INTERNATIONAL HALON REPLACEMENT WORKING GROUP

A Message From The Coordinator's Office

October 28, 1996

Dear International Halon Replacement Working Group Member:

Enclosed please find a copy of the Minutes/Information Package of the October 9-10, 1996, meeting held in England.

Please note that included with the minutes is a copy of the Halon Replacement Schedule, the Minimum Performance Standard for Lavatory Trash Receptacles for final comment by November 25, 1996, a copy of the FIREDASS Program Cargo Compartment Minimum Performance Standard for comments by November 25, 1996, and a copy of the Handheld Extinguisher Minimum Performance Standard draft for review only (no comments are requested at this time).

A Meeting Details Package will be sent out under separate cover in advance of the April 1997 meeting. This package will include meeting location information and a Preliminary Agenda.

Please contact me if you have any questions or need any additional information. My telephone number is 609-485-4471, and my fax number is 609-646-5229.

Sincerely yours,

April Horner

April Horner

Enclosure

Sponsored by:
Federal Aviation
Administration
Technical Center

INTERNATIONAL HALON REPLACEMENT WORKING GROUP MEETING

October 9-10, 1996

Held at British Airways Club, Hatton Cross, England

OCTOBER 9, 1996

Schedule for Halon Replacement Program Update - R. Hill

From the research perspective we are going to assume that Class 'D' cargo compartments will be converted to Class 'C' cargo compartments.

A copy of the Revised Halon Replacement Schedule is enclosed in this package.

Due to the FAATC Fire Safety Section engineers' involvement in the ValuJet, the TWA 800 and the Federal Express DC-10 accident investigations, the research schedule at the FAATC has been revised.

Cargo Compartment: We (FAATC) plan to begin the CF3I tests within the next few months, but we will be doing some tests on oxygen generators for the NTSB prior to the public hearings in November on the ValuJet accident. We plan to have the tests on FM200, FE25, and CF3I completed by the end of Spring 1997.

Our (FAATC) full staff of engineers has been involved in the above discussed accident investigations, therefore, some adjustments have been made and will have to be made to this schedule.

M. Potchkat: Would you (FAATC) accept help from industry in running the tests since you have a lack of manpower? R. Hill: As long as there is no perception of unfairness. In running the program to develop standards, we have to make sure that there is no perception that one company had influence in making the regulations. We are agreeable to this.

D. Dierdorf: Will the results of the cargo compartment tests be suitable to publish the certification criteria at the end of Spring 1997? R. Hill: No, we figure it will take about a year more to develop the certification criteria for the cargo compartment. We are figuring on May 1998 for the completion of the halocarbon cargo compartment certification criteria. A. Gupta: Will you have the test methods by Summer 1997? R. Hill: We will have the test methods as we have run them. We still must look into toxicity.

Cargo Compartment: We (FAATC) will look at Water Mist systems once we complete the halocarbon tests in the cargo compartment area. This work will not begin until at least January or February. The timing of this work will vary because of manpower at the FAATC and because of the potential requirement for the conversion of Class 'D' to Class 'C' cargo compartments. FAATC research personnel may make a recommendation based on test data on safety. The research side (of the FAA) provides technical data to the regulatory side in preparing minimum performance standards by providing information on what agents/systems have been found to be equivalent to Halon.

Engine/APU Schedule: We (FAATC) plan to have the engine nacelle simulator up and operational by mid-Spring 1997.

Lavatory Trash Receptacle: This is done. R. Sears will give a presentation during this meeting. A copy of the Minimum Performance Standard is included in this package for final comments. The comments are due to April Horner by Monday, October 25, 1996.

Handheld Extinguishers: The CAA funded work at Kidde-Graviner to design a test for handheld extinguishers. The FAATC has reproduced that test, and there are only a few items to discuss and finalize prior to the publication of a Technical Note on this.

SUBGROUP LEADER PRESENTATION/UPDATES

CARGO - We (FAATC) ran FE25 concentration tests. We will be running tests on CF3I as discussed earlier.

FIREDASS: Clive Goodchild (GEC) gave brief description of the FIREDASS work and a brief timeline of the work planned. A. Gupta: Is FIREDASS part of the IHRWG? R. Hill: Our draft minimum performance standard was adapted for use in the FIREDASS program. N. Povey: Even with the computer modeling of FIREDASS, the participants in FIREDASS still believe that tests will be required. R. Hill: FIREDASS Is an R&D project to see if computer models can be used in the future. We will send the draft minimum performance standard the FIREDASS group comes up with through the IHRWG for comments.

ENGINE NACELLE SIMULATOR - D. Ingerson

Gave update on status of FAATC engine nacelle simulator. A copy of his presentation is included in this package.

D. Catchpole: Is it possible to use the test data obtained at Wright Patterson? D. Ingerson: their simulator is different than ours. Wright Patterson is trying to do something different than we are. R. Hill: The design equation is different. D. Ingerson: We (FAATC) don't use design equations. D. Dierdorf: We had a promise earlier that the Wright Patterson simulator would be available again in the Spring, is this still accurate? D. Ingerson: I will check into this. B. Glaser: What is the status of the minimum performance standard for the engine/APU? R. Hill: This will be discussed later today.

HANDHELD: We (FAATC) are looking into toxicity if there is a large fuel spill on a seat/ignition source in the cabin.

CEAT TOXICITY TESTING - A. Chattaway

A screening test has been proposed at CEAT. A. Chattaway presented the proposed screening test program and test apparatus. R. Mazzone: Do you have a detailed test plan? A. Chattaway: Yes, it will be included in the meeting minutes.

LAVATORY EXTINGUISHER - R. Sears

Reported on changes made to Minimum Performance Standard for Lavatory Trash Receptacle Fire Extinguishers after the July 1996 IHRWG meeting. R. Mazzone: How do we arrive at closure for this Minimum Performance Standard? R. Hill: If the Task Group that was working on this standard is in agreement, we will send the standard out to the Working Group with the Minutes for review. We (FAATC) will then finalize the report that Bob Glaser began some time ago and publish the report with the Minimum Performance Standard included.

There was some discussion on what was determined at the July 1996 IHRWG meeting about the "SNAP approved..." statement in the Minimum Performance Standard. D. Dierdorf: Not only do you have to worry about whether the container is an occupied or unoccupied area, but you have to consider the agent concentration.

DISCUSSION ON MINIMUM PERFORMANCE STANDARDS

Status of Lavatory Trash Receptacle Minimum Performance Standard

It will be incorporated into the technical report that the Task Group has put together (B. Glaser was chairman of this Task Group about 1 1/2 years ago). The Minimum Performance Standard will be reviewed by the Task Group to make sure that all members concur. Once all Task Group members concur on the Minimum Performance Standard, it will be circulated with the Meeting Minutes. Working Group members will have an opportunity to review and give comments (there will be a short period of time for comments-comments will be due back to April Horner by Monday, November 25, 1996). The intent is to have this report published by the end of 1996.

Status of Handheld Minimum Performance Standard

A copy of this Minimum Performance Standard as it stands now (there are still some holes in it) will also be circulated with this Minutes Package as information (one page - no comments will be requested at this time). The hidden fire test method can be attached to this Minimum Performance Standard. We still need to establish what a pass/fail is for the hidden fire test.

Status of Engine/APU Minimum Performance Standard

H. Mehta - A copy of the draft of the Minimum Performance Standard was distributed for comments with the July 1996 Minutes Package, so everyone has had a chance to comment on this. We welcome any comments on the Minimum Performance Standard. Send your comments on the Minimum Performance Std to Doug Ingerson at the FAATC (his mailing address is included in the List of Attendees). H. Mehta has gone through the AIA to obtain information on what engine/APU materials will be affected by the agent (this is a concern about corrosion on certain parts of the engine/APU) from the engine/APU manufacturers. He is looking for the engine/APU manufacturers to do some testing with the 3 possible alternative agents on the engine/APU materials they think will be affected. *ACTION ITEM*: Any WG member that has specific capability questions should give them to H. Mehta to be incorporated in his questions to the engine/APU manufacturers. J. Paillet: We should invite the engine manufacturers to these Working Group meetings.

Status of Cargo Compartment Minimum Performance Standard

We have a Minimum Performance Standard that has been produced for the FIREDASS Program. This will be the initial Minimum Performance Standard for cargo compartments. It has been suggested that we set up a Task Group to meet prior to or after the April 1997 meeting to go through it. We will send out a copy of the FIREDASS Program cargo compartment Minimum Performance Standard with this Minutes Package for comments back to N. Povey by Monday, November 25, 1996.

OCTOBER 10, 1996

CONVERSION OF CLASS 'D' TO CLASS 'C' CARGO COMPARTMENTS AND AVAILABILITY OF SYSTEMS/AGENTS - R. Hill

D. Dierdorf - Pacific Scientific has refit kits available at a cost of $25,000-$30,000 per airplane available for a short time. These are detection and extinguishing systems with Halon 1301. It is a two-shot system. 33-lbs. of agent per bottle for cargo compartments of 750 to 1,000 cubic feet.

R. Hill - Can this system be modified easily for another agent? D. Dierdorf - We are looking into a system that can be converted for use with other agents.

J. Blackburn - Do any of the European airlines have any comments?

H. Humfeldt - Lufthansa cannot spend any money to convert 'D' to 'C' unless there is a request from authorities. We will follow what the request states.

F. Stossel - Swissair does not know if the systems that we have installed already will fulfill the FAA requirement. R. Hill - The rule may require 'D' to be converted to 'C'. At this time there is no rule.

INTEREST IN CONTINUING ALTERNATIVE AGENTS TASK GROUP - R. Hill

Is group interested in continuing with this Task Group? S. Hariram - The first report was very beneficial, and we should continue this Task Group. Consensus: Keep this Task Group going.

TASK GROUP LEADER PRESENTATIONS/UPDATES

Halon Restrictions Update - J. O'Sullivan

Gave update on latest discussions on Halon restrictions.

Fire Alarm Survey Update - J. O'Sullivan

As of the July 1996 meeting, we had received a poor response to the survey. G. Rountree at ATA distributed survey to the airlines through his organization. A. Gupta expressed concern about the detection systems in cargo compartments and the occurrence of false alarms. Member comment - The detection systems today need to be optimized to reduce the occurrence of false alarms.

G. Sarkos/J. O'Sullivan Task Group

Gus and John put together a report outlining what has been done towards halon replacement. We have covered the events over the past two years which we would like to use to explain to those in power why it will take some time to find halon alternatives in aviation.

G. Sarkos: - Update on Work he and J. O'Sullivan did on Halon - He wrote the newsletter from the point of view of past accidents and incidents and that this working group guides the efforts on an international level with regulatory authorities and industry to address the problem of halon replacement. I sent a copy to J. O'Sullivan and N. Povey for their input. John and Nick will get together to globalize this document and return their input back to Gus. J. O'Sullivan - This publication will be used as a PR piece. When this publication is completed, it can be distributed to the members of the working group.

A. Gupta - The aviation industry is a small user of halon. Do other industries such as the oil industry have a similar group? D. Catchpole - The oil exploration and production industry has a group working to remove halon systems especially in the North Sea.

A. Gupta - Is Germany allowed to export halon? H. Humfeldt - I tried to export halon out of Germany, but in Germany we are not allowed to transport waste over the borders. The recycled halon was considered waste by the authorities. It took me one year to get approval for this halon to be transported to England. We had to get a written bank guarantee that this halon would be returned to Germany to be destroyed. In Germany, the rules on halon are not mandated by the central government. The regulations on halon are handled by district.

R. Hill - Is there still a need for a standardized methodology to use simulants for the certification of Halon 1301? Consensus: Yes, there is a need. D. Dierdorf: When will the FAA as a certifying agency allow the use of a simulant? R. Hill - The reason we put this task group together was to define how the simulant would be used as in the engine nacelle. N. Povey - The main emphasis of this Task Group was for the authorities to get information from data on the use of simulants from companies like Rolls Royce, etc. R. Hill - What should we do with this Task

Group? *ACTION ITEM*: Nick Povey will contact B. Leach and C. Womeldorf to see what the status of this group is and if they have been continuing their work in this task group and plan to continue with it. R. Hill - We need people from industry to provide us with this data. D. Dierdorf - We need input from the FAA ACO offices on what data they need from us. Member question: Is there a rule in place now that states that you cannot discharge halon to certify a system? R. Hill - Yes, there are a number of places in the world where it is illegal to discharge halon to certify a system. There are parts of states in the U.S. where it is illegal to discharge halon to certify a system. C. Lewis: There are places in Canada where it is illegal to discharge halon to certify a system. There are rules in place in Canada where it is illegal to transport halon on the roads. Consensus: We will wait to see what B. Leach and C. Wolmeldorf's response is when Nick talks to them. N. Povey: Who has an interest in continuing this task group? (Douglas has an interest in continuing this task group). D. Dierdorf - Would like to see this Task Group continue if the scope of the group is expanded to include quality assurance, etc. R. Hill suggested that D. Dierdorf join the Task Group and ask other Task Group members to include these areas.

ADDITIONAL DISCUSSION

CARGO COMPARTMENT MINIMUM PERFORMANCE STANDARD SUBGROUP - This group will meet in Long Beach, California, in April either just before or just after the Working Group meeting.

N. Povey - This Working Group should explore some ideas to try to supply manpower for FAATC to continue testing. R. Hill - We are trying to obtain more funding and manpower. We are willing to work with companies when it is possible to accomplish the work.

R. Hill - We need industry to let us know exactly which agents they would consider using to replace halon. One big difference is that when there is a deep-seated class 'A' fire the agent is required to suppress the fire to a low rate of burning for the length of time that the airplane is in flight with passengers right over top of it. Other agents cannot handle this type of suppression as halon 1301 can.

WORKING GROUP MEMBER PRESENTATIONS

Peter Haaland - "High Efficiency Nacelle Fire Suppression"
Richard Sears - "Lavatory Trash Receptacle Extinguisher Replacement Agent"
Terry Simpson - "Recent Alternative Agent Test Results in Walter Kidde Aerospace Small Scale Aircraft Engine Fire Simulator"
Matt Kolleck - "Booz, Allen, Hamilton and Wright Patterson Laboratory Projects"

NEXT MEETING

The next meeting will be hosted by Douglas Aircraft Company in Long Beach, California, on April 15-16, 1997. The meeting will be held at WestCoast Long Beach Hotel. All Working Group members will receive complete meeting details prior to the meeting.

SPRING TASK GROUP MEETINGS

Sham Hariram has made arrangements for conference room space at the hotel the afternoon and evening of Monday, April 14, 1997, for Task Group Meetings. If your Task Group would like to meet at that time, please contact April Horner by Monday, March 10, 1997, so that she may assign a meeting time and notify your Task Group members. This will ensure that all Task Groups planning to meet that day are given an opportunity to use the conference room.

LIST OF ATTENDEES

INTERNATIONAL HALON REPLACEMENT WORKING GROUP MEETING

October 9-10, 1996

NAME	ORGANIZATION/ AFFILIATION	ADDRESS	PHONE/FAX
Russell Stark	Autronics Corp	325 E. Live Oak ave arcadia, Ca 91006	PHONE: 818-445-5470 FAX: 818-446-0014
ALANKAR GUPTA	BOEING	M/S 02-WF P.O. Box 3707 SEATTLE, WA 98124	PHONE: 206-294-3179 FAX: 206-294-7434 Email: Alankar.Gupta@boeing.com
SIMON CHAER	CERBERUS GUINARD	617, RUE FOURNY 78530 BUC FRANCE	PHONE: 33-1-30.84.66.34 FAX: 33-1-39-56-13.64
SHAM HARIRAM	MCDONNELL DOUGLAS DOUGLAS AIRCRAFT COMPANY	MAIL CODE 800-32 3855 LAKEWOOD BLVD. LONG BEACH, CA. 90846	PHONE (310) 593-4305 FAX (310) 593-7104
RICH MAZZONE	BOEING - PAYLOAD SYSTEMS	M/S OR-TL P.O. BOX 3707 SEATTLE, WA 98124	PHONE: (206)-266-9994 FAX: (206)-717-0433
ERIC LYON	CHUBB FIRE	LANCASTER ROAD CRESSEX BUSINESS PK HIGH WYCOMBE BUCKS HP12 3QF UK	PHONE: +44(0)1494 441114 FAX: +44(0)1494 531710
Bill Bowen	United Airlines	Maint. Operations Center San Fran. Int. Airport San Francisco, Calif. 94128	PHONE: (415) 634-4783 FAX: (415) 634-4215
Clive Goodchild	GEC Marconi Avionics	Mission Avionics Division Airport Works Rochester Kent ME1 2XX	PHONE: 01634-844400 Ext4777 FAX: 01634-816721
R.H. (Dick) Lewis	GEC Marconi Avionics	— " —	PHONE: 01634 816017 FAX: 01634 816030
HARRY MEHTA	BOEING COMMERCIAL AIRPLANE GROUP	M.S. 49-53 c/o BOEING Co. P.O. BOX 3707 SEATTLE, WA 98124-2207	PHONE: 206-655-5069 FAX: 206-655-4955
CLAIRE DODD	DEPARTMENT OF THE ENVIRONMENT	B259, ROMNEY HOUSE 43 MARSHAM ST LONDON SW1P 3PY	PHONE: 0171 276 8196 FAX: 0171 276 8285

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INTERNATIONAL HALON REPLACEMENT WORKING GROUP MEETING

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NAME	ORGANIZATION/ AFFILIATION	ADDRESS	PHONE/FAX
CLAUDE LEWIS	TRANSPORT CANADA - CIVIL AVIATION	TOWER 'C', PLACE DE VILLE 330 SPARKS ST. OTTAWA, ONT. CANADA K1A 0N8	PHONE: (613) 990-5906 FAX: (613) 996-9178
NICK POVEY	UK CIVIL AVIATION AUTHORITY	AVIATION HOUSE GATWICK AIRPORT W-SUSSEX RH6 0YR	PHONE: 44 1293 573... FAX: 44 1293 573981
STEVE JAMES	UK CIVIL AVIATION AUTHORITY SYSTEMS DEPT.	AVIATION HOUSE GATWICK AIRPORT WEST SUSSEX RH6 0YR	PHONE: 441293573116 FAX: 441293573975
DOUG INGERSON	FEDERAL AVIATION ADMINISTRATION HUGHES TECHNICAL CTR - USA -	HUGHES TECH CENTER BLDG 287 AAR422 FIRE SAFETY SECTION ATLANTIC CITY INT'L, NJ 08405 USA	PHONE: 609-485-4945 FAX: 609-646-5229
JOHN BLACKBURN	AVRO INTERNATIONAL AEROSPACE.	P/S 23A, AVRO HOUSE CHESTER ROAD, WOODFORD CHESHIRE, SK7 1QR, ENGLAND	PHONE: (44) 161 955 4028 FAX: (44) 161 955 4035
ADAM CHATTAWAY	KIDDE INTERNATIONAL RESEARCH	POYLE RD, COLNBROOK SLOUGH, SL3 0HB UK	PHONE: (44) 1753 766190 FAX: 44 1753 683810
TERRY SIMPSON	WALTER KIDDE AEROSPACE	4200 AIRPORT DRIVE WILSON NC 27896 USA	PHONE: 1-919-237-7004 ext. 296 FAX: 1-919-237-4717
DOUG DIERDORF	PACIFIC SCIENTIFIC	3916 JUAN TABO NE ALBOQUERQUE, NM 87111	PHONE: (505) 291-1109 FAX: (505) 291-1141
ROBERT PITTWOOD	PACIFIC SCIENTIFIC	8 BOSTON DRIVE BOURNE END BUCKINGHAMSHIRE SL8 5YS, U.K.	PHONE: (44) 1628 810252 FAX: (44) 1628 810124
JEROEN VAN DAM	K.L.M. Royal Dutch Airlines	P.O. BOX 7700 1117 ZL SCHIPHOL THE NETHERLANDS	PHONE: +31 20 6499128 FAX: +31 20 6488162
Hans Humfeldt	Lufthansa Technik	P.O. Box 630 300 22313 Hamburg Germany	PHONE: 49-40-5070 24 06 FAX: 49-40-50702385

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INTERNATIONAL HALON REPLACEMENT WORKING GROUP MEETING
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NAME	ORGANIZATION/ AFFILIATION	ADDRESS	PHONE/FAX
JOHN O'SULLIVAN	BRITISH AIRWAYS	TRIDENT HOUSE (S583) P.O. BOX 10 HEATHROW AIRPORT HOUNSLOW, MIDDX TW6 2JA UK	PHONE: 44-181-562-5660 FAX: 44-181-562-2026 E-MAIL: JOHN.J.O'SULLIVAN@BRITISH AIRWAYS.COM
GUS SARKOS	FAA	AAR-422, Bldg 201A FAA Wm J. Hughes Tech Ctr Atlantic City Airport, NJ 08405	PHONE: 609-485-5620 FAX: 609-485-4004
Bob Glaser	Walter Kidde Aerospace	4200 AIRPORT DR WILSON, NC USA 27896-9643	PHONE: 919 237-7004 FAX: 919 237-4717
DAVID BALL	KIDDE INTERNATIONAL	MATHISEN WAY, COLNBROOK, SLOUGH, BERKSHIRE SL3 0HB UK	PHONE: +1753 766189 +1753 682572 FAX: DBall@kg1.mhs.compuserve.com
RICHARD SEARS	WALTER KIDDE AEROSPACE	4200 AIRPORT DRIVE WILSON, NC USA 27896-9643	PHONE: 919 237 7004 FAX: 919 237 4717
DAVE CATCHPOLE	BP EXPLORATION (ALASKA)	P.O. Box 196612 ANCHORAGE ALASKA 99519-6612 U.S.A.	PHONE: 907-564-5038 FAX: 907-564-5020
ANDY MULLENDER	ROLLS-ROYCE (Commercial Aero Engines Ltd.)	P.O. Box 31 Derby DE24 8BJ UNITED KINGDOM	PHONE: +44 1332 249357 FAX: +44 1332 249513
YEHUDA TEOMI	ISRAEL AIRCRAFT INDUSTRIES	BEN-GURION INT AIRPORT ISRAEL 70100 DEPT. 1123	PHONE: 972-3-9357374 FAX: 972-3-9358986
GERARD CROLET	AIR FRANCE	AIR FRANCE MAINTENANCE ME-UX BP 10253 95704 ROISSY CDG CEDEX FRANCE	PHONE: 33-1-48-64-66-57 FAX: 33-1-48-64-08-27
Laurent GRUZ	DGAC/STPA	4, avenue de la Porte d'Issy 75015 Paris FRANCE	PHONE: 33 1 45 52 41 43 FAX: 33 1 45 52 61 76
John Petrakis	FAA	800 Independence Ave. Washington, DC 20591	PHONE: 202 267-9274 FAX: 202 267-5340

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NAME	ORGANIZATION/ AFFILIATION	ADDRESS	PHONE/FAX
Richard Uren	MoD(PE) C-130J Project	MAP22D, WALNUT 1C, MOD ABBEY WOOD #72 PO BOX 702, BRISTOL BS12 7DU	PHONE: 01179134635 FAX: " 961
FRED TUFNELL	MOD(PE) FS(AIR)42	MOD(PE) ABBEY WOOD MAPLE 0a #45 PO BOX 702 BRISTOL BS12 7DU	PHONE: 0117913428) FAX: 01179134933
PHIL SLEIGHT	BRITISH AIRWAYS ENGINEERING.	B4, TBA (S375) PO BOX 10 HEATHROW AIRPORT, HOUNSLOW, MIDDX. TW6 2JA	PHONE: 44-181-513-3707 FAX: 44-181-513-3733 E-MAIL: PHIL.P.H.SLEIGHT@BRITISHAIRWAYS
GRAHAM ROSS	ICI EXPLOSIVES	ARDEER SITE, STEVENSTON, AYRSHIRE, SCOTLAND KA20 3LN	PHONE: 44-1294-487213 FAX: 44-1294-487370
PETER HAALAND	Huntington Research + Engineering	518 W. LINDEN ST. LOUISVILLE, COLORADO USA 80027	PHONE: 303 604 6526 FAX: 303 604 6457
CHARLES MAY	MASS SYSTEMS, INC MSI	4601 LITTLEJOHN ST BALDWIN PARK CA. 91706 U.S.A	PHONE: 818-3374640 FAX: 818-337 1641
DENNIS TANNER	— " —	— " —	PHONE: — " — FAX:
NEIL PERCIVAL.	PERCIVAL ASSOCIATES LIMITED.	THE SIDINGS, KNOWLE, FAREHAM, HAMPSHIRE, PO17 5LZ ENGLAND.	PHONE: 01329 - 833814 (44) FAX: 01329 - 834013
GERALD WHITWORTH	NORTH AMERICAN FIRE GUARDIAN TECHNOLOGY	83 MANOR ABBEY RD LAPAL HALESOWEN UK. B62 0AB	PHONE: 44(0)121 421 4354 FAX: — DITTO. —
DAVID LIDDY	MINISTRY OF DEFENCE	2/80 METROPOLE BUILDING NORTHUMBERLAND AVENUE LONDON WC2N 5BL	PHONE: +171 218 4908 FAX: +171 218 4609
Felix STÖSSEL	SWISSAIR Technical Services	TEP 8058 ZURICH AIRPORT SWITZERLAND	PHONE: 41-1-8126930 FAX: 41-1-8129098

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NAME	ORGANIZATION/ AFFILIATION	ADDRESS	PHONE/FAX
Thomas Grabow	Daimler Benz Aerospace Airbus	Hünefeld str. 1-5 28199 Bremen Germany	PHONE: 49-421-538-4033 FAX: 49-421-538-4639
Marco Potschkat	Airbus Industrie	1, rond point Maurice Bellonte F-31707 Blagnac, Cedex France	PHONE: 33.05.61933759 FAX: 33.05.61934908
Jean PAILLET	Aerospatiale	316, route de Bayonne 31060 Toulouse Cedex 03 France	PHONE: 33056193 7165 FAX: 33056193 8874
Volker THEISS	Daimler-Benz Aerospace Airbus	P.O. Box 95 01 09 21111 Hamburg Germany	PHONE: 49407437-3916 FAX: 49407437-4727
MATT KOLLECK	BOOZ-ALLEN & HAMILTON	4141 COL GLENN SUITE 131 DAYTON, OH	PHONE: 513-429-9509 FAX: 513-429-9795
MARTIN STURLA	KIDDE AEROSPACE & DEFENSE	MATHISEN WAY COLNBROOK SLOUGH SL3 OHB ENGLAND	PHONE: 01753 766241 FAX: 01753 685126
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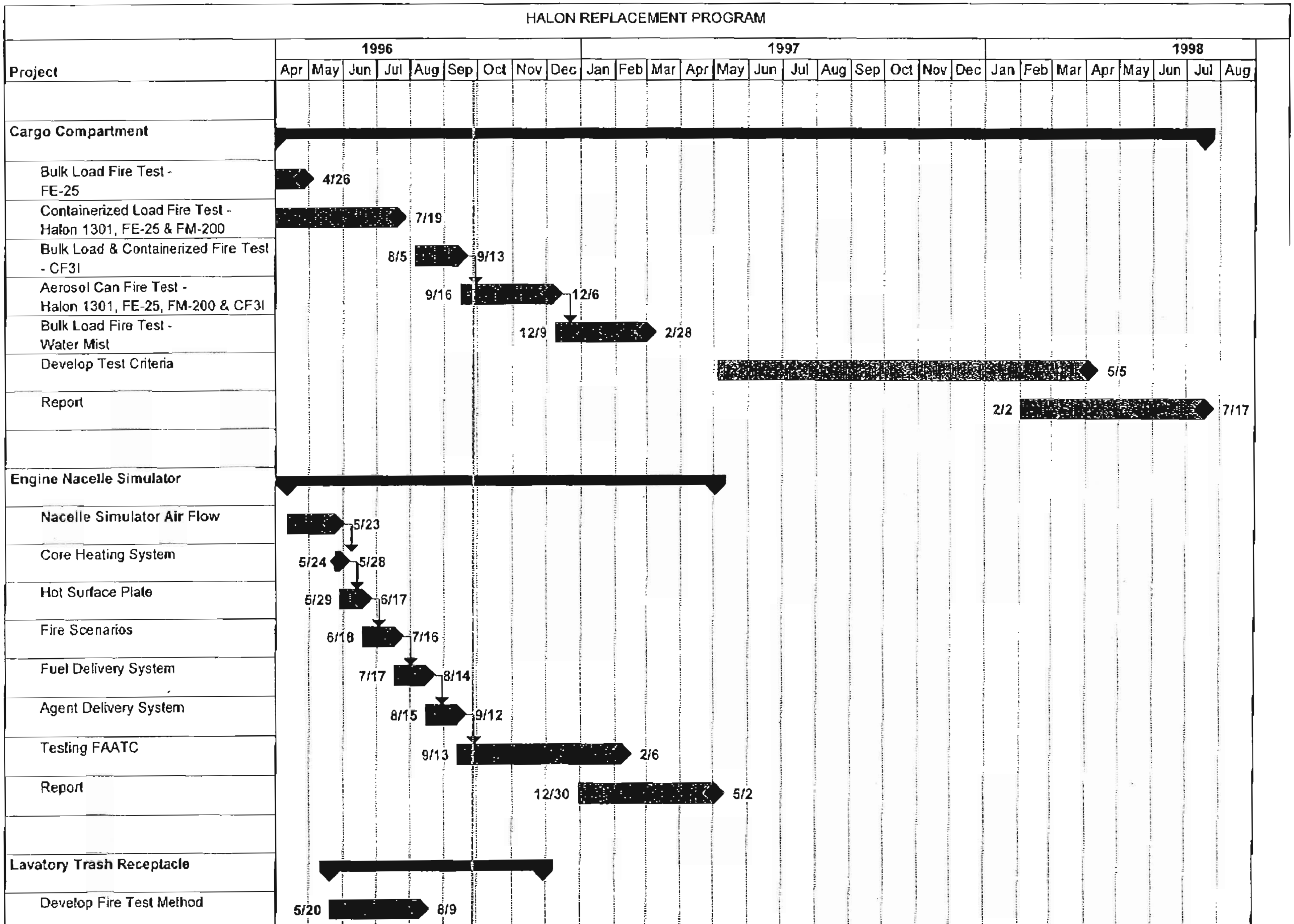
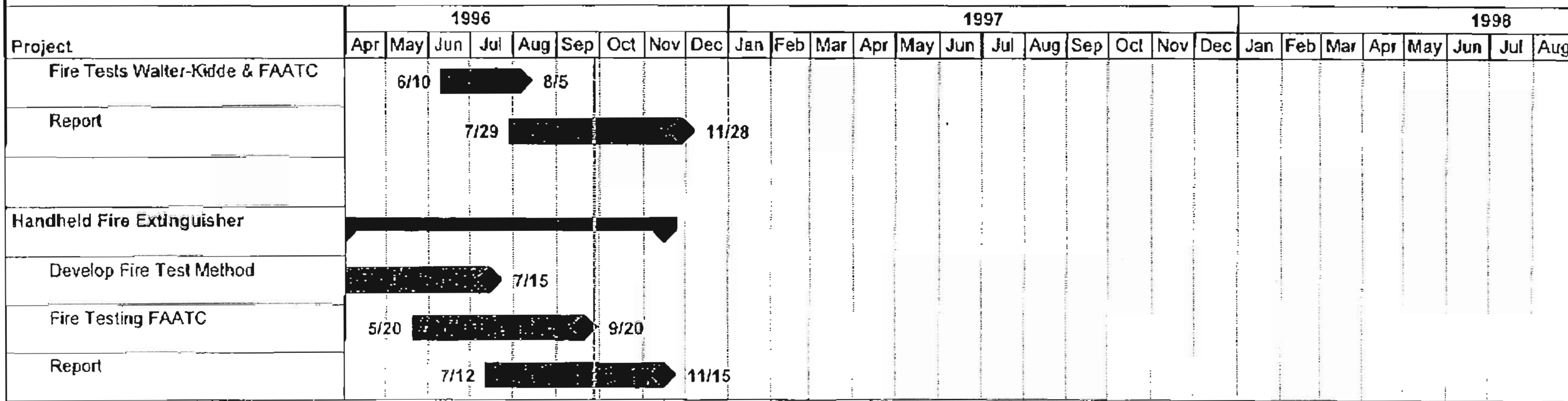

HALON REPLACEMENT PROGRAM
Project
1996
1997
1998
Apr May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr May Jun Jul Aug
Cargo Compartment
Bulk Load Fire Test - FE-25
4/26
Containerized Load Fire Test - Halon 1301, FE-25 & FM-200
7/19
Bulk Load & Containerized Fire Test - CF3I
8/5
9/13
Aerosol Can Fire Test - Halon 1301, FE-25, FM-200 & CF3I
9/16
12/6
Bulk Load Fire Test - Water Mist
12/9
2/28
Develop Test Criteria
5/5
Report
2/2
7/17
Engine Nacelle Simulator
Nacelle Simulator Air Flow
5/23
Core Heating System
5/24
5/28
Hot Surface Plate
5/29
6/17
Fire Scenarios
6/18
7/16
Fuel Delivery System
7/17
8/14
Agent Delivery System
8/15
9/12
Testing FAATC
9/13
2/6
Report
12/30
5/2
Lavatory Trash Receptacle
Develop Fire Test Method
5/20
8/9

HALON REPLACEMENT PROGRAM



THIS IS THE LATEST VERSION OF THE LAVATORY TRASH RECEPTACLE MINIMUM PERFORMANCE STANDARD - COMMENTS ARE DUE BACK TO APRIL HORNER BY MONDAY, NOVEMBER 25, 1996 (THIS IS YOUR LAST OPPORTUNITY TO SUBMIT COMMENTS)

Lavatory Disposal Receptacle Built-In Extinguisher
Halon Replacement Proposed Minimum Performance Standard

As required by 14 CFR 121.308(b), since April 29, 1987, each lavatory in every passenger carrying transport category airplane is equipped with a built-in automatic discharge fire extinguisher for each disposal receptacle for towels, paper, or waste located within the lavatory. Fire extinguishers, to be evaluated as a replacement for the currently used Halon lavatory extinguisher, must meet the performance regulations specified in BCA SCD 10-61909 and comply with the following proposed minimum performance standards:

(a) The agent, for use in areas occupied by humans, must be demonstrated to meet or exceed recognized national or international standards. The quantity of agent shall not exceed the NOAEL when distributed homogenously within the lavatory.

(b) The agent must be approved under the Environmental Protection Agency (EPA) Clean Air Act, Significant New Alternatives Policy (SNAP) program. Approved agents on the SNAP list must not exceed the established criteria for Ozone Depletion Potential (ODP) and toxicity.

(c) The fire extinguisher must successfully extinguish a test fire contained in the test receptacle after automatically discharging into the test receptacle in accordance with the test procedures specified below.

(d) Additional testing may be required to substantiate agent/system effectiveness in trash receptacles larger than the 1.333 cu ft volume test article. If an extinguishing system is to be used on receptacles of with internal volume larger than 1.333 cu ft, it is the responsibility of the manufacturer to demonstrate the effectiveness of a particular agent amount.

(e) Acceptance Criteria. Each lavatory receptacle automatic discharge extinguisher must meet the following criteria:

(1) Five extinguishers must be tested (the extinguisher must extinguish the fire during five successive tests).

(2) The discharge performance of the extinguisher must meet the requirements of BCA SCD 10-61909, which specifies maximum allowable design discharge temperature (usually $170^{\circ}F \pm 10^{\circ}F$).

(3) The test fire must be extinguished and must not re-ignite or flare-up after the access panel to the test receptacle has been opened.

(4) An extinguisher that meets the requirements for use in trash receptacles up to 1.333 cu ft is acceptable for use in a smaller receptacle, with a similar installation, without additional testing.

(f) Test Conditions. Each test must be performed under the following conditions:

(1) The ambient temperature must be 80°F $\pm$ 20°F

(2) The fire load materials described in (h) must be conditioned to 70°F $\pm$ 5°F and a maximum of 55% relative humidity until moisture equilibrium is reached for 24 hours. Note: the test must be initiated within 30 minutes of removal of fire load materials from the conditioning chamber if the atmospheric conditions within the test area are different.

(3) Agent Temperature. Temperature of extinguishant must be at or below 30°F <u>at the time the agent is discharged</u> into the receptacle (SEE APPENDIX).

note: if agent temperature rises above 30°F prior to lavex discharge, the test should be aborted and considered a non-test.

Example 1. Keep agent in a separate cold chamber during the test, ensuring that the temperature will be at or below 30°F. The chamber should allow the agent bottle to be as close to the discharge point as possible, to allow for the shortest possible transfer plumbing.

Example 2. Overcooling of agent. This method could be used when an accurate estimate of the elapsed time can be determined for the eutectic device to open (i.e. temperature in the receptacle to reach 170°F at the top) after initiation of the ignitor. This would allow the tester to back calculate the maximum amount of time available to ensure that the agent is at or below 30°F, once it is removed from the cold chamber.

(g) Test Apparatus. The test receptacle and extinguisher bottle installation is described below:

(1) Trash Receptacle Test Article. The test receptacle must be constructed of either aluminum or steel. The test receptacle apparatus for trash containers up to 1.333 cubic feet (.038 m^3) volume is shown in figure 1. All receptacle dimensions are internal measurements.

(i) The front of the test receptacle must contain a clear access panel constructed of fire resistant polycarbonate or glass to facilitate the visual observation. The access panel must be 9.5 inches wide $\pm$ .5 inches by 8.5 inches high $\pm$ .5 inches with the lower edge of the panel positioned 6 inches $\pm$ .5 inches from the bottom surface.

(ii) A 2.0 inch (5.08 cm) diameter hole must be centered 2 inches up the side of the test receptacle for ignitor insertion and must be sealed after insertion of the ignitor.

(iii) The front and back face of the test receptacle must have six 1.00 inch (2.54 cm) diameter holes (12 holes total) equally spaced for ventilation which are equipped with a mechanism for quick opening or closing.

(iv) A waste flap opening must be provided at the top of the test receptacle. The opening must be 6.20 inches (15.75 cm) by 6.20 (15.75 cm). A plate which is no more than .50 inches (1.27 cm) larger than the opening must be mounted .50 inches (1.27 cm) above the opening.

(v) The agent discharge tube must be centered in the top of the test receptacle, pointing straight down.

(2) Ignition Source. A standard electrical resistance ignitor must be used. The ignitor shall consist of a nichrome wire (nominal 0.025 inch diameter) with 15 loops of 0.25 inch diameter. The length of the ignitor (loop section) must be 1.25 inches $\pm$ .125 inch. To

ensure consistent test commencement, the voltage through the ignitor shall be adjusted to provide 1650°F ±50°F at the center point. The temperature at the center point should be calibrated as follows:
Step 1. Ensure thermocouple reading device is functioning properly.
Step 2. Mount 30 AWG thermocouple in center of a vertically positioned ignitor device, making certain that the wires do not come in contact with the ignitor (see fig 2).
Step 3. Energize ignitor and simultaneously start timing device. Measure temperature at 30, 60, and 90 seconds.
Step 4. Repeat 4 times for a total of 5 tests, using a new ignitor each time.

Note: ensure that ignitor temperature measuring set-up is protected from drafts.

(3) Thermocouples. The three thermocouples to be used for testing must be type K grounded with a nominal 30 American Wire Gauge (AWG) size conductor.

(i) One thermocouple must be installed on the fire extinguisher to measure surface temperature.

Note: in order to obtain the most accurate reading of the agent temperature, it is reccommended that the thermocouple be placed over a non-painted area on the agent vessel and covered using adhesive tape (this may necessitate light sanding of the painted exterior of the agent vessel).

(ii) One thermocouple must be installed at the centerline of the test receptacle.

(iii) One thermocouple must be placed to measure ambient temperature.

(4) Instrumentation. A data acquisition system or other suitable instrument with an appropriate range must be used to measure and record the output of the thermocouples.

(5) Timing Device. A stopwatch or other device must be used to measure the time of ignition energizing, smoke generation, open flaming, agent discharge, and extinguishment.

(h) Test Fire Load.

(i) Towel specification.

Type: Bleached, C-Fold Deep Embossed handifold towels
External dimensions: 10.25 inches by 13.25 inches
Weight: 4.5 ± 0.1 g per towel
Tensile Strength Dry (grams/inch): 707
Tensile Strength Dry (Kg/15mm): 0.42
Tensile Strength Wet (grams/inch): 189
Tensile Strength Wet (Kg/15mm): 0.11
Note: all Tensile strength test results derived from average of both directions
Absorbency (sec/0.1 ml): 30

Towels manufactured by:
Fort Howard Corporation
1919 South Broadway (54304)
P.O. Box 19130
Green Bay, WI 54307
Telephone: 1-800-558-7325

Fax: 1-800-635-6906
part number 244-00

Towels distributed by:
W.W. Grainger Inc.
(713) 748-8280
part number 2U215

(ii) Paper crumpling specification. Prior to loading the paper towels into the test receptacle, they must be opened and crumpled to simulate used hand towels. This can be accomplished by performing a free fill density procedure in which 340 paper towels, $\pm$ 10 towels are crumpled to fill an 18 X 18 X 18 inch container to the top level to ensure similarity of crumpling between the various testing facilities (note: this procedure may require several attempts in order to achieve the proper crumpling tightness). A total of 815 g $\pm$ 5 g of the crumpled paper towels will then be used in each test.

(i) Test Booth or Chamber. The test receptacle should be located in a booth or room containing adequate ventilation capabilities. The maximum air velocity directly adjacent to the test receptacle should not exceed 50 feet per minute.

(j) Test Procedure.

(1)Condition the fire load

(2) Weigh the extinguisher and record the value

(3) Set up data acquisition system

(4) Install and clamp the ignitor in the test receptacle 1 inch above the ventilation holes at the approximate centerline of the receptacle.

Note: a clipping device or other non-intrusive means to prevent the ignition source from skewing left or right when the paper is being loaded is helpful.

(5) Installation of fire load. Ensure that the entire bottom of the test receptacle is fully covered with a layer of pre-crumpled towels (also pack one or two pre-crumpled hand towels under the ignitor to prevent damage during subsequent loading). Finish loading remainder of 815 g $\pm$ 5 g of crumpled towels into the receptacle through the bin flap, making certain that the observation window is closed. If there is difficulty in fitting the entire 815 g of crumpled towels into the test receptacle, it can be shaken lightly to provide adequate space.
Note: the test must be initiated within 30 minutes of removal of fire load materials from the conditioning chamber if the atmospheric conditions within the test area or booth are different.

(6) Mount the conditioned fire extinguisher per manufacturers installation drawing.
Note: ensure that the agent temperature will be at or below 30°F at the time of discharge, as described above.

(7) Record initial ambient, extinguisher surface, and test receptacle temperatures.

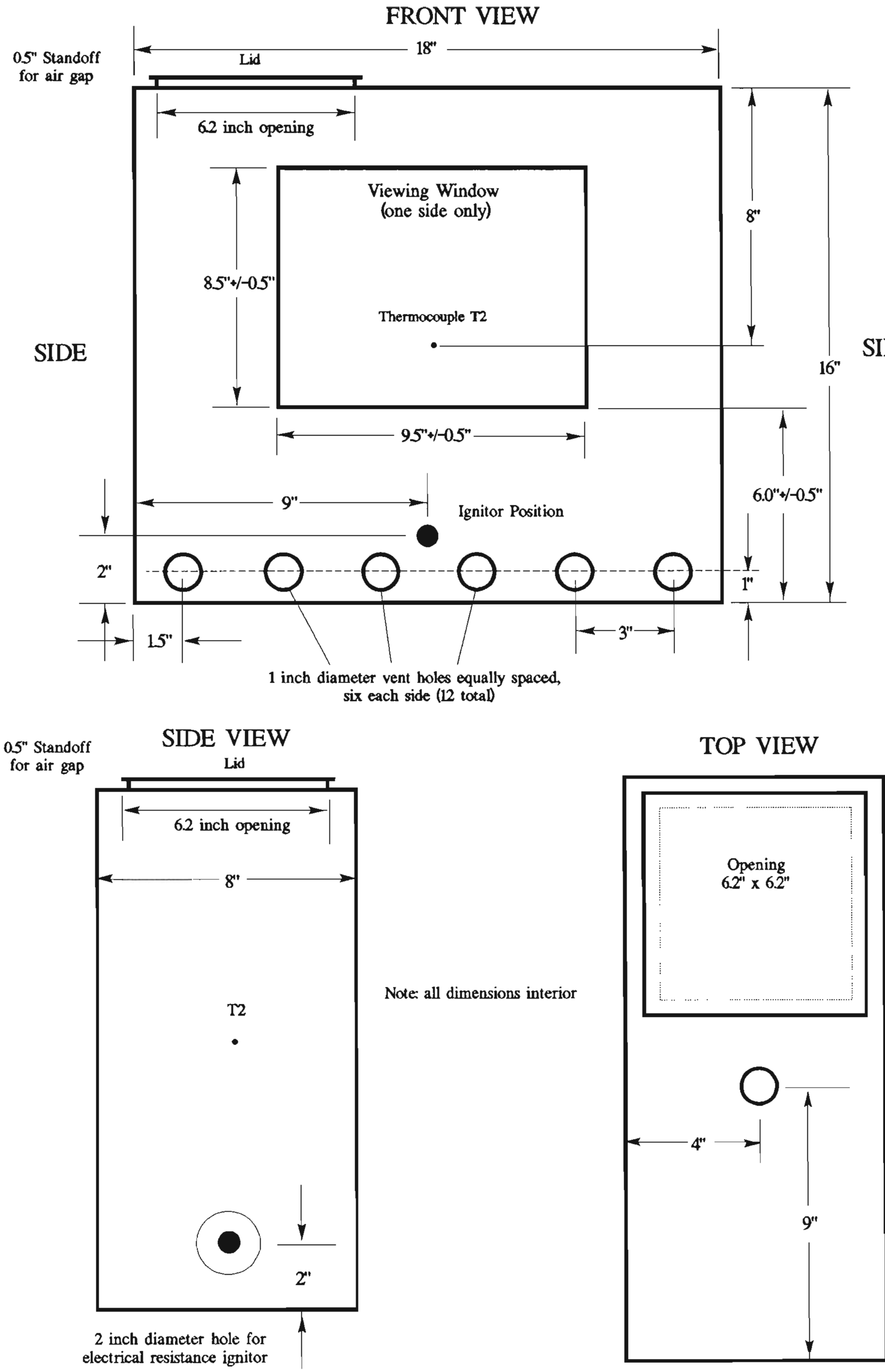


Figure 1. Standard Lavatory Disposal Receptacle For Evaluating Fire Extinguishing Agents

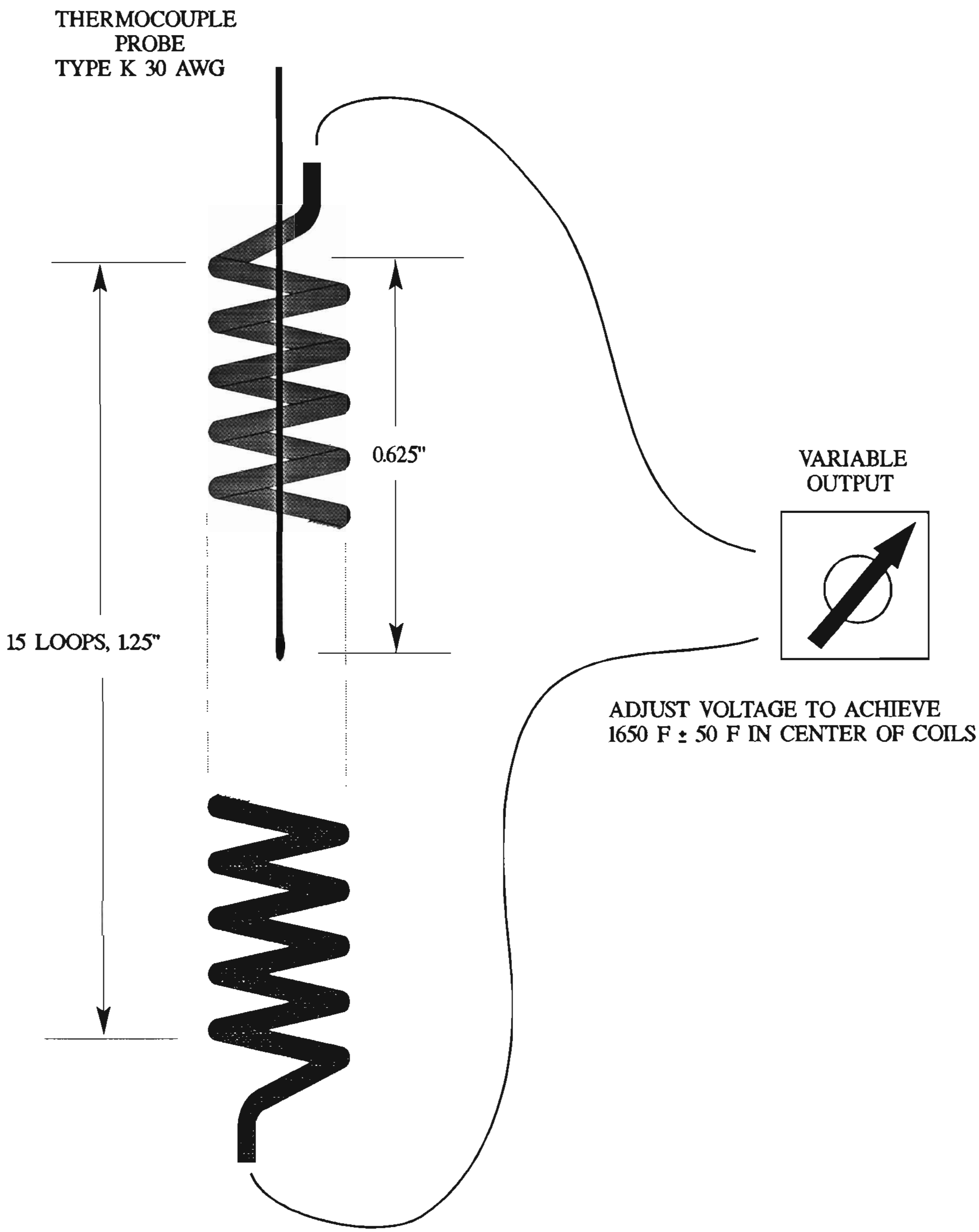


Figure 2. Ignition Source for Standard Lavatory Disposal Receptacle

FIREDASS

Fire Detection and Suppression Simulation

Minimum Performance Standard for Class C Cargo Compartment Fire Suppression/Detection Systems

CONTRACT N°: BRPR-CT95-0040

PROJECT N°: BE95-1977

TITLE: FIREDASS - Fire Detection and Suppression Simulation

PROJECT COORDINATOR: GEC-Marconi Avionics

PARTNERS: Cerberus Guinard
SINTEF NBL
University of Greenwich
National Technical University of Athens
DLR
Civil Aviation Authority

Subcontractor: Ginge Kerr

REPORT N° : 560/62198
Project Reference N° - 5.1-1
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FIREDASS
Minimum Performance Standard for Class C Cargo Compartment Fire Suppression Systems
Contract No. BRPR-CT95-0040
Project Reference No. 5.1-1
560/62198, Draft A, October 1996

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10	Halon Replacement Working Group	

ABSTRACT

This document provides guidance for the performance required of Fire Suppression Systems designed to replace the standard practice halon systems currently in use in aircraft Class C cargo bays in the fire threat conditions herein specified. This document supersedes report number 560/62186 which was issued July 1996. Throughout this document a vertical line in the margin indicates places where there has been a change in content from the previous report.

List of Active Sheets
as at October 1996

All sheets are at revision Draft A

Page	Revision
i-vi	Original
1-22	Original

Throughout this document a vertical line in the margin indicates places where there has been a change in content from the previous issue.

(8) Start data acqusition system

(9) Energize the ignitor (time =0) and begin to record the times to relevant events as described in k2.

(10) Upon extinguisher discharge:

(i) Remove power from the ignitor

(ii) Close all ventilation holes in the test receptacle

(iii) Record time of discharge

Note: if extinguisher does not discharge within 5 minutes of ignitor energizing, the test should be aborted and considered a non-test.

(11) After 5 minutes:

(i) if the temperature and visual observations indicate that combustion has ceased, open the access panel and secure it open.

(12) If after a further 2 minutes re-ignition does not occur:

(i) empty the compartment and spread the waste into a single layer.

(ii) observe and note any residual smoldering. Record the extent of fire load consumption, presence or lack of smoldering, etc. If residual smoldering is present, the test is a failure.

(13) if re-ignition does occur, the test is a failure:

(i) Extinguish the fire using water or other environmentally friendly method

(14) Weigh the discharged extinguisher to determine and record weight of agent discharged.

(k) Test Report. The test report must include the following:

(1) A complete description of the test receptacle and the fire extinguisher, including photographs, if appropriate.

(2) Details of the test results should include the temperature of the extinguisher surface, temperature of the receptacle, and the times from ignition energizing to generation of: smoke, open flaming, agent discharge, and end of test.

APPENDIX

Agent Temperature. Temperature of extinguishant must be at or below 30°F <u>at the time the agent is discharged</u> into the receptacle. This can be accomplished several ways, all of which can be left at the discretion of the testing facility or the appropriate certification authority (in a TSO, the FAA would typically use the standards of RTCA DO-160C, Environmental Conditions and Test Procedures for Airborne Equipment, 12/89, which in this case calls for a low temperature of 5°F. However, the original halon fire extinguising bottles with eutectic devices do not function properly below temperatures of 25°F, therefore all replacement agents must only be tested/discharged at or below 30°F).

FIREDASS
Minimum Performance Standard for Class C Cargo Compartment Fire Suppression Systems
Contract No. BRPR-CT05-0040
Project Reference No. 5.1-1
560/62196, Draft A, October 1996

CONTENTS

ILLUSTRATIONS

1. INTRODUCTION

This document provides guidance for the performance required of Fire Suppression and Detection Systems designed to replace the standard practice halon systems currently in use in aircraft Class C cargo bays in the fire threat conditions herein specified. This document supersedes report number 560/62186 which was issued July 1996. Throughout this document a vertical line in the margin indicates places where there has been a change in content from the previous report.

2. AIMS AND ADVISORY

2.1 System Requirement

The Class C cargo compartment fire suppression system must be designed and installed to allow the continued safe flight and landing of the aircraft in the event of a fire occurring in the cargo or baggage likely to be carried in that compartment.

2.2 Environmental

Existing fire protection measures, required by Airworthiness Regulations, are largely based on the use of halons. For all practical purposes, production of halons has ceased under the provisions of the Montreal Protocol. The primary environmental characteristics to be considered in assessing a new agent are Ozone Depletion Potential (ODP), Global Warming Potential (GWP), and Atmospheric Lifetime. The agent selected should have environmental characteristics in harmony with international laws and agreements, as well as applicable local laws. This Minimum Performance Specification sets out means of assessing the technical performance of potential alternatives, but in selecting a new agent it should be borne in mind that an agent which does not have a zero or near-zero ODP, and the lowest practical GWP and Atmospheric Lifetime, may have problems of international availability and commercial longevity.

2.3 Toxicological

The toxicological acceptability of an agent is dependent on its use pattern. As a general rule, the agent must not be allowed to present an unacceptable health hazard for workers during installation and maintenance of the extinguishing system. In areas where passengers or workers are present, or where leakage could cause the agent to enter the passenger compartment, at no time should the agent concentration present an unacceptable health hazard. Following release in fire extinguishment, the cumulative toxicological effect of the agent, its pyrolytic breakdown products, and the by-products of combustion must not pose an unacceptable health hazard

3. THE FIRE THREATS

The following fire threats shall be detected and suppressed to meet the protection criteria in section 5.

3.1 Deep Seated Within a Cargo Container

This is typically a fire resulting within cargo that is packed in an aircraft cargo container

3.2 Deep Seated Within Loose Luggage

This is typically a fire resulting within luggage loose stowed in slings or in appropriate cargo volumes.

3.3 Surface Fires

This fire is typically the surface burning of luggage (or Cargo), and ignited from external heat sources. The fuels may be the surface materials themselves or the spillage/seepage of inflammable substances or liquids from within the luggage/cargo.

3.4 Gas Explosions

See Appendix B

4. FIRE DETECTION

The fire detection system or systems must provide the Flight Deck crew with warning of the fire in accordance with JAR25.858(a)

5. PROTECTION CRITERIA

For the fires listed in Section 3 the fire suppression and detection systems shall provide protection of the aircraft equivalent to that obtained by approved Halon 1301 systems. This should include consideration of:

i) Structure and systems — The fire protection system shall ensure that the structure or essential systems do not experience any conditions (e.g. temperature) that could adversely effect the continued safe flight and landing of the aircraft

ii) Toxic Gas — Hazardous quantities of smoke, flames, or extinguishing agent must be excluded from any compartment occupied by the crew or passengers, in accordance with JAR25.857(c)(3).

iii) Aircraft Operation — The fire protection system shall not cause malfunction of any flight critical systems or components. The effects of possible breakdown products of the fire suppression agent should also be considered in the design.

Where there is Halon 1301 protection criteria data, then compliance can be proven by demonstrating that the fire protection system provides the equivalent level of protection.

6. SYSTEM REQUIREMENTS

6.1 System Fire Resistance

The fire protection system must be designed and installed so that the likely exposure of any system components to the effects of fire will not adversely affect the fire protection of the system.

6.2 Displays and Controls

6.2.1 Displays

As a minimum, displays shall be provided of:

- Fire Warning
- System Serviceability
- Fire Location (e.g. Which cargo hold or part of aircraft)

6.2.2 Controls

Controls shall be provided on the flight deck to discharge the fire suppressant agent or to arm the system where the agent discharge is an automatic function of the system. Other controls necessary to achieve the fire protection criteria as defined in Section 5 (e.g. ventilation controls) shall be placed in the same location as the controls to discharge the fire suppression agent.

6.3 System Reliability

6.3.1 Inadvertent Operation

Inadvertent operation of the fire protection system, shall not prevent the continued safe flight and landing of the aeroplane.

6.3.2 Reliability

The probability of the fire protection system failing to operate when required shall be such that the objectives of JAR 25.1309 are met.

6.4 System Performance Demonstration

The following shall be demonstrated by the fire protection system:

(1) The fire protection system shall demonstrate that the fires as defined in section 3.1. and 3.2 are controlled in accordance with the test requirements of Appendix A.

(2) The fire protection system shall not present a pressure hazard when discharged which will endanger the aircraft

(3) The fire protection system shall perform its intended function under all the environmental conditions of the aircraft operational envelope.

7. DEFINITIONS AND ABBREVIATIONS

7.1 Definitions

Fire Detection System	A system which differentiates between the presence and absence of a fire and annunciates a warning before the fire becomes hazardous or uncontrollable.
Fire Suppression System	A system which will control the fire.
Fire Protection System	The fire detection and suppression system

7.2 Abbreviations

FAA	Federal Aviation Administration
IHRWG	International Halon Replacement Working Group
IR	Infrared
NOAEL	No Observed Adverse Effects
TBD	To Be Determined

7.3 References

JAR 25	Joint Aviation Requirements for Large Aeroplanes
RTCA/DO-160	Radio Technical Commission for Aeronautics "Environmental conditions and test procedures for airborne equipment"
IHRWG	Likely threats in Class C Cargo Compartments Cargo Compartment Halon Replacement Agent/System Proposed Minimum Performance Standards
TSO6517	Defines LD3 Cargo containers

APPENDIX A - TEST REQUIREMENTS

A1 GROUND TEST CONDITIONS

Tests should be accomplished in test article under the following conditions:

A1.2 Air Flow Rate

The volumetric air flow rate before and after fire detection must be representative of any inflight air flow (ventilation and leakage) through the cargo compartment + 10% - 0%

For the FIREDASS programme, the following leakage airflow rates shall be used:

Test Cell	Volume	Surface Area	Leakage airflow
SINTEF Test Cell	31m^3 (1068 cu ft)	65m^2	12 litre/sec
GMAv cargo compartment	45m^3 (1600 cu ft)	45 m^2	18 litre/sec
DLR cargo compartment	105m^3 (3620 cu ft)	186 m^2	25 litre/sec

For the FIREDASS programme, any tests conducted with forced 'air conditioning' ventilation shall use an airflow system which will provide an air change in the compartment every 5 minutes.

Appendix C provides more detailed information on how these figures were derived and specifies the operational and physical conditions for the FIREDASS project

A1.3 Humidity

All combustible materials must be conditioned to 21°C ±11°C (70°F ± 20 °F) and at 65% maximum relative humidity until moisture equilibrium is reached or for 24 hours.

A1.4 Ambient Temperature

All tests must be performed at an ambient temperature of 21°C ±11°C (70°F ±20°F).

A1.5 Low Temperature

A test of the system and agent on a fire must be conducted at a temperature representative of the lowest average sustained temperature expected during the most severe operation. (Reference DO-160).

A2 FLIGHT TEST CRITERIA

A2.1 Acceptable Operating Conditions

In an empty compartment concentrations and operating conditions found acceptable under Appendix A5 are obtained and maintained for the duration of time required.

A2.2 Cargo bay Liners

The integrity of the compartment lining system is not breached. This must be evaluated by testing with a full compartment which would be the worst case for overpressurisation following system discharge.

A2.3 Conditions in Occupied Areas

Conditions in any occupied area of the aircraft must not exceed No Observed Adverse Effects Limit (NOAEL), during the above tests.

A3 TEST FACILITIES

A3.1 Baseline Test Article Size

A3.2 Cargo Compartment Test Articles

Test articles must be representative of aircraft cargo compartments.

A3.3 Cargo Test Article Size for Flooding Agents

Cargo tests with flooding agents must be conducted in test articles of 1000, 3000, and 5000 cubic feet + 10% - 0% for general applications or the most appropriate test article size for specific applications.

A3.4 Cargo Test Article Size for Directed Agents

Cargo tests for directed agents may be conducted in a test article in excess of 1000 cubic feet for general applications providing sufficient test evidence, is also provided to prove that test article volume has nil or a clearly quantifiable effect.

A4 TEST INSTRUMENTATION

Test articles shall as a minimum be equipped with the following calibrated instrumentation:

A4.1 Thermocouple

The thermocouple to be used for testing must be 1/16 inch ceramic sheathed, type K, grounded thermocouple with a nominal 30 American wire gauge (AWG) size conductor. Accuracy: ± 1°C ±0.375% or a suitably calibrated equivalent type.

Thermocouples are to be positioned a maximum of 1.7 metres apart longitudinally and a maximum of 1.5 metres apart laterally in the roof of the test article, and installed to provide temperature measurement 10 cms (4 inches) above the compartment liner.

A4.2 Gas Measurement

Should gas measurement be a mandatory measurement ?

The gas sampling and analysis unit used to measure the concentration of carbon monoxide, carbon dioxide and oxygen shall meet the following specification

	Gas Composition	Accuracy
Oxygen	0 to TBD% minimum (by volume)	<±TBD%
Carbon Dioxide	0 to TBD% minimum (by volume)	<±TBD%
Carbon Monoxide	0 to TBD% minimum (by volume)	<±TBD%

The gas sampling unit shall sample the gas concentration at a minimum of one point. The sampling point shall be positioned at the centre of the compartment cross-section, and at the maximum practical distance from the fire source.

A4.2.4 Air Flow

The air flow in the test cell shall be measured by appropriate flowmeter(s) located in the inlet duct(s). The flowmeter(s) shall have an accuracy of <5% of the measured value over the range specified in section A1.2.

A4.2.5 Air pressure

The pressure inside the test chamber shall be monitored using an appropriate pressure transducer. The transducer shall have an accuracy of <1% of the reading.

A5 TEST DETAILS

All tests must be conducted at least 5 times for each condition to ensure result credibility. This number may be reduced by agreement with the Certifying Authorities, where early test results provide evidence of particularly satisfactory performance.

A5.1. Baseline Test Fire Load

Class B materials consisting of one litre of Jet A fuel over 2.5 to 3 cm depth cold water with 100ml of automobile petroleum as an ignitor accelerator in a 1 metre x 1 metre square and 3cm max. deep pan, positioned in an empty cargo bay test article at two heights. The worst case location of the pan, with respect to system performance, must be used for each of the two defined heights.

A5.1.1 Height of Fire Load

A5.1.1.1 Bottom Height

0.25 metre from the floor

A5.1.1.2 Top Height

0.25 metre from the liner ceiling

A5.1.2 Baseline Test Ignition

Electrical or pyrotechnic methods may be utilised to ignite the Fire Load.

A5.1.3 Baseline Test Suppression System Performance

The system shall extinguish the fire and prevent re-ignition for a period of 5 minutes, or shall achieve the pass criteria listed in Appendix A7 until the fire load is consumed.

A5.1.4 Observations

Temperature measurement at each thermocouple shall be recorded during the test. The sample period for each thermocouple shall be ≤ 10 seconds..

Oxygen, Carbon Monoxide and Carbon Dioxide measurements within the cargo bay test article shall be recorded at ≤5 minute intervals.

Air flow measurements shall be recorded at ≤1 minute intervals. air pressure shall be continuously measured and recorded.

Where practical, visual, video or I R video observation of ignition, fire development, effect of agent, extinguishment, or re-ignition of the fire should be made.

Where practical, additional instrumentation such as additional temperature sensors in the vicinity of the pan should be employed to monitor the fire progress.

All observations and measurements shall be presented in a concise time related test report.

A6.2 Cargo Tests

Class A materials consisting of cardboard boxes 45.7cm (18 ins) x 45.7cm (18 ins) x 45.7cm (18 ins) loosely filled with a nominal 0.73Kg (1.6lbs) of shredded bond paper. Total weight of each filled box to be 1.81Kg ± 0.18Kg (4lbs ± 0.4lbs).

The cardboard boxes shall meet the following requirements:

Carton style 201 in 200K/C/200T

0201 Style of carton. It is standard 4 flaps on top, 4 flaps on top. 4 flaps on bottom flat plain box.

200K Grammage, 200 gms per square metre of Kraft paper

C Denotes the corrugation in the middle of the layer between top and bottom of a side.

200T Grammage, 200 gms of test paper

The cardboard box shall be untreated and not have undergone any treatment to give it additional heat resistance.

A6.2.1 Deep Seated (Container) Fire

Three LD3 containers are to be used for this test, one container to be filled with thirty three packed cardboard boxes as shown in Figure 1 and Figure 2.

A6.2.1.1 LD3 Container specification

The construction of the LD3 container shall be as follows:

1. The top, bottom and sides of the LD3 container shall be held firmly to the container frame.
2. The top, bottom and side B of the container (see Figure 1) shall be constructed from mild steel.
3. Side A of the container (see Figure 1) shall be constructed from aluminium.
4. The front of the LD3 containers shall be Lexan.

5. A slot (TBD x TBD) shall be cut in the sloping (bottom/side) face to provide ventilation to the container.

A6.2.1.2 Ignitor Installation

Two electrical resistance ignitors should normally be installed in case of first ignitor failure.

Select one of the cardboard boxes and cut 3 off ventilation holes in one of the 18 inch x 18 inch (457mm x 457mm x 457mm) cardboard box sidewalls (see Figure 3 for position and size of these holes).

Remove the shredded bond paper and add 25 to 50 mm thick layer of thin shredded paper (Computer paper of 2mm width) to the bottom of the cardboard box. Install the ignitors and connection cable into the thin shredded paper in positions as shown in Figure 3. The ignitor is formed by twisting one strand of 15cm length Chromel/Alumel diameter 0.2mm wire around a bundle of the thin shredded paper (the resistance of the wire should be 5Ω). The length of shredded paper covered by the heater should be no more than 2cm with a minimum of two turns. Add the shredded bond paper, ensuring that this paper is separated as much as possible to allow air circulation. Add a 25 to 50 mm layer of the thin shredded paper to the top of the box before closing the lid.

The open sided LD3 container shall be positioned in the cargo bay fire test rig (positioned as per Figure 2). 33 off cardboard boxes, including the ignitor box, each of total weight 1.81 kg (4lbs) shall be installed into the open LD3 style cargo container.

The top and bottom flaps of each of the cardboard boxes shall be sealed by folding each side in, no staples or tape should be used to secure the top and bottom. The box containing the ignitors shall be located as shown in Figure 1 with the 3 ventilation holes facing the sloping side of the container. An internal temperature measuring thermocouple, shall be passed through the small hole located in the side of the LD3 container and positioned in the top of the cardboard box containing the ignitors.

The side of the container shall be closed with the Lexan panel (polycarbonate). and the remaining two LD3 containers shall be set up as shown in Figure 2. A 50mm (2 inch) gap shall be maintained around each of the containers.

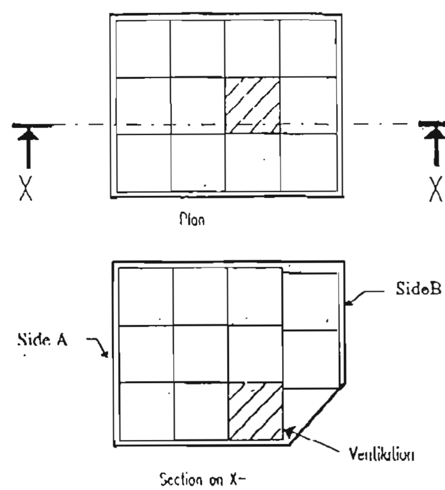


Figure 1 Position of Fire Ignition System and Cardboard Boxes

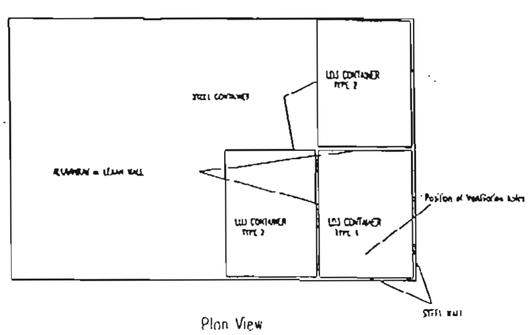


Figure 2 Position of ULD Cargo Containers in Fire Test Cell

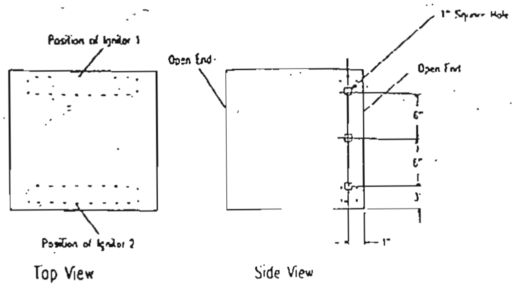


Figure 3 Position of Ignitors and Ventilation Holes in Cardboard box

A6.2.1.3 Test Duration

Tests should be conducted to evaluate the performance of the fire protection system to suppress, control, or extinguish the fire over periods of 90 minutes, 180 minutes, 240 minutes, or as appropriate to a specific aircraft Certification requirement.

A6.2.1.4 Observations

Temperature measurement at each thermocouple shall be recorded during the test. The sample period for each thermocouple shall be ≤10 seconds.

Oxygen, Carbon Monoxide and Carbon Dioxide measurements within the cargo bay test article shall be recorded at 5 minute intervals. Air flow measurements shall be recorded at 1 minute intervals. air pressure shall be continuously measured and recorded.

Where practical, visual, video or I R video observation of ignition, fire development, effect of agent, extinguishment, or re-ignition of the fire.

The initial development of the fire shall be monitored by recording the temperature of a thermocouple in the ignition box at ≤10 second intervals for the first 15 minutes of the test. The ignitor power should be removed after the fire suppression system has been activated.

Data from any control or warning sensors shall be recorded as appropriate.

All observations and measurements shall be presented in a concise time related test report.

A6.2.2 Deep Seated (Loose Luggage) Fire

A 30% by volume load of cardboard boxes filled as specified in A6.2. shall be positioned two boxes deep commencing at one end of the test article.

A6.2.2.1 Ignitor Installation

One cardboard box shall contain the ignitor installations in accordance with A6.2.1.1. This box shall be located in the bottom layer of boxes, one box in from the end and centrally positioned. Example Figure 4

A6.2.2.2 Test Duration

Tests should be conducted to evaluate the performance of the agent/system to suppress, control, or extinguish the fire over periods of 90 minutes, 180 minutes, 240 minutes, or as appropriate to a specified aircraft Certification requirement.

A6.2.2.3 Observations

Temperature measurement at each thermocouple shall be recorded during the test. The sample period for each thermocouple shall be ≤10 seconds.

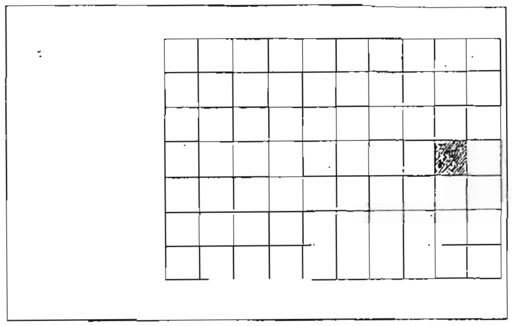
Oxygen, Carbon Monoxide and Carbon Dioxide measurements within the cargo bay test article shall be recorded at 5 minute intervals. Air flow measurements shall be recorded at 1 minute intervals, air pressure shall be continuously measured and recorded.

Where practical, visual, video or I R video observation of ignition, fire development, effect of agent, extinguishment, or re-ignition of the fire should be made.

The initial development of the fire shall be monitored by recording the temperature of a thermocouple in the ignition box at ≤10 second intervals for the first 15 minutes of the test. The ignitor power should be removed after the fire suppression system has been activated.

Data from any control or warning sensors shall be recorded as appropriate.

All observations and measurements shall be presented in a concise time related test report.



Plon View

Figure 4 Loose Luggage Test Load Example

A7 PASS/FAIL CRITERIA

The following Pass/Fail criteria are the defined limits for the purposes of the FIREDASS programme.

A7.1 Temperatures

The following temperature limits have been extrapolated from FAR 25.855, Appendix F, Part III and aircraft structural data. As more fire test data and aircraft structure data becomes available, then these figures will be modified accordingly.

A7.1.1 Maximum Continuous Temperature

The maximum continuous temperature 4 inches above the liner at any one position shall not exceed 250°F/121 °C (Based on a typical composite floor beam).

A7.1.2 Temperature Excursions

Temperatures measured on the liner/walls of the cargo compartment between 400 °F/204 °C and 1500 °F/815 °C at any one point may be reached, provided that the total time spent within this temperature range does not exceed 5 minutes (Based on FAR 25.855, with a safety factor of 100°F for the upper limit).

A7.1.3 Temperature

Temperatures measured at the liner/walls of the cargo compartment above 1500°F/815°C will constitute an immediate failure (Based on FAR 25.855, with a safety factor of 100°F for the upper limit).

A7.2 Pressure Change

The pressure differential within the cargo compartment shall be maintained at less than 0.375 psi (pressure loading for blow out panels to vent. See Appendix C). This must be evaluated by testing with a full compartment which would be the worst case for overpressurisation following system discharge.

A7.3 Toxic Gas Concentrations

Concentrations of toxic gases measured in the passenger cabin during Cargo bay (Deep Seated) tests must be shown to be equivalent or better than the levels now accepted for the use of 5% by volume concentration of halon 1301 for the specific test.

These are: TBD

Higher concentrations will be acceptable if human tolerance can be demonstrated or detailed analysis shows that higher concentrations can be handled by ventilation system improvements or any other acceptable means.

A7.4 Reliability

The probability of the fire protection system becoming inoperable should be no worse than 10^{-5} per hour (ACJ No. 1 to JAR 25.1309).

A7.5 Fire Detection

The fire detection system shall as a minimum provide a warning of the fire within one minute.

APPENDIX B - GAS EXPLOSIONS

More research is required to define the requirements for the testing of pressurised containers in cargo compartments. The following define a possible requirement for this type of fire hazard. It should be noted that this test will not be considered during the FIREDASS project.

B1 GAS EXPLOSIONS

The recent changes of propellant types in Pressurised Containers, creates an additional hazard. Pressurised Containers can be ruptured by over pressurisation which is heat induced from a surrounding fire. The resultant ignition of the Pressurised Container contents may create an explosion which should ideally be suppressed or whose consequences must be controlled in specific circumstances.

B1.1 Gas Explosion Test Article Size

Pressurised Container tests shall be conducted in a test article of 1000 cubic feet + 10% - 0%.

B1.2 Gas Explosion Test

Thirty two cardboard boxes shall be positioned in a four box by four box by two layer stack in the centre of the test article. The bottom layer of boxes may be empty, the top layer packed with standard rags. On top shall be positioned five cardboard boxes maximum size 76.2cms (30ins) x 50.8 (20 ins) x 22.86cms (9ins) filled with rags and laid flat. The rags shall be a mixture of nylon and cotton and each of the five cardboard boxes will contain 10lb of rags. The thirty two cardboard boxes shall contain a mixture of nylon and cotton rags, weight *lbs. The centre suitcase shall contain a ≥9 US Fluid ounce (266ml) can of air freshener with Propane or Butane propellant. On top of the Pressurised Container containing suitcase, shall be placed another identical size suitcase filled with rags(See Figure 5).

Each of the suitcases shall be equipped with a thermocouple wired to recording equipment.

B1.3.1 Test Conditions

The test shall be conducted with a flooding agent concentration in accordance with the design requirements of the agent for long term protection. In the case of a directed agent, this is to be deployed in accordance with the design requirements and where applicable at the average frequency found applicable in tests for Deep Seated (Loose Luggage) fires TBD minutes after fire detection to TBD minutes after fire detection.

B1.3.2 Test Duration

In the event that the agent subdues the fireball which may result from Pressurised Container rupture, and any ensuing fire, the test may be terminated 15 minutes after the fire is shown to be extinguished.

In the event that the agent does not subdue the fireball, the test should be continued for 90, 180, or 240 minutes as appropriate to desired certification, or until at least 15 minutes after the fire has been extinguished or controlled to a condition where safe entry to the test article is assured.

In the event that the agent subdues the fireball such that no observable effect occurs, the suitcase containing the Pressurised Container shall be equipped with instrumentation (e.g. air pressure measurement) to identify the time at which rupture occurs.

B1.3.3 Observations

Temperature measurement at each thermocouple in the test article and in the suitcases, shall be recorded at a maximum of ≤10 second intervals.

Oxygen, Carbon Monoxide and Carbon Dioxide measurements within the cargo bay test article shall be recorded at 5 minute intervals. Air flow measurements shall be recorded at 1 minute intervals, air pressure shall be continuously measured and recorded.

Where practical, visual, video or I R video observation of the effect of Pressurised Container rupture, fire development, effect of agent, extinguishment, or re-ignition of the fire should be made.

All observations and measurements shall be presented in a concise time related test report

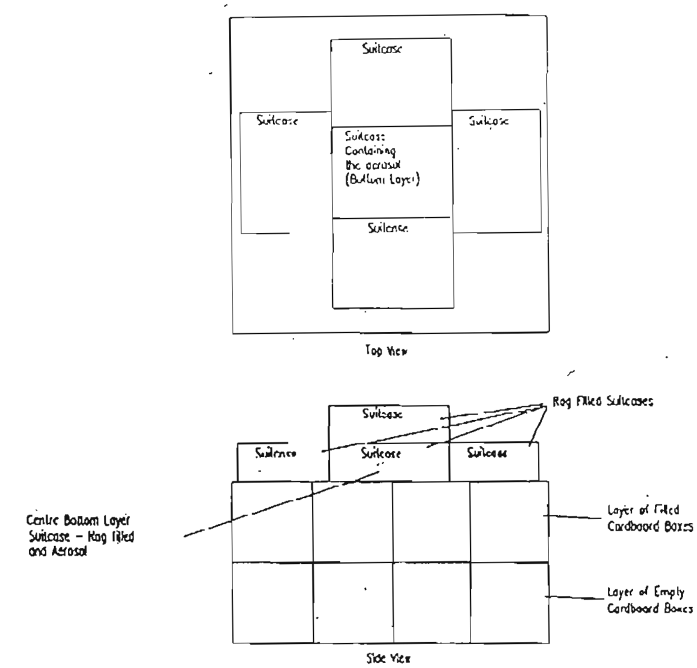


Figure 5 Pressurised Container Test Set up

APPENDIX C - OPERATIONAL AND PHYSICAL CONDITIONS.

C1. INTRODUCTION

This Appendix defines for the purposes of the FIREDASS project the operational and physical conditions assumed to apply to an aircraft cargo compartment in which there is a fire detection system and a built-in fire suppression system, in JAR 25.857 (c) such a system is classified as a Class C cargo compartment

C2. OPERATIONAL PROCEDURES

C2.1 Normal Operation prior to detection

Normal operation prior to detection of a fire. There are essentially two conditions which could apply:

C2.1.1 'Air conditioned' ventilation.

This is usually provided by the airframe manufacturer as a customer option and will typically be specified by the airline if they envisage carrying large numbers of animals on any one flight or they may be carrying animals in very hot climates, the airflow is often dictated by the need to control temperature.

C2.1.2 Leakage and ventilation airflow.

This results due to leakage out from around the external cargo door seal and air being drawn into the cargo compartment from the passenger cabin through gaps in joints. In addition some aircraft provide a small ventilation airflow (often at one location) partially to ensure pressure equalisation and partially for comfort of small animals that may occasionally be carried.

C2.2 Procedures following detection of a fire.

The detector system monitoring conditions within the compartment is designed to alert the crew to the presence of a fire within one minute of the start of the fire.

The crew will then:

i) Shut off the airflow
ii) Activate the fire extinguishing system

Q1 How long to do this ?
Q2 What percentage of JAR25 aircraft have 'air conditioning' ventilation ?

Q3 How often is the 'air conditioning ventilation' system used ?

Q4 Do many aircraft have a dedicated system providing very low ventilation airflow and is this shut off on detection of a fire?

C3 PHYSICAL CONDITIONS

When at cruise altitude there is typically a pressure differential between the inside of the fuselage and the outside atmosphere of 8.5 psi. The cabin (and hence the cargo compartment) are maintained at a pressure altitude of 8000ft typically. It is pressure differential that causes air to leak around the cargo door seals and leaks in the cargo compartment that allow air from the cabin to enter the compartment and hence produce the leakage airflow.

It should be remembered that airflow in this direction acts in the interest of occupants by helping to prevent smoke and fumes form entering the cabin.

The temperature in the cabin is under control of the crew and would normally be set at a comfortable value around 20°C. The cargo hold temperature would typically be lower, say 15°C.

The cargo compartment is also designed to relieve any pressure differential that may occur as a result of rapid decompression by means of blow-out panels, these are designed to vent at a loading of 0.375 psi.

When a halon 1301 extinguishing system is used the quantity of halon that has to be provided is determined by the requirement to maintain 3% concentration by volume for the remainder of he flight. In order to minimise the quantity of halon carried it is necessary to minimise the leakage airflow, however there is no defined maximum permitted airflow.

For a Class D cargo compartment which does not have a fire extinguishing system but instead relies on oxygen depletion the airflow permitted is defined in ACJ JAR 25.857 (d) the maximum airflow permitted is derived from the formula W = 2000 - V. Where W = ventilation and leakage airflow in cu. ft./hour and V = the capacity of the compartment in cu ft up to the maximum permitted size of 1000 cu. ft.

Therefore the maximum airflow permitted for a Class D compartment of 1000 cu ft is 1000 cu ft per hour or 7.5 litres/sec.

Tests in a 5000 cu ft compartment with a 2% fire load and no extinguishing system also demonstrated that for leakage rates of 4500 cu ft per hour the fires were on the borderline of producing results the same as those produced with no airflow. However for higher leakage rates the rate of combustion did rise (Ref. FAA RD-70-42).

From discussion with manufacturers the typical leakage for a Class C compartment may be 50% higher than for a Class D compartment. the leakage is approximately proportional to the surface area of the compartment.

In those compartments which have forced 'air conditioning' ventilation an air change every 5 minutes is typical.

C4 TEST CONDITIONS

Fire test facilities to be used for the FIREDASS project are all located at, or very close to, sea level.

C4.1 Airflow

SINTEF test cell is $31m^3$ (1068 cu. ft) with a surface area of approximately 65 m^3, a leakage airflow of 12 litres per second would be appropriate.

GMAv cargo compartment is 45 m^3 (1600 cu. ft) with a surface area of $95m^3$, an airflow of 18 litres per second is appropriate.

DLR cargo compartment is 105 m^3 (3620 cu ft) with a surface area of 186 m^2, an airflow of 35 litres per second is appropriate.

C4.2 Vent area

The vent area from the compartment to atmosphere is very small, in normal operation the maximum leakage occurs because of the 8.5 psi. pressure differential across the door sealing surfaces, calculation yields an area of only a few mm^2 as being sufficient to develop the required airflow. However the inlet 'vent area' into the compartment is not defined, it is distributed around the compartment and is much larger, a value of $1cm^2$ per m^2 surface area is suggested.

DRAFT MINIMUM PERFORMANCE CRITERIA
FOR REPLACEMENT
HAND HELD PORTABLE EXTINGUISHERS FOR
AIRCRAFT CABIN FIRE PROTECTION

Purpose

To establish minimum performance requirements for an environmentally acceptable replacement for the current Halon 1211 hand held fire extinguishers.

Background

FAR/JAR 25.851 require that Halon 1211 or equivalent hand held extinguishers to be installed on transport category aircraft. The regulation states that the type and quantity of extinguishing agent (if other than Halon 1211) must be appropriate for the kind of fires likely to occur where used.

These regulations had their origins with enhancing in-flight fire fighting capability including the need to deal with the arsonist/highjacking threat whichwas prevalent in the 1970s. The FAA Technical Centre identified that Halon 1211 was vastly superior to the previously used CO_2 and dry chemical extinguishers, and inparticular for protecting against flammable fluid fires on typical seat materials (DOT/FAA/CT-87/111). Later it was determined that Halon 1211 in handheld extinguishers, while primarily a streaming agent provided an additional benefit by having capacity to fight "hidden" fires through total flood effect. This was demonstrated on an in flight cheek space fire in a large cabin aircraft which might otherwise have resulted in a major catastrophe.

It is agreed that any replacement extinguisher must offer at least an equivalent level of fire fighting capability to the hand held fire extinguisherscurrently in service.

Agent Selection Guidelines

Types of Fire

The agent must be suitable for fire suppression needs typically encountered in transport and commuter type aircraft cabins, lavatories, accessible baggage compartments and flight decks.

Environmental Effect

Airworthiness Requirements specifically call for the provision of halon based portable fire extinguishers for in-flight fire fighting. For all practical purposes production of halons has ceased u nder the provisions of the Montreal Protocol. The primary environmentalcharacteristics to be considered in assessing a new agent are Ozone Depletion Potential (ODP), Global Warning Potential (GWP), and Atmospheric Lifetime. The agent selected should have environmental characteristics in harmony with International laws andagreements, as well as applicable local laws. This Minimum Performance Specification sets out means of assessing the technical performance of potentialalternatives, but in selecting a new agent it should be borne in mind that an agent which does not have a zero ornear zero ODP, and the lowest practical GWP and Atmospheric Lifetime, may have problems of international availability and commercial longevity

Toxicology

As a general rule the agent must not pose an unacceptable health hazard for those likely to be exposed to the agent repeatedly such as workers during installation and maintenance of the extinguishing system. In confined areas suchas the cockpit or galley at no time should the agent concentration present an unacceptable health hazard whether as a result of deliberate discharge or leakage. Following release in fire extinguishment, the cumulative toxicological effect of the agent, its pyrolytic breakdown products and the by-products of combustion must not pose an unacceptable health hazard.

Performance Criteria for Fire Extinguishers and Agent

General

The extinguisher must be approved by a recognised fire testing laboratory which is acceptable to the Regulatory Authorities.

Minimum Rating

Each extinguisher employed must contain an agent with ClassA fire extinguishing capability and meet the minimum rating.
UL 5BC or,
BS 5423 3A34B or,
equivalent.

Hidden Fire Demonstration: (see Appendix I)

The extinguisher must meet the minimum performance standardof the hidden/remote fire challenge test.

Arson / Highjacking Threat Protection Demonstration: (see Appendix II)

The extinguisher must meet the minimum performance standardof the aircraft Arson/Highjacking Threat fire challenge test.

Compatibility with Aircraft Operating Environment

Each extinguisher utilized on the aircraft must satisfactorily demonstrate compatibility with the appropriate aircraft operational environments.

The extinguisher including its method of attachment in the aircraft must meet the following paragraphs of RTCA / DO 160C:

Section 4: Temperature and Altitude
Section 6: Humidity
Section 7 Operational Shocks and Crash Safety
Section 8 · Vibration
Section 15: Magnetic Effect

Appendix I: Proposed Hidden Fire Demonstration

VI.1 Test Fixture

The test fixture shall be 2 ± 0.050 m high, 2 ± 0.050 m long and 0.5 ± 0.025 m wide, fabricated from 0.9 ± 0.1 mm sheet steel, as shown in Figure VI.1 (see also Figures 2.5 & 2.7 forreference). The temperature within the test fixture shall be maintained at 21 ± 1°C (70 ± 2°F). The agent shall be introduced through a hole positioned centrally in one of the end walls of the test chamber. The internal baffles shall comprise 33% hole area, and shall occupy the upper half of the test fixture, adjacent to the end wall through which the agent is injected. The baffle plates shall extend to the side walls and the roof. The spacing between the baffle plates shall be not less than 0.300 mm and not more than 0.350 m (refer to Figure VI.1). The solid 'stop' plates shall be 0.300 ± 0.025 m, centrally aligned with the agent injection point. Transparent plasticwindows will be placed either at one end, or along one side of the test fixture to allow observation (or preferably video recording) of fire extinction times.

VI.2 Fire Threats

The *n*-heptane fire cups shall be 35 ± 2 mm in diameter, and are positioned in two arrays of four as shown in FigureVI.1. The fire cups shall be charged with 5 ± 1 mL *n*-heptane, floated on 10 ± 2 mL water. The trays for the paper fires shall be made from the same perforated material as the baffle plates, and shall be 80 ± 5 mm in diameter, 60 ± 5 mm deep. The fire load shall be 8 ± 0.1 g shredded white 80 g.s.m. copier paper, dosed with 1 ± 0.1 mL *n*-heptane to aid ignition.

VI.3 Test Procedure

The extinguisher is charged with the agent then equilibrated at 25 °C for a minimum of 15 minutes in a temperature controlled water bath. The fires are positioned in the correct zones, charged with water and *n*-heptane and ignited. Any access doors or windows are closed at this time. A pre-burn of 60 seconds is allowed, after which the agent is discharged. The discharge time and the fire extinction times shall be noted. Any fires remaining alight 60 seconds after discharge are classed as failed suppressions, and are to be extinguished manually. The chamber should then be thoroughly vented to remove both the acrid decomposition products and traces of agent which might otherwise affect the outcome of the following test A suggested test matrix is outlined below

Test No Fires in Locations

1	A & B
2	A & B
3	B & C
4	B & C
5	A & D
6	A & D
7	C & E
8	C & E
9	D & E
10	D & E

Thus each location is tested four times, in two different configurations.

VI.4 Presentation of Results

For each fire location the aggregate number of successful and failed suppressions shall be plotted in a figure similar to 3.2. The overall percentage extinguishment for *n*-heptane fires shall be calculated and compared to the minimum performance standard, which is yet to be defined.

References are to CAA Paper 95013

Appendix II: Proposed Arson/Hijacking Threat Protection Demonstration

Input from FAA Technical Center required.

Suggest 1 litre of gasoline spread on a triple seat, 1/3 seat backs, 1/3 top of seat cushions, 1/3 under the seat on the floor. The idea being to generate a 3 dimensional fire in a manner that could readily occur.

HALON REPLACEMENT : ANALYSIS OF BREAKDOWN PRODUCTS

TEST PROCEDURE MODIFIED DURING THE MEETING HELD AT CEAT ON SEPTEMBER, 18 th (CAA, Kidde, STPA, CEAT)

PRESENTED BY: ADAM CHATTAWAY
KIDDE INTERNATIONAL

INTRODUCTION

Taking inspiration from the Kidde investigation on hidden fires, the different steps of this study have been defined as follow :

Task 1 - toxicity measurements on Halon 1211 breakdown products to be used as a baseline

Task 2 - tests on alternative agents with standardized nozzles to deliver constant mass flow rate

Task 3 - if needed and available, tests on agents conditionned following their current use.

1 - TEST EQUIPMENT, DESCRIPTION

The $8m^3$ chamber (figure 1) was designed as a compromise between :

- a realistic volume for the use of a full scale extinguishing system
- an efficient sampling of the breakdown products.

1.1 - FIRE SOURCE

- n-heptane fire : 500ml in a 25,5cm diameter fuel pan, height 10cm and thickness 1,5mm

- **materials fire** : aircraft seat cushion materials, FR foams (graphite and non graphite) and 100% wool fabric.

The sample is made of two superposed blocks of foam (20x20x5 cm3). A 4 cm diameter hole is drilled in the center of the sample to create a chimney and help developping the fire. The all is covered with wool fabric on the 4 lateral faces and the top (the bottom side is not covered). Specimens of foam and fabric are conditionned to 21 ± 3°C and 50 ± 5% relative humidity for at least 24 hours before test.

The test rig has been adapted to limit the contact between halon and hot metallic parts. It is built symetrically over the fire source which is a 15 cm diameter fuel pan containing 100 ml n-heptane. The materials are placed on a grill made of stainless steel wires (figure 2).

1.2 - SAMPLING DEVICE

presentation :
- 3 impinger bottles for HCl, HF, HBr analysis (n°1 and 2 for sampling and one for the blank), the sampling pipes are located at the ceiling, the end beeing at 30 cm from the top inside the test chamber (see drawing for exact location)

- A heated pipe is connected to a series of on-line analysers (CxHy, CO, CO_2, SO_2, NOx, O_2) The sampling location is at the ceiling near the blank.

- Sampling parameters for impinger bottles : 100 ml of distilled water, flow rate 2l/min

- Sampling parameters for on-line analysers : pipe temperature 80 ± 5°C, flow rate 3 - 4 l/min

discussion : It has been decided to make a sequential sampling in order to evaluate the production rate of breakdown products (every 15 seconds during 1 minute).

1.3 - EXTINGUISHING SYSTEM

presentation : In order to control the time of discharge and quantity of agent discharged, a special device is beeing built. A pipe is connected, on one end to the bottle and on the other end, to the nozzle. This pipe is equipped with a safety ball valve, a pressure gauge and an automatic valve remotely controlled through a timer.

discussion : a bottle will be modified by KIDDE DEXAERO for discharging agents at constant pressure (see fig. 3). Specific nozzle will be adapted to each agent.

2 - TEST SEQUENCE

2.1 - PREPARATION BEFORE TEST

presentation :
Check room temperature and relative humidity :

- if HR% > 53 but < 65, relative humidity is set at 50±3% using dry air
- if HR% > 65 the test is adjourned
- room temperature must be 20 to 25 °C

check sampling flow rate in each impinger bottle

check thermocouples located over the fire, at the ceiling and attached to sampling pipes

check the acquisition device.

Preparation of the fire source :

n-heptane fire
- set the fuel pan temperature to 40°C
- put in position the electric lighter

materials fire
- take materials from the conditionning chamber
- arrange the specimens of foam and wool fabric
- put the test rig in position, in the test chamber
- put the 15 cm diameter fuel pan in position under the grill
- set the fuel pan temperature to 40°C
- put in position the electric lighter

Just before test

- set the ventilation of the enclosure containing the test chamber, to remove smoke and gases coming from the test chamber

- set the timing device to zero

- put on the video recording

- weigh the extinguisher bottle

- connect it to the discharge device and check the pressure inside the bottle.

discussion : the pressure will be set (8 to 14 bars) according to agents characteristics.

2.2 - TEST SEQUENCE FOR N-HEPTANE FIRES

t_0 : start up of the test, ignition, put on the on-line analysers

it takes 2 minutes for the stabilization of the fire

t_0 + 1 min : blank sampling through impinger bottle, duration 1 minute

t_0 + 2 min : remotely controlled discharge

simultaneously sampling through impinger bottles n°1 and 2, duration 1 minute

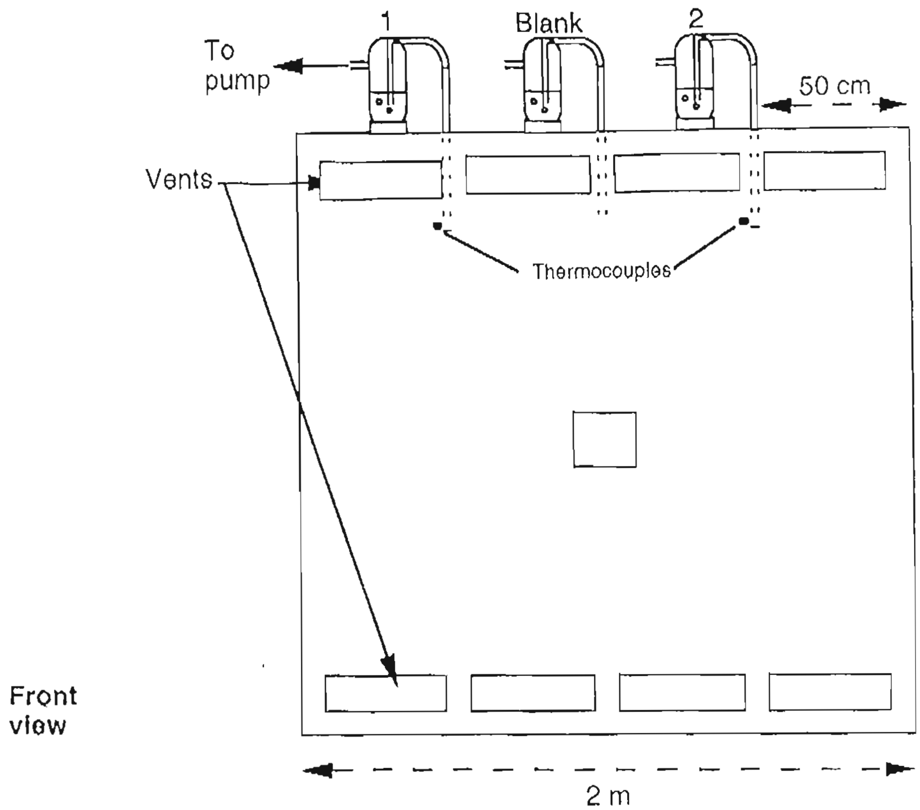
t_0 + 5 min : stop on-line analysers

2.3 - TEST SEQUENCE FOR GRAPHITE FOAM FIRE

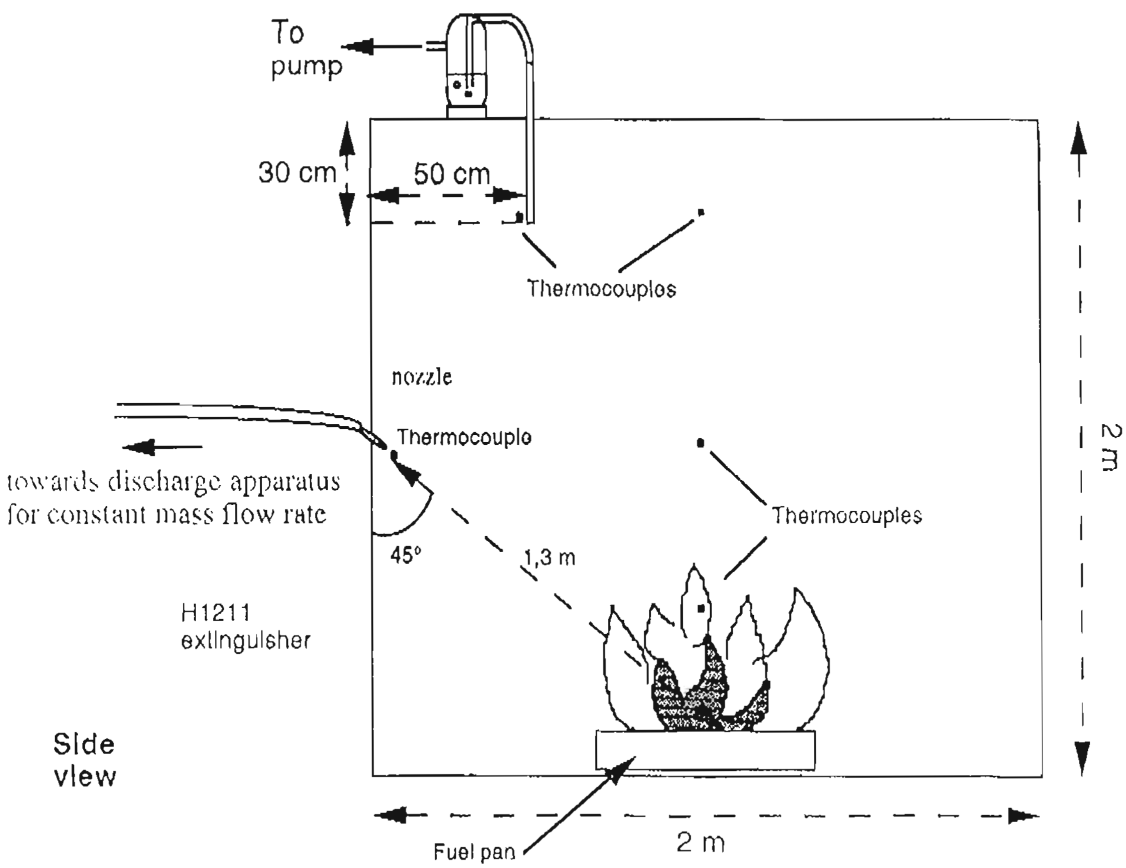
discussion : To take into account the terrorist threat, it has been suggested to make the discharge on both heptane + mareriál fire.

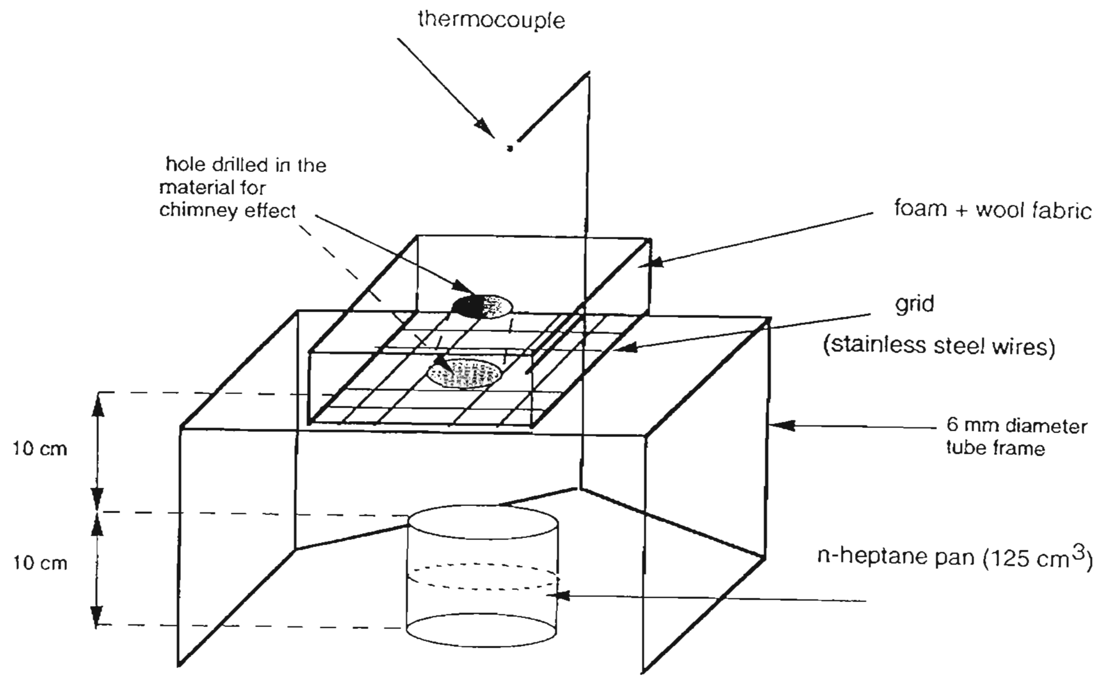
3 - TOXIC CRITERIA

discussion : to assess the total toxicity of decomposition products, different models based on the FED (fractional effective dose) are available. Nevertheless it seems useful to take into account the doses (concentration x time) corresponding to a high concentration during a short time.First, it is necessary to search for biological data on irritant gases. Following this bibliographic task, toxic criteria coulld be defined.

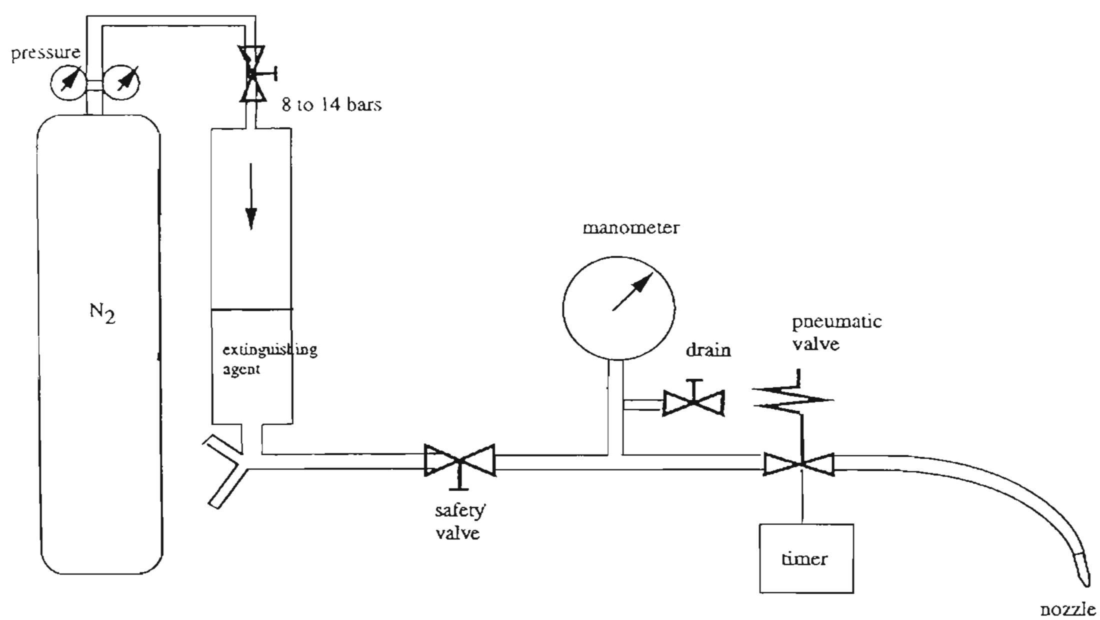


8 METER CUBE HALON TEST CHAMBER





MATERIALS FIRE DEVICE



DEVICE FOR CONSTANT MASS FLOW RATE

Engine Minimum Performance Standard Overview

Simulator Geometry

Simulator	Minimum compartment volume :	65 ft^3 (1.84 m^3).
	Minimum annular cross sectional area :	5.5 ft^2 (0.51 m^2).
	(all prior to reductions for clutter)	
Hot Surface	Length, longitudinal :	2.0 ft (61.0 cm).
	"Width" :	minimum 90° arc.
	Location :	proximal to spray and pool fire simulations.
Clutter	Area :	up to 50% local annular area reduction.

Simulation Parameters

Simulator air supply	Air flow rate, high setting :	2.5 - 3.0 lbm/s (1.1-1.4 kg/s)
	Air flow rate, low setting :	0.2 - 0.9 lbm/s (0.09-0.4 kg/s)
	(work flow rates with geometry to approximate 57 air changes/min)	
	Air supply temperature, high setting :	400 °F (204°C)
	Air supply temperature, low setting :	100 °F (38°C)
Fuel	Fuel types :	Hydraulic fluid Lubricating oil Turbine fuel
	Supply temperature :	150°F (66°C)
	Spray fire nozzle supply flow rate :	0.1 - 1.0 gpm (0.4-3.8 lpm)
	Pan fire pool volume :	0.25 gal (with 1.5 inch tall freeboard) 0.94 l (with 3.8 cm tall freeboard)
Fires	Types :	Spray Residual (a.k.a. pool)
	Locations :	spray → upper half of annulus (top dead center) residual → at convenience
	(each scenario must be proximal to a hot surface)	
	Preburn time :	spray → $t \geq 5$ seconds residual → $t \geq 15$ seconds
Agent storage	Storage temperatures :	-65 °F (-54°C) 100 °F (38°C) 200 °F (93°C)

D. Ingerson
Hughes Technical Center
Atlantic City Int'l Airport, NJ, USA
tel : 609-485-4945

Total Process

Construct Simulator.

Establish Halon 1301 distribution in simulator at the prescribed conditions.

Find two robust spray fires and one robust pan fire.

Using three robust fires previously found, challenge Halon replacement.

Establish equivalency to Halon 1301.

D. Ingerson
Hughes Technical Center
Atlantic City Int'l Airport, NJ, USA
tel : 609-485-4945

Halon 1301 Concentration Profile Search

Set distribution system and primary conditions for simulation.

Agent storage temperature = -65°F (-54°C)
Hot Surface Temperature = 1300° (704°C)
Air flow rate = 0.2-0.9 or 2.5-3.0 lbm/s (0.09-0.4 or 1.1-1.4 kg/s)
Air flow temperature = 100° or 400°F (38° or 204°C)

Shoot Halon 1301.

If concentration profile is not met, this will be an iterative process.

Repeat three times for acceptable concentration profile.

Set secondary conditions for simulation.

Agent storage temperature = 100° and 200°F (38° and 93°C)
Air flow rate and temperature set at the same conditions used in primary simulation.

Shoot Halon 1301.

NOTE:
This process would be run for two separate simulation conditions.

These two conditions are the conditions used for the robust fire search.

The air flow rate and air flow temperatures will have impact on concentration profiles.

If concentration profile is met and secondary tests behave as expected, this phase is complete.

D. Ingerson
Hughes Technical Center
Atlantic City Int'l Airport, NJ, USA
tel: 609-485-4945

Robust Fire Search

Set primary conditions for simulation.

> Agent storage temperature = 100°F (38°C)
> Hot surface temperature = 1300°F (704°C)
> Fuel flow rate = 1.0 gpm (3.8 lpm)
> Air flow rate = 0.2-0.9 or 2.5-3.0 lbm/s (0.09-0.4 or 1.1-1.4 kg/s)
> Air flow temperature = 100° or 400°F (38° or 204°C)
> Preburn time = 5 (spray) or 15 (pool) seconds

Start simulation and allow stabilization. Start fire. Expend preburn time.

Shoot Halon 1301. Continue fuel flow for 8 seconds longer. Hot surface may be turned off.

Determine if fire was suppressed.

> A fire is suppressed if fire is not visible for 8 seconds continuously

If fire was not suppressed, alter secondary parameters; otherwise proceed.

> Secondary parameters, in preferred order of alteration:
> Fuel flow rate = 0.1-1.0 gpm (0.4-3.8 lpm)
> Preburn duration at minimum setting
> Hot surface temperature = 900°-1300°F (482°-704°C)

Repeat fire test at condition. If 70-90% suppression rate, proceed.

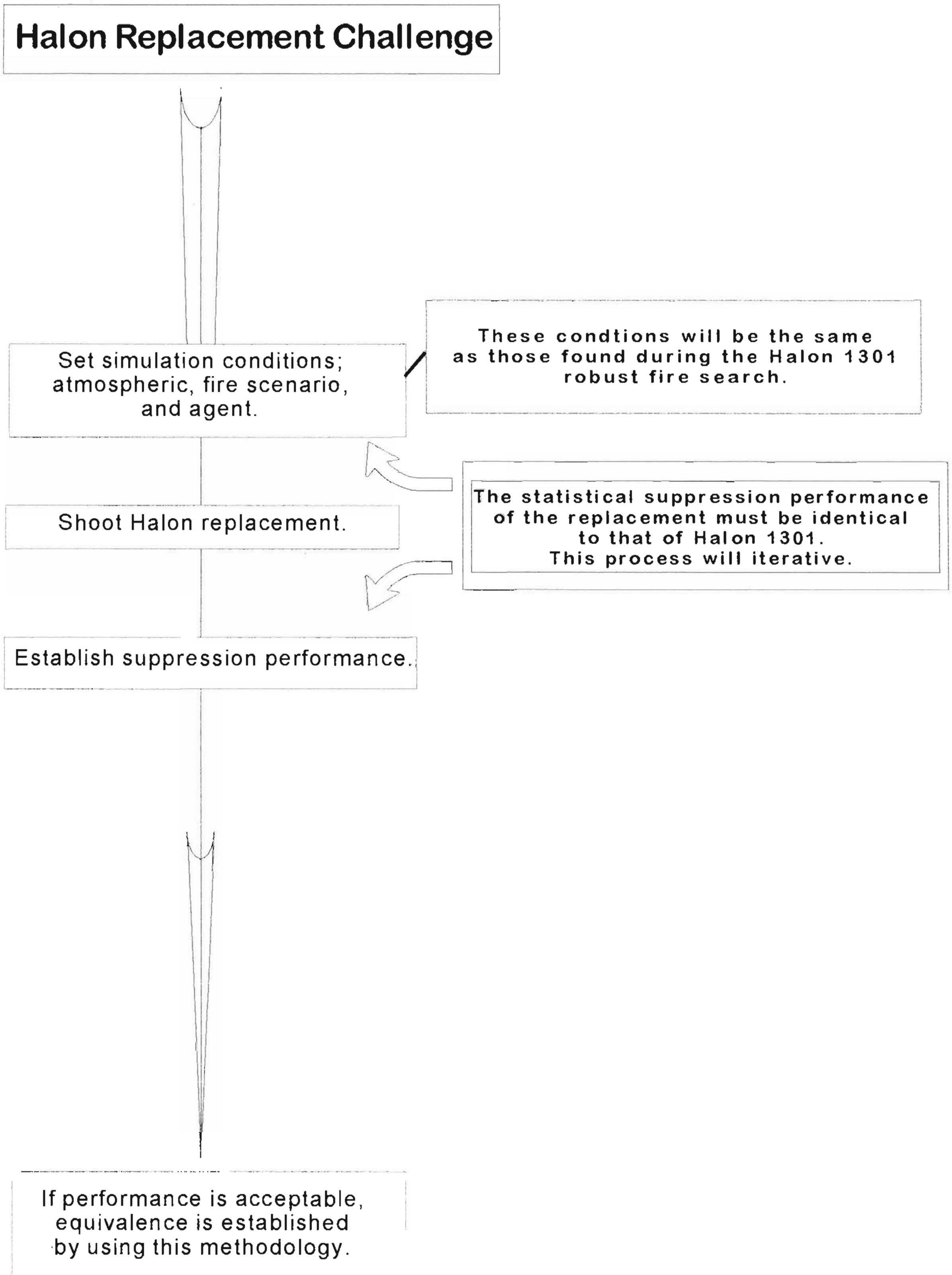
> Minimum of 5 tests to show performance.

Run tests to show 40% or greater suppression rate at other agent storage temperatures. If successful, proceed.

> **Minimum of 5 tests to show performance. Agent storage temperatures = -65° and 200°F (-54° and 93°C)**

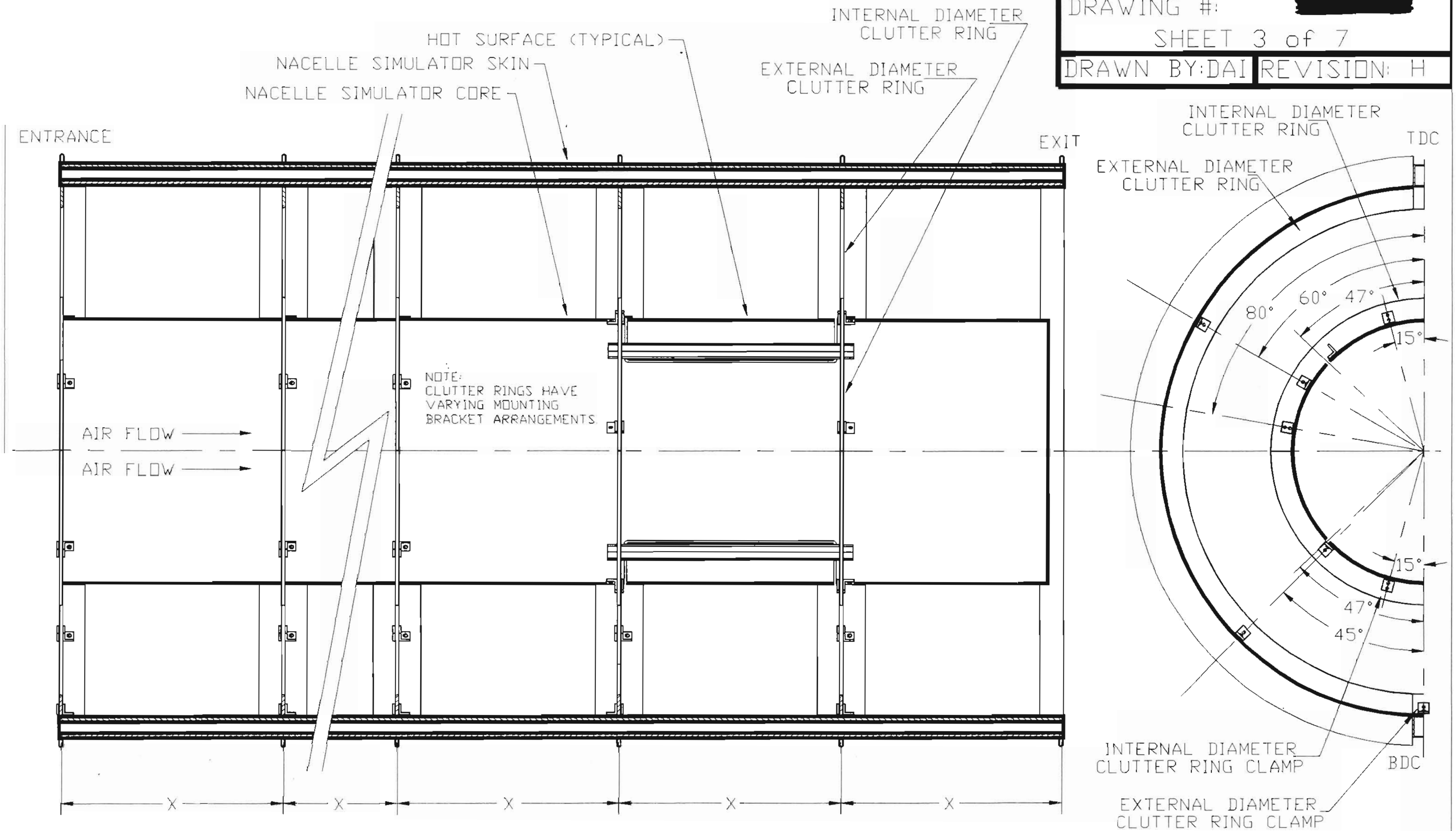
A robust fire has been found.

D. Ingerson
Hughes Technical Center
Atlantic City Int'l Airport, NJ, USA
tel: 609-485-4945



D. Ingerson
Hughes Technical Center
Atlantic City Int'l Airport, NJ, USA
tel: 609-485-4945

RIB AND BRACKET LOCATION DETAILS



DIMENSION 'X' IS 24.5 inches +/- 0.5 inches (62.2 cm +/- 1.27 cm)

D. INGERSON
IHRWG
9-10 OCT 96
LONDON ENGLAND

CLUTTER, NACELLE SIMULATOR	
DRAWING #: [redacted]	
SHEET 3 of 7	
DRAWN BY:DAI	REVISION: H

NTS

FEDERAL AVIATION ADMINISTRATION TECHNICAL CENTER
BUILDING 203, BUILDING 287
ATLANTIC CITY INTERNATIONAL AIRPORT, NJ 08405

FEDERA AVIATION ADMINISTRATION TECHNICAL CE..TER
BUILDING 203, BUILDING 287
ATLANTIC CITY INTERNATIONAL AIRPORT, NJ 08405

NTS

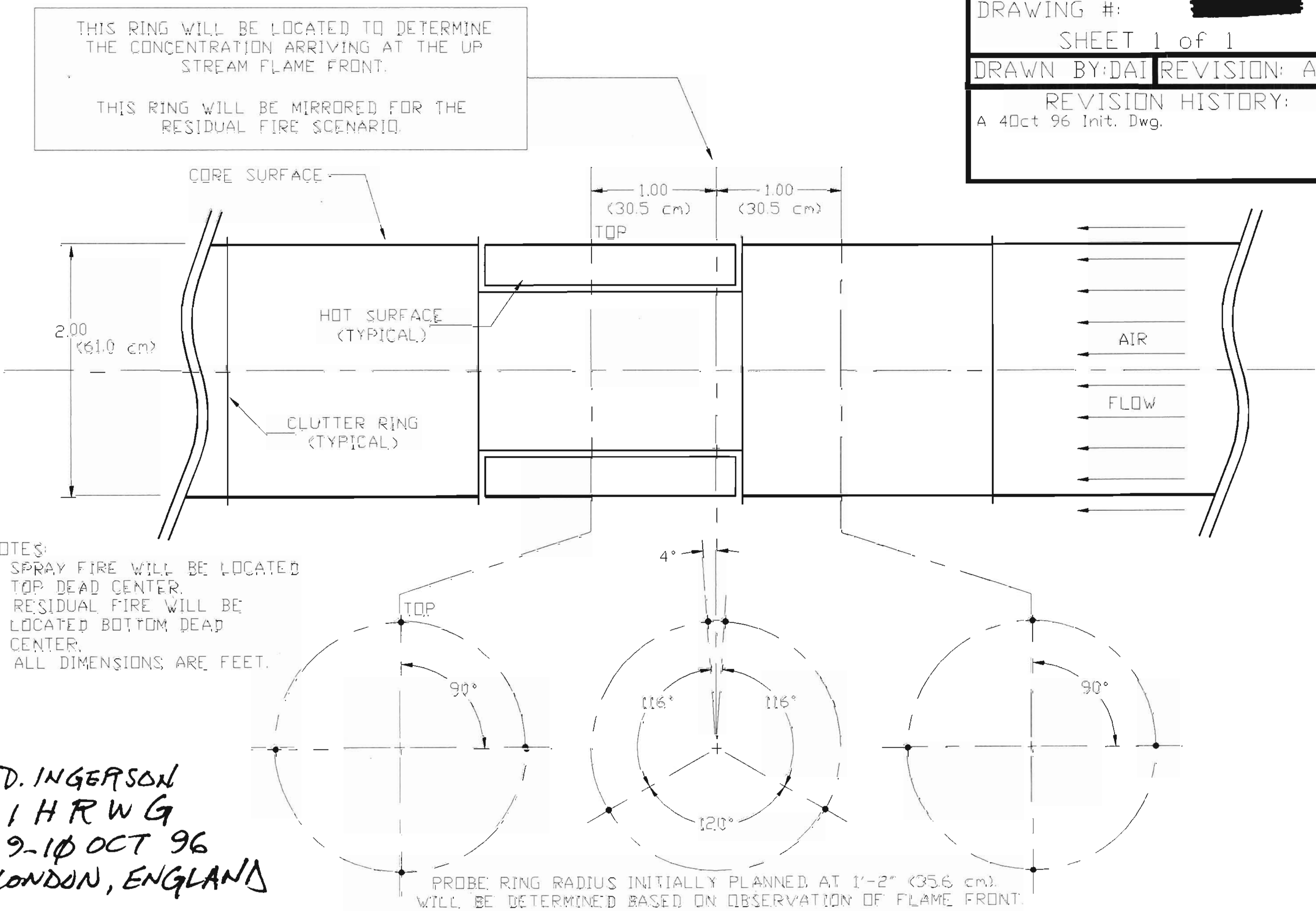
HALONYZER ?ROBE PLACEMENT; FAATC NACELLE SIMULATOR HALON REPLACEMENT PROJECT

DRAWING #: [redacted]

SHEET 1 of 1

DRAWN BY:DAI | REVISION: A

REVISION HISTORY:
A 4Oct 96 Init. Dwg.



NOTES:
1 SPRAY FIRE WILL BE LOCATED TOP DEAD CENTER.
2 RESIDUAL FIRE WILL BE LOCATED BOTTOM DEAD CENTER.
3 ALL DIMENSIONS ARE FEET.

D. INGERSON
IHRWG
9-10 OCT 96
LONDON, ENGLAND

INTERNATIONAL HALON REPLACEMENT WORKING GROUP

LAVATORY COMPARTMENT TRASH CONTAINER AUTOMATIC FIRE EXTINGUISHER
MINIMUM PERFORMANCE STANDARD

REPORTED ON OCTOBER 9, 1996
LONDON HEATHROW

BY
R. F. SEARS

CONTENTS

ISSUES RESOLVED FOLLOWING LAST MEETING:

- MINIMUM OPERATING TEMPERATURE;

  Testing has demonstrated that the minimum operating temperature of the 1301 container per BCA SCD 10-61909 is 30°F. Consequently, the minimum performance standard calls for 30°F as the minimum operating temperature.

  <u>HOWEVER, OPERATORS MAY SPECIFY A LOWER TEMPERATURE IF REQUIRED.</u>

LAVEX MINIMUM PERFORMANCE STANDARD TEST SUMMARY

1/ Condition (dry) fire load (paper towels) at 70 ± 5°F and maximum Rh 55% for 24 hours

2/ Weigh extinguisher and record value

3/ Set up temperature data acquisition and video camera:
- Record video leader

4/ Install igniter, clamp 1 inch above ventilation holes, at the centerline of the receptacle

5/ Load fire materials: (The test must be initiated within 30 minutes of removing the fire load from the conditioning chamber.)
- packing density 340 ± 10 towels in 18 X 18 X 18 inch container
- quantity 815 ± 5 g

6/ Mount the extinguisher

7/ Photograph installation

8/ Record prevailing ambient conditions, temp, relative humidity, pressure

9/ Record extinguisher surface and test receptacle temperatures

10/ Start data acquisition

11/ While the extinguisher surface temperature is below 30°F:
- Start video camera
- Start stop watch
- Energize the ignitor

12/ Record elapsed time if visible flames appear

13/ Upon agent discharge :
- Record elapsed time
- De-energize the ignitor
- Close the 12 ventilation holes

14/ 5 minutes after agent discharge:
- If temperature and visual observations indicate that combustion has ceased open or remove the access panel and

A/ If after a further 2 minutes re-ignition does not occur:
- ○ Empty the compartment and spread the fire load into a single layer.
- ○ Observe and note any residual smoldering. Record the extent of fire load consumption by the test.
- ○ Take a still photograph of the fire load.

B/ If re-ignition does occur:
- ○ Extinguish the fire using water or other environmentally friendly method.

15/ Weigh the discharged extinguisher, calculate and record the quantity of extinguishant discharged.

16/ Evaluation criteria:
- Visual evidence must show that the fire was extinguished.
  - ○ No smoke
  - ○ No re-ignition when access panel is opened
  - ○ No residual smoldering evident while removing and spreading the fire load.
- The receptacle thermocouple must show a continuously decreasing trend after the extinguisher has discharged.
- The extinguisher must meet the above criteria on five successive tests.

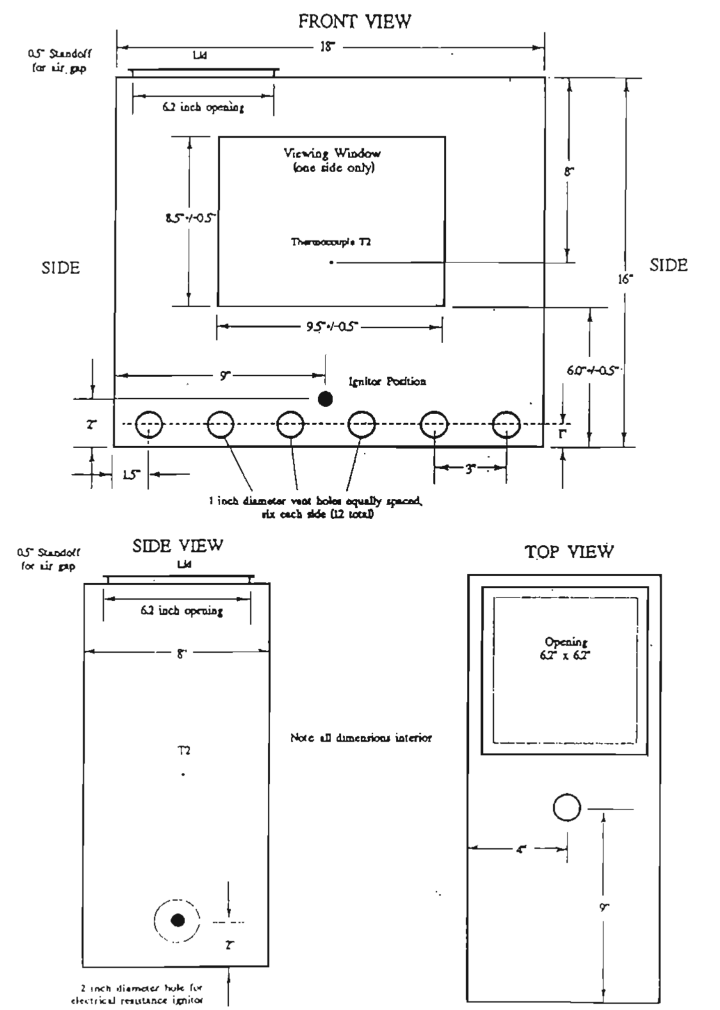


Figure 1. Standard Lavatory Disposal Receptacle For Evaluating Fire Extinguishing Agents

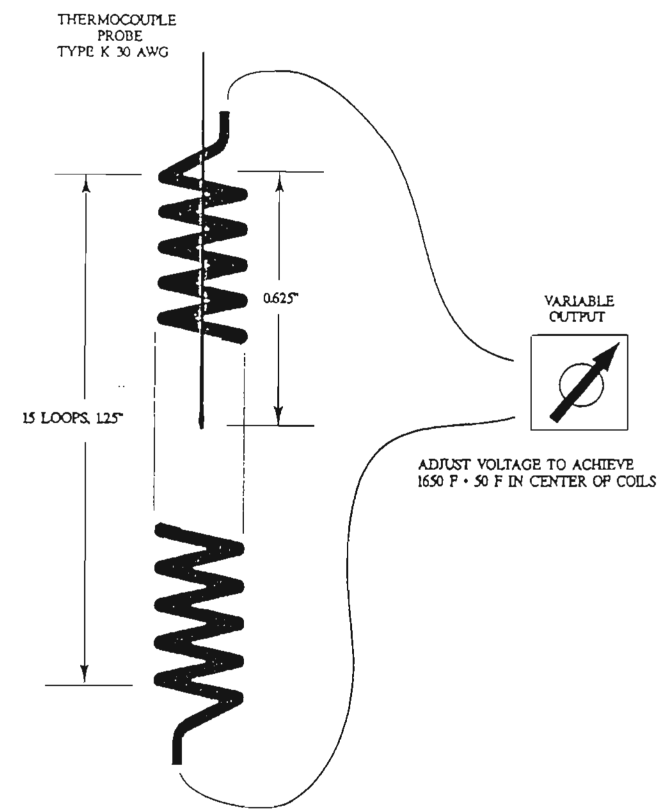


Figure 2. Ignition Source for Standard Lavatory Disposal Receptacle

INTERNATIONAL HALON REPLACEMENT WORKING GROUP

- STANDARDIZATION OF THE PAPER TOWELS;

The specification calls for a specific towel manufactured by the Fort Howard corporation, part number 244-00. This is a C-fold 2-ply bleached towel having dimensions of 10.25 inches x 13.25 inches. The weight of each towel is 4.5 ± 0.1 g.

○ Tensile strength dry 707 grams/inch

○ Tensile strength wet 189 grams/inch

(Note: all tensile strength results derived from average of both directions)

○ Absorbency 30 sec/0.1 ml

- FUEL LOADING TECHNIQUE

– The towels are to be opened and crumpled such that 340 ± 10 towels will fill an 18 x 18 x 18 inch cube.

– The towels are to be conditioned at 70°F ± 5°F with a maximum Rh of 55% for a minimum of 24 hours. The test is to be initiated within 30 minutes of removal of the fire load from the conditioning environment.

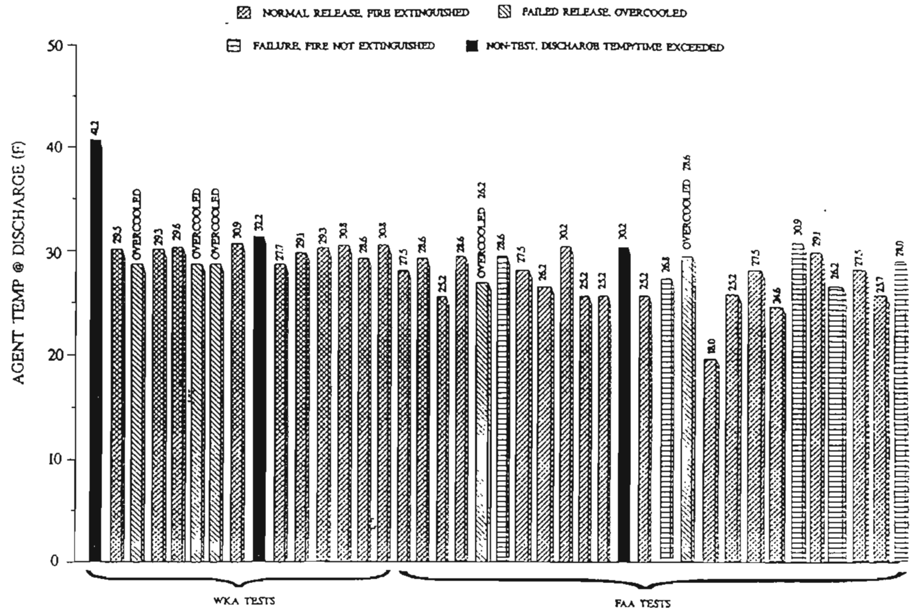
– 815 g ± 5 g of the crumpled towels are to be loaded into the test article.

- IGNITION SOURCE;

– The ignition source is a 15 loop nichrome wire coil wound on a ¼ inch diameter mandrel and spaced to form a coil approximately 1¼ inches long. The wire diameter is 0.025 inches. The voltage is to be adjusted to obtain a temperature (measured inside the coil at the center) of 1650°F ± 50°F.

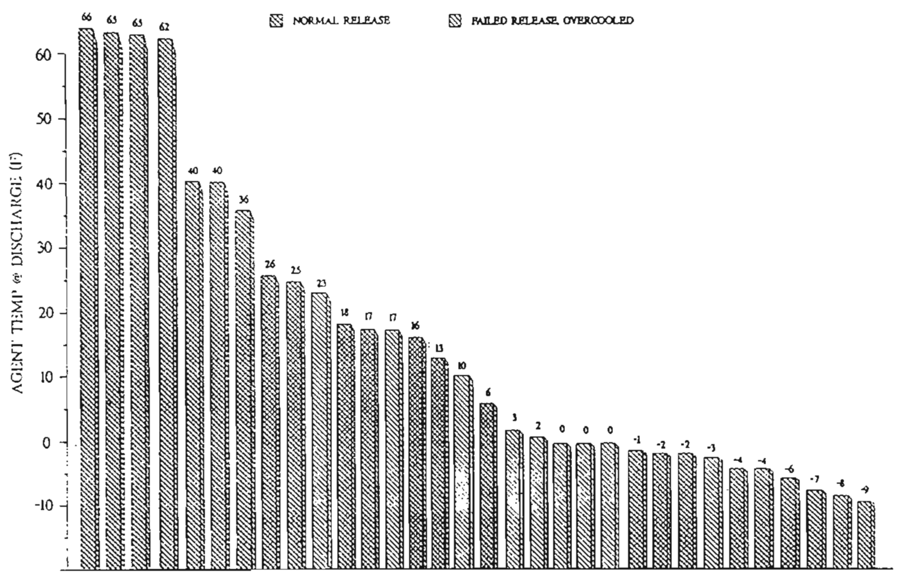
LAVATORY TRASH RECEPTACLE EXTINGUISHMENT TESTING

HALON 1301 TEST RESULTS @ FAA & WKA



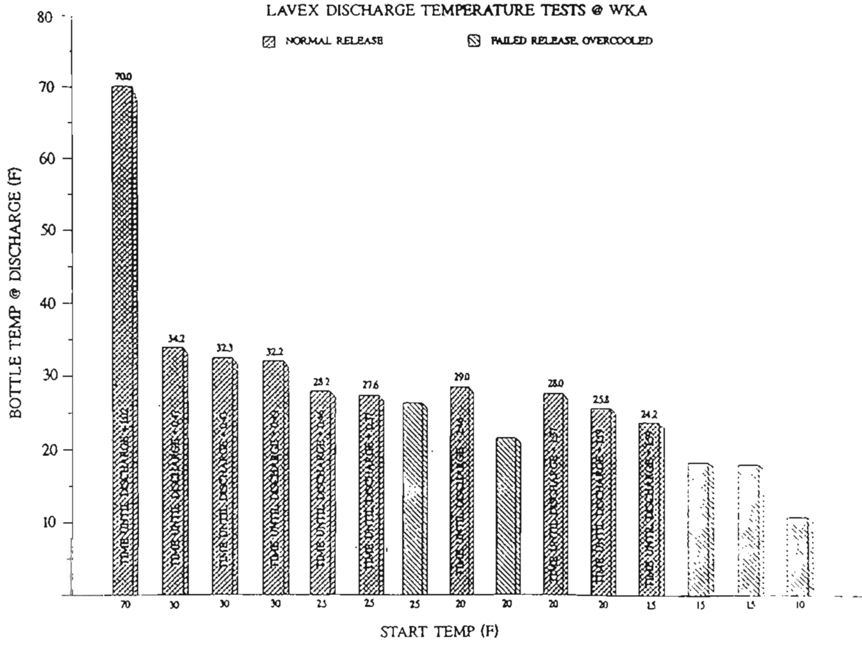
LAVATORY TRASH RECEPTACLE EXTINGUISHMENT TESTING

EFFECT OF TEMPERATURE ON EUTECTIC OPERATION (FAA)



LAVATORY TRASH RECEPTACLE EXTINGUISHMENT TESTING

LAVEX DISCHARGE TEMPERATURE TESTS @ WKA



Draft Statement by the European Community on the Guidelines for minimising emissions of halons prepared by TEAP and HTOC

Paragraph 2 of Decision VII/12 on control measures concerning halons, requested TEAP and HTOC to prepare a report to provide guidance on this decision.

The EU thanks TEAP and HTOC for the work done, but it also believes that the guidelines lack consistency, contain no real guidance and simply repeat arguments and considerations which are already well known.

In order to elaborate clear guidelines which will enable Parties to limit emissions of halons, the EU suggests that the focus should be on the following two central problems:

1. The definition of critical uses should be closely examined and better evaluated in order to identify a common list of critical uses for halons to be proposed to all Parties in order to achieve uniformity in the firefighting sector.

   Care should be taken when defining use as "critical", taking account of the fact that substitute products and alternative technologies already exist for most of the applications where halons were and are used.

   The following examples of existing practices are a useful indication of what we have in mind:

   - within the EU, several countries have made decommissioning, except in critical uses, mandatory and/or have prohibited halons in new installations;

   - similar restrictions are in place in a number of countries outside the EU, both developed and developing.

2. The real stocks of halon 1211 and 1301 should be correctly estimated, perhaps by way of information submitted by Parties to the Secretariat.

   The following are the principal actions which should be undertaken by Parties and for which TEAP and HTOC should provide clear and useful guidelines:

   - definition of uses that are absolutely critical,

   - elaboration of a critical uses list,

   - evaluation of the quantity of Halons required for critical uses,

   - estimation of existing stocks,

   - possible destruction of excess halons.

WALTER KIDDE *AEROSPACE*

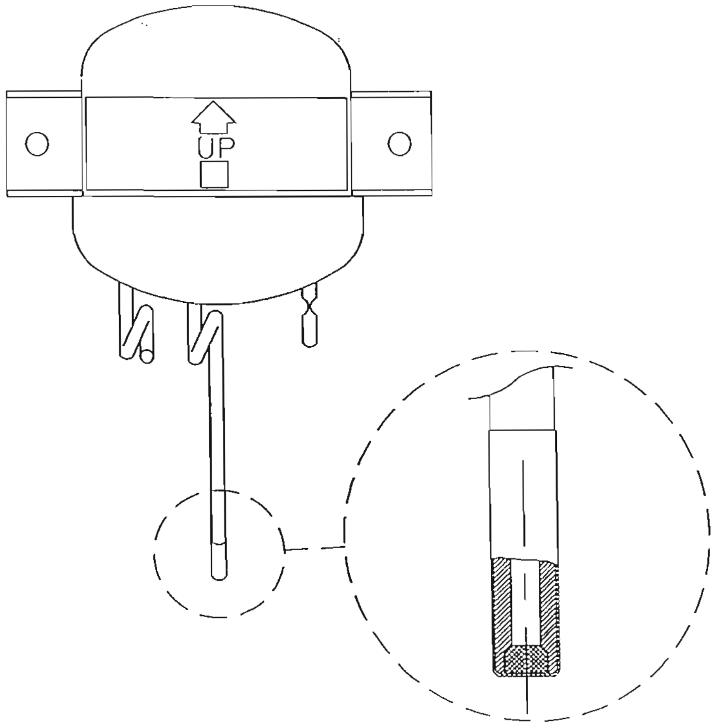
LAVATORY TRASH RECEPTACLE AUTOMATIC EXTINGUISHER REPLACEMENT AGENT HFC-227ea

REPORTED OCTOBER 1996
LONDON
BY
R. F. SEARS

TRASH RECEPTACLE AUTOMATIC EXTINGUISHER REPLACEMENT AGENT

CONTENTS

• Fire Extinguisher Configuration



AGENT SELECTION:

- Environmental concerns:
  - ○ HCFC's, non- zero ODP, Montreal protocol requires phase out during 2015 - 2030.
  - ○ PFC's, long atmospheric lifetime, EPA will only permit use "if nothing else will do the job".
  - ○ CFC's currently subject to phase out.
  - ○ CF_3I & HFC's, meet environmental requirements.

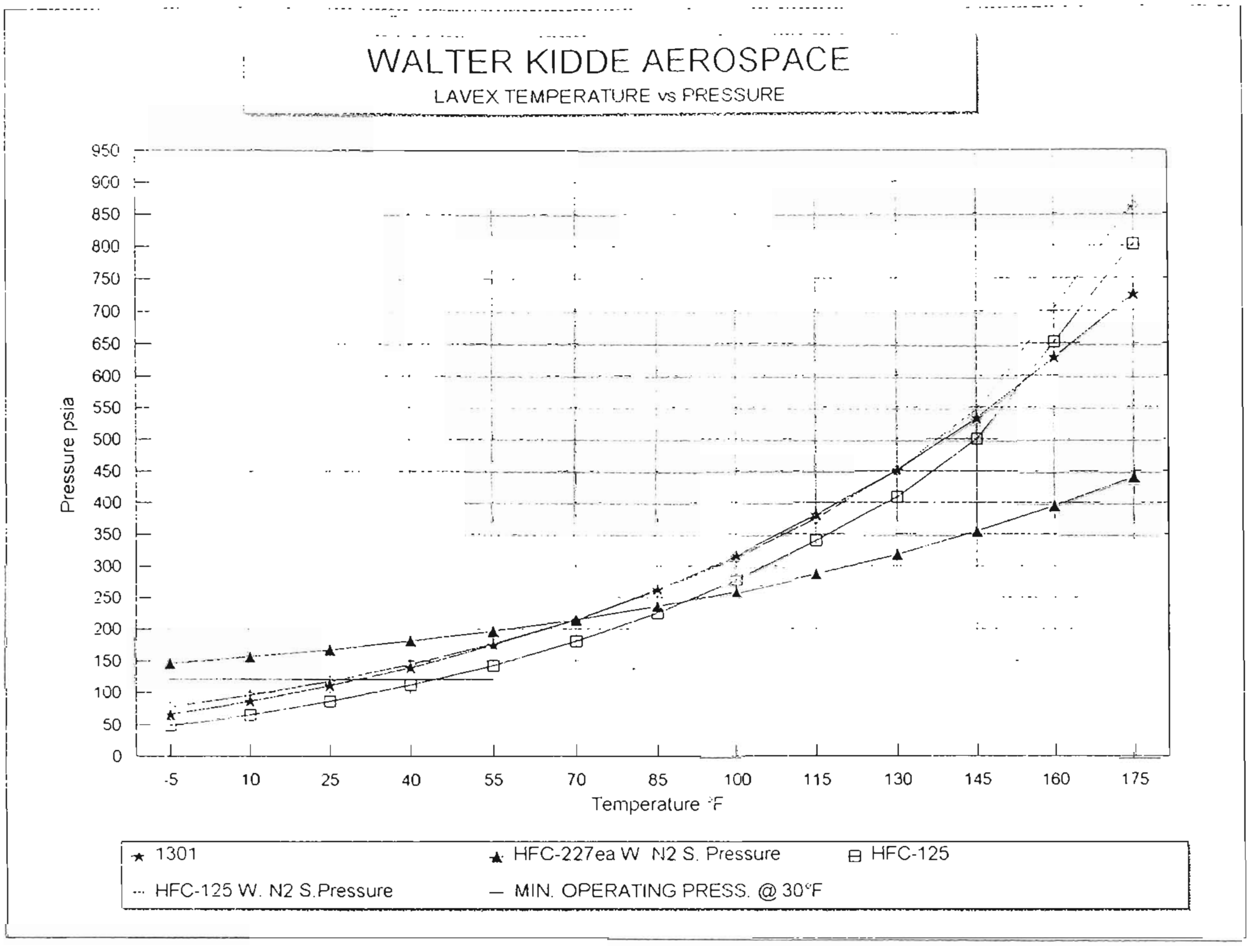
DOWN SELECT TO HFC'S or CF_3I

- Toxicity:
  - ○ Agent must have SNAP approval for use in occupied spaces
  - ○ CF_3I is only approved for use in non-residential handheld extinguishers. The NOAEL value of 0.2 % is too low for use in a lavatory compartment. (e.g. if the whole lavatory compartment is considered, 0.25 lb in 160 ft^3 ≡ 0.3%)
  - ○ HFC's 125 and 227ea are on SNAP list. Approval for HFC-236fa is pending.

DOWN SELECT TO HFC-125 OR HFC-227ea

- Fill conditions and minimum operating temperature:
  - ○ Minimum operating temperature of 1301 Lavex was found to be 30°F which corresponds to an internal pressure of 120 psia. It is required to at least match this performance.

AGENT	LIQUID FILL FOR ¼ Lb in $9in^3$ @ 70°F, %	PRESSURE @ -5°F, psia	PRESSURE @ 30°F, psia	PRESSURE @ 70°F, psia	PRESSURE @ 175°F, psia
1301	49	72	120	215	756
HFC-125	62	48	95	181	808
HFC-125 with N_2 superpressure	62	78	127	215	864
HFC-227ea with N_2 superpressure	55	146	173	215	440



- Cost & availability:
  - HFC-227ea (FM-200) is commercially available at approximately $15 per pound.

<u>HFC-227ea WITH N_2 SUPERPRESSURE IS BEST CHOICE & OFFERS PERFORMANCE AT 0°F</u>

SUMMARY OF HFC-227ea PROPERTIES

ODP(rel CFC-11)	HGWP (rel CO_2)	Atmospheric lifetime (years)	Controls/ Legislation	Vapor Volume @ 70°F, ft^3/Lb	Liquid Density @ 70°F, Lb/ft^3	n-Heptane Cup Burner, %
0	3300	41	SNAP Approved	2.2056	87.58	6.2*

* Average of 5 values

WALTER KIDDE *AEROSPACE*
TRASH RECEPTACLE AUTOMATIC EXTINGUISHER REPLACEMENT AGENT

- Summary of Minimum Performance Test Protocol

1/ Condition (dry) fire load (paper towels) at 70 ± 5°F and maximum Rh 55% for 24 hours

2/ Weigh extinguisher and record value

3/ Set up data acquisition and video camera:
- Record video leader

4/ Install igniter, clamp 1 inch above ventilation holes, 1 inch above the centerline of the receptacle

5/ Load fire materials: (The test must be initiated within 30 minutes of removing the fire load from the conditioning chamber.)
- packing density 340 ± 10 towels in 18 X 18 X 18 inch container
- quantity 815 ± 5 g

6/ Mount the extinguisher

7/ Photograph installation

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- Start video camera
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12/ Record elapsed time if visible flames appear

13/ Upon agent discharge :
- Record elapsed time
- De-energize the ignitor
- Close the 12 ventilation holes

14/ 5 minutes after agent discharge:
- If temperature and visual observations indicate that combustion has ceased open or remove the access panel and

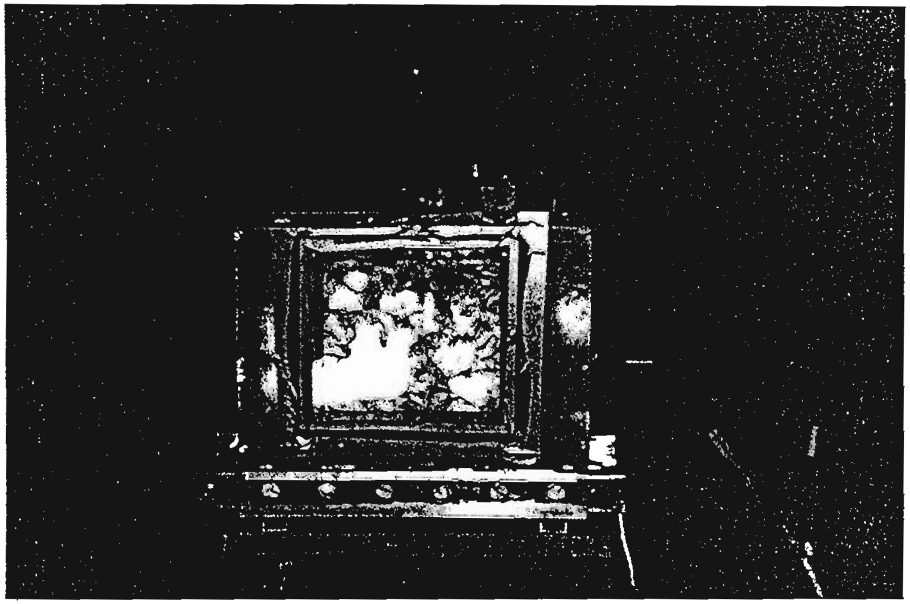
A/ If after a further 2 minutes re-ignition does not occur:
- Empty the compartment and spread the fire load into a single layer.
- Observe and note any residual smoldering. Record the extent of fire load consumption by the test.
- Take a still photograph of the fire load.

B/ If re-ignition does occur:
- Extinguish the fire using water or other environmentally friendly method.

15/ Weigh the discharged extinguisher, calculate and record the quantity of extinguishant discharged.

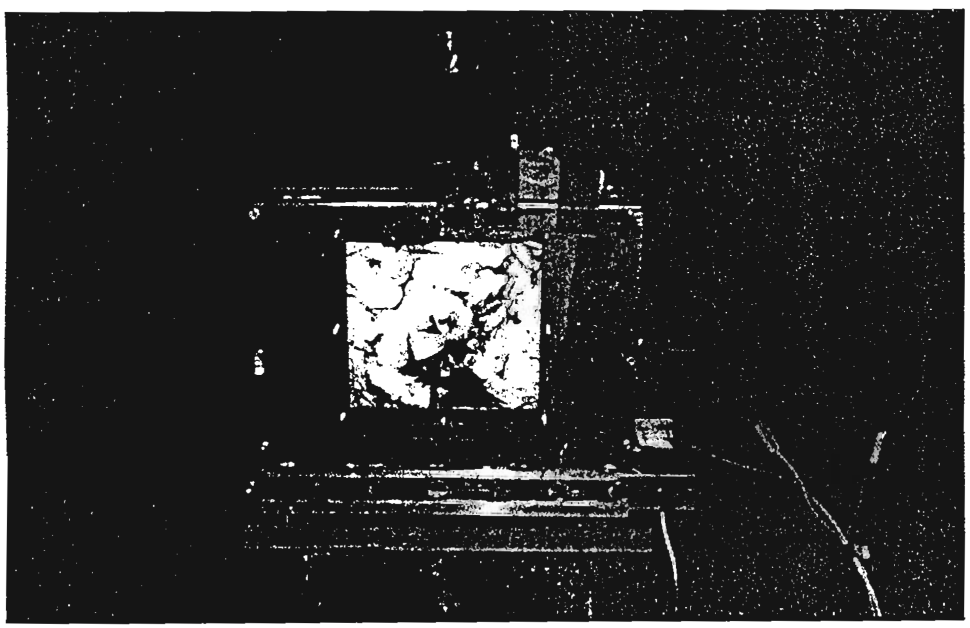
16/ Evaluation criteria:
- Visual evidence must show that the fire was extinguished.
  - No smoke
  - No re-ignition when access panel is opened
  - No residual smoldering evident while removing and spreading the fire load.
- The receptacle thermocouple must show a continuously decreasing trend after the extinguisher has discharged.
- The extinguisher must meet the above criteria on five successive tests.

FM-200: Trash Receptacle Fire Test



Prior To Test

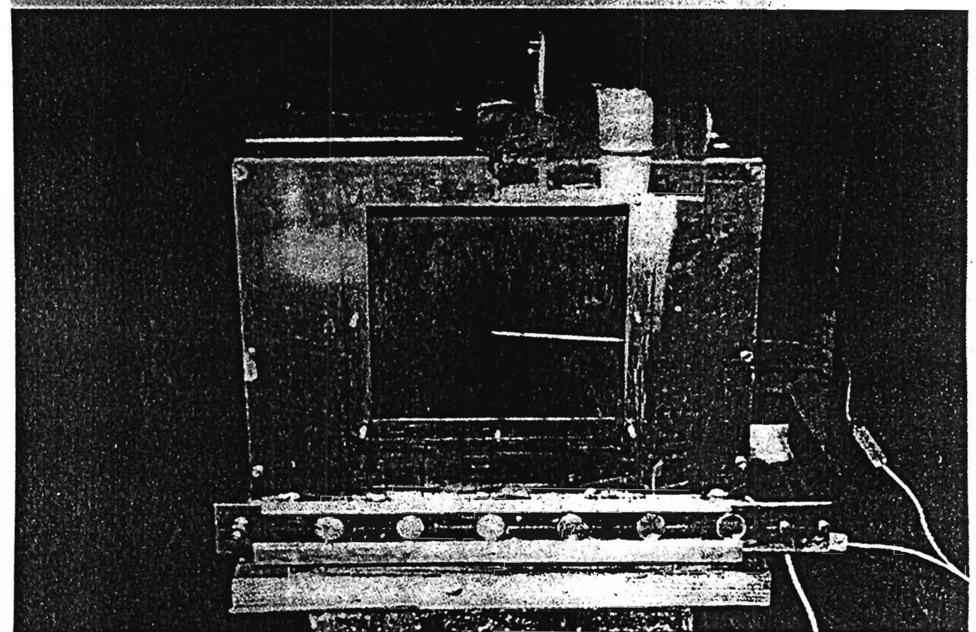
WKA



After Extinguishment

WKA

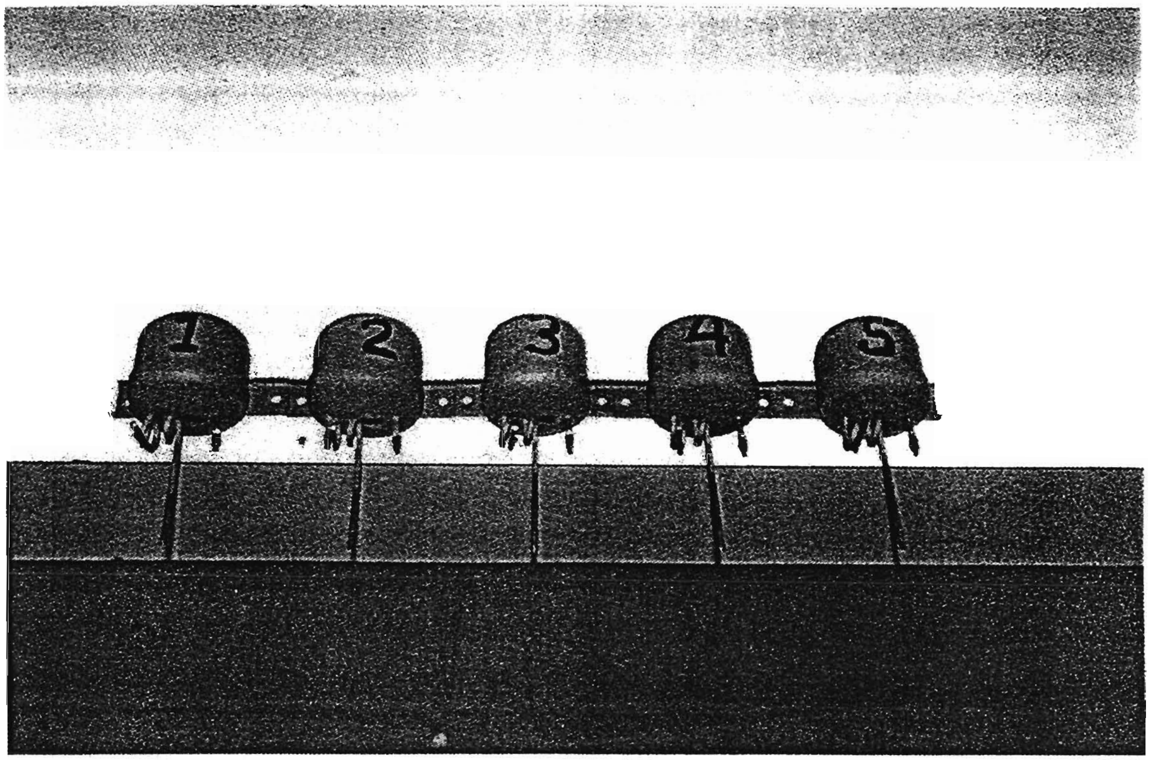
FM-200: Trash Receptacle Fire Test



Test Trash Receptacle

WKA

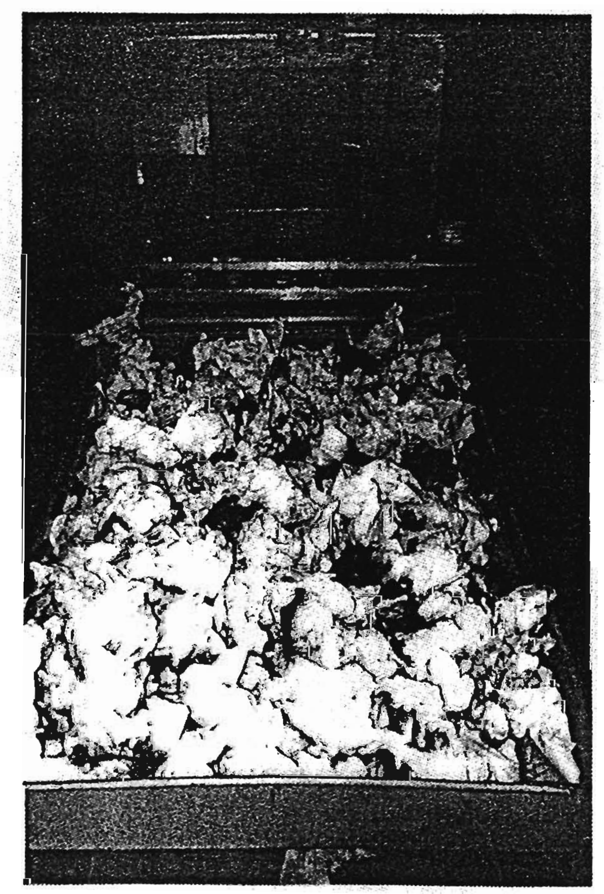
FM-200: Trash Receptacle Fire Test



Test Articles

WKA

FM-200: Trash Receptacle Fire Test



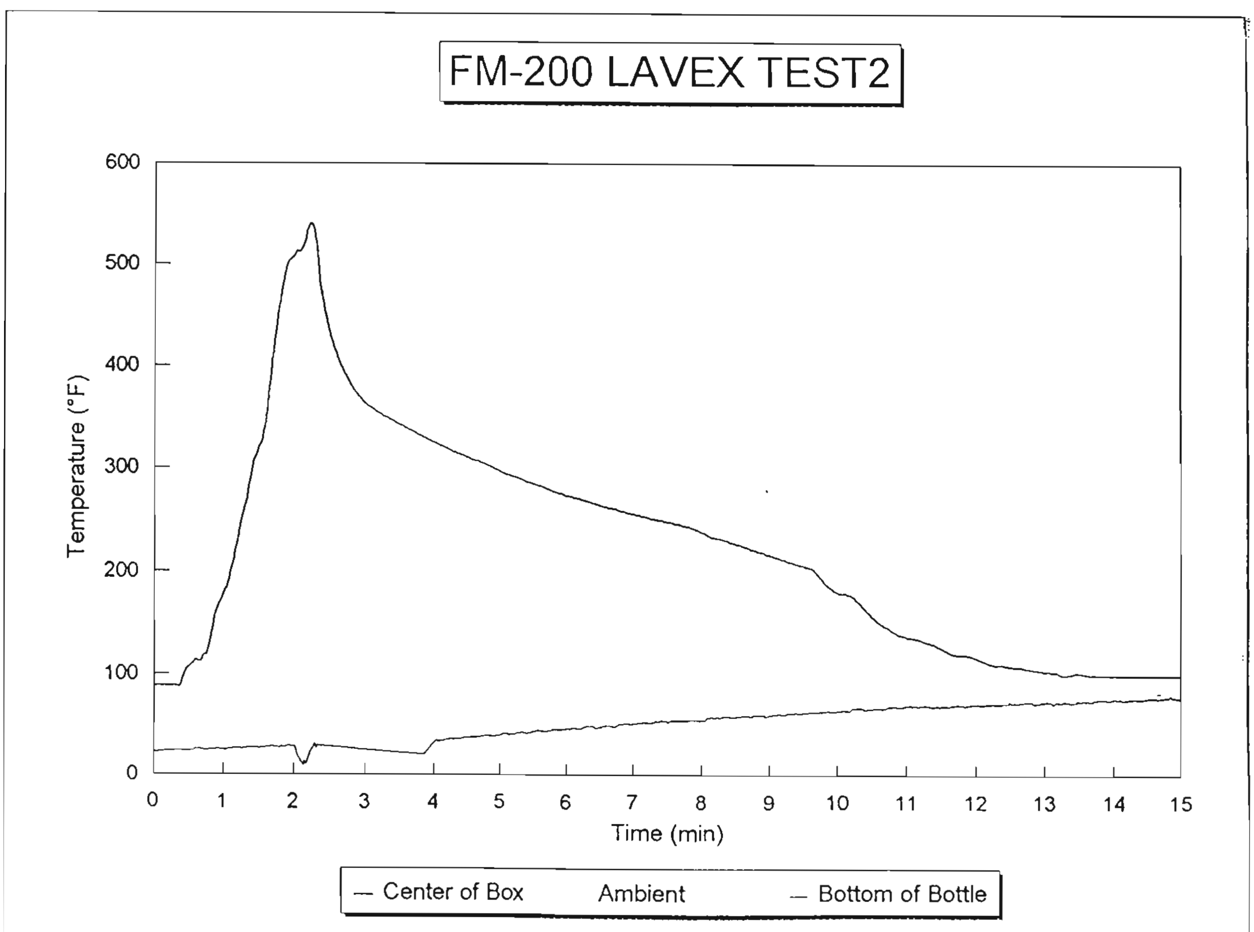
After Test

WKA

WALTER KIDDE *AEROSPACE*
TRASH RECEPTACLE AUTOMATIC EXTINGUISHER REPLACEMENT AGENT

WALTER KIDDE AEROSPACE LAVEX MINIMUM PERFORMANCE STANDARD; FM-200 RESULTS					
TEST #	Wt. of AGENT DISCHARGED g	EXTINGUISHER TEMPERATURE AT DISCHARGE °F	ELAPSED TIME, IGNITOR ENERGIZED TO DISCHARGE min:sec	MAXIMUM TEMPERATURE RECORDED IN CENTER OF TEST ARTICLE °F	COMMENTS
1	129	30.0	1:34	Thermocouple failed	Fire completely extinguished.
2	121	30.2	2:10	540	Fire completely extinguished.
3	123	29.6	1:24	470	Fire completely extinguished.
4	118	30.2	2:15	660	Fire completely extinguished.
5	115	-2.6 *	2:06	560	Fire completely extinguished.

* Test run below 0°F to demonstrate low operational temperature capability of design.



WALTER KIDDE *AEROSPACE*
TRASH RECEPTACLE AUTOMATIC EXTINGUISHER REPLACEMENT AGENT

COMPLIANCE/TEST MATRIX

	10-61909 PARAGRAPH	TITLE	COMPLIANCE	FUNCTIONAL COMPLIANCE		TEST ARTICLE
				ANALYSIS	TEST: PARAGRAPH OF KIDDE TP-869	
	1.0	SCOPE	TITLE ONLY			
	1.1	PURPOSE	✓ (FM-200)			
	1.2	GENERAL DESCRIPTION	✓			
*	1.2.1	SIZE	✓ SEE G800100			
*	1.2.2	COVERAGE		✓		
	1.2.3	WEIGHT	✓			
	1.2.4	CONFIGURATION	✓ SEE G800100-1			
	2.0	APPLICABLE DOCUMENTS	TITLE ONLY			
	2.1	GENERAL	UNDERSTOOD			
	2.2	D6-5800	✓			
	2.3	D6-10914 D6-54921	✓ ✓			
	2.4	D6-5000	✓			
	3.0	REQUIREMENTS	TITLE ONLY			
	3.1	GENERAL	✓	✓		
	3.2	MATERIALS & CONSTRUCTION	✓	✓		

COMPLIANCE/TEST MATRIX

	10-61909 PARAGRAPH	TITLE	COMPLIANCE	FUNCTIONAL COMPLIANCE		TEST ARTICLE
				ANALYSIS	TEST: PARAGRAPH OF KIDDE TP-869	
	3.3	ENVIRONMENTAL CONDITIONS	TITLE ONLY			
*	3.3.1	AMBIENT TEMPERATURE	✓		11.7	1,2
*	3.3.2	VIBRATION	✓		11.8	1,2
*	3.3.3	LOADING	✓		11.11	1,2
	3.3.4	CORROSION	✓	✓		
	3.3.5	MISCELLANEOUS	✓	✓		
	3.3.6	HUMIDITY	✓	✓		
	3.4	PERFORMANCE	✓	✓		
*	3.4.1	ACTUATION TEMPERATURE	✓		11.9	1
*	3.4.2	ACTUATION RESPONSE	✓		11.10	2
*	3.4.3	TIME FOR AGENT DISPERSAL	✓		11.9	1
	3.5	DESIGN OBJECTIVES	TITLE ONLY			
	3.5.1	RELIABILITY	✓	✓		
	3.5.2	TAMPER/THEFT PROOF	✓	✓		
	3.5.3	MAINTENANCE	✓	✓		

WALTER KIDDE *AEROSPACE*

TRASH RECEPTACLE AUTOMATIC EXTINGUISHER REPLACEMENT AGENT

COMPLIANCE/TEST MATRIX					
			FUNCTIONAL COMPLIANCE		
10-61909 PARAGRAPH	TITLE	COMPLIANCE	ANALYSIS	TEST: PARAGRAPH OF KIDDE TP-869	TEST ARTICLE
3.6	IDENTIFICATION	TITLE ONLY			
3.6.1	LABEL	✓			
3.6.2	ORIENTATION INDICATION	✓			
4.0	Q.A. PROVISIONS	TITLE ONLY			
4.1	GENERAL	✓			
* 4.2	PROTOTYPE TESTS	✓		APPENDIX B	
4.3	ADDITIONAL TESTS	TBD			
5.0	PREPARATION FOR DELIVERY	✓			
6.0	RECEIVING FUNCTIONAL TEST	TITLE ONLY	N/A	N/A	N/A
6.1.1	SAMPLE SIZE	✓	N/A	N/A	N/A
6.1.2	SAMPLE SIZE ON REJECTION	✓	N/A	N/A	N/A
6.2	FUNCTION TEST	TITLE ONLY	N/A	N/A	N/A
6.2.1	THERMOCOUPLE	✓	N/A	N/A	N/A
6.2.2	OVEN	✓	N/A	N/A	N/A
6.2.3	TEMPERATURE	✓	N/A	N/A	N/A

COMPLIANCE/TEST MATRIX					
			FUNCTIONAL COMPLIANCE		
10-61909 PARAGRAPH	TITLE	COMPLIANCE	ANALYSIS	TEST: PARAGRAPH OF KIDDE TP-869	TEST ARTICLE
6.2.4	OBSERVATIONS	✓	N/A	N/A	N/A
6.2.5	REJECTION CRITERIA	✓	N/A	N/A	N/A
6.3	REJECTION RATE	TITLE ONLY	N/A	N/A	N/A
6.3.1	SINGLE UNIT REJECTION	✓	N/A	N/A	N/A
6.3.2	BATCH REJECTION	✓	N/A	N/A	N/A

- Logistics:
  - Certification, by similarity to existing BCA SCD 10-61909 extinguisher based on equivalent performance using IHRWG minimum performance standard.
  - Availability, March 1997

RECENT ALTERNATE AGENT TEST RESULTS IN THE WALTER KIDDE AEROSPACE SMALL SCALE AIRCRAFT ENGINE FIRE SIMULATOR

International Halon Replacement Working Group
London
10th October, 1996

Terry Simpson
Walter Kidde Aerospace
4200 Airport Drive
Wilson, NC, 27896
Phone: 919-237-7004 ext. 296
Fax: 919-237-4717

CONTENTS

1. INTRODUCTION

- Many of the currently available fire extinguishing agents have been investigated in the WKA Small Scale Aircraft Fire Simulator (SSAEFS):
  - Vaporizing liquid agents (e.g. Halon 1301, HFCs, HCFCs, FICs)
  - Dry chemicals
  - POWSUS "Envirogel"
  - Pyrotechnics

- Recent WKA studies have focused on HFC-125, HFC-227ea, CF_3I

- The aim of recent studies has been to assess the fire extinguishing capabilities of these agents in terms of <u>both</u> agent mass and vapor phase concentration required to achieve suppression (results compared to Halon 1301)

2. SSAEFS CAPABILITIES

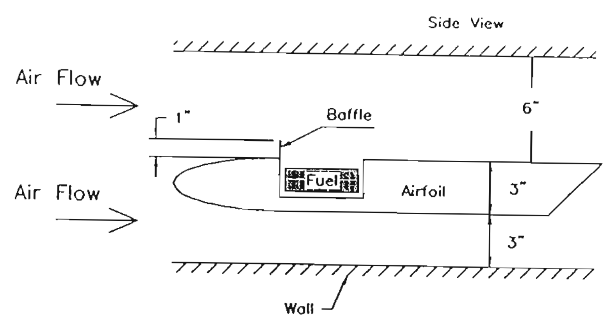
- Design based on that used by Hirst, Farenden and Simmons
  - Wind tunnel houses a "hidden" pan fire
  - Deduced to be the worst case fire threat for aviation engine nacelles

- Airspeeds from 1 - 12 m s^{-1} (0.5 to 3.0 lbs/s) available

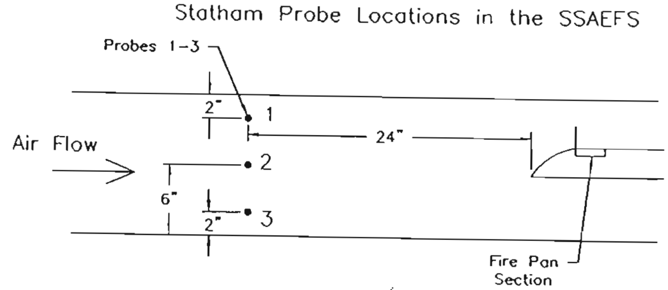
- Constant fire challenge
  - Temperature control
  - Fuel level control

- Agent dispensing system
  - Constant pressure
  - Solenoid or electro-pneumatic ball valve and nozzle

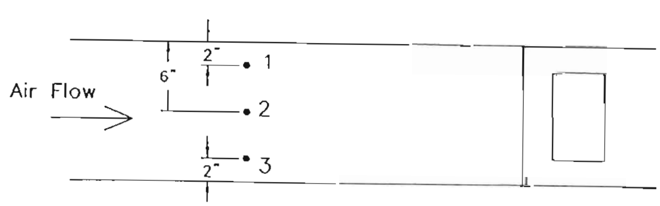
SSAEFS Fire Pan Section



Statham Probe Locations in the SSAEFS



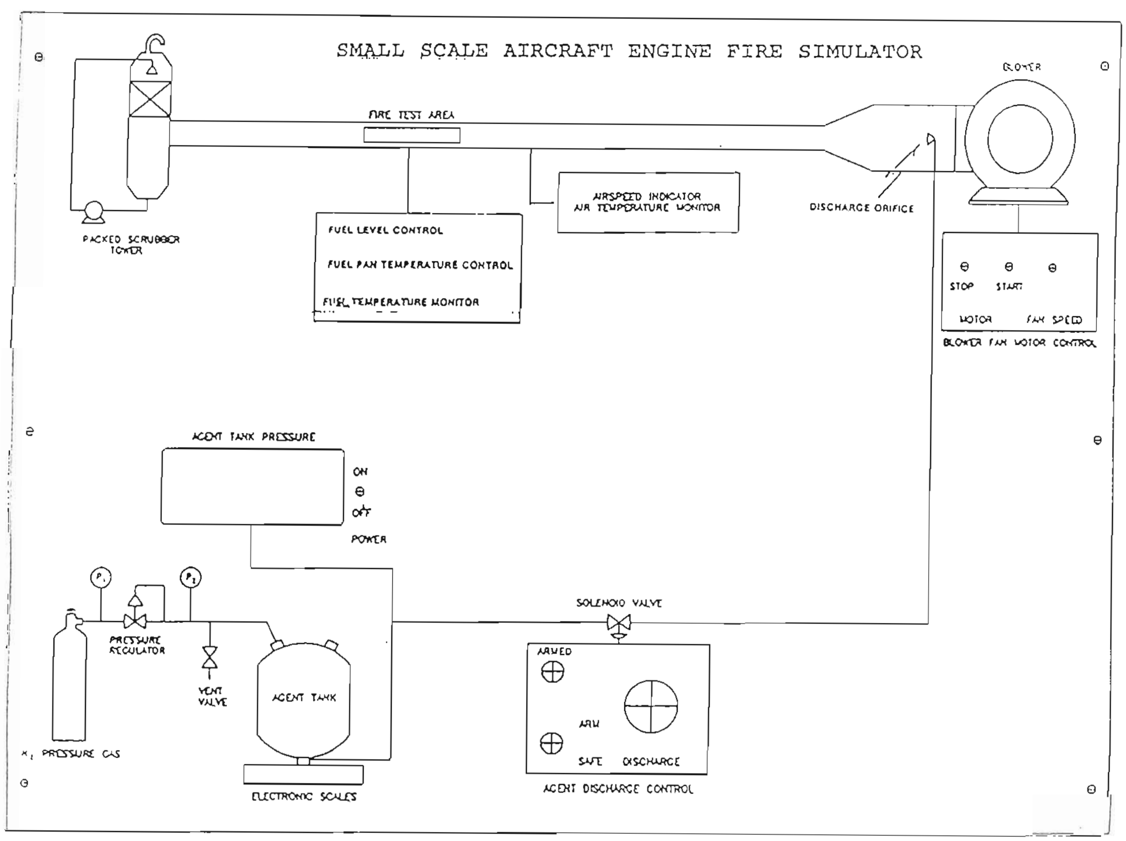
(i) SSAEFS Side



(ii) SSAEFS Plan

3. Instrumentation

- Ambient temperature, pressure, humidity monitors
- Omega HHF7-10 anemometer (1 - 30 m s^{-1})
- Mettler ID-1 KC-120 platform scale
- Thermocouples
- Video
- Statham gas analyzers
- Data acquisition system (9 channels, 30 s duration, 50 ms sampling rate)



INTERNATIONAL HALON REPLACEMENT WORKING GROUP

A Message From The Coordinator's Office

TO: ALL HALON REPLACEMENT WORKING GROUP MEMBERS

FROM: APRIL HORNER

DATE: JANUARY 2, 1997

SUBJECT: SIMULANTS TASK GROUP
RE: OCTOBER 9-10, 1996, MINUTES PACKAGE, PAGES 4-5, (See Below)

During the October 9-10, 1996, Working Group Meeting there was a discussion on the need to continue the work of the Simulants Task Group. Nick Povey offered to contact Bill Leach for any updated information on simulants.

Bill Leach provided the attached information which is the amendment enacting the change in the U.S. Navy to require the use of HFC-125 as the only allowable simulant for halon 1301.

Nick asked me to pass this information along to the Working Group members.

October 9-10, 1996, Minutes Excerpt:

R. Hill - Is there still a need for a standardized methodology to use simulants for the certification of Halon 1301? Consensus: Yes, there is a need. D. Dierdorf: When will the FAA as a certifying agency allow the use of a simulant? R. Hill - The reason we put this task group together was to define how the simulant would be used as in the engine nacelle. N. Povey - The main emphasis of this Task Group was for the authorities to get information from data on the use of simulants from companies like Rolls Royce, etc. R. Hill - What should we do with this Task Group? *ACTION ITEM*: Nick Povey will contact B. Leach and C. Womelaorf to see what the status of this group is and if they have been continuing their work in this task group and plan to continue with it. R. Hill - We need people from industry to provide us with this data. D. Dierdorf - We need input from the FAA ACO offices on what data they need from us. Member question: Is there a rule in place now that states that you cannot discharge halon to certify a system? R. Hill - Yes, there are a number of places in the world where it is illegal to discharge halon to certify a system. There are parts of states in the U.S where it is illegal to discharge halon to certify a system C. Lewis: There are places in Canada where it is illegal to discharge halon to certify a system. There are rules in place in Canada where it is illegal to transport halon on the roads. Consensus: We will wait to see what B. Leach and C. Wolmeldorf's response is when Nick talks to them. N. Povey: Who has an interest in continuing this task group? (Douglas has an interest in continuing this task group) D Dierdorf - Would like to see this Task Group continue if the scope of the group is expanded to include quality assurance, etc. R. Hill suggested that D. Dierdorf join the Task Group and ask other Task Group members to include these areas.

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MIL-E-22285(AS)
AMENDMENT 3
31 July 1996
SUPERSEDING
AMENDMENT 2
6 November 1995

MILITARY SPECIFICATION

EXTINGUISHING SYSTEM, FIRE, AIRCRAFT, HIGH-RATE-DISCHARGE TYPE, INSTALLATION AND TEST OF

This amendment forms a part of MIL-E-22285(AS), dated 11 December 1959, and is approved for use by the Naval Air Systems Command, Department of the Navy, and is available for use by all Departments and Agencies of the Department of Defense.

PAGE 3

3.7: At the end of the paragraph, add "(see 6.1.1)."

3.8, line 2: Delete "at least 15 percent by volume" and substitute "at least 6 percent by volume in air (22% by weight)."

PAGE 4

3.8.3: Delete and substitute:

"3.8.3 Added factor for agent loss - Where long discharge lines are used, compliance with 3.8 may require an increase in the value of W obtained in the formulas of 3.8.1, in order to compensate for agent lost in wetting the discharge lines."

PAGE 5

3.16: Delete the second sentence and substitute: "Supply lines between the containers and the discharge opening should, where practicable, be 10 feet or less in length."

Add the following new paragraph: "3.15.2.1 Number of containers - In a 4 engine aircraft, both initial and reserve fire extinguishing coverage may be obtained by using a total of 4 agent containers. This includes 2 central systems, with each central system serving 2 engines. Each central system thus includes one initial discharge container and one reserve discharge container."

DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited.

* 4.3.2.2, add to end of paragraph:

"Bromotrifluoromethane (CF_3Br, halon 1301) shall not be used to conduct the discharge test. Instead, pentafluoroethane (CHF_2CF_3, HFC-125) shall be used as the only approved halon 1301 simulant during discharge testing. Simulant concentration and discharge duration shall meet the requirements of 3.8 and 3.9, respectively."

* Add the following new paragraph:

"4.3.2.2.1 Simulant fill parameters. The discharge test cylinder(s) shall be filled with pentafluoroethane to an amount equivalent to 77 percent of the actual suppression system agent weight, based on an equivalent liquid fill ratio of the halon 1301 bottle being simulated. Nitrogen pressurization of the test cylinder(s) shall be equivalent to that of the actual suppression system cylinder."

Add the following new paragraph:

"6.1.1 ODS assessment. Paragraph 3.7 requires the use of bromotrifluoromethane, CF_3Br, an ozone depleting substance. Based on the appropriate Technical Representative's assessment, it has been determined that a suitable substitute is not currently available. The use of bromotrifluoromethane, CF_3Br, is permitted pending approval from the Senior Acquisition Official for each acquisition."

NOTE: The margins of this amendment are marked with asterisks to indicate where changes from the previous amendment were made. This was done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notations and relationship to the last previous amendment.

Preparing activity:
Navy - AS

(Project 1680-N654)