamber (including temporary flexible wiring or exposed power supply terminals), the voltage between the chamber ground and equipment chassis shall be measured across a 10 ohm resistor. The voltage shall not exceed 0.5 volts.

(7) If a current interruption device activates, all activity shall cease and the area shall be inspected before power is restored.

(8) In the event that fire or smoke is detected, the first concern is for personnel safety. If possible, steps should be taken to contain a fire within the chamber to prevent involvement of the entire building. However, <u>personnel should take no actions that would seriously endanger their personal safety</u>. All personnel arriving at the scene of the fire should be advised of the hazard of breathing toxic gases and of the dangers of absorption of smoke through the skin. In case of fire, the procedures below shall be followed, in the order listed, by the personnel near the fire who presumably set off the fire alarm:

(a) Notify Code 1250. Use automatic fire alarm if possible.

(b) Shut off all electrical power to the chamber, including lighting.

(c) Secure all ordinary doors to the chamber. (Any electrically operated door should be closed by the remote switch outside the hazardous area after determining that no one remains inside the chamber.)

(d) Evacuate all personnel from the building to a specified location to facilitate accounting for personnel and for providing information to Code 1250. Chamber procedures should specify the meeting area.

(e) Actuate CO_2 suppression system if available. Water deluge systems should be actuated only by order of the anechoic chamber safety representative or Code 1250.

(f) Evacuate all personnel from the building.

(g) Chamber ceiling vents should be opened only by Code 1250.

(9) After a fire, the chamber should not be entered until permission has been granted by Codes 1240 and 1250.

(10) Special precautions should be taken for some time after a fire since gases generated by the fire are readily absorbed on surfaces of the chamber. If the chamber has been closed for a period of time, toxic gas concentrations can build up inside. Chambers should therefore be ventilated continuously, and toxic gas levels should be measured before entering.

9. <u>Forms Availability</u>. Building Fire Bill (NAVFAC 11320/9 (4-67)) is available from the Occupational Safety and Health Section (Code 1241).