N74-27492

NASA TECHNICAL MEMORANDUM

NASA TM X-7155

NASA TM X-71553

(NASA-TM-X-71553-Vol-2-Pt-1) BIBLIOGRAPHY ON AIRCRAFT FIRE HAZARDS AND SAFETY. VOLUME 2: SAFETY. PART 1: KEY NUMBERS 1 TO 524 (NASA)

N74-27492

Unclas
43139

BIBLIOGRAPHY ON AIRCRAFT FIRE HAZARDS AND SAFETY
Volume II - SAFETY

compiled by James J. Pelouch, Jr. and Paul T. Hacker
Aerospace Safety Research and Data Institute
Lewis Research Center
Cleveland, Ohio 44135

May 1974

This information is being published in preliminary form in order to expedite its early release.

NASA TMX-71553

BIBLIOGRAPHY ON AIRCRAFT FIRE HAZARDS AND SAFETY

Volume II - SAFETY, Part 1 - Key Numbers 1 to 524

Compiled by
James J. Pelouch, Jr. and Paul T. Hacker

Aerospace Safety Research and Data Institute
Lewis Research Center
Cleveland, Ohio 44135

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FOREWORD

The mission and objectives of the Aerospace Safety Research and Data Institute are (a) to support NASA, its contractors, and the aerospace industry with technical information and consultation on safety problems; (b) to identify areas where safety problems and technology voids exist and to initiate research programs, both in-house and on contract, in these problem areas; (c) to author and compile state-of-the-art and summary publications in our areas of concern; (d) to establish and operate a safety data bank. As a corollary to its support to the aerospace community, ASRDI is also to establish and maintain a file of specialized information sources (organizations) and recognized, acknowledged experts (individuals) in the specific areas or fields of ASRDI's interest.

To match our resources with our priorties, ASRDI is concentrating on selected areas - fire and explosion; cryogenic systems; propellants and other hazardous materials, with special emphasis on oxygen and hydrogen; aeronautical systems and spacecraft operations; lightning hazards; and the mechanics of structural failure. Staff expertise is backed by a safety library and is further supported by a computerized bank of citations and abstracts built from literature on oxygen, hydrogen, and fire and explosion. Computer files on mechanics of structural failure, fragmentation hazards, and safety information sources are also being established. In addition, ASRDI has two NASA RECON terminals and people adept at querying the system for safety-related information.

Frank E. Belles, Director
Aerospace Safety Research and Data Institute
National Aeronautics and Space Administration

INTRODUCTION

A part of the Aerospace Safety Research and Data Institute's (ASRDI) mission is to compile and store in a computerized system bibliographic citations on hazards and safety in various areas related to aerospace activities. One of these areas is fire and explosion. The program in this area has been underway for about three years and is continuing. At the present time the computerized data bank contains about 2000 bibliographic citations on the subject.

Each citation in the data bank contains many items of information about the document. Some of the main items are title, author, abstract, corporate source, description of figures pertinant to hazards or safety, key references, and descriptors (keywords or subject terms) by which the document can be retrieved. In addition each document is assigned to two main categories that are further divided into subcategories. The two main categories are fire hazards and fire safety. Each document is also further categorized according to its area of applicability such as - aircraft and spacecraft and their associated facilities; aerospace research and development test facilities; buildings; and general applicability.

This report is a compilation of all the document citations in the ASRDI data bank as of April 1974 on fire hazards and fire safety that pertain to aircraft. The report is somewhat preliminary in nature in that input to the data bank is continuing; moreover not all the information contained in the bank has been edited for errors. The report is being published as an illustrative example of the contents of the data dank and to obtain user feedback on the usefulness of such compilations and whether the subject scope should be narrowed in future compilations.

The report is divided into two volumes. Volume I, Hazards, presents bibliographic citations that describe and define the aircraft fire hazards and covers a wide range of subjects such as - combustion characteristics of materials; accidents and incidents reports; causes of fire; methods and techniques of evaluating the fire hazard; and the resulting effects of fire on man and property. Volume II, Safety, presents bibliographic citations that describe and define aircraft fire safety methods, equipment, and criteria. It covers such subjects as prevention, detection, and extinguishment of fire, and codes and standards. Each volume of the report contains, in addition to the citations, an author index and an index of major descriptors (keywords or subject terms). The indices are related to the citations by the ASRDI key number, which appears in the upper right hand corner of the first page of each citation. To facilitate binding, both volumes are broken into parts.

Volume I has two parts -

Part 1 - Key Numbers 1 to 817
Part 2 - Key Numbers 818 to 2146,
Author Index and Descriptor Index

Volume II has three parts -

Part 1 - Key Numbers 1 to 524
Part 2 - Key Numbers 525 to 1064
Part 3 - Key Numbers 1065 to 2165,
Author Index and Descriptor Index

The preparation of this report for printing was essentiall accomplished automatically. The search strategy (in this case subject category) and information on citation content and forma was fed into the computer. The output from the computer wa placed directly on multilith paper by a high-speed printer.

VOLUME II

PART 1

WHIFFLE BALL FIRE AND EXPLOSION SUPPRESSION CONCEPT PROGRESS REPORT, PHASE 1 SPHERES

by

BOTTERI, B.P.
GANDEE, G.W.
MORRISEY, D.J.

07/00/68

-ABSTRACT-

Feasibility of the perforated hollow sphere (whiffle balls) concept for the control of fires and explosions in aircraft fuel tanks was studied, and one configuration was evaluated. These Phase 1 spheres, which have 1-in. diameters with 34 0.1-in. holes, exhibited considerable explosion suppression performance, but did not meet the maximum 3 psi pressure increase limit required for aircraft application. These spheres, however, are stable in a fuel system environment and, with the exception of fuel induced swelling, are comparable in performance to reticulated polyurethane foam. A 1-in. or smaller diameter sphere is required to achieve effective vapor space explosion suppression capability, and the spheres must be suitable for use at temperatures between -65 and +180 deg. F.

-SOURCE INFORMATION-

CORPORATE SOURCE -
AIR FORCE AERO PROPULSION., WRIGHT-PATTERSON AFB, OHIO.
REPORT NUMBER -
APFL-TM-68-10//PROJ. NO. 1559//TASK 191
OTHER INFORMATION -
0046 PAGES, 0010 FIGURES, 0007 TABLES, 0000 REFERENCES

AN ULTRAVIOLET SENSING FLAME DETECTOR FOR USE ON HIGH PERFORMANCE MILITARY AIRCRAFT

by

LEEN, A.

02/00/70

-ABSTRACT-

A small, quartz enclosed photon detector utilizing the avalanche in a gas discharge to amplify the photoelectric signal currents was developed as a solar blind ultraviolet sensitive flame detector for use on high performance military aircraft. Decreased response of the sensors at elevated temperatures was observed during development but its cause is not known. A reasonable upper temperature limit for reproducible sensor characteristics was set at 550 deg. F., although operation at lower temperatures will extend sensor life and increase reliability. The complete detection system comprises the detector, an associated test lamp, and a control circuit with associated power supply and alarm devices. Some difficulty during field tests indicated problems with alarm actuation from voltage spikes introduced through the power source. Optimization of the design of the sensor and ultraviolet test lamp is discussed, and the electrical circuitry and flight test equipment are described. A specification for covering the performance and installation of a system on an aircraft is included, along with installation and maintenance instructions.

-BIBLIOGRAPHY-

GREEN, A.E.S., THE MIDDLE ULTRAVIOLET: ITS SCIENCE AND TECHNOLOGY, JOHN WILEY AND SONS, 1966//KOLLER, L.R., ULTRAVIOLET RADIATION, 2 ED., JOHN WILEY AND SONS, 1965//HUGHES AND DUBRIDGE, PHOTOELECTRIC PHENOMENA, 1ST ED., 4TH IMPR., MCGRAW-HILL, 1932

-SOURCE INFORMATION-

CORPORATE SOURCE -
EDISON (THOMAS A.) INDUSTRIES, WEST ORANGE, N.J.
REPORT NUMBER -
AFAPL-TR-69-107//X70-14496//AD-866136
SPONSOR -
AIR FORCE AERO PROPULSION LAB., WRIGHT-PATTERSON AFB, OHIO.
CONTRACT NUMBER -
CONTRACT AF33(615)-3531
OTHER INFORMATION -
0106 PAGES, 0012 FIGURES, 0006 TABLES, 0003 REFERENCES

EVALUATION OF FLAME ARRESTOR MATERIALS FOR AIRCRAFT FUEL SYSTEMS

by

KUCHTA, J.M.
CATO, R.J.
SPOLAN, I.
GILBERT, W.H.

02/00/68

-ABSTRACT-

Flame quenching effectiveness for a 20 pore/in. reticulated polyurethane foam used for fire protection in military aircraft fuel systems was examined under small and large-scale flame propagation conditions at various temperatures and pressures. In the small-scale experiments, pressure rise measurements showed that dry samples of this foam prevent flame propagation at arrestor length/ignition void length ratios as low as about 0.17 at ambient temperature and pressure. At ratios equal to or greater than 1.5, the material was effective at pressures up to about 15 psig and temperatures to 200 deg. F. Improved performance was obtained when the foam was wetted with liquid fuel or when a foam of greater porosity rating was used. Full-scale experiments in a 450-gal. fuel tank indicated that the foam is effective to pressures of at least 5 psig using an arrestor packing configuration that permits a 40 percent gross void volume. However, the foam tends to be less effective when additional air is supplied following ignition. Results obtained with electrical spark ignition sources were comparable to those found with tracer or incendiary ammunition. Generally, the effectiveness of the 20 pore/in. foam was noticeably greater than that of the 10 pore/in. material previously examined.

-PERTINENT FIGURES-

TAB. 1 FLAME ARRESTOR DATA FOR 10 AND 20 PORES/IN. POLYURETHANE FOAM MATERIALS FROM EXPERIMENTS IN A 6-IN. CYLINDRICAL STEEL VESSEL WITH APPROX. 2.5 PERCENT N-PENTANE-AIR MIXTURES AT ATMOSPHERIC PRESSURE PAGE 6//TAB. 2 FLAME ARRESTOR DATA FOR 10, 20, and 40 PORES/IN. POLYURETHANE FOAM MATERIALS FROM EXPERIMENTS IN A 6-IN. DIA. CYLINDRICAL STEEL VESSEL WITH APPROX. 2.5 PERCENT N-PENTANE-AIR MIXTURES AT VARIOUS INITIAL PRESSURES PAGE 8//TAB. 3 GAS TEMPERATURE, PRESSURE AND FLAME SPEED DATA FROM FLAME ARRESTOR (20 PORES/IN.) EXPERIMENTS IN A 450-GAL. AIRCRAFT TANK WITH APPROX. 3.2 PERCENT N-BUTANE-AIR MIXTURES AT 0 AND 5 PSIG. PAGE 17//TAB 4. GAS TEMPERATURE PRESSURE, AND FLAME SPEED DATA FROM FLAME ARRESTOR (20 PORES/IN.) EXPERIMENTS IN A 450-GAL. AIRCRAFT FUEL TANK WITH AN APPROX. 3.2 PERCENT N-BUTANE-AIR MIXTURE AT 0 PSIG. PAGE 20//TAB. 6 PRESSURE DATA FROM FLAME ARRESTOR (20

PORES/IN.) EXPERIMENTS IN 450-GAL. AIRCRAFT FUEL TANK AT 0 OR 5 PSIG USING 30-CALIBER TRACER AND INCENDIARY AMMUNITION AND ELECTRIC SPARKS AS THE IGNITION SOURCES (APPROX. 3.2 N-BUTANE-AIR MIXTURES) PAGE 26

-SOURCE INFORMATION-

CORPORATE SOURCE -
BUREAU OF MINES, BRUCETON, PA. EXPLOSIVES RESEARCH CENTER.
REPORT NUMBER -
AFAPL-TR-67-148
SPONSOR -
AIR FORCE AERO PROPULSION LAB., WRIGHT-PATTERSON AFB, OHIO.
OTHER INFORMATION -
0030 PAGES, 0014 FIGURES, 0006 TABLES, 0000 REFERENCES

A FEASIBILITY STUDY OF A CRASH-FIRE PREVENTION SYSTEM FOR THE SUPERSONIC COMMERCIAL TRANSPORT

by

EGGLESTON, L.A.
HOFFMAN, H.I.
SMITH, H.M.
YUILL, C.H.

08/01/63

-ABSTRACT-

The feasibility of a crash-fire prevention system as it might be applied to a Mach 3 supersonic commercial transport (SST) was studied. Early efforts directed toward crash-fire prevention were reviewed for applicability to the SST in the light of advances in the state-of-the-art. Design parameters and general requirements for a crash-fire prevention system are outlined, and attention is given to combustibles and ignition sources on the SST and anticipated crash situations. A crash-fire prevention system for the SST based on the suppression of ignition sources is considered feasible and within the capability of industry and government. Weight of such a system is estimated to be within 1500-1800 lbs. The projected use of stainless steel and titanium skin materials presents a serious friction spark ignition problem under some crash conditions. Efforts directed toward the development of arresting gear mechanisms, crash-resistant fuel tanks, and rapid fuel gelling as a means of preventing crash fires are indicated; and work has been done on the development and engineering of arresting gear for heavy, high-performance aircraft.

-PERTINENT FIGURES-

TAB. 1 ESTIMATES OF HAZARDOUS LIQUID CONDITIONS AT GROUND CONTACT PAGE 9// TAB. 3 SUMMARY OF JET ENGINE INERTING PAGE 27//FIG. 4 WATER QUANTITIES USED FOR INERTING PAGE 32//FIG. 2 CRASH-FIRE PREVENTION SYSTEM FOR ALLISON T56 ENGINE PAGE 25//FIG. 3 CRASH-FIRE PREVENTION SYSTEM FOR GE CJ805 ENGINE PAGE 26//FIG. 5 CRASH-FIRE PROTECTION SYSTEM INSTALLED IN J57 ENGINE SHOWING SPRAY NOZZLE LOCATIONS PAGE 33

-BIBLIOGRAPHY-

CAMPBELL, J.A., BUSCH, A.M.: A COMBINED WATER-BROMOTRIFLUOROMETHANE CRASH-FIRE PROTECTION SYSTEM FOR T-56 TURBOPROPELLER ENGINE. NASA TN D-28 AUG. 1959//CARY, H., EASTERDAY, J.L., FARRAR, D.L., WELLER, A.E., AND STEMBER, JR., L.H.: A STUDY OF FLIGHT-VEHICLE FIRE-PROTECTIVE EQUIPMENT, PHASE 2. BATTELLE MEMORIAL INST., ASD TR 61-65, SEPT. 1961//CLARK,

J.H.: DEVELOPMENT OF CRASH RESISTANT AIRCRAFT FLAMMABLE FLUID SYSTEMS, PART 1A. NATIONAL AVIATION FACILITIES EXPERIMENTAL CENTER, ATLANTIC CITY, N.J., MAY 1960//DRAKE, W.V. AND DRELL, I.L.: SURVEY OF LESS-INFLAMMABLE HYDRAULIC FLUIDS FOR AIRCRAFT, NACA RM E50F29, SEPT. 1950//KUCHTA, J.M., LAMBIRIS, S., AND ZABETAKIS, M.G.: FLAMMABILITY AND AUTOIGNITION OF HYDROCARBON FUELS UNDER STATIC AND DYNAMIC CONDITIONS. BUR. OF MINES. REP. OF INVESTIGATIONS 5992, 1962//KUCHTA, J.M., LAMBIRIS, S., PERLEE, H.E., HALAGAN, D.R., AND ZABETAKIS, M.G.: FLAMMABILITY CHARACTERISTICS OF HIGH TEMPERATURE HYCROCARBON FUELS. WADC TR 59-663, FEB. 1960//MALCOLM, J.E.: DEVELOPMENT AND ENGINEERING TEST REPORT, CHARGES, ANTI FREEZE, FIRE EXTINGUISHER LITHIUM/CALCIUM CHLORIDE BASE, US ARMY CORPS OF ENGINEERS, TR 1681, JULY 20, 1961

-SOURCE INFORMATION-

CORPORATE SOURCE -
SOUTHWEST RESEARCH INST., SAN ANTONIO, TEX.
REPORT NUMBER -
ASD-TDR-63-478//X64-11882
SPONSOR -
AIR FORCE AERO PROPULSION LAB., WRIGHT-PATTERSON AFB, OHIO.
CONTRACT NUMBER -
CONTRACT AF 33(657)-8894
OTHER INFORMATION -
0118 PAGES, 0018 FIGURES, 0007 TABLES, 0199 REFERENCES

AVIATION FUEL SAFETY

by

BURK, F.C.

02/00/65

-ABSTRACT-

Available information on safe handling and usage of aviation gasolines, Jet A (kerosene), and Jet B (JP-4) was reviewed by an Ad Hoc Group on Aviation Fuel Safety. Characteristics of commercial aviation fuels, flammability, and ignition of fuel-air mixtures, and aircraft environmental factors affecting fuels and their ignition were considered; and some related research in progress is noted. The Ad Hoc Group noted that the adoption of a single type of aviation turbine fuel by the entire industry would not significantly improve the overall excellent safety record of commercial aviation; and that safety is more a function of equipment design, proper handling techniques, and rigorous precautions than of the particular fuel type employed.

-PERTINENT FIGURES-

FIG. 3 ALTITUDE-TEMPERATURE FLAMMABILITY LIMITS OF JET A AND JET B FUELS PAGE 59//FIG. 4 ALTITUDE-TEMPERATURE FLAMMABILITY LIMITS UNDER DYNAMIC CONDITIONS PAGE 60//FIG. 5 LIMITS OF FLAMMABILITY OF GASOLINE VAPOR IN VARIOUS AIR INERT GAS ATMOSPHERES PAGE 61//FIG. 6A VERTICAL PROFILES OF FLAMMABLE ZONES IN A SIMULATED AIRCRAFT WING TANK DURING FUELS LOADING PAGE 62//FIG. 6B FLAMMABLE ZONES IN A SIMULATED AIRCRAFT WING TANK DURING FUEL LOADING PAGE 62//FIG. 8 TYPICAL CURVES OF AUTOIGNITION TEMPERATURE OF FUEL VERSUS ALTITUDE PAGE 64//FIG. 9 MINIMUM SPARK IGNITION ENERGIES FOR FUEL-AIR SPRAY MIXTURES PAGE 65

-BIBLIOGRAPHY-

FLAMMABILITY AND AUTOIGNITION OF HYDROCARBON FUELS UNDER STATIC AND DYNAMIC CONDITION. BUR. OF MINES, RI 5992, 1962//EXPLOSION HAZARDS ASSOCIATED WITH FUEL LOADING OPERATION. BUR. OF MINES, PROGRESS REP. 1-7, 1962; AMERICAN PETROLEUM INST. API PROJ. S-3, 1963//THE SECRETARY OF THE TREASURY'S COMMITTEE ON TANKER HAZARDS, FINAL REPORT TO SECRETARY OF THE TREASURY; US COAST GUARD, TREASURY DEPT., AUG. 14, 1963//INVESTIGATION OF MECHANISMS OF POTENTIAL AIRCRAFT FUEL TANK VENT FIRES AND EXPLOSIONS CAUSED BY ATMOSPHERIC ELECTRICITY. LOCKHEED-CALIF. CO.-NASA, NASA TN D-2240, JAN. 1964//IGNITION OF TANK ATMOSPHERES DURING FUEL LOADING OPERATIONS. AMERICAN PETROLEUM ,NST.; BUR. OF MINES, FINAL REP. 3914, FEB. 28, 1964

-SOURCE INFORMATION-

CORPORATE SOURCE -
    COORDINATING RESEARCH COUNCIL, INC., NEW YORK.
REPORT NUMBER -
    CRC PROJ. CA-37-64//N65-20077
SPONSOR -
    FEDERAL AVIATION AGENCY, WASHINGTON, D.C.
OTHER INFORMATION -
    0072 PAGES, 0010 FIGURES, 0002 TABLES, 0023 REFERENCES

FIRE SUPPRESSION FOR AEROSPACE VEHICLES

by

MARTINDILL, G.H.
SPOLAN, I.
KUCHTA, J.M.

07/00/70

-ABSTRACT-

Fire extinguishing experiments were conducted to evaluate Halon 1301 as an extinguishant of Class A fires by the total flooding mode for possible use in advanced aircraft. The effectiveness of the extinguishant was determined by burning cotton sheeting in a 216 cu. ft. chamber at various combustible loadings, preburn times, and extinguishant discharge pressures or rates. Extinguishing times increased with increased combustible loading but varied little with preburn time and Halon discharge pressure when the Halon concentration in the chamber was 6 vol. percent. With this concentration, cotton sheeting fires at a loading of 0.035 oz./cu. ft. were extinguished within 2 sec. or less using Halon discharge pressures of 220,350, and 700 psig. A 3 percent Halon concentration appeared to be inadequate under test conditions. With 6 percent Halon, the toxicity hazard from the formation of CO, HF, or HBr was relatively small for preburn times of 15 sec. or less. The concentration of toxic product vapors increased noticeably when the total burning period before extinguishment was increased from 15 to 25 sec. Under all test conditions, the toxic product concentrations after equilibrium conditions prevailed were much less than the lethal concentrations reported for short exposure times. Data are also presented on the rates of pressure rise and mass consumption that characterized the cotton sheeting fires.

-PERTINENT FIGURES-

TAB. 3 GAS ANALYSES AND PRESSURE RISES FROM BURNING OF COTTON SHEETING IN A 12 CU. FT. CHAMBER WITH AN AIR ATMOSPHERE PAGE 8//TAB. 4 GAS ANALYSIS DATA FROM A FIRE EXTINGUISHING EXPERIMENT IN A 12 CU. FT. CHAMBER WITH COTTON SHEETING (0.035 OZ/CU. FT.) IN AIR AND 6.3 PERCENT HALON 1301 PAGE 8//TAB. 5 EXTINGUISHING TIMES AND MAXIMUM PRESSURE RISES FROM EXTINGUISHING EXPERIMENTS AT VARIOUS COMBUSTIBLE LOADINGS AND PREBURN TIMES PAGE 18//TAB. 6 GAS ANALYSIS DATA FROM FIRE EXTINGUISHING EXPERIMENTS IN A 216 CU. FT. CHAMBER WITH COTTON SHEETING (0.035 OZ/CU. FT.) IN AIR AND 6 PERCENT HALON 1301. HALON INJECTION PRESSURE - 700 PSIG PAGE 21

-SOURCE INFORMATION-

CORPORATE SOURCE -
BUREAU OF MINES, BRUCETON, PITTSBURGH, PA. SAFETY RESEARCH CENTER.
SPONSOR -
AIR FORCE AERO PROPULSION LAB., WRIGHT-PATTERSON AFB, OHIO.
CONTRACT NUMBER -
CONTRACT F33615-69-M-5002
OTHER INFORMATION -
0031 PAGES, 0011 FIGURES, 0006 TABLES, 0000 REFERENCES

DETECTION TECHNIQUES FOR HAZARDOUS VAPORS OF ELEMENTAL PROPELLANTS

by

CHLECK, D.
CUCCHIARA, O.
DONAGHUE, T.

07/00/63

-ABSTRACT-

Techniques for detecting hazardous vapors from elemental propellants and fluorine-containing oxidizers were evaluated for possible use in a field instrument. A literature survey revealed a paucity of methods for determining elemental fluorine and hydrogen. However, fluorescent quenching, radiochemical release using clathrates, and chemiluminescence methods fulfill the necessary requirements of simplicity, ruggedness, and sensitivity for fluorine detection. A technique based on radiochemical exchange using kryptonates can be adapted to a simple rugged field-type instrument for detecting less than 0.1 ppm fluorine and less than 1 percent hydrogen. This new technique, which involved the use of radio krypton homologs, would have a kryptonated source and a detector as its two basic components. No solutions or moving parts are required.

-PERTINENT FIGURES-

TAB. 1 COMPARISON OF DETECTION METHODS FOR FLUORINE AND HYDROGEN PAGE 8

-BIBLIOGRAPHY-

STRANGE, J.P., BALL, K.E. AND BARNES, D.O.: CONTINUOUS PARTS PER BILLION RECORDER FOR AIR CONTAMINANT. 53RD ANNUAL MEETING OF AIR POLLUTION CONTROL ASSN., CINCINNATI, OHIO, MAY 22-26, 1960//CHLECK, D.J., YOUNG, J.C. AND GELMAN, C.: DEV. OF FLUORESCENCE QUENCHING PAPER SYSTEM FOR AUTOMATIC DETECTION OF GB. CRLR 421 PROJ. 4-08-06-006, OCT. 1955//CHLECK, D.J. AND ZIEGLER, C.A.: RADIOMETRIC ANALYSIS OF NONRADIOACTIVE MATERIALS BY CHEMICAL EXCHANGE. IAEA CONF. ON THE USES OF ISOTOPES IN THE PHYSICAL SCIENCES AND INDUSTRY, COPENHAGEN, SEPT. 1960//HOMMEL, C., BROUSAIDES, F. AND BERSIN, R.: DETERMINATION OF GASEOUS FLUORINE USING RADIOACTIVE CLATHRATES. ANNAL. CHEM. 34: NO. 12, NOV. 1962

-SOURCE INFORMATION-

CORPORATE SOURCE -

PARAMETRICS, INC. WALTHAM, MASS.
REPORT NUMBER -
ASD-TDR-63-294//X63-14935
SPONSOR -
AERONAUTICAL SYSTEMS DIV., WRIGHT-PATTERSON AFB, OHIO.
FLIGHT ACCESSORIES LAB.
CONTRACT NUMBER -
CONTRACT AF 33(6571-8916)
OTHER INFORMATION -
0076 PAGES, 0023 FIGURES, 0007 TABLES, 0059 REFERENCES

INTEGRATED FIRE AND OVERHEAT DETECTION SYSTEM FOR AIRCRAFT

by

RASKAUSKAS, B.J.

12/00/69

-ABSTRACT-

A fire and overheat detection system consisting of sensitizing modules, detection circuits, and logic circuits was designed and built to operate on manned flight vehicles at temperatures from -55 to +125 deg. C. Infrared and ultraviolet sensors are used for fire detection and continuous element sensors for overheat detection. A microcircuit computer was redesigned to accept various combinations of sensors, including the continuous sensors, PIN sensors, silicon solar cell sensors, and silicon carbide sensors. The fire and overheat detection systems has three basic functions: (1) sensitizing circuitry which conditions the output of the sensors, (2) detection circuitry which interprets the conditioned sensor information, and (3) logic circuitry which determines the correct fire or overheat signal. The four outputs that result are: FIRE, OVERHEAT, FAIL, and OK.

-PERTINENT FIGURES-

FIG. 1 TYPICAL ENGINE NACELLE SHOWING RADIATION DETECTORS MOUNTED ON FIREWALL AND CONTINUOUS SENSORS EXTENDING THE LENGTH OF THE COMPARTMENT PAGE 2

-SOURCE INFORMATION-

CORPORATE SOURCE -
GENERAL MOTORS CORP., KCKOMO, IND. DELCO RADIO DIV.
REPORT NUMBER -
AFAPL-TR-69-97
SPONSOR -
AIR FORCE AERO PROPULSION LAB., WRIGHT-PATTERSON AFB, OHIO
CONTRACT NUMBER -
CONTRACT NO. F33615-69-C-1196//PROJ. NO. 3048
OTHER INFORMATION -
0071 PAGES, 0031 FIGURES, 0004 TABLES, 0000 REFERENCES

INVESTIGATION OF HAZARDOUS VAPOR DETECTION FOR ADVANCED FLIGHT VEHICLES

by

CUCCHIARA, O.
SEIDEN, L.
DONAGHUE, T.

08/00/66

-ABSTRACT-

Techniques were evaluated for the detection of hydrocarbon vapors and hydrogen aboard advanced aircraft. A radiochemical exchange technique utilizing kryptonates was employed satisfactorily for detecting hydrocarbon vapors aboard aircraft with a Mach 3 to Mach 6 capability and hydrogen for Mach 7 and higher capability aircraft. However, it was shown that it is highly unlikely that hydrogen will exist in the presence of oxygen at temperatures in excess of 1300 deg. F. Therefore, an aluminum oxide humidity element was investigated for its ability to detect the water formed by combustion. This element appeared suitable if its present maximum temperature limitations can be overcome. A nondispersive, open-path, infrared technique could be upgraded to detect hydrocarbon fuels but not hydrogen or water under the stipulated environmental conditions; however, a considerable developmental effort would be required. Catalytic combustion is limited in applicability due to its relatively poor sensitivity, stability, and operating life. A photoionization technique appeared most promising, but would require a considerable developmental effort.

-BIBLIOGRAPHY-

CHLECK, D., CUCCHIARA, O. AND DONAGHUE, T.: DETECTION TECHNIQUES FOR HAZARDOUS VAPORS OF ELEMENTAL PROPELLANTS, ASD-TR-63-294, 1963//CUCCHIARA, O., DONAGHUE, T. AND CHLECK, D.: DETECTION OF HYDROGEN ABOARD AEROSPACE FLIGHT VEHICLES. APL-TR-64-51 1964//CUCCHIARA, O., REX, R. AND DONAGHUE, T.: THE DEVELOPMENT OF AN INSTRUMENT FOR THE DETECTION OF HAZARDOUS VAPORS. AFAPL-TR-65-50, 1965//MILITARY SPECIFICATION, JET FUEL, GRADE JP-6 MIL-J-25656B (U.S.A.F.), 1961//BILLETDEAUX, A.C., LAWRENCE, R.W. AND FREITINO, R.S.: AN EXPLOSIVE VAPOR DETECTOR FOR ROCKET POWERED AIRCRAFT. ASD-TDR-62-531, 1962

-SOURCE INFORMATION-

CORPORATE SOURCE -
PARAMETRICS, INC., WALTHAM, MASS.
REPORT NUMBER -

AFAPL-TR-66-71
SPONSOR -
AIR FORCE AERO PROPULSION LAB., WRIGHT-PATTERSON AFB, OHIO.
CONTRACT NUMBER -
CONTRACT AF 33(615)-2477
OTHER INFORMATION -
0070 PAGES, 0018 FIGURES, 0003 TABLES, 0019 REFERENCES

THE DEVELOPMENT OF AN INSTRUMENT FOR THE DETECTION OF HAZARDOUS VAPORS

by

CUCCHIARA, O.
REX, R.
DONAGHUE, T.

06/00/65

-ABSTRACT-

A prototype model of an instrument capable of detecting low concentrations of hydrogen, fluorine, and fluorine-containing oxidizers was developed. The instrument provides an audible alarm within 3 to 5 sec. after exposure to near hazardous concentrations of these gases, with alarm concentrations of either 0.5 percent or 1.0 percent hydrogen, and .025 ppm of fluorine, chlorine trifluoride, or oxygen difluoride. Other detection levels, both higher and lower, can be set if required. The instrument which is portable, simple to operate, and reliable, incorporates the technique of radiochemical exchange using kryptonates. Selectivity is achieved by the utilization of different kryptonated sources for the various gases. Other gases can be detected with this instrument by using appropriate kryptonate homologs.

-BIBLIOGRAPHY-

CHLECK, D. AND CUCCHIARA, O.: INT. J. APPL. RAD. ISOTOPES 14, 581 (1963)//CHLECK, D., MAEHL, R. AND CUCCHIARA, O.: INT. J. APPL. RAD. ISOTOPES 14, 599 (1963)//CHLECK, D., CUCCHIARA, O. AND DONAGHUE, T.: DETECTION TECHNIQUES FOR HAZARDOUS VAPORS OF ELEMENTAL PROPELLANTS, CONTRACT NO. AF 33(657)-8916, ASD-TR-63-294 (1963)//CUCCHIARA, O., DONAGHUE, T. AND CHLECK, D.: DETECTION OF HYDROGEN ABOARD AEROSPACE FLIGHT VEHICLES, CONTRACT NO. AF 33(657)-8916, APL-TR-64-51 (1964)

-SOURCE INFORMATION-

CORPORATE SOURCE -
PARAMETRICS, INC., WALTHAM, MASS.
REPORT NUMBER -
AFAPL-TR-65-50
SPONSOR -
AIR FORCE AERO PROPULSION LAB., WRIGHT-PATTERSON AFB, OHIO
CONTRACT NUMBER -
CONTRACT AF33(615)-1473
OTHER INFORMATION -
0053 PAGES, 0021 FIGURES, 0004 TABLES, 0009 REFERENCES

EVALUATION OF FLAMMABILITY TEST PROCEDURES FOR AIRCRAFT INTERIOR MATERIALS

by

STARRETT, P.S.
BOBERG, J.E.
JOHNSON, C.L.

10/00/69

-ABSTRACT-

The nature of aircraft fire hazards during flight and at time of crash are reviewed along with factors influencing materials flammability such as composition of the surrounding gas, the heat transfer process, and material properties. The characteristics most important in defining the hazard presented by a material during an aircraft interior fire are, in a rough order of their importance: generation of toxic gases, ignition temperature, flame propagation rate, generation of flammable gases, generation of heat, and generation of smoke. Adequate existing flammability test procedures are available for a definition of these material attributes. In some cases these procedures could be refined, but additional sophistication in small coupon tests appears unwarranted in view of the fact that such tests are not precisely related to real fire behavior. In addition, the recommended tests have gained some industry wide acceptance, making comparative data available on many common materials. A new procedure would require retesting, as well as a long gestation period before wide acceptance and official adoption. Certain analytical tests are valuable to provide supporting information to the basic flammability tests. Because real fire behavior is situation dependent, full-scale fire simulation is a necessary part of any balanced investigation.

-PERTINENT FIGURES-

FIG. 1 COMPARATIVE BURNING RATE OF 3.46 OXYGEN/SQ. YD. LONG STAPLE COTTON IN OXYGEN AND IN AIR ATMOSPHERES PAGE 12A//FIG. 2 BURNING RATES OF FABRIC MATERIALS IN A 50 PERCENT OXYGEN - 50 PERCENT NITROGEN, 7.5 PSIA ATMOSPHERE PAGE 14A//TAB. 1 ASTM FIRE TESTS (1966 BOOK) PAGES 20-22//TAB. 2 RECOMMENDED TEST PROCEEDURES FOR FIRE HAZARD CHARACTERISTICS OF MATERIALS PAGE 32

-BIBLIOGRAPHY-

AUTOPSIES ON AIRLINERS. MACHINE DESIGN, 18-26, AUG. 1967//KAVADAS, P.P.: FLAMMABILITY TEST METHODS FOR AIRCRAFT INTERIOR MATERIALS - A PRELIMINARY STUDY. BOEING CO., COMMERCIAL AIRLINES DIV. DOC. NO. T6-5251, AUG. 1967// MARCY, J.F.: A STUDY

OF AIR TRANSPORT PASSENGER CABIN FIRES AND MATERIALS. FAA NATIONAL AVIATION FACILITIES EXPERIMENTAL CENTER TECH. REP. ADS-44 DEC. 1965//GOSSMAN, J.J.: CHARACTERISTICS OF FIRE IN LARGE CARGO AIRCRAFT. NATIONAL AVIATION FACILITIES EXPERIMENTAL CENTER TECH. REP. ADS-73 MAR. 1966//NOTTAGE, H.B.: BOUNDARY LAYER ANALYSIS FOR PREDICTING IGNITION AND BURNING CHARACTERISTICS OF MATERIALS. LOCKHEED REP. 20347, APR. 1967// MARCY, J.F.: FLAMMABILITY AND SMOKE CHARACTERISTICS OF AIRCRAFT INTERIOR MATERIALS. FAA NATIONAL AVIATION FACILITIES TECH. REP. ADS-3, 1964

-SOURCE INFORMATION-

CORPORATE SOURCE -
LOCKHEED-CALIFORNIA CO., BURBANK.
REPORT NUMBER -
AD-868347L//LR-21106
OTHER INFORMATION -
0063 PAGES, 0009 FIGURES, 0002 TABLES, 0019 REFERENCES

INVESTIGATION OF JET ENGINE COMBUSTION CHAMBER BURNTHROUGH FIRE

by

RUST, JR., T.

03/00/71

-ABSTRACT-

Experiments directed toward development of standard test conditions are described for testing materials intended for use as fire barriers for protection against a jet engine combustion chamber burnthrough type of failure. The development of such a failure was simulated on a J-47 jet engine. The resulting flame was quite severe, penetrating the present standard firewall material in 2 sec. Studies were made of the flame impingement charactersitics, including impingement temperatures and pressures; and various potential firewall materials were tested for effectiveness as fire barriers for protection against such a failure. Most materials tested in this manner failed to provide adequate protection against such an engine failure. However, more effort is required to further develop this simulator.

-PERTINENT FIGURES-

FIG. 5 BURNTHROUGH TEST FLAME AT 80-PERCENT ENGINE RPM PAGE 8//FIG. 7 TEST NO. 21 SPECIMEN AFTER EXPOSURE TO BURNTHROUGH FLAME. FAILURE OCCURRED IN 2.5 SECONDS PAGE 17//FIG. 17 LEFT SIDE VIEW OF BURNTHROUGH FLAME SIMULATOR PAGE 37//TAB. 1 STATISTICAL SUMMARY OF REPORTED BURNTHROUGH FAILURES 1962 THROUGH 1969 PAGE 1//TAB. 2 TESTS PERFORMED ON POTENTIAL FIREWALL MATERIALS PAGE 10

-BIBLIOGRAPHY-

KEENAN AND KAYE: GAS TABLES, OCT. 1961//AERON, RES. ASSOC. OF PRINCETON, INC.: EXPERIMENTS ON FREE AND IMPINGING UNDEREXPANDED JETS FROM A CONVERGENT NOZZLE. ARAP REP. NO. 63, SEPT. 1963//COURANT AND FRIEDRICHS: SUPERSONIC FLOW AND SHOCK WAVES. 1948//HERZFIELD, C.M.: TEMPERATURE, ITS MEASUREMENT AND CONTROL IN SCIENCE AND INDUSTRY, VOL. 3, 1962

-SOURCE INFORMATION-

CORPORATE SOURCE -
NATIONAL AVIATION FACILITIES EXPERIMENTAL CENTER, ATLANTIC CITY, N.J.
REPORT NUMBER -
FAA-NA-70-40//FAA-RD-70-68

OTHER INFORMATION -
0049 PAGES, 0019 FIGURES, 0007 TABLES, 0004 REFERENCES

AN INVESTIGATION OF IN-FLIGHT FIRE PROTECTION WITH A TURBOFAN POWERPLANT INSTALLATION

by

KLUEG, E.P.
DEMAREE, J.E.

04/00/69

-ABSTRACT-

The potential explosive and fire hazards, as well as methods for detecting and controlling in-flight fires on modern aircraft powerplant installations were investigated under full-scale simulated low altitude flight conditions. Studies were made of (1) environmental conditions producing thermal ignition of combustible mixtures and ignition characteristics, (2) characteristics of nacelle fires, (3) system performance and installation requirements for fire and overheat detection, (4) requirements for extinguishing and controlling fires, and (5) effects of fires and explosions on the powerplant installation. The results are presented as fire safety design criteria and engineering data. The effects of environmental conditions, thermal ignition, and the characteristics of ignition are reported as a function of the amount, location, and type of fluid leakage. The size, intensity, radiation level, and propagation rate of nacelle fires are related to flight condition, fluid type, and fluid leakage characteristics. Fire detection requirements and the feasibility of abbreviated and remotely located sensors are presented as a function of detector operating characteristics, available detection time, nacelle design, and fire characteristics. Fire extinguishing requirements are related to the location, size, intensity, and duration of the fires; flight conditions; nacelle ventilation; and extinguishing agent and container. The resistance of the nacelle and engine components to fire and explosive damage, and means of controlling and preventing the spread of fire are discussed.

-PERTINENT FIGURES-

FIG. 4 NACELLE AIR TEMPERATURE CHANGE FOR TRANSIENT FLIGHT CONDITIONS PAGE 8 //FIG. 7 EFECT OF NACELLE VENTILATION ON THE IGNITION OF TYPE A JET FUEL PAGE 17//FIG. 37 EFFECT OF FLIGHT SPEED ON FIRE EXTINGUISHMENT PAGE 83//TAB. 1 IGNITION HAZARD TEST CATEGORIES FOR NACELLE COMPRESSOR AND ACCESSORY SECTION (ZONE 2) PAGE 11//TAB. 9 EFFECT OF SENSITIVITY OF RADIATION-TYPE SENSORS ON FIRE DETECTION PAGE 59//TAB. 16 RELATIVE EFFECTIVENESS OF FIRE EXTINGUISHING AGENTS PAGE 87

-BIBLIOGRAPHY-

JT3D COMMERCIAL TURBOFAN INSTALLATION HANDBOOK. PRATT AND WHITNEY AIRCRAFT, DIV. OF UNITED AIRCRAFT CORP.//FIRE DETECTORS (RADIATION SENSING TYPE). FAA, TECH. STAND. ORDER C-79, NOV. 12, 1963//DENNARD, J.S.: A TRANSONIC INVESTIGATION OF THE MASS-FLOW AND PRESSURE RECOVERY CHARACTERISTICS OF SEVERAL TYPES OF AUXILIARY AIR INLETS. NACA RML57B07//STATIC PRESSURES INSIDE 707/720 ENGINE COWLING. BOEING CO. LETTER 6-7310-4605, APR. 13, 1966 //ENGINE STRUT AND NACELLE PRESSURE DATA. BOEING CO. LETTER 6-7736-4605, SEPT. 9, 1965//FIRE INTEGRITY OF THE 707/100B1-300B AND 720B SERIES POWER PLANT INSTALLATION. BOEING CO., TRANSPORT DIV., DOC. NO. D6-5922, JAN. 9, 1961

-SOURCE INFORMATION-

CORPORATE SOURCE -
NATIONAL AVIATION FACILITIES EXPERIMENTAL CENTER, ATLANTIC CITY, N.J.
REPORT NUMBER -
NA-69-26 (DS-68-26)
OTHER INFORMATION -
0236 PAGES, 0108 FIGURES, 0045 TABLES, 0008 REFERENCES

A STUDY OF AIRCRAFT FIRE HAZARDS RELATED TO NATURAL ELECTRICAL PHENOMENA

by

KESTER, F.L.
GERSTEIN, M.
PLUMER, J.A.

06/00/68

-ABSTRACT-

The problems of natural electrical phenomena, such as a fire ignition hazard to aircraft, are evaluated. Assessment of the hazard is made over the range of low level electrical discharges, such as static sparks, to high level discharges, such as lightning strikes to aircraft. In addition, some fundamental work is presented on the problem of flame propagation in aircraft fuel vent systems. A laboratory investigation was concerned with the following areas: (1) ignition energies and flame propagation rates of kerosene-air and JP-6 air foams, (2) rate of flame propagation of n-heptane, n-octane, n-nonane, and n-decane in aircraft vent ducts; (3) damage to aluminum, titanium, and stainless steel aircraft skin materials by lightning strikes; (4) fuel ignition by lightning strikes to aircraft skins, and (5) lightning induced flame propagation in an aircraft vent system.

-PERTINENT FIGURES-

FIG. 2 FLAME PROPAGATION IN SIMULATED FUEL VENT DUCT. FUEL IS N-HEPTANE PAGE 19//FIG. 1 TEST CHAMBER FOR HOLE BURNING TESTS CONDUCTED AT GENERAL ELECTRIC HIGH VOLTAGE LABORATORY PAGE 28//FIG. 4 AREA OF HOLE FORMED VS. COULOMB CONTENT OF LIGHTNING STRIKE PAGE 39//TAB. 1 SPARKING AND IGNITION LEVELS OF 640 TURBINE FUEL/AIR FOAMS PAGE 13//TAB. 2 MAXIMUM RATE OF FLAME PROPAGATION IN FUEL DUCT PAGE 22//TAB. 1 TOTAL ENERGY AND NUMBER OF ELECTRICAL STRIKES REQUIRED TO PRODUCE A HOLE IN TEST MATERIALS PAGE 37

-BIBLIOGRAPHY-

ROGERS, D.T., MCDERMOTT, J.P., AND MUNDAY, J.C.: THEORETICAL AND EXPERIMENTA OBSERVATIONS ON STATIC ELECTRICITY IN PETROLEUM PRODUCTS. OIL GAS J., 160, 1965//TOTTORI, K.: STATIC ELECTRICITY IN OIL TANKS. SYMP. ON STATIC ELECTRIFICATION, BRIT. J. APPL. PHYS., SUPPL. NO. 2, MAR. 1953//KLINKENBERG, A.: PRODUCTION OF STATIC ELECTRICITY BY MOVEMENT OF FLUIDS WITHIN ELECTRICALLY GROUNDED EQUIPMENT. FOURTH WORLD PETROLEUM CONGRESS, SECTION VII-C, PAPER NO. 5, 253-64, ROME, 1955//LIEBMAN, I., SPOLAN, I., KUCHTA, J.M., AND ZABETAKIS, M.G.: IGNITION OF TANK ATMOSPHERES DURING FUEL LOADING. SAFE PRODUCT HANDLING AND STATIC

ELECTRICITY, 30TH MIDYEAR MEETING, AMERICAN PETROLEUM INST. DIV. OF REFINING, MONTREAL, MAY 11, 1965//SCHMIDT, H.A., KOVAR, N.S., STOGRYN, D.E. AND GERSTEIN, M.: THE STUDY OF A FACILITY TO INVESTIGATE THE EFFECT OF NATURAL ELECTRICAL PHENOMENA ON AIRCRAFT AND SPACECRAFT. CONTRACT NASW-853, 1964//HOREFF, T.G.: AIRFLOW VELOCITY EFFECTS ON LIGHTNING IGNITION OF FUEL VENT EFFLUX. INTER-AGENCY COORDINATION MEETING ON AIRCRAFT FIRE SAFETY, WRIGHT-PATTERSON AFB, APR. 18, 1967

-SOURCE INFORMATION-

CORPORATE SOURCE -
DYNAMIC SCIENCE CORP., MONROVIA, CALIF.
REPORT NUMBER -
NASA-CR-1076
SPONSOR -
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION, WASHINGTON, D.C.
CONTRACT NUMBER -
CONTRACT NASW-1416
OTHER INFORMATION -
0133 PAGES, 0059 FIGURES, 0013 TABLES, 0018 REFERENCES

THE PROBLEM OF COATING RUNWAYS WITH FOAM (ZUR FRAGE DER PISTENBESCHAUMUNG)

by

SCHEICHL, L.

02/16/67

-ABSTRACT-

Runway foaming is considered to be effective in reducing the probability of fire in aircraft crash landings. The effectiveness of foam as a suppressant of metal friction spark ignition ranges from 100 percent for 420 stainless steel to 0 percent for titanium 100-A. Statistics showed that, in emergency landings on a foamed runway, fire broke out in 3.3 percent of the cases, while on unfoamed runways, fire broke out in 27.5 percent of the cases. Tests show that aircraft braking distances on foamed runways are the same as on rain wet runways. The length and width needed for a foam blanket varies with the size of the aircraft, but a thickness of 5 cm. is considered sufficient for all types. High expansion foams have more rain and wind resistance than low expansion foams, but low expansion foams are longer lived in dry and warm weather and have greater high temperature resistance. The SIDES Co. runway foaming trailer has a capacity of 4800 l. of foaming agent and is equipped with 48 nozzles each with a throughput of 52 l./min. The TOTAL runway foaming trailer has an agent capacity of 5000 l. and is equipped with 50 nozzles. The TITAN water trailer when combined with the SIDES trailer gives a capacity to cover 1000 meters of runway. The GRINGE 4000/20,000 foam tender has a capacity of 4100 l. and produces a foam blanket a maximum of 8 m. wide. The BIRO runway foaming trailer has two pipes each producing 500 l. of stable foam per minute.

-PERTINENT FIGURES-

TAB. 1 SUPPRESSION OF FUEL IGNITION BY SPARKS OF VARIOUS METALS PAGE 7//FIG. 1 SIDES RUNWAY-FOAMING TRAILER PAGE 16//FIG. 3 TOTAL SPRAYING GEAR PAGE 16

-BIBLIOGRAPHY-

EMMRICH, F.: ZUM PROBLEM DER LANDEBAHNBESCHAUMUNG, (ON THE PROBLEM OF RUNWAY FOAMING). DIE WERKFEUERWEHR, NO. 2, 3, 1964//BRUNSWIG, H.: GROSSVERSUCH ZUR LANDEBAHNBESCHAUMUNG, (LARGE-SCALE EXPERIMENT ON RUNWAY FOAMING), BRANDSCHUTZ, VOL. 2, 193, 1966//WILLIAMS, E.J.C.: THE ROYAL AIR FORCE'S USE OF THE RUNWAY FOAMING TECHNIQUE. FIRE INTERN., NO. 9, 56, 1965//ANON: DEMONSTRATION EINES GROSSFAHRZEUGS ZUR BESCHAUMUNG DER PISTEN BEI NOTLANDUNGEN VON FLUGZEUGEN. (DEMONSTRATION OF A LARGE VEHICLE FOR RUNWAY FOAMING

IN EMERGENCY LANDINGS OF AIRCRAFT). LUFTFAHRTZUBEHOR, NO. 5, 105, 1965//PETERSON, H.B., GIPE, R.L., AND TUVE, R.L.: THE DEVELOPMENT OF A COMBINATION RUNWAY FOAMING-TANKER VEHICLE FOR AUGMENTING NAVAL AIR STATION FIRE FIGHTING OPERATIONS. NRL REP. NO. 5887, 1963//WOLFRAM, U.: LANDEBAHNBESCHAUMUNG-EINE EXPERIMENTELLE UNTERSUCHUNG. (RUNWAY FOAMING-AN EXPERIMENTAL INVESTIGATION). REP. OF THE INST. FOR FLIGHT GUIDANCE AND AIR TRAFFIC OF THE TECH. UNIV. OF BERLIN, 1964

-SOURCE INFORMATION-

REPORT NUMBER -
NRL TRANSLATION 1195
JOURNAL PROCEEDINGS -
VFDB - ZEITSCHRIFT, VOL. 16, NO. 4, 113-119 (1967)
OTHER INFORMATION -
0025 PAGES, 0006 FIGURES, 0001 TABLES, 0015 REFERENCES

GENERATION OF INERTING GASES FOR AIRCRAFT FUEL TANKS BY CATALYTIC COMBUSTION TECHNIQUES, VOL. 2

by

WAINRIGHT, R.B.
PERLMUTTER, A.

08/00/69

-ABSTRACT-

This volume contains ten appendices which refer to the major work section of this study (F7100169). The titles of these appendices are: Catalytic combustion tested data and liquid fuel property data; Kinetic interpretation of catalytic combustion data; Method of calculating reaction rate constants; Water removal studies, summaries of test data; Calculation of heat and material balance, SST Flight Plan No. 1; Design calculations, equipment of SST Flight Plan No. 1; Design Calculations, equipment for SST Flight Plan No. 2; Heat and mass balance and equipment design for tactical aircraft; Calculations for C-141 transport aircraft; Effect of moisture content of ballast gas on subsystem weight.

-SOURCE INFORMATION-

CORPORATE SOURCE -
AMERICAN CYANAMID CO., STAMFORD, CONN. CENTRAL RESEARCH DIV.
REPORT NUMBER -
AFAPL-TR-69-68-VOL. 2
SPONSOR -
AIR FORCE AERO PROPULSION LAB., WRIGHT-PATTERSON AFB, OHIO.
CONTRACT NUMBER -
CONTRACT F33615-68-C-1500
OTHER INFORMATION -
0241 PAGES, 0028 FIGURES, 0037 TABLES, 0033 REFERENCES

DEVELOPMENT OF A HAZARDOUS VAPOR DETECTION SYSTEM FOR ADVANCED AIRCRAFT

by

SEIDEN, L.
CUCCHIARA, O.
GOODMAN, P.

10/00/67

-ABSTRACT-

Instrumentation for the detection of hazardous vapors aboar advanced aircraft were evaluated and developed. Prototyp detection systems were constructed both for monitoring JP-6 fue vapor in aircraft compartments and for monitoring oxygen in th ullage space of fuel tanks. These systems will be furthe evaluated in flight tests. Detection of both species i accomplished by the use of a catalyst-coated thermistor sensor Catalytic oxidation occurring at the catalyst surface liberate heat, which is sensed by the thermistor. The JP-6 sensor consist of a simple probe which can be mounted directly in the space to b monitored. No sampling system is required. The oxygen sensor i more complicated, necessitating flow connections to an externa pump and gas supplies. The instruments developed meet almost al of the desired goals. In a few instances, flexibility fo installation in a variety of situations and locations was retaine at the sacrifice of some performance characteristics. Methods fo achieving desired goals in specific installations and operatin modes are indicated and are relatively simple.

-BIBLIOGRAPHY-

CUCCHIARA, O., REX, R., AND DONAGHUE, T.: THE DEVELOPEMENT OF A INSTRUMENT FOR THE DETECTION OF HAZARDOUS VAPORS. CONTR AF33(615)-1473, AFAPL-TR-65- 50, 1965//CUCCHIARA, O., SEIDEN, L. AND DONAGHUE, T.: INVESTIGATION OF HAZARDOUS VAPOR DETECTION FO ADVANCED FLIGHT VEHICLES. CONTR. AF33(615)- 2477, AFAPL-TR-66-71 1966

-SOURCE INFORMATION-

CORPORATE SOURCE -
PANAMETRICS, INC., WALTHAM, MASS.
REPORT NUMBER -
AFAPL-TR-67-123
SPONSOR -
AIR FORCE AERO PROPULSION LAB., WRIGHT-PATTERSON AFB, OHIO
CONTRACT NUMBER -
CONTRACT AF33(615)-3646

OTHER INFORMATION -
0059 PAGES, 0023 FIGURES, 0001 TABLES, 0006 REFERENCES

A SURVEY OF AIRPORT FIRE AND RESCUE FACILITIES: 1971, NORTH AMERICA

by

HEWES, B.V.
ROBINSON, P.R.
COUCH, A.L.

00/00/71

-ABSTRACT-

The Air Line Pilots Association conducted a survey of 488 airports in 1971 to determine the status of the crash fire and rescue equipment available for use in case of an accident involving a scheduled trunk or local service air carrier aircraft. Only those airports receiving daily service are included and only fire and rescue equipment located within the airport boundaries is reported. The survey includes all airports in North America (Canada, Mexico, the Carribean, and United States) receiving daily service by scheduled domestic and international airlines. Appendices include: (1) National Fire Protection Association 403 (1969), Recommendations for protection of aircraft operations at airports and heliports; (2) FAA Advisory Circular 150/5210-6A, aircraft fire and rescue facilities and extinguishing agents; (3) FAA Advisory Circular 150/5210-11, response times to aircraft emergencies; and (4) an extract from the Airport and Airways Development Act 1970 pertaining to airport certification.

-SOURCE INFORMATION-

CORPORATE SOURCE -
AIR LINE PILOTS ASSOCIATION, INTERNATIONAL, CHICAGO, ILL.
OTHER INFORMATION -
0149 PAGES, 0000 FIGURES, 0002 TABLES, 0000 REFERENCES

RESEARCH AND TECHNOLOGY FOR AIRCRAFT FIRE PROTECTION

by

BIERY, G.T.
BOTTERI, B.P.

06/07/66

-ABSTRACT-

The development of high performance, advanced aircraft introduces new problems in fire safety. Insufficient knowledge and experience exist to establish accurately the degree of hazard that results from such considerations as aerodynamic heating of surfaces; higher engine operating temperatures; restricted usage of compartment venting procedures; and the behavior of fuel liquids, mists, and vapors under a greater range of temperatures and pressures. Investigations of these problems as well as of the methods and materials for their solution are currently in progress. These programs include the following: (1) An investigation and analysis are underway to provide definite information on fuel system fire hazards of Mach 3 aircraft, with the emphasis on cool flame phenomena. (2) An analysis on the safety of jet fuels has indicated no significant operational fire safety advantage of a lower volatility fuel such as kerosene over JP-4. (3) An analysis of the current programs by the Federal Aviation Agency and the U.S. Army on emulsfied and gelled fuels indicates that the utilization of such fuels, except for specialized applications, does not appear attractive for jet operations, although the fire safety advantages are significant.

-PERTINENT FIGURES-

FIG. 1 SPONTANEOUS IGNITION TEMPERATURE ZONES FOR TYPICAL HYDROCARBON FUEL IN AIR PAGE 4//FIG. 3 POWER DRAIN WITH TIME FOR SEVERAL FIBERCELL CONFIGURATIONS PAGE 11//TAB. 1 PROPERTIES OF CANDIDATE EXTINGUISHANTS PAGE 14

-BIBLIOGRAPHY-

BOTTERI, B.P., CRETCHER, R.E., FULTZ, J.R., AND LANDER, H.R.: A REVIEW AND ANALYSIS OF THE SAFETY OF JET FUEL. AFAPL-TR-66-9, MAR. 1966//COORDINATING RESEARCH COUNCIL, INC.: AVIATION FUEL SAFETY. FINAL REP., CRC PROJ. NO. CA-37-64, NOV. 1964//CUCCHIARA, O., REX, R., AND DONAGHUE, T.: THE DEVELOPMENT OF AN INSTRUMENT FOR THE DETECTION OF HAZARDOUS VAPORS. AFAPL- TR-65-50, JUNE 1965

-SOURCE INFORMATION-

CORPORATE SOURCE -
AIR FORCE AERO PROPULSION LAB., WRIGHT-PATTERSON AFB, OHIO.
REPORT NUMBER -
AD-635606//AFAPL-CONF-66-5
OTHER INFORMATION -
0016 PAGES, 0003 FIGURES, 0001 TABLES, 0004 REFERENCES

INVESTIGATION OF TWO METHODS FOR IMPROVING THE CRASHWORTHINESS OF INTEGRAL FUEL TANKS. FINAL REPORT, 1967-1970.

by

AHLERS, R.H.

11/00/70

-ABSTRACT-

F-86 droppable fuel tanks, fitted with reticulated polyurethane foam and filled to capacity with JP-4 fuel, were drop tested and catapulted to test the effectiveness of the foam in reducing fuel spray and leakage at impact. Also, structurally reinforced DC-7 integral wing tanks were impacted against an upright beam restrained by a steel shear pin to limit the loads. The forward spar caps were strengthened with aluminum alloy doublers and chordwise stiffeners to determine the effect of structural modifications on the crashworthiness of the structure. It was determined that the 10 pores/in. and the 60 pores/in. polyurethane foams have little effect on the attenuation of fuel misting and spilling. The addition of a 0.040-in. thick doubler strip to the upper and lower DC-7 wing skins did not appreciably decrease the vulnerability of the integral tank to leakage, but the front spar rails when reinforced by chordwise structural shapes did increase impact resistance.

-BIBLIOGRAPHY-

NISSLEY, P.M. AND HEID, T.L.: STRUCTURAL DESIGN FOR FUEL CONTAINMENT UNDER SURVIVABLE CRASH CONDITIONS. FAA-ADS-19, AUG. 1964

-SOURCE INFORMATION-

CORPORATE SOURCE -
NATIONAL AVIATION FACILITIES EXPERIMENTAL CENTER, ATLANTIC CITY, N.J.
REPORT NUMBER -
AD-715445//FAA-RD-70-56
SPONSOR -
FEDERAL AVIATION ADMINISTRATION, WASHINGTON, D.C. SYSTEMS RESEARCH AND DEVELOPMENT SERVICE.
CONTRACT NUMBER -
PROJ. NO. 503-101-01X
OTHER INFORMATION -
0017 PAGES, 0008 FIGURES, 0001 TABLES, 0001 REFERENCES

CRITERIA FOR AIRCRAFT INSTALLATION AND UTILIZATION OF AN EXTINGUISHING AGENT CONCENTRATION RECORDER

by

CHAMBERLAIN, G.

03/00/70

-ABSTRACT-

For a number of years, the Federal Aviation Administration (FAA) has been active in the field of testing and evaluation of aircraft powerplant fire-extinguishing systems. In this area, the FAA has supplied the specialized test equipment and experienced personnel necessary for such testing and has been, essentially, the sole organization providing these services within the United States. The specialized test equipment, criteria for the installation and operation of this equipment, and the guidelines for utilization of the equipment for the conduct of meaningful test programs are described. The extinguishing agent concentration recorder, as specialized gas analyzer test equipment, and its operational principle are described. Guidelines are presented for the location and installation of extinguishing agent concentration sampling probes within the test article. Also included are sections concerning the importance of agent distribution system conformity; factors which influence agent distribution and concentration; suggested flight and ground test procedures; the relative importance of flight tests and ground tests with and without supplemental airflow; and test data form, reduction, interpretation, and presentation. The value and recognition of the utilization of the gas analyzer test equipment as the most effective means of determining the performance of an aircraft extinguishing system are also discussed.

-PERTINENT FIGURES-

-SOURCE INFORMATION-

CORPORATE SOURCE -
NATIONAL AVIATION FACILITIES EXPERIEMTNAL CENTER, ATLANTIC CITY, N.J.
REPORT NUMBER -
FAA-DS-70-3//FAA-NA-70-17
OTHER INFORMATION -
0074 PAGES, 0022 FIGURES, 0001 TABLES, 0000 REFERENCES

AIRCRAFT FUEL TANK INERTING BY MEANS OF FUEL CELL FOGGING

by

WIGGINS, E.W.
MALMBERG, Q.C.

05/00/69

-ABSTRACT-

Tests have shown that fuel sprayed into the ullage space of a fuel cell in the form of fog (10 to 100 micron particles) acts as a vapor adding to the natural vapor concentration; thereby, reducing the flammability zone temperature limits. Inerting by this method proved to be only partially effective in that an apparent limiting concentration of fuel fog was reached, that being well below the fuel to air concentration needed for inerting over the full temperature range encountered by aircraft. Fog concentrations on the order of 0.14 lb. fuel/lb. air were produced as indicated in ignition tests whereas 0.28 lb. fuel/lb. air is needed for inerting over the full operating range of temperature. Verification of the maximum obtainable concentration of 0.14 lb. fuel/lb. air could only be made through ignition studies as attempts to sample the fog by various methods including syringe, settling device and vacuum bottle failed due to data scatter. Hydraulic nozzles were able to surpress the rich flammable temperature limit of JP-4 from 70 deg. F. to 35 deg. F., whereas pneumatic nozzles were only able to surpress this limit to 55 deg. F. Ignition energies proved to be very important in the establishment of flammability data. Rich limits for JP-4, both under vapor equilibrium and dynamic fog conditions, varied as the ignition energy changed. This occurred to a point where the ignition source energy became sufficient to show the true flammable limit of the fuel. This energy was obtained by both electrical and incendiary sources of 23 joules and approximately 12,000 joules, respectively.

-PERTINENT FIGURES-

FIG. 13 PHOTOCELL READING OF LIGHT ABSORPTION AFTER FOG FLOW SHUTOFF PAGE 28//FIG. 14 PHASE 2 EXPLOSION CHAMBER SET UP PAGE 31//FIG. 22 RICH LIMIT FOR JP-4 UNDER DYNAMIC FOG CONDITIONS USING BETA IMPINGEMENT TYPE NOZZLE (PT-5) 14 JOULE CAPACITANCE IGNITION SOURCE PAGE 42//FIG. 24 RICH LIMIT FOR JP-4 UNDER DYNAMIC FOG CONDITIONS USING DETA IMPINGEMENT TYPE NOZZLE (PT-5) INCENDIARY IGNITION SOURCE PAGE 44//TAB. 1 FOG SAMPLING DATA PAGE 7//TAB. 3 SONIC NOZZLE - JP-4 FUEL WITH ANTI-STATIC ADDITIVE PAGE 21

-BIBLIOGRAPHY-

BOTTERI, P.B., CRETCHER, R.E., FULTZ, J.R., AND LANDER, H.R.: A REVIEW AND ANALYSIS OF THE SAFETY OF JET FUEL. AFAPL-TR-66-9//KUCHTA, J.M., CATO, R.J., AND MARTINDILL, G.H.: FIRE AND EXPLOSION HAZARD ASSESSMENT AND PREVENTION TECHNIQUES FOR AIRCRAFT. REP. Q/P/R/5005-1, BUR. OF MINES//CUSTARD, G.H., AND DONAHUE, J.D.: AIRCRAFT FUEL CELL EXPLOSION SUPPRESSION SYSTEMS AND THEIR APPLICABILITY TO ARMY AIRCRAFT. US AAVLABS TECH. REP. 67-39, JULY 1967 //BAICY, E.O.: A FUNDAMENTAL MODEL OF THE FUEL FIRE PROBLEM. BRL REP. NO. 873, BALLISTIC RES. LAB. ABERDEEN PROVING GROUND, MD., JULY 1953//WIGGINS, E.W.: FUEL FOG FUEL CELL INERTING SYSTEM PROPOSAL. MCDONNELL AIRCRAFT CORP., ST. LOUIS, REP. F730, AUG. 14, 1967//LAPPLE, C.E., HENERY, J.P., AND BLAKE, D.E.: ATOMIZATION - A SURVEY AND CRITIQUE OF THE LITERATURE. STANFORD RES. INST. CONTR. DA-18-035-AMC-122(A), APR. 1967

-SOURCE INFORMATION-

CORPORATE SOURCE -
MC DONNELL AIRCRAFT CO., ST. LOUIS, MO.
REPORT NUMBER -
AFAPL-TR-69-46
SPONSOR -
AIR FORCE AERO PROPULSION LAB., WRIGHT-PATTERSON AFB, OHIO.
CONTRACT NUMBER -
CONTRACT F33615-68-C-166
OTHER INFORMATION -
0068 PAGES, 0028 FIGURES, 0014 TABLES, 0017 REFERENCES

AN ENGINEERING INVESTIGATION AND ANALYSIS OF CRASH-FIRE RESISTANT FUEL TANKS

by

YANCEY, M.M.
HEADRICK, R.T.

07/00/70

-ABSTRACT-

A study was made of the use of available rubber, plastic, and other material to reduce the probability of fire in fuel tanks during and after survivable crashes. Techniques investigated apply to integral tanks and bladder cells. General contributions included prevention of original penetration; containme of penetration; maintenance of fuel integrity even with failure of above two systems; change in characteristics of fuel expulsion from major wound to non-vapor, low flow liquid leak; flame and explosion suppression and surge attenuation. Proper selection of building blocks to optimize desired performance characteristics indicated a major contribution is available with slight, almost unmeasurable, displacement of usable fuel and addition of weight. Structures so protected may be inspected.

-PERTINENT FIGURES-

FIG. 13 CAVITY PRESSURE AND FREQUENCY ATTENUATION AS FOAM IS INTRODUCED INTO THE TEST CAVITY PAGE 30//FIG. 18 FLUID EXPULSION WITH TEST CAVITY FILLED WITH 10 and 40 PORE PER IN. FOAM PAGE 38//TAB. 3 EXPULSION FLOW ATTENUATION USING INTERNAL FOAM PAGE 35

-BIBLIOGRAPHY-

SOME PHYSICAL PROPERTIES OF A NUMBER OF PROPOSED CONSTRUCTIONS OF MATERIALS FOR NON-METALLIC CRASH RESISTANT AIRCRAFT FUEL TANKS. CAA/TDEC TDR220, DEC. 1953//STRUCTURAL DESIGN FOR FUEL CONTAINMENT UNDER SURVIVABLE CRASH CONDITIONS. FAA-ADS-19, AUG. 1964//CRASH LOADS ENVIRONMENT STUDY. FAA-DS- 67-2, FEB. 1967//TEMPERATURE EFFECT ON BLADDER CELLS. NAFEC, NOV. 1959// IMPACT TESTS ON CRASH-RESISTANT FUEL TANKS. FIRESTONE COATED FABRICS REP. 843//FIRESTONE COMPRESSED AIR GUN, TENSILE EVALUATION OF CONSTRUCTIONS E1074-5, E1270, E1229, E1235, E1277 and NR 1173. FIRESTONE COATED FABRIC REP. 1252

-SOURCE INFORMATION-

CORPORATE SOURCE -
FIRESTONE COATED FIBRICS CO., AKRON, OHIO.

REPORT NUMBER -
AD-709846//NA-69-43(DS-69-7)
SPONSOR -
NATIONAL AVIATION FACILITIES EXPERIMENTAL CENTER, ATLANTIC CITY, N.J.
CONTRACT NUMBER -
CONTRACT FA-67NF245
OTHER INFORMATION -
0082 PAGES, 0025 FIGURES, 0003 TABLES, 0023 REFERENCES

keys 153 through 159

FUEL SYSTEM FIRE SAFETY, 2ND. CONF. WASHINGTON, D.C., MAY 6-7, 1970

by

FEDERAL AVIATION ADMINISTRATION

05/06/70

-ABSTRACT-

Contents: Reed, T.O., USAF Experience with Polyurethane Foam Inerting Material (See F7100160)//Brookley, W.Q., USAF, C-141 and C-135 Fuel Tank Nitrogen Inerting Tests (See F7100161)//Kuchta, J., Oxygen Dilution Requirements for inerting Aircraft Fuel Tanks, (See F7100162)//Klueg, E.P., In-flight Control of Power Plant Fires with Liquid Nitrogen (See F7100163)// Clodfelter, R.G., Fuel Tank Inerting Catalytic Combustion Techniques (See F7100164)//Plumer, J.A., Lightning-Induced Voltages in Electrical Circuits Associated with Aircraft Fuel Systems (See F7100165)//Hereff, T.G., FAA DC-9, Liquid Nitrogen Fuel Tank Inerting Program (See F7100166)

-SOURCE INFORMATION-

CORPORATE SOURCE -
FEDERAL AVIATION ADMINISTRATION, WASHINGTON, D.C.
REPORT NUMBER -
AD-711059
OTHER INFORMATION -
9999 PAGES, 9999 FIGURES, 9999 TABLES, 9999 REFERENCES

USAF EXPERIENCE WITH POLYURETHANE FOAM INERTING MATERIAL

by

REED, T.O.

05/06/70

-ABSTRACT-

A summary of the Air Force's experience with reticulated polyurethane foam as an inerting material in fuel tanks of combat aircraft includes background data and experience on the presently-used fully-packed concept, as well as an outline of the efforts to reduce the weight and range penalties associated with the present foam through the use of low density foams and voiding concepts the inherent advantages and disadvantages of polyurethane foam for fuel tank inerting are briefly outlined. On the plus side, the foam provides complete or total inerting at all times regardless of ignition source, temperature, altitude, and fuel condition simply because it completely fills the protected tank. Some of the disadvantages of the foam include such items as cost; weight and volume penalties; and, to some degree, the added maintenance burden when a fuel tank entry is required. The material characteristics and installation requirements of the foam are reviewed. Foam development testing, including explosion suppression studies, material compatibility, and fuel system performance is discussed. To use the foam inerting concept in commercial and very large aircraft, the foam penalties of weight and volume of weight must be reduced.

-PERTINENT FIGURES-

FIG. 18 COMPARISON OF PENALTIES FOR VARIOUS FOAMS PAGE 72

-BIBLIOGRAPHY-

THOMAS, W.J.: DEVELOPMENT AND TESTING OF CELLULAR PACKING MATERIAL. CONTR. AF33(615)-3423, PROJ. 1559-40, COATED FABRIC PROD., FIRESTONE TIRE AND RUBBER CO., LOS ANGELES, CALIF., MAY 20, 1966//CATO, R.J., FURNO, A.L., BARTKOWIAK, A., AND KUCHTA, J.M.: EVALUATION OF FLAME ARRESTOR MATERIALS FOR AIRCRAFT FUEL SYSTEMS. REP. AFAPL-TR-67-63, BUR. OF MINES, MAR. 1967 AND AFAPL-TR-67-148, BUR. OF MINES, FEB. 1968//CATO, R.J., GILBERT, W.H., KUCHTA, J.M., AND SPOLAN, I.: FUEL TANK EXPLOSION PROTECTION. REP. AFAPL-TR-68-11, BUR. OF MINES, MAR. 1969//GIBSON, J.R. NELSON, D.B., ANDRUZE, R.A., AND HARRIS, J.C.: INVESTIGATION OF POLYURETHANE FOAM FOR AIRCRAFT FUEL SYSTEM APPLICATIONS. ASJ-TM-66-1, NOV. 1966//HOUSE, P.A.: HUMIDITY AND WATER RESISTANCE OF FIRE SUPPRESSANT FOAM. AF MATERIALS LAB. REP. NO. MAA 69-45, JULY 2, 1969//KELLY, D.J. AND TRIOLO, R.P.: EFFECTS OF AVIATION FUELS ON

POLYESTER POLYURETHANE FOAM. RES. REP. NO. 556, SCOTT PAPER CO.
AUG. 30, 1968

-SOURCE INFORMATION-

CORPORATE SOURCE -
DEPARTMENT OF THE AIR FORCE WASHINGTON, D.C.
JOURNAL PROCEEDINGS -
IN:FAA FUEL SYSTEM FIRE SAFETY CONF. 1970 (SEE F7100159)
OTHER INFORMATION -
0049 PAGES, 0018 FIGURES, 0000 TABLES, 0008 REFERENCES

USAF, C-141 AND C-135 FUEL TANK NITROGEN INERTING TESTS

by

BROOKLEY, W.Q.

05/06/70

-ABSTRACT-

A system of fuel tank liquid nitrogen inerting was explored as a method for fire and explosion suppression in C-135 and C-141 aircrafts. A summary of the flight test results is provided for the C-141; the C-135 program was delayed, but the test plans are included. The tests were established to show proper operation of the components and systems and to prove that in no way could safety of flight of the aircraft be jeopardized by the inerting systems. Considered were normal operations, any type of failure, or effects on aircraft components or structures. Emphasis was placed on the testing of the vent valve since it was the most critical and newly designed component in the system. No maintenance problems were encountered with the inerting system for an operating time of 112 hr. and 282 takeoffs and landings. Oxygen concentration samples taken after several flights showed that the oxygen content varied between land 3 percent depending on the starting and flight conditions. An analysis of the vapor space was taken directly from two fuel tanks through the over wing filler neck and the results corresponded reasonably with the vent sampling.

-SOURCE INFORMATION-

CORPORATE SOURCE -
DEPARTMENT OF THE AIR FORCE, WASHINGTON, D.C.
JOURNAL PROCEEDINGS -
IN: FAA FUEL SYSTEM FIRE SAFETY CONF. 1970 (SEE F7100159)
OTHER INFORMATION -
0009 PAGES, 0000 FIGURES, 0000 TABLES, 0000 REFERENCES

OXYGEN DILUTION REQUIREMENTS FOR INERTING AIRCRAFT FUEL TANKS

by

KUCHTA, J.M.

05/06/70

-ABSTRACT-

The effectiveness of various inerting agents (gaseous carbon dioxide, nitrogen, helium, argon, water vapor, engine exhaust gases, halogenated hydrocarbons) to prevent ignition and flame propagation in hydrocarbon fuel- air systems is reviewed. Data are presented on the variation of flammability limits, minimum ignition energies, and minimum autoignition temperatures with oxidant or diluent concentration for typical jet fuels. During a flight of an aircraft, the hazard of forming flammable fuel vapor-air mixtures in a fuel tank will vary with temperature, pressure, vent conditions, and the vapor pressure of the fuel. Guidelines are given for specifying safe oxygen concentrations for aircraft fuel tanks. Since flight conditions can vary greatly, the inerting requirements must provide protection over a wide range of temperatures and pressure altitudes. According to the available flammability data, aircraft fuel tanks initially at 100 deg. F. can be protected against explosions by maintaining the oxygen concentration below 10 percent with nitrogen or below 12.5 percent with carbon dioxide. These values are applicable to both Jet A and Jet B type fuels and are based on data obtained with a severe ignition source.

-PERTINENT FIGURES-

TAB. 1 MINIMUM OXYGEN REQUIREMENTS FOR FLAME PROPAGATION WITH VARIOUS FUELS IN AIR-CARBON DIOXIDE AND AIR-NITROGEN ATMOSPHERES PAGE 92//FIG. 3 MINIMUM OXYGEN CONCENTRATIONS REQUIRED FOR FLAME PROPAGATION OF JP-4 AND AV GAS 115/145 SPRAYS IN CARBON DIOXIDE AND NITROGEN VITIATED ATMOSPHERES PAGES 95 AND 96//FIG. 4 LIMITS OF FLAMMABILITY OF GASOLINE VAPOR IN AIR WITH VARIOUS INERT GASES AND HALOGENATED HYDROCARBONS AT 80 DEG. F. AND ATMOSPHERIC PRESSURES PAGES 99 AND 100//FIG. 5 VARIATION OF MINIMUM SPARK IGNITION ENERGIES WITH OXYGEN CONCENTRATION FOR PROPANE-OXYGEN-NITROGEN MIXTURES AT 0.2, 0.5, AND 1 ATM. PAGES 103 AND 104//FIG. 6 EFFECT OF OXYGEN PARTIAL PRESSURE ON THE MINIMUM AUTOIGNITION TEMPERATURE OF JP-6 FUEL-VAPOR-OXYGEN- NITROGEN MIXTURES AT VARIOUS INITIAL PRESSURES PAGES 107 AND 108

-BIBLIOGRAPHY-

BOTTERI, B.P., CRETCHER, R.E., FULTZ, J.R., AND LANDER, H.R.: A

REVIEW AND ANALYSIS OF THE SAFETY OF JET FUEL. TECH. REP. AFAPL-TR-66-9, 40-41, WRIGHT- PATTERSON AFB, MAR. 1966//FISHER, D.H. AND WEISS, H.G.: INVESTIGATION OF SUPERSONIC AIRCRAFT FUEL TANK FIRES AND EXPLOSION HAZARDS. TECH. REP. AFAPL- TR-66-105, SEPT. 1966//JONES, G.W., ZABETAKIS, M.GC., SCOTT, G.S., AND FURNO, A.L.: RESEARCH ON THE FLAMMABILITY CHARACTERISTICS OF AIRCRAFT FUELS. WADC TECH. REP. 52-35, BUR. OF MINES, SUPPL. 1, JAN. 1954 AND SUPPL. 4, JAN. 1956//NAULTY, H.W.: THE ELIMINATION OF AIRCRAFT FUEL TANK HAZARDS. REP. NO. V-449-D-4, CORNELL AERONAUT. LAB., JUNE 25, 1949//NOWACK, C.J.: REDUCTION OF FLAMMABILITY OF FUEL VAPORS THROUGH USE OF HALOGENATED COMPOUNDS IN THE FUEL. AIRCRAFT FLUIDS FIRE HAZARD SYMP., 46, CORNELL UNIV., JUNE 7-8, 1966// WAINRIGHT, R.B. AND PERLMUTTER, A.: GENERATION OF INERTING GASES FOR AIRCRAFT FUEL TANKS BY CATALYTIC COMBUSTION TECHNIQUES. TECH. REP. AFAPL-TR- 69-68, VOL. 1, AM. CYANAMID CO., AUG. 1969

-SOURCE INFORMATION-

CORPORATE SOURCE -
BUREAU OF MINES, PITTSBURGH, PA. SAFETY RESEARCH CENTER.
JOURNAL PROCEEDINGS -
IN: FAA FUEL SYSTEM FIRE SAFETY CONF. 1970 (SEE F7100159)
OTHER INFORMATION -
0031 PAGES, 0006 FIGURES, 0002 TABLES, 0015 REFERENCES

IN-FLIGHT CONTROL OF POWERPLANT FIRES WITH LIQUID NITROGEN

by

KLEUG, E.P.

05/06/70

-ABSTRACT-

The effectiveness of liquid nitrogen as a fire extinguishing agent was investigated in two wind tunnel facilities. One facility simulates the subsonic low altitude flight conditions around an instrumented Number 2 Jet Star power plant installation. The second facility is a boilerplate mockup of an engine nacelle. The nitrogen was stored under pressure as a saturated liquid. All of the test fires, which resulted from spray releasing and spark igniting JP-4 jet fuel, were located in a remote area relative to the discharge location to prevent localized high concentration of nitrogen in the fire area. Typical minimum nitrogen requirements for extinguishment are shown for low and high airflows. The effectiveness of liquid nitrogen appeared to be primarily a function of the rate at which it was applied to the fire, not the discharge time or total quantity utilized. Two tests were conducted to determine the relative effectiveness of liquid nitrogen to the fire extinguishing agent (bromotrifluoromethane) used on the majority of U.S. commercial transport aircraft. A 1.1 lb./sec. discharge of liquid nitrogen for 3.9 sec. was required, expending an effective quantity of 4.1 lb. of liquid nitrogen. On the basis of weight, approximately four times more liquid nitrogen required as compared to bromotrifluoromethane. The effects of an inadvertent discharge, damaged cowling, and the cooling of potential reignition sources were considered.

-PERTINENT FIGURES-

TAB. 2 INSTALLATION EFFECTS ON NITROGEN FIRE EXTINGUISHING REQUIREMENTS PAGE 123//TAB. 3 EFFECT OF AGENT TYPE ON FIRE EXTINGUISHING REQUIREMENTS PAGE 125 //FIG. 5 AMBIENT TEMPERATURE DURING NITROGEN DISCHARGE PAGES 135-136

-SOURCE INFORMATION-

CORPORATE SOURCE -
FEDERAL AVIATION ADMINISTRATION, WASHINGTON, D.C.
JOURNAL PROCEEDINGS -
IN ITS: FUEL SYSTEM FIRE SAFETY CONF. 1970 (SEE F7100159)
OTHER INFORMATION -
0024 PAGES, 0006 FIGURES, 0005 TABLES, 0000 REFERENCES

FUEL TANK INERTING USING CATALYTIC COMBUSTION TECHNIQUES

by

CLODFELTER, R.G.

05/06/70

-ABSTRACT-

The catalytic combustion technique for inerting aircraft fuel systems offers potential advantages over other combustion concepts by providing efficient oxygen conversion over a wide range of operating conditions with the generation of only a small amount of corrosive reaction products. The current Air Force effort to develop this technique into an effective system for generating inerting gases for aircraft fuel tanks is summarized; and a discussion of the conceptual design of the catalytic combustion reactor is included. Various test runs were made using both JP-7 and JP-4 fuels to investigate space velocity and temperature effects, effect of sulfur, coke deposition, and conversion to carbon dioxide. Tests were also performed to determine catalyst lifetime, catalyst regeneration, and water removal from the system. Advantages of a catalytic inerting system include lower recurring costs and weight, unlimited gas supply, and dry bay inerting potential. Disadvantages include high non-recurring costs, the bleed and ram air as well as fuel required, and complexity. A second phase of this project includes the preliminary design of a catalytic reactor inerting concept which offers system advantages over existing inerting techniques and has a high potential of satisfying future Air Force requirements.

-PERTINENT FIGURES-

FIG. 1 SIMPLIFIED COMBUSTION-TYPE INERTING SYSTEM PAGES 149-150// FIG. 7 EFFECT OF REGENERATION ON PERFORMANCE OF CODE A CATALYST AFTER 60 HR. TEST RUN PAGES 162-163//FIG. 9 ADVANTAGES/DISADVANTAGES OF CATALYTIC INERTING SYSTEM PAGES 165-166//FIG. 10 TYPICAL CATALYTIC REACTOR-AIR CYCLE REFRIGERATION INERTING CONCEPT PAGES 167-168

-BIBLIOGRAPHY-

WRIGHT, F.A.: AIR FORCE HISTORY AND EXPERIENCE WITH INERTING, SUPPRESSION, AND PURGING SYSTEMS. REP. OF CONF. OF FIRE SAFETY MEASURES FOR AIRCRAFT FUEL SYSTEMS, FAA, DEC. 11-12, 1967. (AD-672036)//GENERATION OF INERTING GASES FOR AIRCRAFT FUEL TANKS BY CATALYTIC COMBUSTION TECHNIQUES, VOL. 1 AND VOL. 2. AFAPL-TR-69-68, AUG. 1969//INERTING CONDITIONS FOR AIRCRAFT FUEL TANKS. WADC-TR-418, SEPT. 1955

-SOURCE INFORMATION-

CORPORATE SOURCE -
DEPARTMENT OF THE AIR FORCE, WASHINGTON, D.C.
JOURNAL PROCEEDINGS -
IN: FAA FUEL SYSTEM FIRE SAFETY CONF. 1970 (SEE F7100159)
OTHER INFORMATION -
0030 PAGES, 0011 FIGURES, 0000 TABLES, 0003 REFERENCES

LIGHTNING INDUCED VOLTAGES IN ELECTRICAL CIRCUITS ASSOCIATED WITH AIRCRAFT FUEL SYSTEMS

by

PLUMER, J.A.

05/06/70

-ABSTRACT-

Lightning induced voltages were measured in the fuel system electrical circuits within the wing of an F-89J aircraft, and mathematical expressions for these voltages were derived in terms of the causative lightning current parameters. Possible effects of these induced voltages upon the fuel system were considered. To determine if induced voltages present a hazard to the fuel system, the two areas of concern are the possibility of electrical sparking within a fuel vapor area and the possibility of damage or interference with avionics or other electronic equipment to which the circuits might be connected elsewhere in the aircraft. From the measurements made, there is no reason to conclude that lightning may induce voltages sufficient to cause sparking in the fuel system electrical circuits or components. The circuits are sufficiently shielded and safely routed so that they are not susceptible to severe, induced voltages. The more likely hazard to be expected from voltages induced in fuel system electrical circuits of aircraft such as the F-89J may be interference or damage to avionics equipments. It is recommended that aircraft designers continually be aware of the possibility of lightning induced voltages and undertake measures to control them and assure that they will create no hazardous effects.

-PERTINENT FIGURES-

TAB. 1 COMPARISON OF VOLTAGES INDUCED BY MODERATE AND SEVERE LIGHTNING STROKES PAGE 189//FIG. 3 CONDUCTOR-TO-AIRFRAME AND CONDUCTOR-TO-CONDUCTOR INDUCED VOLTAGES IN INBOARD FUEL PROBE CIRCUIT PAGE 177//FIG. 4 INDUCED VOLTAGE AND CURRENT IN A SHIELD OF TIP TANK FUEL PROBE CIRCUIT PAGE 178// FIG. 7 DETERMINATION OF EFFECTIVE WING RESISTANCE AND MUTUAL INDUCTANCE FROM EXPERIMENTAL DATA PAGE 184

-BIBLIOGRAPHY-

LLOYD, K.J., PLUMER, J.A., AND WALKO, L.C.: MEASUREMENTS AND ANALYSIS OF LIGHTNING-INDUCED VOLTAGES IN AIRCRAFT ELECTRICAL SYSTEMS. FINAL REP., NASA CONTR. NAS3-12019, G.E. HIGH VOLTAGE LAB. REP. NO. 69-161, MAR. 1, 1970//PETERSON, B.J. AND WOOD, A.R.: MEASUREMENTS OF LIGHTNING STRIKES TO AIRCRAFT. FAA, REP. NO. DS-68-1, JAN. 1968//HAGANGUTH, J.H. AND ANDERSON, J.G.: LIGHTNING

TO THE EMPIRE STATE BUILDING -- PART 3. AIEE TRANS., VOL. 71, 641-649, AUG. 1952//HAGENGUTH, J.H.: LIGHTNING STROKE DAMAGE TO AIRCRAFT--PART 2. AIEE TRANS., VOL. 68, 1036-1044, 1949// KESTER, F.L., GERSTEIN, M., AND PLUMER, J.A.: A STUDY OF AIRCRAFT FIRE HAZARDS RELATED TO NATURAL ELECTRICAL PHENOMENA. NASA CR-1076, 1967// MCEACHRON, K.B.: LIGHTNING TO THE EMPIRE STATE BUILDING. AIEE TRANS., VOL. 60, 885-890, 1941

-SOURCE INFORMATION-

CORPORATE SOURCE -
GENERAL ELECTRIC CO. PITTSFIELD, MASS. HIGH VOLTAGE LAB.
JOURNAL PROCEEDINGS -
IN: FAA FUEL SYSTEM FIRE SAFETY CONF. 1970 (SEE F7100159)
OTHER INFORMATION -
0022 PAGES, 0011 FIGURES, 0001 TABLES, 0007 REFERENCES

DEVELOPMENT OF HIGH TEMPERATURE FIRE AND EXPLOSION SUPPRESSION SYSTEMS

by

GILLIS, J.P.
CUTLER, H.R.

01/00/70

-ABSTRACT-

AN AIRCRAFT CHEMICAL EXTINGUISHANT FIRE AND EXPLOSION SUPPRESSION SYSTEM WAS DEVELOPED AND EVALUATED FOR USE IN HIGH AMBIENT TEMPERATURE AREAS OF AIRCRAFT. SYSTEM PERFORMANCE WAS INVESTIGATED IN SIMULATED AIRCRAFT FUEL TANKS OF 100, 500, AND 1000 GAL. CAPACITY. THE COMBUSTIBLES USED TO CREATE THE FIRES AND EXPLOSIONS WERE JP-4 AND JP-5 FUELS. THE IGNITION SOURCES UTILIZED WERE SMALL ARMS AMMUNITION AND ELECTRIC SPARKS. SUPPRESSION SYSTEM COMPONENTS WERE SUBJECTED TO QUALIFICATION TESTS AS DEFINED BY MIL-STD-810B. A FUNCTIONING SYSTEM WAS SUBJECTED TO A FUEL SLOSH TEST AND AGENT DISTRIBUTION TEST IN A 67 GAL. CYLINDRICAL TANK. THE SYSTEM DEVELOPED CAN SUBSTANTIALLY REDUCE THE EXPLOSION HAZARD POTENTIAL ASSOCIATED WITH THE PENETRATION OF INCENDIARY PROJECTILES INTO THE FLAMMABLE ULLAGE VOLUME OF AIRCRAFT FUEL TANKS.

-PERTINENT FIGURES-

FIG. 12 CONTROL BOX, EXTERNAL VIEW PAGE 26//FIG. 27 SIMULATED 500 GALLON FUEL TANK PAGE 61//FIG. 36 SLOSH TEST TANK SYSTEM AND INSTRUMENTATION LAYOUT PAGE 76//TAB. 2 PHYSICAL PROPERTIES OF CANDIDATE AGENTS PAGE 34//TAB. 3 EFFECT OF HALONS ON ALUMINUM, BRASS AND STEEL PAGE 34//TAB. 6 RESULTS OF AGENT STABILITY AND COMPATIBILITY TESTS PAGE 39

-BIBLIOGRAPHY-

AIRCRAFT FUEL CELL EXPLOSION SUPPRESSION SYSTEMS AND THEIR APPLICABILITY TO ARMY AIRCRAFT, USAAVILABS TECH. REP. 67-39, JUL. 1967//ULTRAVIOLET FIBER OPTICS FOR FIRE AND EXPLOSION DETECTION, TECH. REP. AFAPL-TR-67-31, FEB. 1967//FREON FLUORINATED HYDROCARBON FIRE EXTINGUISHING AGENT, DUPONT, KINETIC TECH. BULL. B4 NOV. 15, 1954//FINAL REPORT ON FIRE EXTINGUISHING AGENTS FOR THE PERIOD SEPT. 1, 1947, TO JUNE 30, 1950, COVERING RESEARCH CONDUCTED BY PURDUE RESEARCH FOUNDATION AND DEPARTMENT OF CHEMISTRY, CONTRACT W44-009-ENG-507

-SOURCE INFORMATION-

CORPORATE SOURCE -
    FENWAL INC., ASHLAND, MASS.
REPORT NUMBER -
    AD-869386//AFAPL-TR-69-115
SPONSOR -
    AIR FORCE AERO PROPULSION LAB., WRIGHT-PATTERSON AFB, OHIO.
CONTRACT NUMBER -
    CONTRACT AF 33615-68-C-1643
OTHER INFORMATION -
    0223 PAGES, 0059 FIGURES, 0016 TABLES, 0005 REFERENCES

CRASH FIRE HAZARD EVALUATION OF JET FUELS

by

ATKINSON, A.J.
EKLUND, T.I.

01/00/71

-ABSTRACT-

AN INVESTIGATION WAS CONDUCTED TO DETERMINE THE RELATIVE CRASH FIRE HAZARDS OF JET FUELS UNDER SURVIVABLE CRASH CONDITIONS. KEROSENE, JP-4, AND MIXTURES OF BOTH WERE EVALUATED UNDER VARIOUS RELEASE MODES (POOLS, DRIPS, STREAMS AND SPRAYS) AND IN THE PRESENCE OF POSSIBLE IGNITION SOURCES (ELECTRICAL SPARKS, FRICTION SPARKS, OPEN FLAMES, AND HOT SURFACES). WIND SPEED, WIND AIR TEMPERATURE AND FUEL TEMPERATURES WERE ALSO VARIED. IT WAS CONCLUDED THAT: (1) THE POSSIBILITY OF FLAME CLIMBING A COLUMN OF DRIPPING FUEL (JP-4 OR KEROSENE) IS EXTREMELY REMOTE, (2) THE SPATIAL IGNITION ENVELOPE FOR FUEL STREAMS CEASES TO EXIST WHEN THE FUEL TEMPERATURE FALLS BELOW THE FLASH POINT, AND (3) NEITHER JP-4 NOR KEROSENE OFFER SUBSTANTIAL ADVANTAGE WITH REGARD TO IGNITION OR PROPAGATION OF FLAMES THROUGH MISTS.

-PERTINENT FIGURES-

-BIBLIOGRAPHY-

PINKEL, I.I., WEISS, S., PRESTON, G.M., AND PESMAN, G.J.: ORIGIN AND PREVENTION OF CRASH FIRES IN TURBOJET AIRCRAFT, NACA TN 3973, MAY 1957// GOODALL, D.G., AND INGLE, R.: THE IGNITION OF INFLAMMABLE FLUIDS BY HOT SURFACES, AIRCRAFT ENGINEERING 38 (4), 20, 24, 29, 35, 1966//MACDONALD, J.A.: IGNITION OF AVIATION KEROSENE BY HOT PIPES, ROYAL AIRCRAFT EST. TR 67162, 1967 (AD-824289)//GLASSMAN, I., AND HANSEL, J.G.: SOME THOUGHTS AND EXPERIMENTS ON LIQUID FUEL SPREADING, STEADY BURNING, AND IGNITABILITY IN QUIESCENT ATMOSPHERES, PRINCETON UNIV. AEROSPACE AND MECHANICAL LAB. REP. 841, JULY 1968//WELKER, J.R.: THE EFFECT

OF WIND ON UNCONTROLLED BUOYANT DIFFUSION FLAMES FROM BURNING LIQUIDS, PH.D. THESIS, UNIV. OF OKLAHOMA, NORMAN, 1965//HIRST, R., AND SUTTON, D.' THE EFFECT OF REDUCED PRESSURE AND AIRFLOW ON LIQUID SURFACE DIFFUSION FLAMES, COMBUSTION AND FLAME 5, 319-330, 1961

-SOURCE INFORMATION-

CORPORATE SOURCE -
NAVAL AIR PROPULSION TEST CENTER, PHILADELPHIA, PA. AERONAUTICAL ENGINE DEPT.
REPORT NUMBER -
AD-718116//FAA-NA-70-64//FAA-RD-70-72
SPONSOR -
FEDERAL AVIATION ADMINISTRATION, WASHINGTON, D.C. SYSTEMS RESEARCH AND DEVELOPMENT SERVICE.
CONTRACT NUMBER -
DOT FA66NF-AP-14
OTHER INFORMATION -
0054 PAGES, 0028 FIGURES, 0002 TABLES, 0027 REFERENCES

key 202

FUTURE OF AIRPLANE CRASH FIREFIGHTING (DIE ZUKUNFT DER BEKAMPFUNG VON FLUGZEUGAUFSCHLAGBRANDEN)

by

SCHEICHL, L.

00/00/68

-ABSTRACT-

POWDER TYPE EXTINGUISHING AGENTS AND A FOAMING AGENT ARE CONSIDERED FOR USE IN AIRPORT FIRE FIGHTING EQUIPMENT FOR CRASH FIRES. THE MAIN DIFFERENCE BETWEEN THE COMBINATION POWDER/FOAM METHOD AND THE EXTINGUISHING METHOD RECOMMEDNED BY THE ICAO (INTERNATIONAL CIVIL AVIATION ORGANIZATION) IS THAT, IN THE LATTER METHOD, THE FOAM SERVES AS THE PRIMARY EXTINGUISHING AGENT USED IN MAJOR AMOUNTS AND ACTING AS THE MAIN EXTINGUISHING AGENT FOR EXTINGUISHING THE FIRE; CONVERSELY, IN THE COMBINATION POWDER/FOAM EXTINGUISHING METHOD THIS FUNCTION IS DISTRIBUTED OVER POWDER AND FOAM IN SUCH A MANNER THAT THE POWDERED AGENT QUELLS THE FLAMES WHILE THE FOAM PREVENTS REIGNITION OF PORTIONS OF THE FIRE CORE SMOTHERED BY THE POWDER. IN ADDITION, THE FOAM SERVES FOR COOLING THE FUSELAGE. ANOTHER BASIC DIFFERENCE BETWEEN THE TWO METHODS IS THAT THE ICAO METHOD ALLOWS CARBON DIOXIDE AND HALONS AS SUBSTITUTES FOR THE DRY POWDER. THE PRESENT STATE OF DEVELOPMENT OF AIRPORT POWDER AND FOAM EXTINGUISHING VEHICLES IN GERMANY IS SPECIFIED BY 1967 GUIDELINES AND THESE GUIDELINES ARE DISCUSSED RELATIVE TO THEIR FUTURE REQUIREMENTS FOR FIRE FIGHTING EQUIPMENT. PRESENTLY AVAILABLE AIRPORT FIRE FIGHTING EQUIPMENT AND THE CONVENTIONAL TACTICS ARE NOT CONSIDERED SUFFICIENT TO SAVE THE 150 TO 200 PASSENGERS ABOARD A MODERN LARGE AIRCRAFT. IN THIS CONTEXT, THE FOLLOWING QUESTIONS ARE CONSIDERED' (1) WHICH EXTINGUISHING METHOD IS TO BE USED (2) WHICH MINIMUM AMOUNTS OF
EXTINGUISHING METHOD IS TO BE USED (2) WHICH MINIMUM AMOUNTS OF
EXTINGUISHING AGENTS ARE REQUIRED (3) WHICH TACTICS ARE TO BE USED

-SOURCE INFORMATION-

REPORT NUMBER -
AD-868349//NRL TRANSLATION 1201
JOURNAL PROCEEDINGS -
VFDB ZEITSCHRIFT, VOL. 17, NO. 3, 96-100 (1968) AND VOL. 17, NO. 4, 101-103 (1968)
OTHER INFORMATION -
0033 PAGES, 0000 FIGURES, 0001 TABLES, 0000 REFERENCES

SURVEY OF FLAME-RESISTANT PROPERTIES OF AIRCRAFT INTERIOR MATERIALS

by

SIMON, S.S.

12/28/67

-ABSTRACT-

BASED ON A SURVEY OF INDUSTRIAL NEEDS, TARGET REQUIREMENTS WERE PREPARED WITH MORE STRINGENT FLAME RESISTANT REQUIREMENTS THAN PRESENT FEDERAL AVIATION AGNENCY STANDARDS REQUIRED FOR FIVE CATEGORIES OF AIRCRAFT INTERIOR MATERIALS. AFTER THESE TARGET REQUIREMENTS WERE PRESENTED TO KNOWN SUPPLIERS, IT WAS CONCLUDED THAT MORE DEVELOPMENT IS NEEDED IN MOST TRANSPARENCIES (WINDOWS) AND IN FOAM APPLICATIONS TO ATTAIN SELF-EXTINGISHING PROPERTIES WITHOUT SACRIFICING OTHER REQUIREMENTS. SOME OF THE CHANGES IN PROPERTIES AND PROCESSING AFFECTED BY PENDING CHANGES IN MATERIALS ARE POINTED OUT. ALSO, THOSE AREAS WHERE ADDITIONAL DEVELOPMENTS ARE REQUIRED ARE DEFINED WITH RECOMMENDATIONS FOR A FOLLOW-UP PROGRAM.

-SOURCE INFORMATION-

CORPORATE SOURCE -
LOCKHEED-CALIFORNIA CO. BURBANK
REPORT NUMBER -
AD-867684L//LR-21209
OTHER INFORMATION -
0023 PAGES, 0000 FIGURES, 0000 TABLES, 0000 REFERENCES

FAA DC-9 LIQUID NITROGEN FUEL TANK INERTING PROGRAM

by

HOREFF, T.G.

05/06/70

-ABSTRACT-

A nitrogen fuel tank inerting system to be installed on the FAA DC-9-15 airplane, which is used for air carrier inspector training, will comply with all applicable air worthiness standards of Part 25 of the FAA Regulations for transport category airplanes. Following supplemental type certification of this inerting system in the DC-9, the airplane will be used in its normal missions to evaluate the functional characteristics of the inerting system and determine whether it is feasible and viable for commercial air carrier service. The inerting system will replace oxygen with nitrogen in the fuel tank vapor spaces and vent lines so that the oxygen concentration will normally be 8 percent by volume or less under all flight and ground conditions. The 8 percent system concentration will provide for protection in the event flames enter the vent outlet after the vapor temperature has been increased as a result of a ground fire. While this effort is related to the DC-9, the program is intended to generate data on nitrogen inerting systems which will be applicable to all turbine powered aircraft. This program should enable the safety advantages and functional characeristics of an approved production fuel tank nitrogen inerting system to be evaluated and the costs associated with the use of the system to be determined. A schematic of the proposed system and its installation in the DC-9 are shown.

-PERTINENT FIGURES-

FIG. 3 DC-9 INERTING SYSTEM WEIGHT PAGES 201-202

-SOURCE INFORMATION-

CORPORATE SOURCE -
FEDERAL AVIATION ADMINISTRATION, WASHINGTON, D.C. AIRCRAFT DEVELOPMENT SERVICE
JOURNAL PROCEEDINGS -
IN ITS: FUEL SYSTEM FIRE SAFETY CONF. 1970 (SEE F7100159)
OTHER INFORMATION -
0000 PAGES, 0000 FIGURES, 0000 TABLES, 0000 REFERENCES

DESIGN, DEVELOPMENT, AND FLIGHT TESTING OF FIRE SUPPRESSANT VOID FILLER FOAM KITS FOR VARIOUS TACTICAL ARMY AIRCRAFT

by

WILLISFORD, W.M.

10/00/70

-ABSTRACT-

Fifteen Army aircraft were examined to determine if a fire suppressant void filler foam kit could be designed for each of them to fill the void space surrounding the lower hemisphere of the fuel tank, thus reducing the susceptibility of the aircraft to fire from incendiary rounds. The various aircraft were made available at Army facilities around the United States. Under Phase I these aircraft were examined to determine if a kit could be designed to comply with the specific requirements lof the contract. Phase II included the fabrication and installation of a complete prototype kit conforming to the configuration approved under Phase I. Phase III consisted of a 200-hr. flight test. Phase IV included the preparation of kit drawings and instructions to ensure proper installation of the foam. No adverse flight characteristics were discovered with any of the foam kits installed. One fault was reported. The plastic film envelope covering some of the foam blocks was improperly sealed, allowing an increase in the weight of the blocks due to liquid absorption. This document relates to development of void filler blocks for various aircraft; and, apart from is use in this nature, provides little information of value.

-SOURCE INFORMATION-

CORPORATE SOURCE -
GOODYEAR TIRE AND RUBBER CO., GOODYEAR, ARIZ. AVIATION PRODUCTS DIV.
REPORT NUMBER -
APR-301
SPONSOR -
ARMY AVIATION SYSTEMS COMMAND, ST. LOUIS, MO.
CONTRACT NUMBER -
CONTRACT DAAJ01-69-C-0039(3G)
OTHER INFORMATION -
0036 PAGES, 0018 FIGURES, 0000 TABLES, 0000 REFERENCES

key 274

DESCRIPTION AND ANALYSIS OF PROTOTYPE OF A PORTABLE HYDROGEN FIRE DETECTOR

by

TRUMBLE, T.M.

12/00/65

-ABSTRACT-

The development of a useful portable fire detector for invisible hydrogen flames is reported. A basic analysis of the infrared versus ultraviolet emission from hydrogen-air diffusion flames is made, and this was followed by a study of ultraviolet radiation detection and design criteria. A preliminary model of a portable hydrogen fire detector was built, tested and analyzed. This portable detector, which monitors ultraviolet radiation between 2000 A and 2400 A, can detect a 1 in. high hydrogen-air diffusion flame 80 ft. away. It is shown to be mathematically possible to detect a 2 1/2 in. flame at a distance of 120 ft. Because hydrocarbon flames emit much more radiation, they are easier to detect; for example, a 1 in. propane-air flame, which emits about 80 times the energy of a hydrogen-air flame, would be detectable at a distance of approximately 500 ft. Guidelines are given for increasing the sensitivity and optical systems of a field use detector. The main objectives of this program were to prove the feasibility and provide a prototype of a portable hydrogen fire detector for ground support facilities which store large amounts of hydrogen to support advanced weapons systems. A rapid and reliable means for detecting hydrogen flame is essential in minimizing the fire and explosion hazards in these installations.

-PERTINENT FIGURES-

FIG. 4 ULTRAVIOLET DETECTION ANALYSIS CHART PAGE 7//FIG. 9 PROTOTYPE SYSTEM PAGE 17//FIG. 15 SPECTRAL RADIANT INTENSITY OF HYDROGEN-AIR DIFFUSION FLAME AT 760 MM HG (1P28) PAGE 26//FIG. 18 SPECTRAL RADIANT INTENSITY OF HYDROGEN-AIR DIFFUSION FLAME (TUBE NO. 42743) PAGE 30//FIG. 19 ATMOSPHERIC TRANSMISSION AT 5, 50, AND 500 FT. PAGE 32//FIG. 26 RADIANT INTENSITY VERSUS HYDROGEN FLOW RATE USING 0.635 CM SS BURNER AT NTP PAGE 42

-BIBLIOGRAPHY-

ROSS, B. AND BICKLER, D.B.: SOLAR ENERGY MEASUREMENT TECHNIQUES. ASD TDR 62-882, AERONAUTICAL SYSTEMS DIV., WRIGHT-PATTERSON AFB, O., JAN. 1963// HILL, K. AND HORNSTEIN, B.: DETECTION OF HYDROGEN-AIR FLAMES AND EXPLOSIONS IN AEROSPACE VEHICLES VIA OH BAND AND WATER BAND EMISSION. ASD TDR 63-113, AERONAUTICAL SYSTEMS DIV., WRIGHT-PATTERSON AFB, O., 1963//HRASKY, W.C. AND MCKEE,

T.B.: RADIANCE OF THE EARTH AND ITS LIMB IN THE MIDDLE ULTRAVIOLET. NASA TN D-2355, JULY 1964//ELTERMAN, L.: ATMOSPHERIC ATTENUATION MODEL, 1964, IN THE ULTRAVIOLET, VISIBLE, AND INFRARED REGIONS FOR ALTITUDES TO 50 KM. ENVIRONMENTAL RES. PAPERS NO. 46, AFCRL-64-740, SEPT. 1964

-SOURCE INFORMATION-

CORPORATE SOURCE -
AIR FORCE AERO PROPULSION LAB., WRIGHT-PATTERSON AFB, OHIO.
REPORT NUMBER -
AD-478534//AFAPL-TR-65-75
OTHER INFORMATION -
0056 PAGES, 0026 FIGURES, 0000 TABLES, 0004 REFERENCES

key 282

DO FIRE RETARDANTS CONTAMINATE HELICOPTERS?

by

DAVIS, J.B.
DODGE, M.

00/00/68

-ABSTRACT-

The distribution and quantity of fire retardant spray that might reach various parts of a helicopter during a retardant drop are examined to determine the variations occurring between helicopter types, the differences between commonly used retardant tanks, the effect of retardant viscosity on spray patterns, the effect of flight speed on the spray, and other sources of contamination that might be problems. A dye solution of sulphoflavin analin, thickened to simulate a retardant, and made up in 100 gal. batches, was used in the tests. All drops were made from about a 50 ft. altitude into a prevailing 5 to 10 mph wind. To record contamination, Mylar strips were attached to various spots on the helicopters that are particularly vulnerable to corrosion, including engine air intake and rotor drive assembly. Fluorescent photographs, fluorescent analysis, and motion picture analysis gave consistent results in analyzing the experiments. Almost no contamination was produced by the Los Angeles County tank when reasonable care was used in filling it. The Bowles tank requires more care in filling because its open top permits splashing the bottom of the helicopter. The Meade tank snaps back into place after dropping the retardants and a small quantity remaining is thrown out over the tail of the helicopter. Speed did not appear to be an important consideration in these trials, except in the Hiller-Bowles combination in which some splashing occurred during both high speed flight to the drop area and return. Viscosity of the dye solution appeared to have no effect on the quantity or distribution of spray in any of the helicopter tank combinations. Retardant spilled on the heliport was not blown onto the helicopter by rotor blast. Lack of adequate care in filler hose handling was found to be one of the chief causes of contamination.

-SOURCE INFORMATION-

CORPORATE SOURCE -
PACIFIC SOUTHWEST FOREST AND RANGE EXPERIMENTAL STATION, BERKELEY, CALIF.
JOURNAL PROCEEDINGS -
FITCAA, FIRE TECHNOL, VOL. 4, NO. 1, 17-24 (1968)
OTHER INFORMATION -
0008 PAGES, 0003 FIGURES, 0000 TABLES, 0015 REFERENCES

key 284

FUEL TANK INERTING AND FIRE FIGHTING WITH LIQUID NITROGEN

by

GEFFS, T.

00/00/69

-ABSTRACT-

A fuel tank inerting system was developed that protects an aircraft from the hazard of fuel tank explosion at all times, including a limited period following crash or damage, regardless of ignition source. The system is lightweight, inexpensive to operate, fully automatic, and practical within the current state of the art. It has been successfully flight tested aboard an Air Force C-141. During the tests, the aircraft was subjected to the extreme limits of its operating envelope, including descent at 13,000 ft./ min. The inerting system provides protection by use of nitrogen to displace the oxygen present in the vapor space of the fuel tanks to a concentration that is too lean to support the propagation of a flame front.

-SOURCE INFORMATION-

CORPORATE SOURCE -
PARKER-HANNIFAN CORP., CLEVELAND, OHIO.
JOURNAL PROCEEDINGS -
FITCAA, FIRE TECHNOL, VOL. 5, NO. 3, 193-196 (1969)
OTHER INFORMATION -
0004 PAGES, 0001 FIGURES, 0000 TABLES, 0000 REFERENCES

LIQUID NITROGEN AS A POWERPLANT FIRE EXTINGUISHANT

by

KLEUG, E.P.

00/00/69

-ABSTRACT-

Because of its availability in large quantities, it has been proposed that liquid nitrogen be used for extinguishing powerplant fires. Like carbon dioxide, the effectiveness of liquid nitrogen in extinguishing fires is dependent upon cooling to reduce the temperature of the combustible below its ignition temperature, or that when vaporized dilutes oxygen to a level that will no longer support combustion. A comparison is made of the physical properties of liquid nitrogen, carbon dioxide, dibromodifluoromethane, and bromotrifluoromethane. Tests are being conducted in a wind tunnel that simulates the subsonic, low altitude flight conditions around an instrumented JT-12 turbojet engine and nacelle to determine the effectiveness of liquid nitrogen as a fire extinguishing agent. Preliminary results indicate that liquid nitrogen is effective in extinguishing fires in aircraft powerplant compartments; that the quantity of liquid nitrogen expected to be available from a fuel tank inerting system would be sufficient to extinguish this type of fire; and that, on an aircraft where a large quantity is available, a liquid nitrogen fire extinguishing system could provide greater in-flight powerplant fire protection than the limited quantity of chemically active agent available in a conventional high rate of discharge system.

-BIBLIOGRAPHY-

JONES, G.W., ZABETAKIS, M.G., SCOTT, G.S., AND FURNO, A.L.: RESEARCH ON THE FLAMMABILITY CHARACTERISTICS OF AIRCRAFT FUELS. WADC TECH. REP. 52-35, SUPPL. 1, JAN. 1954//CREITZ, E.C.: INHIBITION OF DIFFUSION FLAMES BY METHYL BROMIDE AND TRIFLUOROMETHYL BROMIDE APPLIED TO THE FUEL AND OXYGEN SIDES OF THE REACTION ZONE. J. OF RES., NBS, A. PHYSICS AND CHEMISTRY, VOL. 65A, NO. 4, JULY-AUG. 1961

-SOURCE INFORMATION-

CORPORATE SOURCE -
NATIONAL AVIATION FACILITIES EXPERIMENTAL CENTER, ATLANTIC CITY, N.J.
JOURNAL PROCEEDINGS -
FITCAA, FIRE TECHNOL, VOL. 5, NO. 3, 197-202 (1969)
OTHER INFORMATION -

0006 PAGES, 0003 FIGURES, 0002 TABLES, 0002 REFERENCES

key 310

FIRE PROTECTION TESTS IN A SMALL FUSELAGE-MOUNTED TURBOJET ENGINE AND NACELLE INSTALLATION. FINAL REPORT 1965-1970

by

SOMMERS, D.E.

11/00/70

-ABSTRACT-

Tests under simulated flight conditions were conducted on a small fuselage-mounted turbojet engine and nacelle installation to investigate the potential explosion and fire hazards and detection and fire control methods. Hot-surface ignition of flammables did not occur during simulated flight operating conditions until a change to the normal nacelle configuration reduced cooling airflow to the hot section of the engine (Zone I) below 0.15 lb./sec. The installed detection system did not provide for prompt detection of all fires originated in the lower forward portion of the compressor compartment (Zone II). Both the Zone II fire retection and the Zone I overheat detection system, a portion of which traversed the aft inboard section of Zone II, were sensitive to fires originated in the inboard portion of Zone II. The installed extinguishing system provided rapid extinguishment of all Zone II fires until extensive accumulative damage from fires destroyed the integrity of the zone. Fireproof protection incorporated in the nacelle was very effective in performing its intended function. Most susceptable to damage by fire was the aluminum portion of the nacelle, especially aluminum receptacles for camlock-type fasteners, an aluminum ventilation louver panel in the top aft portion of Zone II, and aluminum ribs, formers, and baffles inside the nacelle in the path of fire. The fire damage to the engine and accessories was insignificant in regard to engine operation.

-PERTINENT FIGURES-

FIG. 4 TEST ENGINE POWER AND FUEL RELEASE SCHEDULES FOR HOT-SURFACE IGNITION TESTS PAGE 9//FIG. 5 NACELLE CONTINUOUS TEMPERATURE-SENSITIVE FIRE AND OVERHEAT DETECTION SYSTEMS PAGE 16//FIG. 9 INCREASE IN AIR TEMPERATURE ABOVE NORMAL FROM FIRE AT LOCATION 5A PAGE 25//FIG. 15 EXTINGUISHING AGENT CONCENTRATION WITH 2.5 LB./SEC. SECONDARY AIRFLOW RATE IN ZONE II//FIG. 24 INTERNAL VIEW OF DAMAGE IN THE TOP OF THE NACELLE FORWARD AND AFT OF THE FIRE SEAL PAGE 48//TAB. 3 SUMMARY OF HOT-SURFACE IGNITION TESTS CONDUCTED IN ZONE I WITH JET A-1 FUEL AND REDUCTION IN AREA OF SECONDARY AIR INLET PAGE 11

-SOURCE INFORMATION-

CORPORATE SOURCE -

NATIONAL AVIATION FACILITIES EXPERIMENTAL CENTER, ATLANTIC CITY, N.J.
REPORT NUMBER -
N71-11018//FAA-RD-70-57
OTHER INFORMATION -
0062 PAGES, 0025 FIGURES, 0006 TABLES, 0000 REFERENCES

FIRE DETECTION SYSTEMS, AIRCRAFT

by

ARMY TEST AND EVALUATION COMMAND

04/17/70

-ABSTRACT-

This test procedure describes test methods and techniques for evaluating the performance and characteristics of Army Aircraft Fire Detection Systems, and for determining their suitability for service use by the U.S. Army. The evaluation is related to criteria expressed in applicable Qualitative Material Requirements, Small Development Requirements, Technical Characteristics, or other appropriate design requirements and specifications The fire detection systems are provided on military aircraft to monitor and to automatically warn personnel of the actual presence of or a trend towards dangeous overheat conditions. These systems are usually provided with continuous linear sensing elements whose length provides for maximum surveillance of each monitored area. Since these are safety devices, each system must be extremely reliable, must be fail safe, and must provide for fast verification of integrity. Of primary importance, however, is the ability of the system to operate reliably, without false indication, in the various environments to which it will be subjected with the aircraft in flight operations. The testing program outlined will examine this ability.

-SOURCE INFORMATION-

CORPORATE SOURCE -
ARMY TEST AND EVALUATION COMMAND, ABERDEEN PROVING GROUND, MD.
REPORT NUMBER -
AD-870450//MTP-7-3-050//X70-16383
OTHER INFORMATION -
0022 PAGES, 0000 FIGURES, 0000 TABLES, 0022 REFERENCES

AIRCRAFT GROUND FIRE SUPPRESSION AND RESCUE SYSTEMS-CURRENT TECHNOLOGY REVIEW

by

SALZBERG, F.
CAMPBELL, J.

10/22/69

-ABSTRACT-

An overview is presented on the state-of-the-art of aircraft ground fire suppression and rescue. Subjects considered include: hostile characteristics of liquid fuel fires, effectiveness of suppression agents, and fire suppression equipment. Current research related to aircraft ground fire suppression and rescue is identified and future studies are recommended. Only limited data are available for quantitatively comparing the effectivenesses of various suppression agents on two-dimensional fires containing obstacles. Light water and FC-194 are two to three times more efficient than protein foam in suppressing fires. Recommended agents for typical aviation ground fire situations based on present knowledge as well as those agents which should be investigated for future use are listed. No single agent or agent combination is recommended for all fire situations. Improved response of equipment is in very critical need. Three potential classes can be considered: the helicopter, automotive vehicles similar to the Ansul experimental Magnum X-2, and the ground effect machine. None of these provide rapid response and the ability to locate the crash under all conditions of weather and visibility. This ability is almost totally neglected in current vehicle design.

-BIBLIOGRAPHY-

CIVIL AIRCRAFT ACCIDENT REPORT ON THE ACCIDENT TO BOEING 707-465 G ARWE AT HEATHROW AIRPORT, LONDON, ON APRIL 8, 1968. C.A.P. 324, HER MAJESTY'S STATIONARY OFFICE//HOTTEL, H.C.: REVIEW OF CERTAIN LAWS GOVERNING DIFFUSE BURNING OF LIQUIDS. FIRE RES. ABS. AND REV., VOL. 1, NO. 2, JAN. 1959// FITTERS, D.W., GRIFFITHS, D.J., AND NASH, P.: THE USE OF 'LIGHT WATER' FOR MAJOR AIRCRAFT FIRES. FIRE RES. STATION NOTE NO. 762, APR. 1962//PETERSON, H.B., JABLONSKI, E.J., NEILL, R.R., GIPE, R.L., AND TUVE, R.L.: FULL-SCALE FIRE MODELING TEST STUDIES OF 'LIGHT WATER' AND PROTEIN TYPE FOAM. NRL REP. 6573, AUG. 1967//PINKEL, I., PRESTON, G., AND PESMAN, G.: MECHANISM OF START AND DEVELOPMENT OF AIRCRAFT CRASH FIRES. NASA REP. 1133, 1953//NITROGEN-BLOW FOAM USED IN PROXIMITY SUIT FOR BETTER HEAT SHIELD. FIRE ENG., 1968//PETERSON, H.: STUDIES ON THE FUEL IGNITION SUPPRESSION CAPABILITIES OF FOAM COVERED RUNWAYS FOR AIRCRAFT. NFPA AVIATION BULL. NO. 250, SEPT. 1960

-SOURCE INFORMATION-

CORPORATE SOURCE -
IIT RESEARCH INST., CHICAGO, ILL.
REPORT NUMBER -
AD-703393//AGFSRS-70-1//J6182-FR
SPONSOR -
AIRCRAFT GROUND FIRE SUPPRESSION AND RESCUE, ASWF, WRIGHT-PATTERSON AFB, OHIO.
CONTRACT NUMBER -
F33657-69-1183
OTHER INFORMATION -
0135 PAGES, 0016 FIGURES, 0024 TABLES, 0054 REFERENCES

NEW CONCEPTS FOR EMERGENCY EVACUATION OF TRANSPORT AIRCRAFT FOLLOWING SURVIVABLE ACCIDENTS

by

ROEBUCK, JR., J.A.

01/00/68

-ABSTRACT-

A systems analysis and creative engineering study has resulted in descriptions and theoretical evaluations of 51 new concepts concerning hardware and procedures for improving emergency evacuation of passengers from transport category aircraft following survivable accidents. The concepts are organized into the following 15 major categories which are rank ordered in terms of 12 feasibility and economic factors for purposes of selection for experimental evaluation: (1) application of automatic voice instructions and audio signal devices; (2) active, better distributed lighting mix for interiors and exteriors; (3) use of tactual sense displays; (4) situation displays for crews; (5) improved interpersonal communication devices; (6) wide spectrum passenger and crew education program and displays; (7) personal protective devices; (8) improved, general, onboard fire suppressant and prevention systems; (9) automatically and manually controlled cabin venting systems; (10) improved ground support complex; (11) better slide entry and egress devices; (13) power assistance for doors and egress device deployment; (14) automatic passenger egress devices; and (15) application of cargo handling concepts. Requirements for experimental evaluation are presented, with special emphasis on the most favorably rated first five major concepts and their specific associated detail concepts.

-PERTINENT FIGURES-

FIG. 1 RELATION OF EMERGENCY EVACUATION SYSTEM TO AIR TRANSPORTATION SYSTEM PAGE 13//FIG. 2 EMERGENCY EVACUATION SYSTEM ELEMENTS PAGE 14//FIG. 5 FOLDABLE SEATS CONCEPTS FOR EMERGENCY EVACUATION PAGE 56//FIG. 8 REMOTE CONTROLLED POP-UP NOZZLE FIRE SUPPRESSION SYSTEM AT AIRPORT PAGE 62//FIG. 9 GROUND RESCUE VEHICLE PAGE 62//TAB. 1 NEW CONCEPTS PAGE 18

-BIBLIOGRAPHY-

ANDREWS, K.E.: THE SUPERSONIC TRANSPORT DESIGN FOR OCCUPANT SURVIVABILITY. NORTH AM. ROCKWELL REP. NA-63-65, FEB. 1963//BIEBERDORF, F.W. AND YUILL, C.H.: AN INVESTIGATION OF THE HAZARDS OF COMBUSTION PRODUCTS IN BUILDING FIRES. SOUTHWEST RES. INST., OCT. 14, 1963//BOGLAND, J.L.: EXPLOSIVE RELEASE OF EMERGENCY EXIT HATCHES, EXPLOSIVE TECHNOLOGY. FIFTH NAT. FLIGHT

SAFETY, SURVIVAL AND PERSONAL EQUIPMENT SYMP., SEPT. 25-26, 1967//FACTUAL REPORT OF HUMAN FACTORS INVESTIGATION, EAL LOCKHEED L-049C, NEAR CARMEL, NEW YORK, DECEMBER 4, 1965. BUR. OF SAFETY, REP. SA-389,, FILE NO. 1-0033, EXHIBIT 6A, JAN. 12, 1966//DOBLER, J.C.: A STUDY OF DELETHALIZATION AND CRASHWORTHINESS OF A SUPERSONIC TRANSPORT. NORTH AM. ROCKWELL REP. NA-60-255 FEB. 24, 1961//REPRODUCER, SET, VOICE WARNING, AN/ASA-19. SPECIFICATION MIL-R-81000, BUR. OF NAVAL WEAPONS, FEB. 18, 1964

-SOURCE INFORMATION-

CORPORATE SOURCE -
NORTH AMERICAN ROCKWELL CORP., LOS ANGELES, CALIF. LOS ANGELES DIV.
REPORT NUMBER -
AD-665329//ADS-68-2
SPONSOR -
FEDERAL AVIATION ADMINISTRATION, WASHINGTON, D.C. AIRCRAFT DEVELOPMENT SERVICE
CONTRACT NUMBER -
FA67WA-1766
OTHER INFORMATION -
0419 PAGES, 0011 FIGURES, 0013 TABLES, 0144 REFERENCES

key 332

CHARACTERISTICS OF FIRE IN LARGE CARGO AIRCRAFT (PHASE 2). FINAL REPORT

by

GASSMANN, J.J.

09/00/70

-ABSTRACT-

The degree to which fire in large cargo compartments may be suppressed by shutoff of ventilation was investigated. Results of the tests indicated that this action alone would not protect the fuselage of large cargo aircraft from severe fire damage. Peak air temperatures occurring during fire increased significantly with increasing compartment size from 1,000 to 2,000 cu. ft. and were similar with further increase in size to 5,000 cu. ft. Temperatures in the order of 1800 deg. F. were reached in these larger compartments. An increase in loading resulted in a more severe fire condition for compartment volumes of all the sizes used in this program. A single cargo fire test indicated the use of bromotrifluoromethane at the time of detection and ventilation shutoff may be an effective means of greatly reducing peak temperatures and pressures and providing a longer control time.

-PERTINENT FIGURES-

-BIBLIOGRAPHY-

ASADOURIAN, L.A.: EVALUATION OF FLIGHT FIRE PROTECTION MEANS FOR INACCESSIBLE AIRCRAFT BAGGAGE COMPARTMENTS. CAA TECH. DEV. REP. NO. 146, JUNE 1951//SMITH, M.H.: SIMULATED DC-6A FIRE TEST PROGRAM. PRELIMINARY REP., SUPPL. NOS. 1-3, ENG. DEPT. REP. NO. LDC-6A-9920-XIR, SEPT. 1952, MAR. 1953 //GASSMANN, JULIUS J.: CHARACTERISTIC OF FIRE IN LARGE CARGO AIRCRAFT. FAA- ADS-73, MAR. 1966

-SOURCE INFORMATION-

CORPORATE SOURCE -

NATIONAL AVIATION FACILITIES EXPERIMENTAL CENTER, ATLANTIC CITY, N.J.
REPORT NUMBER -
AD-713914//FAA-NA-70-16
OTHER INFORMATION -
0018 PAGES, 0006 FIGURES, 0000 TABLES, 0003 REFERENCES

AIR TRANSPORT CABIN MOCKUP FIRE EXPERIMENTS, FINAL REPORT

by

MARCY, J.F.

12/00/70

-ABSTRACT-

A study was made of the burning characteristics of airplane interior materials ignited inside a 640 cu. ft. cabin mockup enclosure. Test conditions were varied to investigate the effects of the following factors on the ignition and propagation of flames within enclosures: (1) flammability ratings of the materials as obtained from standard laboratory tests; (2) intensity, duration, and type of the ignition source whether flaming or incandescent; (3) ventilation rate as provided by different size openings into the cabin enclusure; (4) partitioning of the cabin space by use of a fire barrier curtain; and (5) discharge of bromotrifluoromethane into the cabin atmosphere, both at different rates and total quantities of application before and during a fire occurrence. Comparative tests conducted on flame retardant urethane and neoprene foams showed that the flash fire hazard prevalent with the use of regular foam could be greatly reduced by replacement with these two self-extinguishing foams. A high rate discharge system employing bromotrifluoromethane was shown to be effective in rapidly extinguishing the flames of a foam fire. A curtain divider placed across the ceiling was shown to be useful as a fire barrier to arrest flame propagation. Roof venting of the mockup at a location away from the fire was relatively ineffective in preventing rapid buildup of smoke and flame spread from a flash fire involving urethane foam.

-PERTINENT FIGURES-

TAB. 1 DATA SUMMARY OF CABIN MOCKUP FIRE TESTS PAGE 6//FIG. 2 SEAT FIRE TEST WITH CONVENTIONAL MATERIALS IN CLOSED CABIN (BEFORE FIRE) PAGE 10//FIG. 4 CEILING FLASHOVER TEMPERATURES FROM SEAT FIRE IN CLOSED CABIN PAGE 13

-BIBLIOGRAPHY-

FAA NOTICE OF PROPOSED RULE MAKING FOR TRANSPORT CATEGORY AIRPLANES: CRASHWORTHINESS AND PASSENGER EVACUATION. 14 CFR PARTS 21, 25, 37, AND 121, NPRM 34 F.R. 13036 AUG. 15, 1969//CRASHWORTHINESS DEVELOPMENT PROGRAM. AEROSPACE IND. ASSOC., WASHINGTON, D.C., JULY 1968//THOMAS, P.H., HESELDEN, A.J.M., AND LAW, M.: FULLY-DEVELOPED COMPARTMENT FIRES - TWO KINDS OF BEHAVIOR. FIRE RES. TECH. PAPER NO. 18, J.F.R.O., LONDON 1967//SALZBERG, F. AND WATERMAN, T.E.: STUDIES OF BUILDING FIRES

WITH MODELS. FIRE TECH., 2, 196-203, AUGUST 1966//MARCY, J.F., A STUDY OF AIR TRANSPORT PASSENGER CABIN FIRES AND MATERIALS. FAA REP. ADS-44, 1965 (AD-654452)//CREITZ, E.C.: INHIBITION OF DIFFUSION FLAMES BY METHYL BROMIDE AND TRIFLUOROMETHYL BROMIDE APPLIED TO THE FUEL AND OXYGEN SIDES OF THE REACTION ZONE. J. OF RES., NBS, VOL. 65A, NO. 4, JULY 1961

-SOURCE INFORMATION-

CORPORATE SOURCE -
NATIONAL AVIATION FACILITIES EXPERIMENTAL CENTER, ATLANTIC CITY, N.J.
REPORT NUMBER -
AD-717855//FAA-NA-70-39//FAA-RD-70-81
OTHER INFORMATION -
0050 PAGES, 0020 FIGURES, 0001 TABLES, 0011 REFERENCES

AIR SAFETY, SURVIVING THE CRASH

by

LEVIN, S.M.

05/00/68

-ABSTRACT-

The ability to survive an aircraft crash depends not only o impact and evacuation capabilities, but on a flame-barrie fuselages, modified fuels, and crash-resistant tanks. Difference in emphasis on safety/cost tradeoffs between FAA and industry ar discussed. Latest FAA rules for aircraft design for larg transports call for more and larger emergency exits. Industry' objections to increased exits is the added weight and cost an danger of fire spreading through doors. Non-burning fuselages an heat barriers for cabins are considered better protection. Th need for a slide or ramp past the exit is cited. The mos effective approach to limiting fires involving fuel spill involves use of modified fuels (gels and emulsions). Studies ar being performed on feasibility of this approach. New standard have been set for fire resistance of cabin materials, but toxicit standards have not been established. Cost-benefit tradeoffs o use of new materials such as Nomex are discussed. A propose answer to smoke and fume risks is a plastic hood to be slippe over the head. Other aspects of crashworthiness are related t structural design to limit impact damage. It is stated that th money being proposed for crashworthiness could be better spent o efforts to eliminate crashes.

-SOURCE INFORMATION-

JOURNAL PROCEEDINGS -
SPACE/AERONAUT VOL. 49, NO. 5, 88-99 (MAY 1968)
OTHER INFORMATION -
0012 PAGES, 0008 FIGURES, 0000 TABLES, 0000 REFERENCES

INTEGRATED FIRE AND OVERHEAT DETECTION SYSTEM FOR MANNED FLIGHT VEHICLES

by

TRUMBLE, T.M.

10/00/67

-ABSTRACT-

A computer was designed for use in a uniquely integrated system for detecting fire and overheat in aircraft engine nacelles. This system uses ultraviolet and infrared sensors for fire detection, continuous elements for overheat detection, and a newly-designed microcircuit computer for sensor analysis, all of which activate a specially designed alphanumeric readout. Computer design criteria are established, and the finalized two-channel, fail-safe, self-checking computer design is described. Boolean equations and final schematic for the computer are given. The limitations of applying the computer from both an engineering and a legislative point of view are specified. A final flight qualified microcircuit computer weighing 6 cz. or less, 1/2 in. x 2 in. x 5 in. in size, and drawing less than 1 w. of power can be built using the basic computer design formulated.

-PERTINENT FIGURES-

FIG. 10 INFRARED DETECTOR SENSITIVITY VS WAVELENGTH PAGE 20//FIG. 11 ULTRAVIOLET SILICON CARBIDE DETECTOR PHOTOVOLTAGE VS WAVELENGTH PAGE 21//FIG. 12 ULTRAVIOLET TUBE DETECTOR SENSITIVITY VS WAVELENGTH PAGE 22//FIG. 13 CADMIUM SULFIDE ULTRAVIOLET DETECTOR SENSITIVITY VS WAVELENGTH PAGE 23

-SOURCE INFORMATION-

CORPORATE SOURCE -
AIR FORCE AERO PROPULSION LAB., WRIGHT-PATTERSON AFB, OHIO.
REPORT NUMBER -
AFAPL-TR-67-129//AD-663213
OTHER INFORMATION -
0047 PAGES, 0022 FIGURES, 0004 TABLES, 0000 REFERENCES

key 357

FIRE PROTECTION FOR BULK FUEL SYSTEMS. FINAL REPORT

by

WEATHERSBY, J.M.

01/00/72

-ABSTRACT-

Tests were conducted to develop practical active and passive fire protection measures to contain and extinguish fires within the Marine Corps Amphibious Assault Fuel Systems (AAFS) equipped with 20,000 gal. bulk fuel storage tanks. The twin agent containing potassium bicarbonate dry chemical (Purple K) and light water system was determined best to fulfill the requirements for fuel in-depth and pressure/spill fires. A total of 900 lb. of Purple K and 200 gal. of light water consisting of two 450/100 skid mounted units is sufficient to extinguish a 20,000 gal. tank fire. The proper tank spacing to minimize fire losses in the AAFS was determined to be 90 ft. between tank centerlines. Due to the difficulty in extinguishing a fire resulting from a catastrophic rupture of a bulk fuel tank, proper tank separation and containment of the initial fire to a single tank is most important. Successful extinguishment of a fire of this type is dependent on prompt reaction, well-trained fire fighters, and sufficient equipment to accomplish the task. Successful extinguishment of a 20,000 gal. tank fire can best be achieved by utilizing a total of four fire fighters: two per 450/100 unit, one fire fighter to direct the discharge of the twinned agent, the second to assist with the hose line and provide a maximum degree of mobility.

-PERTINENT FIGURES-

FIG. 1 OPTIMUM AGENT SELECTION PAGE 10

-SOURCE INFORMATION-

CORPORATE SOURCE -
    MARINE CORPS DEVELOPMENT AND EDUCATION COMMAND, QUANTICO, VA.
REPORT NUMBER -
    AD-890895L//4617DIJMW:VFW
SPONSOR -
    MARINE CORPS, WASHINGTON, D.C.
CONTRACT NUMBER -
    CONTRACT M00027-71-C-0092
OTHER INFORMATION -
    0060 PAGES, 0002 FIGURES, 0000 TABLES, 0004 REFERENCES

SYNTHESIS OF AIRCRAFT (CRASH)FIRE, RESCUE, AND EVACUATION TECHNOLOGY

by

HENNEBERGER, H.G.C.
ROEGNER, H.F.
CAMBEIS, L.

07/00/64

-ABSTRACT-

Material dealing with postcrash aircraft fire, rescue, and evacuation technology is organized into a annotated bibliography that includes abstracts, a personal author file, source-contractor information, type of source material, type of aircraft, reviewer evaluation, subject code, and major identification code. A majority of the documents listed are case histories, but a number of technical documents are included. Major categories in which the collected material is indexed are: hazard exposure; design, test, and analysis; and human factors. In addition, subcategories make it possible to pick documents dealing with narrower areas, as well as areas that may cross category lines. The SAFRET system for storing and retrieving data on aircraft crash fires, which uses coded numbers to identify applicable documents, is described.

-SOURCE INFORMATION-

CORPORATE SOURCE -
AVIATION SAFETY ENGINEERING AND RESEARCH, PHOENIX, ARIZ.
REPORT NUMBER -
AD-607249
SPONSOR -
FEDERAL AVIATION ADMINISTRATION, WASHINGTON, D.C. AIRCRAFT DEVELOPMENT SERVICE.
CONTRACT NUMBER -
CONTRACT FA-WA-4458
OTHER INFORMATION -
0250 PAGES, 0000 FIGURES, 0000 TABLES, 0454 REFERENCES

A STUDY OF THE HELICOPTER CRASH-FIRE PROBLEM

by

SOMMERS, D.E.

02/00/59

-ABSTRACT-

An analysis of fixed and rotary wing aircraft and crash fire research investigations indicated the need for developing design criteria and determining requirements for helicopter crash fire protection. It was found that abnormal engine displacement, landing gear failures, and damaged drain cocks during a crash all were interrelated to fuel cell failures and fuel spillage. Helicopter design features in many instances increase fire probability and limit passenger survival during a crash. Recommended measures for crash fire safety improvement include: engine shutdown during and after a crash; provision of adequate safety exits to prevent entrapment of occupants should the helicopter roll over on one side; relocation of components which contribute to fuel spillage and ignition; and the construction of undercarriage and forward skin crash contact panels of materials which will not produce sparks and high temperatures as a result of scraping contact with runway surfaces. The chief ignition sources common to all types of jet and reciprocating engine aircraft during a crash are: hot surfaces inside and outside the engine, exhaust system or tail pipe flames, induction system flashback, electrical arcs and electrically heated filaments, flames from chemical agents, sparks caused by abrading metals, and electrostatic sparks. Gasoline, kerosene, or JP fuel in the form of mist outside the aircraft or in the form of liquid or vapor within confined areas of the aircraft are considered the most hazardous of all combustibles associated with aircraft crashes.

-PERTINENT FIGURES-

TAB. 3 SUMMARY OF HELICOPTER ACCIDENTS PAGES 6-9

-BIBLIOGRAPHY-

CAMPBELL, J.A.: APPRAISAL OF THE HAZARD OF FRICTION SPARK IGNITION OF AIRCRAFT CRASH FIRES. NACA TECH. NOTE 4024, MAY 1957//PINKEL, I.I., WEISS, S., AND PRESTON, G.M.: ORIGIN AND PREVENTION OF CRASH FIRES IN TURBOJET AIRCRAFT. NACA TECH. NOTE 3973, MAY 19, 1957//SCULL, W.E.: RELATION BETWEEN INFLAMMABLES AND IGNITION SOURCES IN AIRCRAFT ENVIRONMENTS. NACA REP. NO. 1019, 1951//TOWLE, R., DIQUATTRO, R., AND FRITCH, K.: AIRCRAFT CRASH FIRE PROTECTION SYSTEM. FINAL REP., WALTER KIDDE AND CO., INC., JAN. 6, 1954//MOSER, J.C. AND BLACK, D.O.: PROPOSED INITIATING

SYSTEM FOR CRASH-FIRE PREVENTION SYSTEMS. NACA TECH. NOTE 3774, DEC. 1956// KATZENBERGER, E.F. AND RICH, M.J.: AN INVESTIGATION OF HELICOPTER DESCENT AND LANDING CHARACTERISTICS FOLLOWING POWER FAILURE. INST. FOR AERONAUT. SCI. J., VOL. 23, NO. 4, APR. 1956

-SOURCE INFORMATION-

CORPORATE SOURCE -
FEDERAL AVIATION AGENCY, INDIANAPOLIS, IND. TECHNICAL DEVELOPMENT CENTER.
REPORT NUMBER -
TECH. DEV. REP. NO. 354
OTHER INFORMATION -
0020 PAGES, 0006 FIGURES, 0003 TABLES, 0011 REFERENCES

EVALUATION OF HIGH TEMPERATURE FIRE AND EXPLOSION SUPPRESSANT CONFIGURATIONS FOR AIRCRAFT FUEL SYSTEMS APPLICATION

by

BALL, III, G.L.
WOJTOWICZ, A.
SALYER, I.O.

03/00/70

-ABSTRACT-

Aircraft void space filler materials were investigated to provide improved thermal resistance in an aviation fuel environment. It was desirable that the compositions obtained be similar to a 10 pore/in. reticulated urethane foam used in a fire and explosion suppressant application. The materials investigated were coated foams, uncoated foams, filled thermoplastics, and unfilled thermoplastics. Specific materials were selected and evaluated for their retention of mechanical performance as a function of time following exposure to JP-5 fuel at elevated temperatures. A polyester fiber mat and a low density, open-celled polyimide foam exhibited excellent retention of mechanical strength and modulus for 10 week exposure periods in JP-5 fuel at 325 deg. F. Foams coated with nylon 11, thermoplastic polyimide, and polymer 380 all exhibited some improvement in mechanical performance over their substrate reticulated urethane foam. However, none of these materials proved even partially adequate for the refluxing JP-5 fuel environment. Of the thermoplastics investigated, the nylon 66, polyimide, and polymer 360 all exhibited a substantial retention of mechanical properties in the hyperthermal fuel environment. Of importance was the inclusion of glass fillers, which provided geometrical integrity to the thermoplastic while at the elevated temperatures. To establish some utility for the coated urethane foams, the mechanical properties of a series of foams were evaluated at temperatures less than 325 deg. F. and greater than ambient; a useful temperature of 200 deg. F. was established.

-SOURCE INFORMATION-

CORPORATE SOURCE -
MONSANTO CHEMICAL CO., DAYTON, OHIO.
REPORT NUMBER -
AD-867012//AFML-TR-69-319//MRC-DA-239
SPONSOR -
AIR FORCE MATERIALS LAB., WRIGHT-PATTERSON AFB, OHIO.
CONTRACT NUMBER -
F33615-67-C-1716
OTHER INFORMATION -

0070 PAGES, 0046 FIGURES, 0001 TABLES, 0000 REFERENCES

SPACE CABIN FIRE SAFETY

by

GEOGHEGAN, H.R.

02/22/66

-ABSTRACT-

A literature survey indicates that aircraft fire detection techniques may be applied to spacecraft with little or no further development. However, fire extinguishing techniques for zero gravity and high oxygen concentrations are currently unresolved, primarily due to the lack of data for fires in the space cabin environment. An upper limit to the weight of a fire extinguishing system can be estimated by basing the analysis on sea level conditions. Carbon dioxide systems were sized for quenching fires by dilution of the cabin oxygen concentration to approximately 12 percent by weight. The minimum oxygen concentration for combustion was based on fire extinguishing data for carbon dioxide level air at normal gravity. The weight penalty for inerting a 5 psia oxygen atmosphere was estimated to be 0.31 lb./cu. ft. Since recent reports indicate that zero gravity substantially reduces the fire intensity, the sizing of fire extinguishers should be based on zero gravity test data. It is concluded that space cabin fire extinguishers should be small, hand-held types for combating small zero gravity fires. Damping or reducing the cabin pressure will be used in some cases. Sizing of the extinguishers and fire fighting techniques require further test data.

-PERTINENT FIGURES-

TAB. 1 FLAMMABILITY TEST RESULTS PAGE 20//TAB. 5 COMPARISON OF EXTINGUISHING AGENTS PAGE 23//FIG. 3 WT. OF CARBON DIOXIDE FOR EXTINGUISHMENT VS INITIAL FRACTION OF OXYGEN PAGE 31//FIG. 5 WT. OF CARBON DIOXIDE FOR EXTINGUISHMENT VS INITIAL FRACTION OF OXYGEN PAGE 41//FIG. 6 WT. OF CARBON DIOXIDE FIRE EXTINGUISHING SYSTEM FOR DILUENTS OF VARIOUS COMPARTMENT VOLUMES AND INITIAL OXYGEN CONCENTRATIONS PAGE 42

-BIBLIOGRAPHY-

KIMZEY, J.H.: FLAMMABILITY IN ZERO GRAVITY. 55TH NAT. MEETING OF AICHE, FEB. 1965//SCHREIHANS, F.A. AND DRYSOL, D.K.: FLAMMABILITY CHARACTERISTICS OF SOME ORGANIC SPACECRAFT MATERIALS IN ZERO GRAVITY. ASTIC 024222, ACCESSION NO. 05984-65, SID 65-640, NORTH AM. AVIATION, INC., MAY 1965// SPACE CABIN ATMOSPHERES, PART 2, FIRE AND BLAST HAZARDS. NASA SP-48, 1964// STUDY ON MINIMAZATION OF FIRE AND EXPLOSION HAZARDS IN ADVANCED FLIGHT VEHICLES.

A59-TR-61-288, LOCKHEED REP. 15156, LOCKHEED-CALIFORNIA CO., OCT. 1961 (AD-269559)

-SOURCE INFORMATION-

CORPORATE SOURCE -
BOEING CO., SEATTLE, WASH.
REPORT NUMBER -
AD-478268
OTHER INFORMATION -
0060 PAGES, 0006 FIGURES, 0006 TABLES, 0032 REFERENCES

DEVELOPMENT OF A HAZARDOUS VAPOR DETECTION SYSTEM FOR ADVANCED AIRCRAFT. SUPPLEMENTARY REPORT

by

CUCCHIARA, O.D.
SEIDEN, L.
DONAGHUE, T.J.
GOODMAN, P.

06/00/68

-ABSTRACT-

An experimental evaluation was made of prototype instruments based on a catalytic oxidation technique for the detection of hydrocarbon vapors aboard advanced aircraft. Two hydrocarbon vapor probes were placed in the engine compartments of a JT-12 engine housed in a wind tunnel. The response of the probes to controlled leakages of JP-4 fuel under varying engine operating conditions was ascertained. The prototype instruments operated satisfactorily. Reproducible results under identical engine operating conditions were attained. Response times were of the order of 2 sec. and the lower limit of detection was approximately 0.3 percent of the lower flammability limit for JP-4. The evaluation of osmium kryptonate for the detection of oxygen in the ullage space of fuel tanks aboard advanced aircraft was next considered. Sensitivities adequate to cover the oxygen concentration range of interest (0.5 percent to 40.0 percent oxygen) were attained at a sensor operating temperature of 600 deg. F. The response of the sensor to oxygen was independent of JP-6 vapor concentration. Lifetimes attained during this investigation were of the order of 140 percent oxygen-min. to 300 percent oxygen-min. The units used are the product of oxygen concentration and the duration for satisfactory operation in minutes.

-PERTINENT FIGURES-

TAB. 1 ENGINE OPERATING CONDITIONS PAGE 8//TAB. 2 PROBE RESPONSE VS TIME PAGE 10//FIG. 1 SIGNAL VS TIME FOR RUN NO. 1, 2, AND 3 PAGE 23//FIG. 5 OXYGEN DETECTION SYSTEM PAGE 35//FIG. 6 RESPONSE OF OSMIUM KRYPTONATE TO OXYGEN AT 750 DEG. F. PAGE 37

-BIBLIOGRAPHY-

CUCCHIARA, O., SEIDEN, L., AND DONAGHUE, T.: INVESTIGATION OF HAZARDOUS VAPOR DETECTION FOR ADVANCED FLIGHT VEHICLES. CONTR. NO. AF 33(615)-1473, AFAPL-TR-65-50, 1965//GOODMAN, P. AND RONAYNE, JR., M.R.: USE OF KRYPTONATES IN MATERIALS RESEARCH. CONTR. NO. AF 33(615)-1268, AFML-TR-65-66

-SOURCE INFORMATION-

CORPORATE SOURCE -
    PANAMETRICS, INC., WALTHAM, MASS.
REPORT NUMBER -
    AFAPL-TR-67-123, SUPP. 1
SPONSOR -
    AIR FORCE AERO PROPULSION LAB., WRIGHT-PATTERSON AFB, OHIO.
CONTRACT NUMBER -
    CONTRACT AF 33(615)-3646
OTHER INFORMATION -
    0051 PAGES, 0007 FIGURES, 0008 TABLES, 0004 REFERENCES

AIRCRAFT CARRIER AND FIRE

by

ROBERTS, II, J.W.

02/00/69

-ABSTRACT-

An assessment is made of the fire and explosion dangers aboard an aircraft carrier equipped with large amounts of aircraft fuel, jet fuel, and ordnance. The lack of space compounds the problem of sheer volume of flammable and explosive material. A small uncontrolled incident has the potential of becoming a definite hazard and even a tragedy similar to incidents aboard the USS Oriskany, the USS Forrestal, and the USS Enterprise. High performance jet aircraft are another serious hazard. Partial answers to minimizing these hazards are suggested which make use of the fire fighting ability of light water and Purple K and the design of systems to incorporate these extinguishants for carrier use. Training of crew personnel is also required. However, the reduction of accidents depends on design for safety i.e., overall improvement of aircraft carriers as a total weapons system.

-SOURCE INFORMATION-

JOURNAL PROCEEDINGS -
NVEJAX, NAV ENG J, VOL. 81, NO. 1, 143-146 (FEB. 1969)
OTHER INFORMATION -
0004 PAGES, 0011 FIGURES, 0000 TABLES, 0000 REFERENCES

LIGHT WATER PASSES EMERGENCY FIRE TEST

-ABSTRACT-

Fire crews at Miramar Naval Air Station, California, controlled a fuel depot fire in 45 sec. with light water. Although the fire was fed by thousands of gallons of jet fuel, it was completely secured 3 min. after the initial alarm was received. Ignition occurred near the fuel surface inside one of two tank trailers containing gaseous vapors from a previous load. Cause of the fire was presumed to be a static arc discharging from a metallic sampling apparatus to the fuel fill pipe. The resulting fire was fed by jet fuel cascading over one of the tank trailers onto the ground at 225 gpm causing the trailer's aluminum body to melt. Pre-burn, prior to the arrival of fire fighting rigs, was estimated to be about 90 sec. In similar incidents related to switch loading, entire fueling facilities and all shipping units were destroyed. In this case, extinguishment was so rapid that the rubber tires on the tank trailer unit which were involved did not explode. The resulting damage was confined to one of four fueling facilities, specifically the fuel piping filters and structural beams made of aluminum.

-PERTINENT FIGURES-

FIG. 1 FIREMEN APPLYING LIGHT WATER TO TRAILER TANK AT THE FUEL DEPOT PAGE 37//FIG. 2 TIRES WERE INTACT ALTHOUGH THE SIDE OF THE TANKER MELTED PAGE 38

-SOURCE INFORMATION-

JOURNAL PROCEEDINGS -
SAFMAN, SAFETY MAINT, VOL. 137, NO. 1, 37-8 (JAN. 1969).
OTHER INFORMATION -
0002 PAGES, 0002 FIGURES, 0000 TABLES, 0000 REFERENCES

AIRCRAFT CABIN FIRE PROTECTION

by

ANDREWS, C.

07/00/69

-ABSTRACT-

A brief survey is presented of the type of fire protection afforded to aircraft cabins by Graviner Company, Ltd., of England. A survey of the extinguishant field revealed that bromochlorodifluoromethane (BCF) was found to have the valuable combination of high efficiency and high stability, in addition to low toxicity, low corrosiveness, and low cost. To contain the BCF extinguishant, a new hand extinguisher known as the type 34H was designed. It consists of a seamless copper cylindrical container and an operating head. The latter is fitted with a trigger and extinguishant nozzle and contains a spring-loaded cylindrical plunger, frangible annulus, and secondary seal. A 34H was subjected to a number of tests to obtain approval for aircraft use. The BCF pressure/temperature relationship for 67.5 percent fill ratio pressurized with nitrogen to 45 psig at 0 deg. C. is depicted. Since the maximum vapor pressure of BCF at 70 deg. C. and the ultimate pressure required to burst the container is of the order of 1500 psig, the extinguisher was proved to be safe at temperatures far in excess of those likely to be met in normal operations.

-SOURCE INFORMATION-

CORPORATE SOURCE -
GRAVINER, LTD., COLNBROOK (ENGLAND).
JOURNAL PROCEEDINGS -
FLIGHT SAFETY, VOL. 3, NO. 1, 3-5 (JULY 1969)
OTHER INFORMATION -
0003 PAGES, 0005 FIGURES, 0000 TABLES, 0000 REFERENCES

CONCORDE POWER PLANT FIRE PROTECTION SYSTEM

by

DAVIS, R.A.

05/00/71

-ABSTRACT-

Descriptions are given of the fire protection systems and equipment installed on the prototype Concorde aircraft and of the equipment currently being supplied for pre-production and production aircraft. Each powerplant on the Concorde is protected by separate fire and overheat warning systems. The prototype is fitted with a Graviner high temperature Firewire Triple F.D. continuous elements system for fire detection and a similar medium temperature system for engine bay overheat detection. To comply with airworthiness requirements, on pre-production and production aircraft these systems were augmented by a Graviner optical system that uses the ultraviolet radiation emitted by a fire to detect engine combustion chamber flame burnthrough. The design of the powerplant installation on the prototype, pre-production, and production Concorde aircraft is such that the primary means of extinguishing an in-flight engine bay fire is to starve the fire of inflammable fluid and oxygen, followed by a conventional fire extinguishing system as a safety back-up system. Bromochlorodifluoromethane (Freon 12B1) is used as the extinguishing agent; a dual head automatic extinguisher supplying a spray nozzle system protects each of the four engines. On both the pre-production and production aircraft, the wing and fuselage fuel tank vent overboard via a common pipe which has its outlet in the rear fuselage below the tail fin. To conform to FAA requirements for protecting against direct or swept lightning strikes igniting the fuel vapor emitted from the vent pipe outlets, a flame suppression system was fitted within the vent pipe. This system uses a silicon cell-type detector with a detonator-operated suppressor unit filled with dibromodifluoromethane extinguishant.

-PERTINENT FIGURES-

FIG. 2 AS THE COMBUSTIBLES AND IGNITION SOURCES ARE IN A COMMON AREA, ROUTING OF THE SENSING ELEMENTS IS A 35 FT. NACELLE MOUNTED SYSTEM PAGE 1//FIG. 3 THE ELEMENT ROUTING ENSURES DETECTION OF PUDDLE FIRES PAGE 2//FIG. 9 THE FIRE TUNNEL AT WARTON WHERE B.A.C. CARRIED OUT FULL-SCALE TESTS PAGE 4

-SOURCE INFORMATION-

CORPORATE SOURCE -

GRAVINER, LTD., COLNBROOK (ENGLAND).
JOURNAL PROCEEDINGS -
AIENAF, AIR ENG, VOL. 43, 26-30 (MAY 1971).
OTHER INFORMATION -
0005 PAGES, 0011 FIGURES, 0001 TABLES, 0000 REFERENCES

FIRE FIGHTER'S EXPOSURE STUDY

by

GRAVES, K.W.

12/00/70

-ABSTRACT-

Experimental fires of burning aircraft fuels were instrumented with heat meters to determine heat flux distributions for application to the design of protective clothing for fire fighting personnel. The spectral distribution of infrared radiation emitted by fires was also measured. Conditions affecting the fires and the resulting heat effects that were studied were wind velocity, fuel pool area, time of burning, orientation around the fire relative to wind direction, distance from the fire, and an extraneous object in a fire. Heating rates within the fire were found to be a maximum of 8.0 cal./sq.cm./sec. Since this imposed an extreme and impractical restriction upon clothing design and since the convective heating mode was significant only in a downwind direction from fires, it was concluded that radiative heating was the predominant mode that determines clothing design requirements for fire proximity. The maximum value of this heating that would be encountered for a large-scale fire was estimated at 1.8 cal./sq.cm./sec. A means for evaluating reflective clothing is described.

-PERTINENT FIGURES-

FIG. 2F EFFECT OF POOL SIZE UPON HEATING RATE NEAR FIRE FROM BURNING AIRCRAFT FUEL PAGE 20//FIG. 4D COMPARISON BETWEEN AVERAGE AND PEAK HEATING RATE TO A SURFACE NEAR FIRE FROM BURNING AIRCRAFT FUEL PAGE 23//FIG. 5 EFFECT OF WIND VELOCITY UPON SPECTRAL INTENSITY OF FLAME RADIATION PAGE 28// FIG. 14 EFFECT OF OBJECT IN FIRE UPON HEATING RATE TO A SURFACE NEAR FIRE FROM BURNING AIRCRAFT FUEL PAGE 41//TAB. 3 THERMOCOUPLE DATA FOR FIRES PAGE 12//TAB. AI RADIOMETER DETECTOR AND FILTER CHARACTERISTICS PAGE 67

-BIBLIOGRAPHY-

MILLIKAN, R.C.: OPTICAL PROPERTIES OF SOOT. J. OPT. SOC. OF AM., VOL. 51, 278, 1961//TOURIN, R.H.: MONOCHROMATIC RADIATION PYROMETRY OF HOT GASES, PLASMAS, AND DETONATIONS, TEMPERATURE: ITS MEASUREMENT AND CONTROL IN SCIENCE AND INDUSTRY. VOL. 3, PART 2, REINHOLD PUB. CORP., 1962//ECKERT, E.R. AND DRAKE, R.M.: HEAT AND MASS TRANSFER. MCGRAW-HILL BOOK CO., INC., 1959//THRING, M.W. AND FOSTER, P.J., ET AL.: PREDICTION OF THE EMISSIVITY OF HYDROCARBON FLAMES. PAPER NO. 96, 1961-1962 HEAT TRANSFER CONF., UNIV. OF COLO., BOULDER//SPENCER, D.E.: OUT-OF-FOCUS PHOTOMETRY. J. OPT.

SOC. OF AM., VOL. 55, NO. 4, APR. 1965//GARDON, R.: A TRANSDUCER FOR THE MEASUREMENT OF HEAT-FLOW RATE. TRANS. OF THE ASME J. OF HEAT TRANSFER, NOV. 1960

-SOURCE INFORMATION-

CORPORATE SOURCE -
CORNELL AERONAUTICAL LAB., INC., BUFFALO, N.Y.
REPORT NUMBER -
AD-722774//AGFSRS-71-2
SPONSOR -
AIRCRAFT GROUND FIRE SUPPRESSION AND RESCUE, WRIGHT-PATTERSON AFB, OHIO.
CONTRACT NUMBER -
CONTRACT F33615-70-C-1715
OTHER INFORMATION -
0085 PAGES, 0030 FIGURES, 0006 TABLES, 0011 REFERENCES

FOAM AND DRY CHEMICAL APPLICATION EXPERIMENTS. INTERIM REPORT.

by

GEYER, G.B.

12/00/68

-ABSTRACT-

Full-scale tests were conducted under fixed fire conditions employing air aspirating foam and dry powder dispensing equipment in which protein foams, light water, high expansion foam, compatible dry chemical powder, and Purple K powder were evaluated both alone and in combination. The time required to control circular pool fires of aviation gasoline, JP-4, and Jet A fuels 40, 60, and 80 ft. in dia., containing an obstacle, was determined. The optimum solution application rate for obtaining rapid fire control employing protein foam in air aspirating equipment used in the tests of Jet A pool fires up to 80 ft. in dia. is approximately 0.35 gal./ min.-sq. ft. JP-4 and aviation gasoline fires are more destructive to protein foam than Jet A fuel fires. The fluoroprotein agents, when considered as a class, and regular protein foam have essentially equivalent fire fighting capability in controlling 40 ft. dia. Jet A fuel fires. Light Water employed alone results in a significant reduction in the control time compared with that of protein foam under similar pool fire conditions and can be used with air aspirating equipment. High expansion foam is capable of obtaining rapid control and extinguishment of aviation fuel fires as low solution application densities, but its vulnerability to wind and limited vapor securing characteristics restrict its use as a crash fire fighting agent. Dry chemical powders may result in very rapid reduction in thermal radiation, but do not provide the fuel vapor securing action required to prevent flashback.

-PERTINENT FIGURES-

FIG. 4 FIRE CONTROL TIME DATA ON VARIOUS SIZE JET A FUEL FIRES USING PROTEIN FOAM AT DIFFERENT SOLUTION DISCHARGE RATES PAGE 7//FIG. 6 THE VARIATION IN FIRE CONTROL TIME WITH POOL FIRE SIZE PAGE 9//FIG. 8 FIRE CONTROL TIME DATA OF THE FLUOROPROTEIN AGENTS, FLIGHT WATER, AND PROTEIN FOAM ON 60 FT. DIA. JP-4 FIRES PAGE 12//FIG. 10 FIRE CONTROL TIME DATA FOR HIGH EXPANSION FOAM ON 60 FT. DIA. JP-4 FUEL FIRES PAGE 16//TAB. 1 FIRE TEST CONDITIONS AND RESULTS USING COMPATIBLE DRY CHEMICAL PAGE 15//TAB. 2 FIRE TEST CONDITIONS AND RESULTS USING PURPLE K POWDER PAGE 18

-SOURCE INFORMATION-

CORPORATE SOURCE -
NATIONAL AVIATION FACILITIES EXPERIMENTAL CENTER, ATLANTIC CITY, N. J.
REPORT NUMBER -
AD-680068//NA-68-34 (RD-68-55)
OTHER INFORMATION -
0048 PAGES, 0019 FIGURES, 0002 TABLES, 0015 REFERENCES

keys 447 through 454

FIRE SAFETY MEASURES FOR AIRCRAFT FUEL SYSTEMS, CONF. ON. WASHINGTON, D.C., DEC. 11-12, 1967.

by

FEDERAL AVIATION ADMINISTRATION.

12/11/67

-ABSTRACT-

Contents: Hallman, A.B., NTSB Summary of Transport Aircraft Accidents Involving Fire or Expolsions in the Fuel System (see F7100326)//Horeff, T.G., FAA Propulsion R&D Program on Fuel System Ignition Hazards (see F7100327)//Wright, F.A., Air Force History and Experience with Inerting, Suppression, and Purging Systems (see F7100328)//Hewes, V., ALPA Statements on Needs for Fuel Tank Inerting and/or Flame Suppression on New and In-Service Aircraft (see F7100329)//Dallas, A.W., Air Transport Association Presentation on Fire Safety Measures on Aircraft Fuel Systems (see F7100220)//Weise, C.A., Aerospace Industries Association Presentation. Part 1 - Evaluation of Fuel System Fire Safety in the Aircraft Industry (see F7100331)//Honsberger, B.A., Part 2 - Current Developments of Fire Safety for Aircraft Fuel Systems (see F7100332)//Versaw, E.F., Part 3 - Factors Influencing Application of New Fire Safety (see F7100333)

-SOURCE INFORMATION-

CORPORATE SOURCE -
FEDERAL AVIATION ADMINISTRATION, WASHINGTON, D.C. FLIGHT STANDARDS SERVICE.

REPORT NUMBER -
AD-672036

OTHER INFORMATION -
9999 PAGES, 9999 FIGURES, 9999 TABLES, 9999 REFERENCES

FAA PROPULSION R AND D PROGRAM ON FUEL SYSTEM IGNITION HAZARDS

by

HOREFF, T.G.

12/11/67

-ABSTRACT-

Research and development programs on fuel system ignition hazards are summarized. One of the short-range project revealed that lightning strikes at wing access panels and fuel fillercaps can cause internal sparking if a good conductive path is not provided between the mating surfaces and the wing structure. Flame propagation tests in an actual surge tank and vent duct system were conducted with 1 million v. simulated lightning strikes serving as the ignition source and were repeated in an apparatus representative of the vent system using a drive tube to simulate the lightning effects. Results of three long-range projects are summarized. They involved studies of the characteristics of triggered natural lightning discharges and the airflow velocity effects on lightning ignition of fuel vent efflux; an investigation of turbine fuel (JP-4 and kerosene) flammability within fuel tanks under simulated turbulent flight conditions; and an examination of the conditions under which flame propagation from ground and flight ignition sources might occur through any part of the vent system.

-BIBLIOGRAPHY-

INVESTIGATION OF MECHANISMS OF POTENTIAL AIRCRAFT FUEL TANK VENT FIRES AND EXPLOSIONS CAUSED BY ATMOSPHERIC ELECTRICITY. CONTR. NO. NASR-59, NASA TN D-2440, LOCKHEED-CALIF., CO., JAN. 1964//LIGHTNING PROTECTION MEASURES FOR AIRCRAFT FUEL SYSTEMS, PHASE 2. CONTR. NO. FA64WA-4955, FAA ADS-18, ATLANTIC RES. CORP., MAY, 1964//AIRFLOW VELOCITY EFFECTS ON LIGHTNING IGNITION OF AIRCRAFT FUEL VENT EFFLUX. CONTR. NO. FA66WA, DS-67-9, LIGHTNING AND TRANSIENTS RES. INST., JULY 1967//A STUDY OF AIRCRAFT FIRE HAZARDS RELATED TO NATURAL ELECTRICAL PHENOMENA. FINAL REP., CONTR. NO. NASW-1416, DYNAMIC SCI. CORP., OCT. 1967//INVESTIGATION OF TURBINE FUEL FLAMMABILITY WITHIN FUEL TANKS UNDER SIMULATED FLIGHT CONDITIONS. DS-67-7, INTRA-AGENCY AGREEMENT NO. FA65NF-AP-2, NAVAL AIR PROPULSION TEST CENTER, AERONAUT. ENGINE DEPT., JULY 1967

-SOURCE INFORMATION-

CORPORATE SOURCE -
FEDERAL AVIATION ADMINISTRATION, WASHINGTON, D.C. AIRCRAFT

DEVELOPMENT SERVICE.
REPORT NUMBER -
AD-672036
JOURNAL PROCEEDINGS -
IN ITS: FIRE SAFETY MEASURES FOR AIRCRAFT FUEL SYSTEMS, 1967
(SEE F7100325)
OTHER INFORMATION -
0015 PAGES, 0000 FIGURES, 0000 TABLES, 0009 REFERENCES

AIR FORCE HISTORY AND EXPERIENCE WITH INERTING, SUPPRESSION, AND PURGING SYSTEMS

by

WRIGHT, T.G.

12/11/67

-ABSTRACT-

Fire inerting, purging, and suppression systems for aircraft were reviewed. Vapor enricher systems were not considered promising since basically all that the enricher does is to decrease the length of time required to bring the vapor mixture up to the equilibrium condition. The engine exhaust gas system was considered for use in reciprocating engine installations and a modification was considered for use in gas turbines; these systems were never used operationally. Three chemical systems were studied: oxygen reactors, ammonia burners in an engine exhaust heat exchanger to produce nitrogen gas, and a catalytic system. Dry ice inerting was used successfully; however, it requires a relatively bulky and heavy installation. Bottled inert gas systems, primarily using nitrogen gas, are simple to operate and the weight is reasonable; however, the system does pose a logistics problem and it is difficult to maintain a low oxygen concentration. The explosion suppression system senses the buildup of a fire, or an explosion, and with a pressure sensing device sends a signal to a small capsule filled with a suppressant, which is exploded and thereby sprays across the flame front before the fire gets to a dangerous level. Reticulated polyurethane foam was found to be the most desirable of the inerting systems primarily due to its ease of installation and lack of logistics problems.

-SOURCE INFORMATION-

CORPORATE SOURCE -
RESEARCH AND TECHNOLOGY DIV., WRIGHT-PATTERSON AFB, OHIO.
REPORT NUMBER -
AD-672036
JOURNAL PROCEEDINGS -
IN: FAA FIRE SAFETY MEASURES FOR AIRCRAFT FUEL SYSTEMS, 1967
(SEE 7100325)
OTHER L FORMATION -
0011 PAGES, 0000 FIGURES, 0000 TABLES, 0000 REFERENCES

ALPA STATEMENTS ON NEEDS FOR FUEL TANK INERTING AND/OR FLAME SUPPRESSION ON NEW AND IN-SERVICE AIRCRAFT

by

HEWES, V.

12/11/67

-ABSTRACT-

The fire and explosion hazards involved in operating transport aircraft with partially empty fuel tanks are reviewed. The need for protecting aircraft from fuel system explosions from the time of loading until unloading at the gate, and on the ground and in flight is stressed. Spokesmen from manufacturers who can provide this type of protection describe their companies' progress in research and developing products of a safety nature. Flame and explosion suppression systems are discussed which are automatic, keep oxygen levels below 10 percent by using liquid nitrogen for inerting, use optical detection coupled with Freon 1301 as a suppressant agent, and use explosive squibs to discharge the agent.

-SOURCE INFORMATION-

CORPORATE SOURCE -
AIR LINE PILOTS ASSOCIATION, INTERNATIONAL. CHICAGO, ILL.
JOURNAL PROCEEDINGS -
IN: FAA FIRE SAFETY MEASURES FOR AIRCRAFT FUEL SYSTEMS, 1967
(SEE F7100325)
OTHER INFORMATION -
0016 PAGES, 0000 FIGURES, 0000 TABLES, 0000 REFERENCES

AIR TRANSPORT ASSOCIATION PRESENTATION ON FIRE SAFETY MEASURES ON AIRCRAFT FUEL SYSTEMS

by

DALLAS, A.W.

12/11/67

-ABSTRACT-

Since fuel spillage in and around aircraft results in the greatest fire hazard, efforts have intensified toward improving fuel handling procedures and the integrity of aircraft fuel systems. Flexible fire resistant fuel lines have been developed to provide greater protection against line damage from structural flexing and line fatigue. Fireproof line connector fittings, improved line support devices, and fuel line shrouds have been incorporated. Many changes have been made to protect the fuel system from damaging surge pressures during refueling. Fuel dispensing systems have been redesigned to minimize surges induced by ground equipment which could damage fuel lines and tank structure. The airlines use rigorous inspection and vigilant maintenance practices which are essential to assure the continued integrity of the fuel system throughout an airplane's life. The greatest possible separation between fuel carrying components and potential sources of ignition must be maintained by design in an effort to avoid unwanted ignition. Continuing safety and reliability in the total fuel system of supersonic aircraft is discussed, taking into account inerting systems, flame suppression systems, and other fire protection methods for the advanced aircraft.

-SOURCE INFORMATION-

CORPORATE SOURCE -
AIR TRANSPORT ASSOCIATION OF AMERICA, WASHINGTON, D.C.
REPORT NUMBER -
AD-672036
JOURNAL PROCEEDINGS -
IN: FAA FIRE SAFETY MEASURES FOR AIRCRAFT FUEL SYSTEMS, 1967
(SEE F7100325)
OTHER INFORMATION -
0014 PAGES, 0005 FIGURES, 0000 TABLES, 0000 REFERENCES

EVALUATION OF FUEL SYSTEM FIRE SAFETY IN THE AIRCRAFT INDUSTRY

by

WEISE, C.A.

12/11/67

-ABSTRACT-

Fire safety measures developed for aircraft fuel systems are reviewed from World War I through the age of commercial jet aircraft. Airworthiness requirements published in 1947 enumerated five basic divisions of fire protection which apply today: (1) prevent fire - keep fuel and ignition separated; (2) prevent the spread of fire - contain it within boundaries or walls; (3) detect fire - know when action is required; (4) extinguish fire - turn off fuel and air, if possible, then use the extinguisher; (5) ventilate and evacuate smoke - remove residual hazard. New problems in the area of fuel safety which arose with the advent of commercial jet aircraft and the ways in which they were solved are discussed.

-SOURCE INFORMATION-

CORPORATE SOURCE -
DOUGLAS AIRCRAFT CO., INC., SANTA MONICA, CALIF.
REPORT NUMBER -
AD-672036
JOURNAL PROCEEDINGS -
IN: FAA FIRE SAFETY MEASURES FOR AIRCRAFT FUEL SYSTEMS, 1967
(SEE F7100325)
OTHER INFORMATION -
0004 PAGES, 0000 FIGURES, 0000 TABLES, 0000 REFERENCES

CURRENT DEVELOPMENTS OF FIRE SAFETY FOR AIRCRAFT FUEL SYSTEMS

by

HONSBERGER, B.A.

12/11/67

-ABSTRACT-

Potential improvements in aircraft fuel system fire safety could result from work being done on the following areas: lightning diverter rods, protected vents, and flame arrestors; non-sparking components; flame suppression; modified fuels, foams, and inerting. A brief discussion is presented on each of the above items. For example, the flame suppression system consists of a photoelectric cell to sense a flame front moving up the fuel tank ventline, which in turn discharges Freon inerting agent into the vent surge tank, thus snuffing out the flame. The response time of the 15 lb. system in its current application is approximately 4 msec. The problem areas of this system are outlined along with those of a total tank flame suppression system. Some of the design considerations and problems that are introduced in a fuel tank liquid nitrogen inerting system are also considered.

-SOURCE INFORMATION-

CORPORATE SOURCE -
BOEING CO., SEATTLE, WASH.
REPORT NUMBER -
AD-672036
JOURNAL PROCEEDINGS -
IN: FAA FIRE SAFETY MEASURES FOR AIRCRAFT FUEL SYSTEMS, 1967
(SEE F7100325)
OTHER INFORMATION -
0026 PAGES, 0019 FIGURES, 0000 TABLES, 0000 REFERENCES

FACTORS INFLUENCING APPLICATION OF NEW FIRE SAFETY

by

VERSAW, E.F.

12/11/67

-ABSTRACT-

The factors influencing the application of new fire safety improvements in aircraft fuel systems are need, operation feasibility, and compatibility with available components. The process of incorporating a new safety design concept in a fuel system entails a detailed evaluation and integrated optimization of safety, reliability, maintainability, amenability to routine checkout, simplicity, weight, and cost. The safety protective measures must reduce hazards. Each new system under development must then be evaluated in terms of protection offered, system complexity, system weight, effects on aircraft maintainability, and the development risk involved. The degree of protection in each of the areas of lightning strike, internal aircraft ignition, ground source ignition, and ignition resulting from crash fires must be examined. In conclusion, it is stated that the industry recognizes that adequate fire safety precautions cannot be proven by a statistical evaluation alone. Constant updating of fire safety practices is the goal so that continued improvement in an already excellent fire safety record can be realized.

-SOURCE INFORMATION-

CORPORATE SOURCE -
LOCKHEED-CALIFORNIA CO., BURBANK.
REPORT NUMBER -
AD-672036
JOURNAL PROCEEDINGS -
IN: FAA FIRE SAFETY MEASURES FOR AIRCRAFT FUEL SYSTEMS, 1967
(SEE F7100325)
OTHER INFORMATION -
0010 PAGES, 0004 FIGURES, 0000 TABLES, 0000 REFERENCES

key 469

CRASH-FIRE RESEARCH WITH JET AIRCRAFT

by

PINKEL, I.I.

01/00/56

-ABSTRACT-

Full-scale research with supporting laboratory studies is reviewed on the origin of jet aircraft crash fires. In the full-scale phase, fully instrumented aircraft are accelerated from rest under their own power and guided into a crash barrier where the damage imposed is typical of take-off or landing accidents in which large quantities of fuel spill. Explosive ignition was studied in detail with a turbojet on a test stand. The studies showed that combustibles sucked into the jet engine can be ignited by the continuous flame of the engine combustors or by the hot metal of the engine interior for a short time after the combustor flame is extinguished. This fact was also verified in full-scale crash tests. A temperature survey of the engine showed that all the engine metal downstream of the combustor is above the ignition temperature of JP-4 jet fuel for varying periods of time following combustor fuel shutoff. It is evident at once that provision should be made to shut off the fuel flow to the engine combustor when crash occurs. This was accomplished by equipping the engine with a crash-sensitive fuel valve to cut off the engine fuel flow. Cognizance is taken of the fact that ignition of hydrocarbon atmospheres by hot surfaces is not instantaneous. Four ignition zones were found in the engine and it appeared feasible to cool them by water streams. In addition to these features, a complete crash-fire protection system includes the combustor fuel shutoff, an electrical system disconnect for cutting off the battery and generator circuits, and the water discharge system.

-PERTINENT FIGURES-

FIG. 2 NORMAL TEMPERATURE DECAY OF TURBOJET COMPONENTS PAGE 55//FIG. 3 RESIDENCE TIME FOR HOT SURFACE IGNITION PAGE 55//FIG. 4 TURBOJET CUTAWAY PAGE 55//FIG. 7 EFFECT OF WATER COOLING ON TURBINE WHEEL TEMPERATURE PAGE 55//FIG. 8 CRASH-FIRE INERTING SYSTEM PAGE 55

-BIBLIOGRAPHY-

PINKEL, I.I., PRESTON, G.M., AND PESMAN, G.J.: MECHANISM OF START AND DEVELOPMENT OF AIRCRAFT CRASH FIRES. NACA REP. 1133, 1954//PINKEL, I., AND PRESTON, G.M.: NACA CRASH-FIRE RESEARCH. NACA TECH. FILM 26, MAY 1953

-SOURCE INFORMATION-

CORPORATE SOURCE -
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION, CLEVELAND, OHIO. LEWIS RESEARCH CENTER.
JOURNAL PROCEEDINGS -
AEREAP, AERONAUT ENG REV, VOL. 15, NO. 1, 53-57 (JAN. 1956)
OTHER INFORMATION -
0005 PAGES, 0009 FIGURES, 0000 TABLES, 0002 REFERENCES

key 474

SMALL-SCALE IMPACT TESTS OF CRASH-SAFE TURBINE FUELS

by

RUSSELL, JR., R.A.

08/00/72

-ABSTRACT-

A variety of regular and modified hydrocarbon turbine fuels, one nonhydrocarbon fuel, and reticulated polyurethane foam filled with neat fuel were subjected to small-scale impact tests to determine burning, misting, and fuel splatter characteristics. The results indicate that it is entirely feasible to retard the ignitibility, combustibility, and flow characteristics of current hydrocarbon fuels by increasing their apparent viscosity. The study showed that non-Newtonian gelled fuels performed better than other modified fuel candidates and better than the reticulated polyurethane foams filled with neat fuel. It is also concluded that the air gun test method is a reliable means of screening candidate fuels to evaluate their ignition and burning characteristics in the mist form and to determine whether or not a particular fuel should be subjected to more sophisticated tests.

-PERTINENT FIGURES-

FIG. 1 FUEL SPECIMEN PACKAGED FOR AIR GUN TEST PAGE 3//FIG. 2 AIR GUN IMPACT TEST FACILITY PAGE 4//FIG. 3 FUEL-MIST ANALYSING APPARATUS PAGE 6//FIG. 4 RADIANT ENERGIES RELEASED BY VARIOUS FUELS - AIR GUN TEST PAGE 9//FIG. 10 CATAPULT TEST FACILITY FOR F-86 FUELS TANKS PAGE 17//TAB. 2 VERTICAL DROP TEST DATA PAGE 13

-BIBLIOGRAPHY-

POSEY, JR., K.: INVESTIGATION OF MODIFIED TURBINE FUELS FOR REDUCTION OF CRASH FIRE HAZARD. CONTR. NO. FA68NF-269, REP. NO. NA-69-10, RES. DIV., THE WESTERN CO., MAY 1969//KUCHTA, J.M., FURNO, A.L., MARTINDILL, G.H., AND IMHOF, A.C.: CRASH FIRE HAZARD RATING SYSTEM FOR CONTROLLED FLAMMABILITY FUELS. NAFEC AGREEMENT NO. FA67NF-AP-24, REP. NO. NA-69-17 (DS-68-25), BUR. OF MINES, MAR. 1969//SALMON, R.F.: STUDY OF TURBINE ENGINE OPERATION WITH GELLED FUELS. REP. NO. DS-70-6 (NA-70-6), NAFEC, MAY 1970//PINKEL, I.I., PRESTON, G.M., AND PESMAN, G.J.: MECHANISM OF START AND DEVELOPMENT OF AIRCRAFT CRASH FIRES. REP. 1133, NAT. ADVISORY COMM. FOR AERONAUT., 1953// PINKEL, I.I., WEISS, S., PRESTON, G.M., AND PESMAN, G.J.: ORIGIN AND PREVENTION OF CRASH FIRES IN TURBOJET AIRCRAFT. REP. 1363, NAT. ADVISORY COMM. FOR AERONAUT., 1958//REED, W.H., ROBERTSON, S.H., WEINBERG, L.W., AND TYNDALL, L.H.: FULL-SCALE DYNAMIC CRASH TEST OF A LOCKHEED CONSTELLATION MODEL 1649 AIRCRAFT. NAFEC CONTR. NO. FA-WA-4569, REP. NO.

FAA-ADS-38, FLIGHT SAFETY FOUNDATION, INC., AVIATION SAFETY ENG. AND RES. DIV., PHOENIX, ARIZ., OCT. 1965

-SOURCE INFORMATION-

CORPORATE SOURCE -
NATIONAL AVIATION FACILITIES EXPERIMENTAL CENTER, ATLANTIC CITY, N.J.
REPORT NUMBER -
N71-32087//FAA-RD-71-49
OTHER INFORMATION -
0051 PAGES, 0025 FIGURES, 0004 TABLES, 0008 REFERENCES

ADVANCING DC-9 MAINTENANCE TECHNIQUES THROUGH MULTI-PARAMETER RECORDING

by

NEMECEK, J.F.

06/12/67

-ABSTRACT-

The installation of a multiparameter recording system on a DC-9 jet fleet has provided an important tool for advancing maintenance techniques on twin engine jet aircraft. The use of recorded data in establishing performance trends on engine, fire warning, and air conditioning systems is discussed. Real time applications of computer data processing to facilitate field maintenance in trouble-shooting specific aircraft systems are described. Specific examples of trouble detection and definition are given, samples of recorded data are illustrated and their significance explained. This system is reportedly suitable for expansion from the 128 to 512 measured variables. The use of a modified form of this basic concept in more advanced systems for the Boeing 747 and SST aircraft is also discussed.

-PERTINENT FIGURES-

FIG. 4 ADAS REMOTE-MULTIPLEXING UNIT PAGE 3//FIG. 6 ENGINE FIRE-WARNING LOOP CHARACTERISTIC CURVE PAGE 7//FIG. 7 ADVANCED AIDS CONCEPT FOR THE SST PAGE 9//FIG. 8 747 AIDS CONCEPT PAGE 10//TAB. 2 EXAMPLE OF COMPUTER PROCESSED DATA RETURNED TO THE LINE STATION PAGE 4//TAB. 3 FLIGHT LOG ANALYSIS DATA TAKEOFF PLOT PAGE 5

-BIBLIOGRAPHY-

NEMECEK, J.F. AND GREEN, W.D.: DYNAMIC ANALYSIS OF AIRBORNE SYSTEM PERFORMANCE BY MULTIPARAMETER SAMPLING. IEEE TRANS. ON AEROSPACE AND ELEC. SYSTEMS, MAY 1966//NEMECEK, J.F. AND BRAINERD, C.H.: AN AIRBORNE INTEGRATED DATA SYSTEM CONCEPT FOR THE SST. ATA ENG. AND MAINTENANCE CONF., LOS ANGELES, CALIF., NOV. 17-18, 1966

-SOURCE INFORMATION-

CORPORATE SOURCE -
TRANS WORLD AIRLINES, INC., KANSAS CITY, MO.
REPORT NUMBER -
AIAA PAPER NO. 67-378
JOURNAL PROCEEDINGS -
AIAA, COMMERCIAL AIRCRAFT DESIGN AND OPERATION MEETING, LOS

ANGELES, CALIF., JUNE 12-14, 1967//JAIRAM, J. AIRCR, VOL. 5,
292-298 (1967)

OTHER INFORMATION -

0011 PAGES, 0008 FIGURES, 0004 TABLES, 0002 REFERENCES

AIRCRAFT FUEL SYSTEM MAINTENANCE 1971, RECOMMENDATIONS ON SAFEGUARDING

by

NATIONAL FIRE PROTECTION ASSOCIATION

05/00/71

-ABSTRACT-

Three possible methods which may be followed during aircraft fuel ground handling are recommended to reduce the flammable vapor hazard of aircraft fuel tank atmospheres. The circumstances under which any one procedure may be followed vary and are subject to the discretion of the operator. The three basic procedures suggested are siphon inerting, pressure inerting, and air ventilation. To assist in the selection of the proper or most desirable instrument for determining the fuel tank atmosphere, a list of the various instruments available is included. Suggested procedures are also outlined as safeguards for the repair of integral, bladder, and metal aircraft fuel tanks. General fire safety recommendations are made for aircraft fuel transfer operations and testing aircraft fuel systems during aircraft maintenance and overhaul operations.

-PERTINENT FIGURES-

-SOURCE INFORMATION-

CORPORATE SOURCE -
NATIONAL FIRE PROTECTION ASSOCIATION, BOSTON, MASS.
REPORT NUMBER -
NFPA NO. 410C
OTHER INFORMATION -
0045 PAGES, 0002 FIGURES, 0003 TABLES, 0000 REFERENCES

key 493

AIRCRAFT RESCUE AND FIRE FIGHTING 1969, STANDARD OPERATING PROCEDURES

by

NATIONAL FIRE PROTECTION ASSOCIATION

00/00/69

-ABSTRACT-

These recommendations deal with airport and municipal fire and rescue services, standard operating procedures designed to provide maximum effective use of aircraft rescue, and fire fighting equipment provided at airports. Included is information on conditions that may exist at the scene of an aircraft accident and a guide that can be used as a basis for establishing training programs and operational procedures. The recommendations are based on the premise that the rescue of aircraft occupants takes precedence over all other operations; and, until it is established that there is no further life hazard, fire suppression is an important enabling supporting measure. The appendixes deal with civil aircraft data for fire fighters and rescue crews, aircrew rescue data for military aircraft, air transport of radioactive materials and nuclear weapons, civil aircraft accident investigation, airport facilities and aids, procedural agreements with the U.S. Air Force and commercial airports, typical specialized runway foaming equipment, and color coding for aircraft piping.

-PERTINENT FIGURES-

TAB. 1 WATER AND FOAM LIQUID REQUIREMENTS FOR RUNWAY FOAMING PAGE 46

-SOURCE INFORMATION-

CORPORATE SOURCE -
NATIONAL FIRE PROTECTION ASSOCIATION, BOSTON, MASS.
REPORT NUMBER -
NFPA NO. 402
OTHER INFORMATION -
0123 PAGES, 0072 FIGURES, 0001 TABLES, 0000 REFERENCES

key 494

AIRCRAFT RESCUE AND FIRE FIGHTING SERVICES AT AIRPORTS AND HELIPORTS 1971, RECOMMENDED PRACTICE FOR

by

NATIONAL FIRE PROTECTION ASSOCIATION

00/00/71

-ABSTRACT-

Recommendations are made on the amount and type of services to provide for a reasonable degree of aircraft rescue and fire fighting protection for aircraft operations at civil airports and heliports. The recommendations are based on providing effective control of aircraft fires to achieve any needed rescue of personnel likely to be involved in survivable types of aircraft accidents and to provide a reasonable degree of mobile fire protection for airport ramp and movement areas. Suggestions are made as to the type of extinguishing agents to use in specific instances, ambulance and medical facilities, water rescue facilities, reporting procedures, and training procedures for rescue and fire fighting personnel.

-PERTINENT FIGURES-

TAB. 2B RECOMMENDED AMOUNTS OF EXTINGUISHING AGENTS BY AIRPORT CATEGORIES (GENERAL AVIATION TYPE AIRCRAFT) PAGE 27

-BIBLIOGRAPHY-

AIRCRAFT GROUND FIRE SUPPRESSION AND RESCUE SYSTEMS-CURRENT TECHNOLOGY REVIEW, OCTOBER 1969. TRI-SERVICE SYSTEM PROGRAM OFFICE FOR AIRCRAFT GROUND FIRE SUPPRESSION AND RESCUE, ASWF, AG-FSRS-71, 1969//MINIMUM NEEDS FOR AIRPORT FIRE FIGHTING AND RESCUE SERVICE, JANUARY 1971. (AVAILABLE NTIS)

-SOURCE INFORMATION-

CORPORATE SOURCE -
NATIONAL FIRE PROTECTION ASSOCIATION, BOSTON, MASS.
REPORT NUMBER -
NFPA NO. 403
OTHER INFORMATION -
0062 PAGES, 0000 FIGURES, 0002 TABLES, 0159 REFERENCES

key 495

AIRCRAFT FUEL SERVICING 1971, STANDARD FOR INCLUDING AIRCRAFT FUELING HOSE, AIRCRAFT FUEL SERVICING TANK VEHICLES AND AIRPORT FIXED FUELING SYSTEMS

by

NATIONAL FIRE PROTECTION ASSOCIATION

00/00/71

-ABSTRACT-

This standard applies to fuel servicing of all types of aircraft on the ground. Parts I through IV are intended to help prevent accidental fuel spills and to eliminate and control fuel vapor ignition sources as far as is presently practicable. It is recognized that there are certain hazards (especially the operation and use of internal combustion engine operated aircraft servicing equipment and ground power generators in close proximity to fueling operations) over which positive control cannot be presently established for practical reasons. Specific cautions are given with regard to these hazards. Part V covers the design and maintenance of aircraft fueling hose. Part VI applies to tank vehicles designed for or employed in the transfer of standard grades of aviation fuel into or from an aircraft. Part VII covers Airport Fixed Fueling Systems. Part VIII deals with Fueling on Elevated Heliports. Appendix A gives information on the fire hazard properties of aviation fuels and Appendix B gives data on the generation of static electricity on aircraft on the ground.

-PERTINENT FIGURES-

TAB. 1 MINIMUM EMERGENCY VENT CAPACITY IN CU. FT. FREE AIR/HR. (14.7 PSIA AND 60 DEG. F.) PAGE 407-40//FIG. 2A TYPICAL FIXED AIRPORT FUELING SYSTEM SHOWING RECOMMENDED ISOLATION VALVING, OPERATING, AND EMERGENCY CONTROLS PAGE 470-60//FIG. 2B SCHEMATIC DIAGRAM OF TYPICAL AIRPORT FIXED FUELING SYSTEM SHOWING RECOMMENDED VALVING AND EMERGENCY REMOTE CONTROLS PAGE 407-63

-SOURCE INFORMATION-

CORPORATE SOURCE -
NATIONAL FIRE PROTECTION ASSOCIATION, BOSTON, MAS.
REPORT NUMBER -
NFPA NO. 407
OTHER INFORMATION -
0077 PAGES, 0002 FIGURES, 0001 TABLES, 0000 REFERENCES

key 496

AIRCRAFT HAND FIRE EXTINGUISHERS 1970, STANDARD ON

by

NATIONAL FIRE PROTECTION ASSOCIATION

00/00/70

-ABSTRACT-

This standard covers the type, capacity, location, and quantity of aircraft hand fire extinguishers and accessory equipment provided essentially for the protection of aircraft compartments occupied by passengers and crew. The aircraft hand fire extinguishers are to be of an approved type employing carbon dioxide or water as extinguishing media. Recommendations are also given for the daily inspection and periodic maintenance of these aircraft hand fire extinguishers. The appendix consists of a suggested air crew training procedure on the use of aircraft hand fire extinguishers. The accessory equipment should include a device suitable for ripping cabin wall linings and seat upholstery in event of a concealed or smoldering fire in such areas.

-SOURCE INFORMATION-

CORPORATE SOURCE -
NATIONAL FIRE PROTECTION ASSOCIATION, BOSTON, MASS.
REPORT NUMBER -
NFPA NO. 408
OTHER INFORMATION -
0012 PAGES, 0000 FIGURES, 0000 TABLES, 0000 REFERENCES

keys 497 through 498

AIRCRAFT HANGERS 1971, STANDARD ON

by

NATIONAL FIRE PROTECTION ASSOCIATION

00/00/71

-ABSTRACT-

The standards in this booklet provide guidance on proper construction and protection of aircraft hangars; and include recommendations for airport authorities, aircraft owners and operators, building and fire officials, and insurance underwriters. Aircraft hangar design and fire protection standards are included, along with standards for sprinklers as well as the maximum square footage of sprinklered and unsprinklered, divided and undivided, areas for various construction classifications. Lightning and other electrical hazards, fuel spills, and external fire protection are discussed; as is the use of hand hoses, portable fire extinguishers, and other fire fighting devices. The booklet does not include information on aircraft maintenance and storage, aircraft rescue and fire fighting, or local fire regulations or standards not directly related to hangar fire protection.

-SOURCE INFORMATION-

CORPORATE SOURCE -
NATIONAL FIRE PROTECTION ASSOCIATION, BOSTON, MASS.
REPORT NUMBER -
NFPA NO. 409
OTHER INFORMATION -
0062 PAGES, 0007 FIGURES, 0004 TABLES, 0000 REFERENCES

AIRCRAFT CABIN CLEANING AND REFURBISHING OPERATIONS 1970, RECOMMENDATIONS ON SAFEGUARDING

by

NATIONAL FIRE PROTECTION ASSOCIATION

00/00/70

-ABSTRACT-

There is a serious fire hazard during cleaning of aircraft interiors if flammable solvents are used. The vapors, restricted by the cabin, can be ignited by sparks produced by the maintenance operations. Only nonflammable materials are recommended for use in aircraft interiors. When a flammable agent must be used, only one with a high flash point is recommended and then only under conditions that will minimize the risk, such as sufficient ventilation and elimination of potential spark hazards, electrical or friction.

-SOURCE INFORMATION-

CORPORATE SOURCE -
NATIONAL FIRE PROTECTION ASSOCIATION, BOSTON, MASS.
REPORT NUMBER -
NFPA NO. 410F
OTHER INFORMATION -
0008 PAGES, 0000 FIGURES, 0000 TABLES, 0000 REFERENCES

AIRPORT RAMP FIRE HAZARD CLASSIFICATIONS AND PRECAUTIONS 1970, STANDARD ON

by

NATIONAL FIRE PROTECTION ASSOCIATION

00/00/70

-ABSTRACT-

A hazardous condition exists on airport ramps when flammable liquids or vapors come into contact with potential ignition sources. The purpose of this standard is to recommend ways of keeping the two separated. The area around fueling operations is considered hazardous. Any area in which flammable liquids are stored is also hazardous. Within 50 ft. of a hazardous operation or location, all open flames are prohibited; electrical wiring and equipment shall be listed as suitable for use in Class 1, Group D, Division 2 hazardous locations (as defined in the National Electrical Code, NFPA No. 70); and service vehicles shall be equipped with safety features to minimize the ignition risk.

-SOURCE INFORMATION-

CORPORATE SOURCE -
NATIONAL FIRE PROTECTION ASSOCIATION, BOSTON, MASS.
REPORT NUMBER -
NFPA NO. 411
OTHER INFORMATION -
0012 PAGES, 0004 FIGURES, 0000 TABLES, 0000 REFERENCES

EVALUATING FOAM FIRE FIGHTING EQUIPMENT ON AIRCRAFT RESCUE AND FIRE FIGHTING VEHICLES 1969, STANDARD FOR

by

NATIONAL FIRE PROTECTION ASSOCIATION

00/00/69

-ABSTRACT-

Standard tests for fire suppressing foams physical properties, ground patterns, and ability to reduce heat radiation are discussed. The effectiveness of foam as a fire suppressant depends on supplying large quantities to the fire to form an impervious fire-resistant blanket on large flammable liquid spills. The three major types of foam used in aircraft fire fighting are protein-foam concentrates, aqueous-film-forming- foam (AFFF) concentrate, and fluoroprotein-foam-concentrates. Foam is produced by nozzle aspirating systems, in-line foam pump systems and in-line compressed air systems. Tests should approximate field conditions that might be encountered at a fire. Aqueous-film-forming-foams (Light Water) require different testing procedures than the other two. This standard covers testing procedures and evaluation of test results for these three types of foam.

-SOURCE INFORMATION-

CORPORATE SOURCE -
NATIONAL FIRE PROTECTION ASSOCIATION, BOSTON, MASS.
REPORT NUMBER -
NFPA NO. 412
OTHER INFORMATION -
0032 PAGES, 0006 FIGURES, 0001 TABLES, 0000 REFERENCES

CANADIAN ARMED FORCES AIRCRAFT RESCUE AND FIRE FIGHTING PROGRAM

by

TORRAVILLE, G.V.

00/00/67

-ABSTRACT-

The development of the Royal Canadian Air Force program for aircraft rescue and fire fighting is discussed, starting with World War II. The first crash vehicle designed was the G15 equipped with a 300 imperial gal. water tank and two 100 lb. carbon dioxide units. For colder climates, these were converted to the G17 which used dry chemicals. The use of dry chemicals became standard and improvements were made in chassis and chemicals. Subsequently, vehicles were purchased which utilized foam and contained increased water capacity. The largest vehicle to date is the G19 with a Sicard chassis and Pyrene foam producing equipment. It has a gross vehicle weight of 37,000 lb., and carries 833 imperial gal. of water and 120 imperial gal. of foam liquid. Airports were categorized according to aircraft weights handled, with five classes at present, and varying fire-fighting standards. Structural fire-fighting services have been provided in addition to aircraft protection by cross-manning of personnel. Future plans include development of new fire extinguishing agents and keeping up with new aircraft development.

-SOURCE INFORMATION-

CORPORATE SOURCE -
CANADIAN FORCES HEADQUARTERS, OTTAWA (ONTARIO). OFFICE OF THE FIRE MARSHAL.
REPORT NUMBER -
NFPA-MP-67-6
OTHER INFORMATION -
0004 PAGES, 0000 FIGURES, 0000 TABLES, 0000 REFERENCES

AUSTRALIA'S AIRPORT FIRE PROTECTION

by

PARKER, J.E.

00/00/67

-ABSTRACT-

A review is given of Australia's airport fire protection system. There are eight international airports and 350 other airports in Australia and its territories. International airports are equipped with facilities in accordance with recommendations of the Interantional Civil Aviation Organization. Also equipped with rescue and fire-fighting equipment are 45 other airports, which account for 90 percent of passenger travel. The Department of Civil Aviation employs 400 men on a full-time basis in the Rescue and Fire Fighting Service in addition to 800 auxiliary firemen. Larger airports which have their own fire-fighting services are responsible for arrangements in emergencies, which must be coordinated with the Rescue and Fire Fighting Service. The primary vehicle, the large fire tender, is designed for one-man operation. It carries 800 imperial gal. of water and 96 imperial gal. of foam compound, and is also equipped with a 200 lb. dry powder unit. Supporting vehicles supply water to the primary vehicle. Emergency communications are provided in the form of VHF units and direct telephone links to the ATC tower. The fighting of building fires at airports is a civil fire brigade responsibility. Other duties of the Department include search and rescue services for aircraft in distress.

-SOURCE INFORMATION-

CORPORATE SOURCE -
DEPARTMENT OF CIVIL AVIATION, CANBERRA (AUSTRALIA)
REPORT NUMBER -
NFPA-MP-67-3
OTHER INFORMATION -
0007 PAGES, 0000 FIGURES, 0000 TABLES, 0000 REFERENCES

key 506

CRASH FIRE CONTROL CAPABILITY STUDY

by

ROBIRTSON, W.D.

00/06/60

-ABSTRACT-

Standards are reviewed and recommended for the fire protection capabilities at Washington State airports. Data were gathered on 21 commercial aircraft survivable accidents. The statistics indicated that fire-fighting capabilities would be related to 50 percent of the occupants involved. FAA requirements state that evacuation should take place within 2 min., but the crash study indicates that only half of the occupants are able to evacuate in this time under crash fire conditions. Fire test data were reviewed to determine application densities in terms of gal./sq. ft. Protein foam was chosen for the study and it was found that effective fire control could be obtained in less than 2 min. with densities of .15 gpm/sq. ft. The next phase of the study was concerned with evacuation zones. Factors considered were human tolerance to heat, elevation above ground, and size of evacuation zones in relation to passenger loads. Extinguishment application rates should be considered as minimum capabilities to provide protection during landing and take-off.

-SOURCE INFORMATION-

CORPORATE SOURCE -
PORT OF SEATTLE FIRE DEPT., WASH.
REPORT NUMBER -
NFPA-MP-66-4
OTHER INFORMATION -
0060 PAGES, 0040 FIGURES, 0000 TABLES, 0000 REFERENCES

FEDERAL AVIATION AGENCY'S CRASH FIRE TESTS

by

MIDDLEWORTH, C.M.
CONLEY, D.W.
BRIDGES, J.W.
RYAN, J.J.

00/00/65

-ABSTRACT-

Tests conducted at the FAA Experimental Center at Atlantic City on aircraft crash fire fighting are reviewed in three presentations: (1) a description of test procedures and results, (2) an explanation of the role of the ground fire-fighting unit, and (3) an explanation pf the role of the helicopter fire-fighting team. The broad objective was to measure and to determine possible means of extending the escape and survival time for occupants of large transport aircraft under crash fire conditions. Of primary interest were the effectiveness and limitations of the helicopter when operating alone and in conjunction with ground fire-fighting equipment in crash fire fighting and rescue operations. Essentially, the test procedures consisted of first burning one C-97 aircraft without the influence of helicopter downwash or foam extinguishing agents. The remaining C-97 aircraft were exposed to fire conditions similar to the first test, but influenced by helicopter downwash and foam extinguishing agents. Conclusions were: (1) The helicopter was of assistance where there was an upwind fire situation, but was detrimental with fire on two sides of the fuselage and on downwind fires. (2) The ability of the crash crew to extend excape time was dependent upon pre-burn time and fuselage integrity. (3) Installation of more suitable materials in aircraft cabins can reduce fire hazards.

-PERTINENT FIGURES-

FIG. 3 GENERAL DESCRIPTIONS OF THE C-97 FIRE TESTS PAGE 6//FIG. 5 CARBON MONOXIDE CONCENTRATIONS RECORDED IN THE C-97 FUSELAGE CABIN; TESTS 1, 2, 3A and 3B PAGE 8//FIG. 12 C-97 CABIN THERMAL CONDITIONS AND ESCAPE TIMES FOR TESTS 1, 3, 3A, and 3B PAGE 18//FIG. 20 TESTS SHOWING EFFECT OF HELICOPTER BLAST ON SIMULATED RESCUE PATH PAGE 32

-SOURCE INFORMATION-

CORPORATE SOURCE -
NATIONAL AVIATION FACILITIES EXPERIMENTAL CENTER, ATLANTIC CITY, N.J.
REPORT NUMBER -

NFPA-MP-65-2
OTHER INFORMATION -
0032 PAGES, 0020 FIGURES, 0000 TABLES, 0000 REFERENCES

key 516

FIRE AND EXPLOSION HAZARDS OF FLIGHT VEHICLE COMBUSTIBLES. QUARTERLY PROGRESS REPORT, JUNE 1 TO AUG. 31, 1965.

by

KUCHTA, J.M.
MARTINDILL, G.H.
SPOLAN, I.

06/01/65

-ABSTRACT-

The ignition and flammability characteristics of titanium and its alloys were studied in air with the following halogenated hydrocarbon fire extinguishing agents: (1) bromochloromethane, (2) dibromodifluoromethane, (3) bromotrifluoromethane, (4) 1,1,1-trifluorobromochloroethane, and (5) 1,2,2-trifluoropentachloropropane. A literature search was conducted, necessary materials were acquired for the intial experimental work, and test apparatus was assembled and calibrated. In addition, ignition temperature type experiments were initiated with the fire extinguishing materials (vapors) in contact with heated titanium metal in air, nitrogen, and argon atmospheres. Autoignition experiments in heated vessels were undertaken, as were experiments with electrically heated wires.

-PERTINENT FIGURES-

TAB. 1 REACTION OF TITANIUM METAL SPECIMENS WITH VARIOUS FIRE EXTINGUISHING AGENTS IN AIR, NITROGEN, AND ARGON ATMOSPHERES AT 1020 DEG. F. PAGE 3// TAB. 2 MINIMUM REACTION TEMPERATURES FOR VARIOUS FIRE EXTINGUISHING AGENTS WITH ELECTRICALLY HEATED TITANIUM WIRES UNDER STATIC CONDITIONS PAGE 5

-BIBLIOGRAPHY-

MAYKUTH, D.J.: METHODS OF CONTROLLING AND EXTINGUISHING TITANIUM FIRES. DMIC TECH. NOTE, BATTELLE MEMORIAL INST., JULY 1964//MISCELLANEOUS EXPERIENCES ON BURNING OF TITANIUM. REP. SER. NO. LR-AD-1531, MATERIALS RES. AND PROCESS ENG. LAB., DOUGLAS AIRCRAFT CO., JUNE 27, 1962// ZABETAKIS, M.G., FURNO, A.L., AND JONES, G.W.: MINIMUM SPONTANEOUS IGNITION TEMPERATURES OF COMBUSTIBLES IN AIR. IEC, VOL. 46, 2173, OCT. 1954//LITCHFIELD, E.L. AND PERLEE, H.E.: FIRE AND EXPLOSION HAZARDS OF FLIGHT VEHICLE COMBUSTIBLES. TECH. REP. AFAPL-TR-65-28, AFSC, MAR. 1965//KUCHTA, J.M., BARTKOWIAK, A., SPOLAN, I., AND ZABETAKIS, M.G.: FLAMMABILITY CHARACTERISTICS OF HIGH TEMPERATURE HYDROCARBON FUELS. ASD-TDR-62-328, PART 2, AFSC, DEC. 1962

-SOURCE INFORMATION-

CORPORATE SOURCE -
BUREAU OF MINES, BRUCETON, PA. EXPLOSIVES RESEARCH CENTER.
REPORT NUMBER -
AD-620899
OTHER INFORMATION -
0006 PAGES, 0000 FIGURES, 0002 TABLES, 0005 REFERENCES

FULL SCALE FIRE MODELING TEST STUDIES OF LIGHT WATER AND PROTEIN TYPE FOAM

by

PETERSON, H.B.
JABLONSKI, E.J.
NEILL, R.R.
GIPE, R.L.
TUVE, R.L.

08/15/67

-ABSTRACT-

Fire extinguishment effectiveness of light water and protein foams on full-scale fires associated with aircraft accidents was studied with an MB-5 aircraft fire-rescue vehicle utilizing a 250-gpm-solution-capacity foam pump. Some testing was also done on an experimental 06X vehicle carrying 2500 lb. of Purple K and 300 gal. of light water discharging 32 lb./sec. of Purple K and 180 gpm of light water for comparative purposes. Both foams were 6 percent solutions. An air aspirating nozzle and one using Refrigerant-12 were used for light foam. Avgas and JP-5 were the test fuels. In all cases, Avgas fires were more difficult to control than JP-5 fires. The margin of superiority of light water over protein foam was found to be as high as 3 to 1 for control as determined by radiometer and visual measurements of Avgas fires and as high a 1.5 to 1 for control of JP-5 fires. The dual-agent fire fighting concept showed no advantage over the use of light water alone. The light water solution was as effective when used with all test equipment. The small laboratory-scale fires required three times the application density to extinguish than the comparable outdoor fires.

-PERTINENT FIGURES-

FIG. 26 THERMAL RADIATION DURING EXTINGUISHMENT OF AVGAS FIRE BY HTL RADIOMETER PAGE 32//FIG. 29 WATER APPLICATION DENSITY REQUIRED FOR FIRE EXTINGUISHMENT WITH PROTEIN FOAM ON AVGAS AND JP-5 FUEL PAGE 34//FIG. 30 WATER APPLICATION DENSITY REQUIRED FOR FIRE EXTINGUISHMENT WITH LIGHT WATER ON AVGAS AND JP-5 FUELS PAGE 34//FIG. 32 FIRE EXTINGUISHMENT TIME AS A FUNCTION OF APPLICATION RATE ON AVGAS AND JP-5 PAGE 36//TAB. 2 COMPARATIVE PERFORMANCE OF AGENTS ON 28 SQ. FT. INDOOR JP-5 AND GASOLINE FIRES PAGE 22// TAB. 5 CONTROL AND EXTINGUISHMENT TIMES FOR LARGE AREA FIRES PAGE 26

-BIBLIOGRAPHY-

TUVE, R.L., PETERSON, H.B., JABLONSKI, E.J., AND NEILL, R.R.: A NEW VAPOR-SECURING AGENT FOR FLAMMABLE-LIQUID FIRE EXTINGUISHMENT.

NRL REP. 6057, MAR. 13, 1964//AIRCRAFT CRASH FIRE INCIDENT SIMULATION TESTS OF LIGHT WATER. ONR FILM REP. 7-64//EVALUATING FOAM FIRE FIGHTING EQUIPMENT ON AIRCRAFT RESCUE AND FIRE FIGHTING VEHICLES. PAMPHLET NO. 412, NFPA, BOSTON, MASS., 1964//PETERSON, H.B. AND GIPE, R.L.: A STUDY OF THE GAS TURBINE POWERED MB-5 AIRCRAFT FIRE FIGHTING AND RESCUE VEHICLE. NRL REP. 6309, SEPT. 22, 1965//CONLEY, D.: FOAM AND DRY CHEMICAL APPLICATION EXPERIMENTS. PROJ. NO° 410-002y02X, GAA TEST PLAT, JAN° 20, 1965// MIDDLESWORTH: C°M.: FOAM AND DRY CHEMICAL APPLICATION RATE EXPERIMENTS. PAPER 65-5; NGPA MEETING, BOSTON, MASS., 1956

-SOURCE INFORMATION-

CORPORATE SOURCE -
NAVAL RESEARCH LAB., WASHINGTON, D.C.
REPORT NUMBER -
AD-658318//NRL REP. 6573
OTHER INFORMATION -
0058 PAGES, 0032 FIGURES, 0008 TABLES, 0009 REFERENCES

A STUDY OF THE GAS TURBINE POWERED MB-5 AIRCRAFT FIREFIGHTING AND RESCUE VEHICLE

by

PETERSON, H.B.
GIPE, R.L.

09/22/65

-ABSTRACT-

Operating characteristics of one of the MB-5 series of crash trucks, equipped with a gas turbine engine as a source of power, were monitored under different load conditions, variable road speed, and variable foam pump speed. The turbine-powered vehicle was compared to two conventional engine trucks now in operation for both rapidity of acceleration and ease of operation. A standardized simulated fire-fighting operation called a "scramble" operation was devised for the integration of human engineering with the relative efficiency of each of the three vehicles. Time intervals required to reach a given series of check points during a fixed fire-fighting procedure were recorded by multichanneled instrumentation or by observation. The turbine-powered vehicle proved to be superior in acceleration performance and equal in fire-fighting capability to conventional engines, but these factors alone may not justify the higher initial cost of the turbine power plant. Future field studies involving maintenance costs over extended periods of field operation and vehicle performance under severe environmental conditions might alter present considerations.

-PERTINENT FIGURES-

FIG. 2 DRIVE TRAIN ARRANGEMENT AS REVISED AND INSTALLED IN THE TURBINE POWERED VERSION OF THE MB-5 PAGE 2//FIG. 5 SCRAMBLE COURSE LAYOUT FOR CHECKING TIMES NEEDED TO PERFORM CRITICAL OPERATIONS NECESSARY DURING AIRCRAFT FIREFIGHTING AND RESCUE WORK PAGE 7//FIG. 14 ACTUAL ACCELERATION CURVE COMPARED TO THE DESIGNER'S CALCULATED ACCELERATION PERFORMANCE PAGE 13//FIG. 17 RECORDED TRACES OF VITAL FUNCTIONS OCCURRING DURING TYPICAL SCRAMBLE PAGE 16//FIG. 18 COMPARISON OF THE 3 MB-5 TIMES OPERATING ON THE SCRAMBLE TEST PAGE 18//TAB. 1 TIME DATA OF FIREFIGHTING OPERATIONS FOR MB-5 TYPE VEHICLES ACCORDING TO POWER TRAIN PAGE 18

-BIBLIOGRAPHY-

PRICE, H.E., CRAIN, C.L., AND SICILIANI, F.A.: A SURVEY OF HUMAN FACTORS ENGINEERING PROBLEMS IN FIRE FIGHTING EQUIPMENT. SERENDIPITY ASSOC., SHERMAN OAKS, CALIF., FEB. 1964

-SOURCE INFORMATION-

CORPORATE SOURCE -
NAVAL RESEARCH LAB., WASHINGTON, D.C.
REPORT NUMBER -
AD-623296//NRL-REP. 6309
OTHER INFORMATION -
0024 PAGES, 0018 FIGURES, 0001 TABLES, 0003 REFERENCES

NASA TMX-71553

BIBLIOGRAPHY ON AIRCRAFT FIRE HAZARDS AND SAFETY

Volume II - SAFETY, Part 2 - Key Numbers 525 to 1064

Compiled by
James J. Pelouch, Jr. and Paul T. Hacker

Aerospace Safety Research and Data Institute
Lewis Research Center
Cleveland, Ohio 44135

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

132-a

FOREWORD

The mission and objectives of the Aerospace Safety Research and Data Institute are (a) to support NASA, its contractors, and the aerospace industry with technical information and consultation on safety problems; (b) to identify areas where safety problems and technology voids exist and to initiate research programs, both in-house and on contract, in these problem areas; (c) to author and compile state-of-the-art and summary publications in our areas of concern; (d) to establish and operate a safety data bank. As a corollary to its support to the aerospace community, ASRDI is also to establish and maintain a file of specialized information sources (organizations) and recognized, acknowledged experts (individuals) in the specific areas or fields of ASRDI's interest.

To match our resources with our priorties, ASRDI is concentrating on selected areas - fire and explosion; cryogenic systems; propellants and other hazardous materials, with special emphasis on oxygen and hydrogen; aeronautical systems and spacecraft operations; lightning hazards; and the mechanics of structural failure. Staff expertise is backed by a safety library and is further supported by a computerized bank of citations and abstracts built from literature on oxygen, hydrogen, and fire and explosion. Computer files on mechanics of structural failure, fragmentation hazards, and safety information sources are also being established. In addition, ASRDI has two NASA RECON terminals and people adept at querying the system for safety-related information.

Frank E. Belles, Director
Aerospace Safety Research and Data Institute
National Aeronautics and Space Administration

INTRODUCTION

A part of the Aerospace Safety Research and Data Institute's (ASRDI) mission is to compile and store in a computerized system bibliographic citations on hazards and safety in various areas related to aerospace activities. One of these areas is fire and explosion. The program in this area has been underway for about three years and is continuing. At the present time the computerized data bank contains about 2000 bibliographic citations on the subject.

Each citation in the data bank contains many items of information about the document. Some of the main items are title, author, abstract, corporate source, description of figures pertinant to hazards or safety, key references, and descriptors (keywords or subject terms) by which the document can be retrieved. In addition each document is assigned to two main categories that are further divided into subcategories. The two main categories are fire hazards and fire safety. Each document is also further categorized according to its area of applicability such as - aircraft and spacecraft and their associated facilities; aerospace research and development test facilities; buildings; and general applicability.

This report is a compilation of all the document citations in the ASRDI data bank as of April 1974 on fire hazards and fire safety that pertain to aircraft. The report is somewhat preliminary in nature in that input to the data bank is continuing; moreover not all the information contained in the bank has been edited for errors. The report is being published as an illustrative example of the contents of the data dank and to obtain user feedback on the usefulness of such compilations and whether the subject scope should be narrowed in future compilations.

The report is divided into two volumes. Volume I, Hazards, presents bibl _:aphic citations that describe and define the aircraft fire hazards and covers a wide range of subjects such as - combustion characteristics of materials; accidents and incidents reports; causes of fire; methods and techniques of evaluating the fire hazard; and the resulting effects of fire on man and property. Volume II, Safety, presents bibliographic citations that describe and define aircraft fire safety methods, equipment, and criteria. It covers such subjects as prevention, detection, and extinguishment of fire, and codes and standards. Each volume of the report contains, in addition to the citations, an author index and an index of major descriptors (keywords or subject terms). The indices are related to the citations by the ASRDI key number, which appears in the upper right hand corner of the first page of each citation. To facilitate binding, both volumes are broken into parts.

Volume I has two parts -

Part 1 - Key Numbers 1 to 817
Part 2 - Key Numbers 818 to 2146, Author Index and Descriptor Index

Volume II has three parts -

Part 1 - Key Numbers 1 to 524
Part 2 - Key Numbers 525 to 1064
Part 3 - Key Numbers 1065 to 2165, Author Index and Descriptor Index

The preparation of this report for printing was essentially accomplished automatically. The search strategy (in this case, subject category) and information on citation content and format was fed into the computer. The output from the computer was placed directly on multilith paper by a high-speed printer.

VOLUME II

PART 2

THE USE OF LIGHT WATER FOR MAJOR AIRCRAFT FIRES

by

FITTES, D.W.
GRIFFITHS, D.J.
NASH, P.

11/00/69

-ABSTRACT-

Experimental fires were conducted in three confined areas bounded by low, firebrick walls. A cylindrical steel tube represented the aircraft fuselage, and steel drums at each side represented the mainplane/nacelle configuration. The fuels used were AVTUR (Jet A or JP-1) and AVTAG (Jet B or JP-4). The fire was allowed to burn freely for about 60 sec. after ignition before application of light water foam, protein foam, and fluorinated protein foam. In comparison with regular protein foam, light water foam was generally up to twice as effective in controlling major aircraft fires. Similarly, a fortified protein-based foam was about 25 percent more effective than regular protein foam. Light water was, in general, found to be proportionately more effective than protein foam in achieving a rapid initial reduction of heat radiation from the fire, although there were notable exceptions to this, possibly due to defective exploitation of its potential. Cost comparisons of the agents were made along with the overall cost of fire protection when using the new foams.

-PERTINENT FIGURES-

TAB. 3 PROTEIN FOAM PERFORMANCE PAGE 288//TAB. 4 LIGHT WATER FOAM PERFORMANCE PAGES 290-291//FIG. 7 COMPARISON OF FIRE CONTROL USING LIGHT WATER AND PROTEIN FOAMS PAGE 294

-BIBLIOGRAPHY-

NASH, P., FITTES, D.W., AND RICHARDSON, D.D.: FOAM FOR AIRCRAFT CRASH FIRES. FIRE RES. NOTE NO. 615, JOINT FIRE RES. ORG.

-SOURCE INFORMATION-

CORPORATE SOURCE -
FIRE RESEARCH STATION, BOREHAM WOOD (ENGLAND).
JOURNAL PROCEEDINGS -
FITCAA, FIRE TECHNOL, VOL. 5, NO. 4, 284-298 (NOV. 1969)
OTHER INFORMATION -
0015 PAGES, 0009 FIGURES, 0007 TABLES, 0002 REFERENCES

keys 527 through 529

SAFEGUARDING AIRCRAFT CLEANING, PAINTING, AND PAINT REMOVAL 1971, RECOMMENDATIONS FOR

by

NATIONAL FIRE PROTECTION ASSOCIATION

00/00/71

-ABSTRACT-

The scope of this standard includes cleaning, painting, and paint removal in connection with repair, overhaul, and any service to a hangar or ramp operation between flights or on a scheduled out of service basis. Solvents are classified as having a high flash point if they do not emit vapors before reaching 100 to 140 deg. F., and as having a low flash point if they emit flammable vapors below 100 deg. F. Areas in which painting is taking place must be well ventilated and be at least 50 ft. away from any dangerous materials or operation; special attention should be made to avoid electrical hazards. Precautions emphasized include: (1) Flammable paints and solvents should be stored in either a separate building or an area protected by fire resistant walls and doors. (2) Portable fire extinguishers should be on hand during the use of flammable materials. (3) All waste should be disposed of at least once a day. This standard does not include spray cleaning and painting of subassemblies small enough to be removed from the aircraft.

-SOURCE INFORMATION-

CORPORATE SOURCE -
NATIONAL FIRE PROTECTION ASSOCIATION, BOSTON, MASS.
REPORT NUMBER -
NFPA NO. 410D
OTHER INFORMATION -
0009 PAGES, 0000 FIGURES, 0000 TABLES, 0000 REFERENCES

REVIEW OF FIRE AND EXPLOSION HAZARDS OF FLIGHT VEHICLE COMBUSTIBLES

by

VAN DOLAH, R.W.
ZABETAKIS, M.G.
BURGESS, D.S.
SCOTT, G.S.

10/00/61

-ABSTRACT-

The prevention of fires and explosions involving combustibles and oxidants likely to be found in flight vehicles requires a knowledge of the flammability and related characteristics of these materials. A compilation of the available characteristics data for a series of combustibles and oxidants of current interest is presented. Vapor pressure and detonability data are given for fluorine, oxygen, chlorine trifluoride, nitrogen tetroxide, nitric acid, hydrogen peroxide, ethylene oxide, hydrogen, ammonia, pentaborane, unsymmetrical dimethylhydrazine, monomethylhydrazine, hydrazine, and a series of hydrocarbons including decalin, tetralin, bicyclohexyl, and other high density fuels. In addition, flammability characteristics diagrams are presented for each of these fuels in contact with air and, where available, other oxidants (e.g., oxygen and nitrogen tetroxide). To assist in an understanding of the data, a discussion is included of pertinent definitions and theory of combustion and detonation. Some speculation is also included on the impact of unusual environmental factors such as intense aerodynamic heating, reduced gravitational forces, and low ambient pressures encountered in aerospace flight. Several illustrative examples of application of the data to specific hazard situations are presented.

-PERTINENT FIGURES-

FIG. 5 RELATIONSHIP BETWEEN MINIMUM IGNITION ENERGY AND OPTIMUM ELECTRODE SEPARATION (QUENCHING DIAMETER) PAGE 7//FIG. 33 FLAMMABILITY CHARACTERISTICS DIAGRAM OF JP-6 IN AIR AT ATMOSPHERIC PRESSURE PAGE 72//FIG. 42 VARIATION IN LOWER TEMPERATURE LIMIT OF FLAMMABILITY (FLASH POINT) WITH PRESSURE FOR UDMH VAPOR IN AIR PAGE 81//FIG. 48 MINIMUM SPONTANEOUS IGNITION TEMPERATURES OF 7 HYDRAULIC FLUIDS IN AIR AT 1 ATM. IN CONTACT WITH A PYREX GLASS SURFACE AS A FUNCTION OF DIESEL INJECTOR PRESSURE PAGE 87// FIG. 52 SPONTANEOUS IGNITION TEMPERATURES AND CORRESPONDING IGNITION DELAY DATA FOR HYDROCARBON TYPE FUELS UNDER STATIC CONDITIONS IN AIR AT ATMOSPHERIC PRESSURE (1-8 APPARATUS) PAGE 90

-SOURCE INFORMATION-

CORPORATE SOURCE -
    BUREAU OF MINES, WASHINGTON, D.C.
REPORT NUMBER -
    ASD-TR-61-278//AD-262989
SPONSOR -
    AERONAUTICAL SYSTEMS DIV., WRIGHT-PATTERSON AFB, OHIO
CONTRACT NUMBER -
    CONTRACT DO-(33-616)60-8
OTHER INFORMATION -
    0104 PAGES, 0052 FIGURES, 0005 TABLES, 0105 REFERENCES

PLASTICS AND FIRE SAFETY IN COMMERCIAL AIRCRAFT

by

KUNREUTHER, E.M.

05/27/70

-ABSTRACT-

Various plastic materials and their qualifications are discussed on the basis of two Federal Aviation Administration notices of proposed rule making: (1) Transport Category Airplanes, Crashworthiness and Passenger Evacuation - 12 Aug. 1969; and (2) Smoke Emission - 30 July 1969. According to specified tests in the 12 Aug. 1969 notice, flammability of the following materials was evaluated: thermosets (epoxy, phenolic, polyester); thermoplastics (acrylics, ABS, acrylic-PVC, polycarbonate, polysulfone, nylon, fluoroplastics, polyvinyl-dichloride); and foams (urethane, polyester phenolic, vinyl). Some smoke test procedures and their obtained results are presented. It is stressed that present test methods are, in many instances, rather involved and not always satisfactory. It is considered imperative that simple, repetitive tests be developed which can be efficiently used by everyone involved with the development, supply, fabrication, and use of plastic materials.

-PERTINENT FIGURES-

FIG. 12 SMOKE DENSITY XP-2 CHAMBER SMOKE DENSITY RATING AFTER 4 MIN. PAGE 13

-SOURCE INFORMATION-

CORPORATE SOURCE -
DOUGLAS AIRCRAFT CO., INC., LONG BEACH, CALIF.
REPORT NUMBER -
DOUGLAS PAP. 5733
JOURNAL PROCEEDINGS -
SOCIETY OF THE PLASTICS INDUSTRY, INC., 27TH ANNUAL CONF. CORONADO, CALIF. MAY 27-29, 1970
OTHER INFORMATION -
0016 PAGES, 0012 FIGURES, 0000 TABLES, 0000 REFERENCES

keys 545 through 547

IGNITION AND FIRE SUPPRESSION IN AEROSPACE VEHICLES

by

KUCHTA, J.M.
CATO, R.J.
MARTINDILL, G.H.
SPOLAN, I.

12/07/11

-ABSTRACT-

Several halogenated hydrocarbons were evaluated as possible ignition or explosion suppressants for aircraft fuel tanks in which ignitions are initiated by incendiary ammunition. The inhibitors included Halons 2402, 1301, 1202, 1211, and 1011. Their effectiveness in retarding ignition or propagation of n-pentane/air mixtures was investigated with ignition sources comprising of heated wires, exploding wires, and an incendiary composition. With a heated platinum wire at 2070 deg. F., the ignition delays of the mixtures increased greatly when the Halon concentration was increased to 0.5 volume percent, except with Halon 1011 which was the least effective inhibitor. With the exploding wire and incendiary ignition sources, the ignition delays of the combustible mixtures were negligible and varied little with inhibitor concentration (0 to 10 percent). All inhibitors suppressed the flame propagations when these ignition sources were used, although the concentrations required were greater than with the heated wire ignitions. Large-scale experiments were also conducted in a 216 cu. ft. chamber with Halon 1301 to determine its effectiveness and toxicity hazard in extinguishing Class A fires by the total flooding mode. A 6 percent Halon concentration was adequate for rapid extinguishment of cotton sheeting, paper sheeting, and nylon-paper sheeting fires at loadings from 0.018 to 0.07 oz./cu. ft. The highest concentrations of toxic decomposition products (HF and HBr) occurred with the paper sheeting, which produced the largest fires and burned at the highest rates. Small- scale experiments were conducted with Halon 38.

-SOURCE INFORMATION-

CORPORATE SOURCE -
BUREAU OF MINES, PITTSBURGH, PA. PITTSBURGH MINING AND SAFETY RESEARCH CENTER.
REPORT NUMBER -
AFAPL-TR-71-93//AD-737383
SPONSOR -
AIR FORCE AERO PROPULSION LAB., WRIGHT-PATTERSON AFB, OHIO.
CONTRACT NUMBER -
CONTRACT F33615-69-M-5002

OTHER INFORMATION -
0045 PAGES, 0019 FIGURES, 0007 TABLES, 0007 REFERENCES

CRASH-FIRE PROTECTION AT LOS ANGELES INTERNATIONAL AIRPORT

by

MCKASKLE, A.J.

10/27/69

-ABSTRACT-

Problems and solutions associated with crash-fire protection at Los Angeles International Airport are reviewed. Divided responsibility between the city Fire Department and airport authorities poses problems. Other problems relate to airport size, traffic load, and handling of flammable fuel. Solutions to the problems were explored using past experience of military and civilian airports as guides. National Fire Protection Association Standards were studied and found to be inadequate. New fire extinguishing agents were tested. Promising results were obtained from comparative tests using light water, and recommendations were made for its use in crash protection. Jumbo jets necessitated the use of bigger and better crash apparatus than were currently in operation. Use of several units of apparatus with coordinated teamwork was recommended. Three new pieces of apparatus were built and old apparatus modified by replacing 300 gpm turrets with 600 gpm. Improvements were made and planned for dry chemical apparatus and structure fire-fighting equipment. Extinguishing agents in use at present are light water (in emergency situations), protein foam, Purple K, and other dry chemical agents. The cost of crash-fire protection is about one million dollars per year.

-SOURCE INFORMATION-

CORPORATE SOURCE -
LOS ANGELES CITY FIRE DEPT., CALIF.
JOURNAL PROCEEDINGS -
NATIONAL FLIGHT SAFETY, SURVIVAL AND PERSONAL EQUIPMENT SYMPOSIUM, 7TH, LAS VEGAS, NEV., OCT. 27-30, 1969
OTHER INFORMATION -
0008 PAGES, 0000 FIGURES, 0000 TABLES, 0000 REFERENCES

AIRCRAFT FIRE PROTECTION DEVELOPMENTS BY THE FEDERAL AVIATION ADMINISTRATION.(1940-1970)

by

HANSBERRY, H.L.

01/30/70

-ABSTRACT-

Aircraft fire protection studie conducted by the Civil Aeronautics Administration/Federal viation Administration from the DC-3 problems of 1940 to the mo recent studies of the Boeing 720 and the Lockheed Jetstar are viewed. The reasons for the changing emphasis from concern over powerplant fires in flight to concern over post-crash fires are discussed. Current studies of fuels flammability, development of protection against burner can burnthroughs, identification of interior materials of increased flame resistance, and development of improved methods of crash fire fighting are outlined. The bibliography includes reports on flight fire tests of piston engine powerplants; fire tests of powerplant components; flight fire tests of turbine engine powerplants; and crash fire studies, specifically controlled flammability fuels, crash resistant fuel systems, fire resistant fuselage studies, and ground fire fighting.

-PERTINENT FIGURES-

TAB. 1 US AIR CARRIER ACCIDENTS INVOLVING ENGINE FIRES PAGE 3//FIG. 4 RADIANT ENERGIES RELEASED BY VARIOUS FUELS UNDER SIMULATED CRASH CONDITIONS PAGE 4//FIG. 5 TURBINE-ENGINE OPERATION ON REGULAR AND GELLED FUELS PAGE 5 //FIG. 6 COMPARATIVE SPREADS OF REGULAR AND GELLED FUEL ON SURFACE CONCRETE PAGE 5//FIG. 7 3 3/4 LITERS OF JP-4 MIST EXPOSED TO OPEN FLAMES PAGE 6// FIG. 8 3 3/4 LITERS OF GELLED JP-4 MIST EXPOSED TO OPEN FLAMES PAGE 6

-BIBLIOGRAPHY-

NESTOR, L.J.: INVESTIGATION OF TURBINE FUEL FLAMMABILITY WITHIN AIRCRAFT FUEL TANKS. REP. NO. DS-67-7, NAVAL AIR PROPULSION TEST CENTER, AERONAUT. ENGINE DEPT., JULY 1967//KLUEG, E. AND DEMAREE, J.: AN INVESTIGATION OF INFLIGHT FIRE PROTECTION WITH A TURBOFAN POWERPLANT INSTALLATION. REP. NO. NA-69-26, APR. 1969//POSEY, JR., K.: INVESTIGATION OF MODIFIED TURBINE FUELS FOR REDUCTION OF CRASH-FIRE HAZARD. REP. NO. NA-69-10, RES. DIV., THE WESTERN CO., RICHARDSON, TEX., MAY 1969//BUCKSON, W., SCHLEGEL, W., AND SMITH, I.R.: DESIGN, DEVELOPMENT, AND EVALUATION OF A CRASH-RESISTANT FUEL SYSTEM INSTALLATION. REP. NO. ADS-27, ALL AM. ENG. CO., WILMINGTON, DEL., DEC. 1965//MARCY, J. AND JOHNSON, R.: FLAMING AND SELF-EXTINGUISHING CHARACTERISTICS OF AIRCRAFT CABIN INTERIOR

MATERIALS. REP. NO. NA-68-30, JULY 1968//CONLEY, D.W.: POST-CRASH FIREFIGHTING STUDIES ON TRANSPORT CATEGORY AIRCRAFT. REP. NO. RD-65-50, MAY 1965

-SOURCE INFORMATION-

CORPORATE SOURCE -
NATIONAL AVIATION FACILITIES EXPERIMENTAL CENTER, ATLANTIC CITY, N.J.

JOURNAL PROCEEDINGS -
ASME GAS TURBINE CONF. AND PRODUCTS SHOW, BRUSSELS, BELGIUM, MAY 24-28, 1970

OTHER INFORMATION -
0012 PAGES, 0010 FIGURES, 0001 TABLES, 0088 REFERENCES

AIRCRAFT FIRE PROTECTION AND RELATED FACTORS

by

STAMPLEY, JR., O.K.

04/23/69

-ABSTRACT-

After reviewing two fatal air crash accidents, statistics on the safety record of U.S. air carriers, and the history of Federal Air Regulations, a discussion is presented on the aircraft industry's continued improvement in fire protection for aircraft components and fuels, as well as the need for improvement in other crashworthiness factors such as passenger restraint devices, exit awareness, interior emergency lighting, passenger evacuation system, and smoke protection. The problems concurrent with hijacking, ditching over water, and bombing of aircraft are also considered with thoughts on the measures necessary to eliminate these hazards. Some of the research programs involving studies relative to occupant safety, fire protection, and crash survival listed include hazardous combustible characteristics of cabin interior materials, dynamic testing of aircraft seats and aircraft components, cargo compartment fire protection criteria, search for new passenger egress concepts, crash resistant fuel system demonstration, crashworthy integral fuel tanks, fuel tank vent system ignition hazards, and feasibility study of controlled flammability fuels to minimize aircraft crash fire hazards.

-PERTINENT FIGURES-

TAB. 1 FAR 25 FIRE PROTECTION AND CRASHWORTHINESS REQUIREMENTS PAGE 31

-SOURCE INFORMATION-

CORPORATE SOURCE -
FEDERAL AVIATION ADMINISTRATION, LOS ANGELES, CALIF.
JOURNAL PROCEEDINGS -
SOCIETY OF THE PLASTICS INDUSTRY, ANNUAL SYMPOSIUM, SAN DIEGO, CALIF., APR. 23-25, 1969.
OTHER INFORMATION -
0033 PAGES, 0000 FIGURES, 0002 TABLES, 0009 REFERENCES

THE CHALLENGE OF AIRCRAFT CRASH FIRE RESCUE

by

KEEGAN, E.W.

04/20/70

-ABSTRACT-

Records indicate that 40 percent of fatalities in survivable crashes could have been saved by faster fire extinguishment. Most of these fires involved the fuel system, and 95 percent occurred during landing or takeoff. Not more than 90 sec. are likely to be available for escape. Although the average escape time per individual has decreased, the number of passengers per plane and the number of miles flown has increased so that the expected number of fatalities due to fire is more than 1,000 annually. A combination of light water foam and Purple K dry chemical has proved to be the most effective extinguishing medium yet devised. Crash rescue vehicles must be manned by thoroughly trained professionals and must be able to move rapidly over any ground that might be encountered. The "go-for-broke" techniques advocated would involve small, fast vehicles able to crash through fences and ride over obstacles to extinguish the fire and evacuate the passengers. Completely extinguishing the fire is secondary to saving lives.

-PERTINENT FIGURES-

FIG. 2 EMERGENCY RESCUE ACCESS PAGE 6//TAB. 4 EVACUATION TIMES PAGE 3// TAB. 5 CRASH FIRE AND RESCUE EQUIPMENT AT AIRPORTS PAGE 3//TAB. 6 QUANTITIES OF EXTINGUISHING AGENT PAGE 3

-BIBLIOGRAPHY-

HEWES, B.V.: A SURVEY OF AIRPORT FIRE AND RESCUE FACILITIES. ALPA FIRE AND RESCUE COMM., 1969//FAA: AVIATION FORECASTS FISCAL YEARS 1969-1980//FSF: STATISTICAL ANALYSIS OF JET TRANSPORT AIRCRAFT ACCIDENTS RELATING TO FIRE SUPPRESSION AND PASSENGER EVACUATION//FOAM FIRE EQUIPMENT. NFPA NO. 412, 1969

-SOURCE INFORMATION-

CORPORATE SOURCE -
FLIGHT SAFETY FOUNDATION, INC., NEW YORK.
REPORT NUMBER -
SAE-700262
JOURNAL PROCEEDINGS -
NATIONAL AIR TRANSPORTATION MEETING, NEW YORK, APR. 20-23,

1970.
OTHER INFORMATION -
0007 PAGES, 0002 FIGURES, 0006 TABLES, 0004 REFERENCES

key 570

THE USE OF FIRE TUNNEL TEST TECHNIQUES IN THE DESIGN OF CONCORDE POWERPLANT

by

TALBOT, J.E.
SLATER, A.

05/24/70

-ABSTRACT-

In the very early design phases of the Concorde powerplant, it was realized that the high airflows passing through the engine bay would pose significant problems in terms of the precautions necessary to withstand and extinguish fires within the powerplant. A better understanding of the conditions existing in the bay during fires would produce a rational approach to the problem for both the designer and the certifying authority. In order to obtain extensive coverage of all flight conditions, it was necessary to depart from current practice and to construct a simulation of the engine and its environment, thereby allowing a large number of tests to be carried out. Using this rig has made it possible not only to prove the means of detection and extinguishing of fires throughout the flight plan, but to obtain a considerable amount of generalized data for use in component design specifications.

-PERTINENT FIGURES-

FIG. 6 HEAT INTENSITY CORRELATION PAGE 8//FIG. 7 TEMPERATURE CORRELATION PAGE 8

-SOURCE INFORMATION-

CORPORATE SOURCE -
BRITISH AIRCRAFT CORP., FILTON (ENGLAND)//BRITISH AIRCRAFT CORP., PRESTON (ENGLAND)
REPORT NUMBER -
ASME-70-GT-128
JOURNAL PROCEEDINGS -
AMERICAN SOCIETY OF MECHANICAL ENGINEERS GAS TURBINE CONF. AND PRODUCTS SHOW, BRUSSELS, BELGIUM, MAY 24-28, 1970
OTHER INFORMATION -
0009 PAGES, 0008 FIGURES, 0000 TABLES, 0000 REFERENCES

FIRE-EXTINGUISHING METHODS FOR NEW PASSENGER/CARGO AIRCRAFT. FINAL REPORT.

by

GASSMANN, J.J.
HILL, R.G.

11/00/71

-ABSTRACT-

Full-scale fire tests were conducted to determine the degree to which fire in large cargo compartments of passenger/cargo aircraft may be controlled by the use of air flow shutoff, bromotrifluoromethane, or liquid nitrogen in conjunction with reduced ventilation. During these tests, the normal in-flight leakage was simulated by providing an air flow of 2000 cu. ft./min. Results, using a 10-percent load, indicated that temperature can be kept below 500 deg. F., and that a flash fire can be averted for at least 2 hr. by the use of reduced ventilation and application of as little as 3 percent by volume of bromotrifluoromethane. The rate of agent application was about 3 1/2 lb./ sec. The effectiveness of liquid nitrogen was also determined in 75 cu. ft./min. reduced ventilation. The weights of agent used were 175 lb. and 284 lb., respectively. The use of liquid nitrogen proved very effective in extinguishing the initial flames, but with the residual 75 cu. ft./min. simulated leakage, when the oxygen concentration rose to 12 percent, a flash fire occurred. In both cases the protection lasted just over 30 min. The rate of application of the liquid nitrogen was as high as 10 lb./sec.

-PERTINENT FIGURES-

FIG. 19 COMPARISON OF EXTINGUISHMENT BY THE USE OF 60 LB. OF BROMOTRIFLUOROMETHANE AND AIRFLOW-SHUTOFF ON A 50 PERCENT LOAD CONFIGURATION PAGE 27//FIG. 20 TEMPERATURE, OXYGEN, AND PRESSURE RECORDINGS OF A FIRE-EXTINGUISHING TEST USING 173 LB. OF LIQUID NITROGEN ON A 10 PERCENT LOAD CONFIGURATION PAGE 29//FIG. 22 COMPARISON OF THE PRESSURES OBTAINED DURING EXTINGUISHMENT BY EACH OF THE THREE METHODS USED PAGE 32

-BIBLIOGRAPHY-

ASADURIAN, L.A.: EVALUATION OF FLIGHT FIRE PROTECTION MEANS FOR INACCESSIBLE AIRCRAFT BAGGAGE COMPARTMENT. CAA TECH. DEV. REP. NO. 146, JUNE 1951// SMITH, M.H.: SIMULATED DC-6A FIRE TEST PROGRAM. AMERICAN AIRLINES, INC., ENG. DEPT. REP. NO. LDC-6A-9920-X1R, SEPT. 1952 AND MAR. 1953// GASSMANN, J.J.: CHARACTERISTICS OF FIRE IN LARGE CARGO AIRCRAFT. FAA TECH. REP. NO. FAA-ADS-73, MARCH

1966//GASSMANN, J.J., CHARACTERISTICS OF FIRE IN LARGE CARGO AIRCRAFT, PHASE 2. FAA TECH. REP. NO. FAA-RD-70-42, SEPT. 1970

-SOURCE INFORMATION-

CORPORATE SOURCE -
NATIONAL AVIATION FACILITIES EXPERIMENTAL CENTER, ATLANTIC CITY, N.J.
REPORT NUMBER -
FAA-RD-71-68
OTHER INFORMATION -
0039 PAGES, 0022 FIGURES, 0001 TABLES, 0004 REFERENCES

AIRCRAFT CRASH FIRE PROTECTION SYSTEM. FINAL REPORT.

by

TOWLE, P.
DIQUATTRO, R.
FRITSCH, K.

01/06/54

-ABSTRACT-

An aircraft crash fire protection system is described that consists of initiating equipment; inerting and cooling equipment; and fuel, oil, and electrical cut-off equipment. The initiating equipment has four separate mechanically operated inertia switches, only two of which need be actuated to initiate the entire system; continuous strip-type deformation switches; a cable-type deformation switch, and an engine-mount reaction switch. These switches are placed on the leading edges of wings, propellers, engine, engine mounts, undercarriage, and the underside of the fuselage. The inerting and cooling system consists of the liquid spray apparatus to prevent ignition of the combustible liquids or vapors by cooling the engine stacks, the exhaust collector ring, and the heat exchangers. By evaporation of the cooling solution, this sytem forms an inert blanket of gas which completely envelopes the affected area. Water was used as the coolant in the tests. Carbon dioxide was used in inert accumulated combustibles in the engine cylinders. The fuel, oil, and electrical cut-off system, which contains the necessary equipment to shut off the fuel and oil lines at the fire wall and the fuel after the carburetor, can inert the entire electrical system.

-PERTINENT FIGURES-

FIG. 7 EXHAUST COLLECTOR RING WITH COOLANT TANK SPRAY RING AND NOZZLES ATTACHED//FIG. 10 INERTIA SWITCH CALIBRATION SET UP//FIG. 17 CONTINUOUS STRIP DEFORMATION SWITCH//FIG. 22 EXHAUST AND COOLING SYSTEM, FINAL ARRANGEMENT OF NOZZLES AND PLUMBING (ALL NOZZLES NOT SHOWN)

-SOURCE INFORMATION-

CORPORATE SOURCE -
KIDDE (WALTER) AND CO., BELLEVILLE, N.J.
REPORT NUMBER -
AD-887325//SEE ALSO F7100546 (AD-887326)
SPONSOR -
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION, CLEVELAND, OHIO. LEWIS RESEARCH CENTER.

CONTRACT NUMBER -
CONTRACT AF-18(600)-167
OTHER INFORMATION -
0112 PAGES, 0047 FIGURES, 0000 TABLES, 0000 REFERENCES

key 605

EFFECTS OF POLYURETHANE FOAM ON FUEL SYSTEM CONTAMINATION

by

REED, T.O.

03/28/71

-ABSTRACT-

The Air Force has successfully implemented the use of a nominal 10-pore/ in. orange polyurethane foam filler material into the fuel tanks of a majority of combat aircraft for protection against internal fire/explosion from ground fire, lightning, and other stray ignition sources. The success of this program has been demonstrated by over 3 1/2-years continuous service without problems, especially those relating to fuel system contamination. This paper attempts to identify the efforts taken throughout the program to develop successful techniques for faom fabrication, installation, testing, and maintenance. Service verification data indicating what appears to be improved fuel system cleanliness are also presented.

-BIBLIOGRAPHY-

CATO, ET AL.: FUEL TANK EXPLOSION PROTECTION. U.S. BUR. OF MINES. AFAPL-TR- 68-11, MAR. 1969, AND AFAPL-TR-70-40, JULY 1970//GIBSON, J.R., ET AL.: INVESTIGATION OF POLYURETHANE FOAM FOR AIRCRAFT FUEL SYSTEM APPLICATIONS. ASJ-TM-66-1, NOV. 1966//PANZARELLA, P.P.: FLIGHT TEST OF BAFFLING MATERIAL. ASTDN-FTR-68-44, DEC. 29, 1968//REED, T.O.: USAF EXPERIENCE WITH POLYURETHANE FOAM INERTING MATERIAL. ASD-TM-ASNJI-70-2, MAY 1970//ANON.: REVISED FOAM INSTALLATION CRITERIA. ASD-TM-ASNJI-69-1, JAN. 5, 1968

-SOURCE INFORMATION-

CORPORATE SOURCE -
AERONAUTICAL SYSTEMS DIV., WRIGHT-PATTERSON AFB, OHIO
REPORT NUMBER -
PAPER 71-GT-54
JOURNAL PROCEEDINGS -
ASME GAS TURBINE CONF. AND PRODUCTS SHOW, HOUSTON, TEX., MAR. 28-APR. 1, 1971
OTHER INFORMATION -
0009 PAGES, 0006 FIGURES, 0000 TABLES, 0015 REFERENCES

key 610

FUEL TANK EXPLOSION PROTECTION

by

KUCHTA, J.M.
CATO, R.J.
GILBERT, W.H.
SPOLAN, I.

03/00/69

-ABSTRACT-

Small scale and large scale experiments were conducted to determine the flame arrestor effectiveness of three types of hollow, perforated polyethylene spheres proposed for fuel tank fire and explosion protection. In small scale experiments, the flame quenching effectiveness of the spheres decreased with an increase in initial pressure and flame run-up distance (ignition void length) and with a decrease in sphere size and packing density. Randomly packed beds of sphere types A (1 in. dia., 0.1 in. perforations) and B (1 in. dia., 0.05 in. perforations) were effective in preventing flame propagation at pressures up to 5 and 0 psig, respectively, whereas sphere type C (3/4 in. dia., 0.10 in. perforations) failed at 0 psig; with uniformaly packed beds, none of the spheres failed at 0 psig. All three types were noticeably less effective than 10 pore/in. reticulated polyurethane foam. Results from most of the large scale gun firing experiments with randomly packed spheres revealed that the spheres were not effective in preventing flame propagation at 0 psig in a 74 gal. modified fuel tank. Other data that were obtained in pressure drop experiments at various air velocities indicated that the flow resistance is slightly greater for sphere type C than for A or B. Empirical relationships are presented for predicting the pressure drop gradients across dry and wet beds of the spheres at air velocities from 5 to 25 ft./sec.

-PERTINENT FIGURES-

FIG. 5 PRESSURE RISE VS PACKING DENSITY FROM FLAME ARRESTOR EXPERIMENTS WITH 1 IN. DIA. PERFORATED POLYETHYLENE SPHERES (TYPE A) AND APPROXIMATELY 2.5 PERCENT N-PENTANE-AIR MIXTURES AT 0 PSIG PAGE 9//FIG. 8 PRESSURE-TIME TRACES FROM FLAME ARRESTOR EXPERIMENTS IN FULLY-PACKED VESSELS WITH RANDOMLY-PACKED POLYETHYLENE SPHERES AND 10 PPI POLYURETHANE FOAM AT VARIOUS INITIAL PRESSURES (APPROXIMATELY 2.5 PERCENT N-PENTANE-AIR MIXTURES) PAGE 14//FIG. 13 REDUCTION IN BED LENGTH VS AIR VELOCITY FOR 24 IN. LONG BEDS OF RETICULATED POLYURETHANE FOAM IN 8 IN. DIA. STEEL PIPE PAGE 25//FIG. 15 PRESSURE DIFFERENTIAL PER UNIT LENGTH VS AIR VELOCITY FOR 24 IN. LONG PACKED BEDS OF 1 IN DIA. AND 3/4 IN. DIA. POLYETHYLENE SPHERES IN 8 IN. DIA. STEEL PIPE PAGE 29//TAB. 2 PRESSURE GAS TEMPERATURE AND LIGHT EMISSION DATA

PAGE 17//TAB. 4 PRESSURE DROP AS A FUNCTION OF AIR VELOCITY AND LONGITUDINAL POSITION PAGE 24

-SOURCE INFORMATION-

CORPORATE SOURCE -
BUREAU OF MINES, BRUCETON, PA. EXPLOSIVES RESEARCH CENTER.
REPORT NUMBER -
AD-849701//AFAPL-TR-69-11
SPONSOR -
AIR FORCE AERO PROPULSION LAB., WRIGHT-PATTERSON AFB, OHIO
CONTRACT NUMBER -
CONTRACT USAF 33(615)-66-5005
OTHER INFORMATION -
0039 PAGES, 0015 FIGURES, 0006 TABLES, 0004 REFERENCES

key 611

COMBATING FIRE RISKS IN AIRCRAFT

by

COCKRAM, R.W.J.

11/00/70

-ABSTRACT-

Aircraft fire risks, design safety, and fire protection engineering are reviewed considering the areas of fuselage fire protection; fuselage fire extinguishing equipment; fire fighting media for freighter aircraft; carbon dioxide, vaporizing liquids, and powder type extinguishers; electrostatics and lightning strikes; and passenger survival in emergency landings. The main fire risks in the fuselage area usually lead, early in the initial combustion process, to the emission of quantities of smoke; the operations of a smoke detector to reliably discover this hazard are discussed. The severe restrictions of acceptable weight penalty associated with airborne conditions impose such limitations on the mass of fire extinguishing media that great dependence must be placed upon early detection of any fire so that attack can be begun before any conflagration has assumed large proportions or has caused severe structural damage to the vehicle. The developments in this area are reviewed. In designing adequate fire fighting media for a freighter aircraft, lack of accessibility whereby personnel may approach any fire and hand-directed appliances may be used to best advantage is a serious problem. Solutions to this problem are suggested, along with safety design solutions for combating electrostatic and lightning hazards. The use of a personal smoke mask as protective equipment in case of crash landing and subsequent fire is considered.

-PERTINENT FIGURES-

FIG. 1 AND 2 SMOKE DETECTOR MOUNTED IN A VC10 FREIGHT HOLD AND WITH PROTECTIVE COVER REMOVED PAGE 2//FIG. 4 POLAR CURVE OF LIGHT REFLECTION PAGE 3//FIG. 5 PROPOSED BCF FIRE PROTECTION SYSTEM FOR FREIGHTER AIRCRAFT PAGE 4//FIG. 6 PALLETISED CONTAINER PROPOSED FIRE PROTECTION SYSTEM PAGE 5

-SOURCE INFORMATION-

CORPORATE SOURCE -
PYRENE CO., LTD., THAMES (ENGLAND).
JOURNAL PROCEEDINGS -
TECH AIR, VOL. 26, 2-7 (1970)
OTHER INFORMATION -
0006 PAGES, 0008 FIGURES, 0000 TABLES, 0000 REFERENCES

key 621

IMPACT ACTUATED MECHANISM FOR ENGAGING FIRE EXTINCTION SYSTEMS (RUSSIAN)

by

KOROLEV, A.I.
VINOGRADOV, A.S.

06/11/64

-ABSTRACT-

If an airplane makes a forced landing with the landing gear retracted, an outbreak of fire is possible as a result of the shock against the ground. An impact mechanism is therefore proposed which operates on ground impact and auto tically engages an emergency fire extinguishment system. A design depicting the placement of the mechanism on an airplane is included. The mechanism functions not only on straight impact with the ground, but also in the case of sliding or landing with inclination to the side.

-SOURCE INFORMATION-

REPORT NUMBER -
AD-602309//PATENT NO. 157887//APPL. NO. 806537/40-23//FTD-TT-64-180
OTHER INFORMATION -
0003 PAGES, 0002 FIGURES, 0000 TABLES, 0000 REFERENCES

INVESTIGATION OF AIRCRAFT CHEMICAL EXTINGUISHANT FIRE AND EXPLOSION SUPPRESSION SYSTEMS

by

GILLIS, J.P.
DALZELL, W.G.

05/00/69

-ABSTRACT-

The effectiveness of an aircraft chemical extinguishant fire and explosion suppression system was evaluated in a simulated aircraft dry bay volume, a simulated aircraft fuel tank, and a C-130 aircraft inboard main tank. The combustibles used to create the fires and explosions were butane, JP-4, and JP-5. The ignition sources utilized were small arms ammunition, electric spark, and a hot surface. Suppression system components were subjected to a fuel slosh test and a flight test. Tests were conducted to determine the extinguishant distribution characteristics of the system in the C-130 aircraft fuel tank. The fire and explosion suppression system evaluated consisted of a broad band radiation detector, suppressor, and a test unit. Two additional modes of detection, thermal and ultraviolet radiation, were investigated. The suppressor used in the system is a flange-mounted, cylindrical, stainless steel container designed to hold 1000 cc. of Halon 2402. The system test unit, in conjunction with the electronic test circuit in the detector, is used to check detector operation, system continuity and the presence of electrical grounds in the system. The system proved to be effective in detecting and extinguishing dry bay tank fires. It also substantially reduces the explosion hazard potential associated with the penetration of incendiary projectiles into the flammable ullage volume of aircraft fuel tanks.

-PERTINENT FIGURES-

FIG. 2 BROAD BAND DETECTOR, ULTRAVIOLET DETECTOR AND SUPPRESSOR PAGE 5// FIG. 3 SMALL ARMS FIRING RANGE DIAGRAM PAGE 8//FIG. 5 SIMULATED DRY BAY TANK PAGE 11

-SOURCE INFORMATION-

CORPORATE SOURCE -
FENWAL, INC., ASHLAND, MASS.
REPORT NUMBER -
AD-852712//AFAPL-TR-69-16
SPONSOR -
AIR FORCE AERO PROPULSION LAB., WRIGHT-PATTERSON AFB, OHIO.
CONTRACT NUMBER -

CONTRACT F33615-68-C-1407
OTHER INFORMATION -
0224 PAGES, 0011 FIGURES, 0000 TABLES, 0000 REFERENCES

key 643

INVESTIGATION OF PYROTECHNIC GENERATED GAS DISCHARGE FIRE EXTINGUISHING SYSTEM

by

DEROUVILLE, M.
HEBENSTREIT, L.V.

05/00/68

-ABSTRACT-

Advanced aircraft operating in supersonic and hypersonic flight regimes will impose many environmental problems on aircraft subsystems. Fire extinguishing equipment will be required to operate efficiently over a -65 deg. to 500 deg. F. temperature range. To meet this requirement, a subscale pyrotechnic fire extinguishing system was designed, developed, and fire-tested under simulated flight conditions. The system design consisted of an agent chamber, two welded steel hemispheres, coupled with a burst disc, baffle and outlet assembly, and an externally mounted propellant chamber assembly. A series of halogenated methanes, ethanes, propanes, and butanes were analyzed for compatibility with the system. Bromotrifluoromethane (Halon 1301), dibromotetrafluoroethane (Halon 2402), and FC-77 possessed superior stability to the other candidate agents at 500 deg. F. The pyrotechnic extinguisher functioned satisfactorily at the environmental extremes and its performance compared favorably with conventional extinguishing systems. It may be concluded that the pyrotechnic extinguisher will perform effectively aboard advanced aircraft. However, further developmental work is required to improve the performance and weight effectiveness of the system (wherein pyrotechnic pressurization replaces nitrogen as an energy source).

-PERTINENT FIGURES-

FIG. 7 PROPELLANT CHAMBER PRESSURE VS TIME PAGE 42//TAB. 3 STABILITY OF HALON FIRE EXTINGUISHING AGENTS AT 500 DEG. F. FOR 2 MO. IN A STEEL AM-362 CYLINDER PAGE 12//TAB. 6 TEST RESULTS FOR GAS GENERATOR FIRINGS PAGE 25//APP. 2 TAB. 1 COMPATIBILITY RATINGS OF "FIRE-EXTINGUISHING AGENT"/METAL SYSTEMS AT 500 DEG. F. PAGE 5//APP. 2 TAB. 2 STABILITY OF FIRE EXTINGUISHING AGENT/METAL SYSTEMS AT 500 DEG. F. PAGE 7

-SOURCE INFORMATION-

CORPORATE SOURCE -
KIDDE (WALTER) AND CO., INC., BELLEVILLE, N.J.
REPORT NUMBER -
AD-833991//AFAPL-TR-68-47

SPONSOR -
AIR FORCE AERO PROPULSION LAB., WRIGHT-PATTERSON AFB, OHIO.
CONTRACT NUMBER -
CONTRACT AF-33(615)3648
OTHER INFORMATION -
0092 PAGES, 0012 FIGURES, 0012 TABLES, 0000 REFERENCES

AIRCRAFT CRASH. EAST HAVEN, CONNECTICUT

by

WATROUS, L.D.

09/00/71

-ABSTRACT-

On June 7, 1971, an Allegheny Airlines Convair 580 crashed short of the runway in East Haven, Connecticut, into a group of summer cottages on the beach. The alarm was first turned in by a nearby woman resident, then by the airport tower. Fire equipment responded from a municipal station located next to the airport. The crash was not in the same jurisdiction as the airport and permission to cross into the next town was requested and received. Investigators concluded that the loss of life was due to the fire and explosions rather than the impact. More rapid and effective fire extinguishment would have saved most of the 28 lives lost. If the fire had occurred two weeks later, the summer cottages would have been occupied and the loss of life would have been much greater. Two people escaped the crash: one, who had carefully studied the energency card and had located the exits before the flight, exited by a window; the other followed him out. Both survivors reported that people were moving about in the cabin when they escaped.

-PERTINENT FIGURES-

FIG. 2 FIRE CONDITIONS UPON THE ARRIVAL OF NEARBY RESIDENTS WHO HEARD THE CRASH PAGE 10//FIG. 3 PLAN OF CRASH AREA PAGE 10

-SOURCE INFORMATION-

CORPORATE SOURCE -
NATIONAL FIRE PROTECTION ASSOCIATION, BOSTON, MASS. FIRE RECORD DEPT.
JOURNAL PROCEEDINGS -
F1JOAU, FIRE J, VOL. 65, NO. 5, 9-11 (SEPT. 1971)
OTHER INFORMATION -
0003 PAGES, 0003 FIGURES, 0000 TABLES, 0000 REFERENCES

U.S. ARMY TEST AND EVALUATION COMMAND MATERIAL TEST PROCEDURE. COMMODITY SERVICE TEST PROCEDURE RESCUE EQUIPMENT, AIRCRAFT CRASH

by

ARMY TEST AND EVALUATION COMMAND

01/27/71

-ABSTRACT-

The design of a test procedure for selecting helicopter crash fire and rescue equipment is discussed, and a list of the test equipment is included. The tests are arranged to provide a step-by-step analysis of the rescue equipment's suitability. These tests are: (1) check equipment on arrival for physical condition and characteristics; (2) determine the requirements for installation; (3) check the effect of the equipment on the weight and balance of the aircraft; (4) check how the equipment is to be used; (5) check its performance capabilities; (6) check the maintenance procedures; (7) evaluate the equipment's safety characteristics; (8) evaluate the human factors involved; and (9) evaluate the personnel and training requirements.

-SOURCE INFORMATION-

CORPORATE SOURCE -
ARMY TEST AND EVALUATION COMMAND, ABERDEEN, MD.
REPORT NUMBER -
AD-720563//MTP-7-3-090//N71-26195
OTHER INFORMATION -
0024 PAGES, 0000 FIGURES, 0000 TABLES, 0006 REFERENCES

AIRCRAFT MECHANICAL SUBSYSTEMS

by

DOLGICH, A.

10/30/68

-ABSTRACT-

A survey of foreign scientific and technical literature on aircraft mechanical subsystems including flight control subsystems, hydraulic and pneumatic subsystems, anti-icing subsystems, cabin pressurization, cabin thermal control, oxygen, and air conditioning subsystems, electrical and fuel subsystems, and fire extinguishing, emergency escape, landing gear subsystems, and stands for testing aircraft instruments is presented. A description of a thermoindicator which closes a circuit when the temperature of the surrounding air is increased above 130 to 180 deg. C. is given. This checking device, which was used during engine inspection, measures the temperature at five points: (1) area of stop valve of wing anti-icing system, (2) area of drain tank, (3) area of stop valve of cabin pressurization system, (4) area of pumps PN-15-28, and (5) area of generator GSR-18000D. The Russian An-2P fire-fighting amphibious aircraft can be used for cargo and passengers, as well as for reconnaissance and fire fighting. In the center of each of the An-2P's floats is a water compartment of 1260-liter capacity. Sulfanol NP-1 solution is carried in tail secton tanks Firemen are set down or dropped near the fire area and the aircraft then fills its water tanks and adds the sulfanol NP-1 solution.

-PERTINENT FIGURES-

FIG. 1 AN-2P AIRCRAFT FIREFIGHTING SYSTEM PAGE 109

-BIBLIOGRAPHY-

BORISOV, V.N. AND KAVERSIN, S.V.: TEMPERATURE EFFECT OF WORKING FLUIDS ON COMPRESSION FRICTION OF HYDRAULIC CYLINDERS. IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY, MASHINOSTROYENIYE, NO. 4, 88-92, 1968//ZHIROV, S.: ON FALSE TRIGGERING OF FIRE ALARMS. AVIATSIYA I KOSMONAVTIKA, NO. 9, 28-29, 1966

-SOURCE INFORMATION-

CORPORATE SOURCE -
LIBRARY OF CONGRESS, WASHINGTON, D.C. AEROSPACE TECHNOLOGY DIV.
REPORT NUMBER -

AD-677056//N69-14719//ATD REP. 68-43-22-4
OTHER INFORMATION -
0133 PAGES, 0077 FIGURES, 0001 TABLES, 0062 REFERENCES

DEVELOPMENT OF POLYURETHANE FOR CONTROLLING FUEL FIRES IN AIRCRAFT STRUCTURES

by

PARKER, J.A.
RICCITIELLO, S.R.
GILWEE, W.J.
FISH, R.

04/00/69

-ABSTRACT-

Polyurethane foam has been modified to provide fire suppression species, and low-temperature thermal protection without sacrificing useful mechanical properties by the addition of three thermally activated components: halogenated polymers, inorganic salts, and encapsulated volatile or reactive halogen-containing compounds. The salt produces fire quenching or supressio species which react with the degradation products of urethane foam. Halogenated alkyl polymers provide hydrogen chloride which acts as a fire suppressant; however, further decomposition yields flammable species. Thermal degradation of the encapsulated volatile or reactive halogen-containing compounds releases the halogen-bearing molecule resulting in dilution of the gases ejected and, also, providing species which can act as free-radical quenchers on the fuel fire propagation species of the flame. This foam can be used to suppress aircraft impact caused fires as well as to absorb the shock of impact.

-PERTINENT FIGURES-

FIG. 1 RESPONSE OF INORGANIC SALT PLUS HALOGENATED POLYMER-ACETATE MODIFIED POLYURETHANE FOAM TO THE HEATING INPUT OF A FUEL FIRE PAGE 42//FIG. 5 TGA OF POLYVINYL CHLORIDE ACETATE COPOLYMER PAGE 44//FIG. 10 DELIVERY SCHEMATIC OF THREE-COMPONENT POLYURETHANE FOAM KIT PAGE 47//FIG. 11 MIXING HEAD ARRANGEMENTS OF THREE-COMPONENT POLYURETHANE PAGE 47//TAB. 2 THERMOCHEMICAL ANALYSIS OF STARTING MATERIALS FOR COMPOSITE FOAMS PAGE 44//TAB. 3 THERMOCHEMICAL ANALYSIS OF COMPOSITE FOAMS PAGE 45

-BIBLIOGRAPHY-

PARKER, J.A. AND WINKLER, E.L.: THE EFFECTS OF MOLECULAR STRUCTURE ON THE THERMOCHEMICAL PROPERTIES OF PHENOLICS AND RELATED POLYMERS. NASA TR R-276, 1967//SAUNDERS, J.H. AND BACKUS, J.K.: FLAMMABILITY AND THERMAL STABILITY ISOCYANATE BASED POLYMERS. RUBBER CHEM. AND TECH., VOL. 29, NO. 2, MAR. 1966//MADORSKY, S.L.: THERMAL DEGRADATION OF ORGANIC POLYMERS. INTERSCI. PUB., 1964//BOETTNER, E.A., BALL, G., AND WEISS, B.: ANALYSIS OF THE

VOLATIL COMBUSTION PRODUCTS OF VINYL PLASTICS. AM. CHEM. SOC., DIV. OF ORGANIC COATINGS AND PLASTICS, APR. 1968

-SOURCE INFORMATION-

CORPORATE SOURCE -
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION, MOFFETT FIELD, CALIF. AMES RESEARCH CENTER.
JOURNAL PROCEEDINGS -
SAJUAX, SAMPE J, VOL. 5, NO. 3, 41-47 (APR.-MAY 1969)
OTHER INFORMATION -
0007 PAGES, 0011 FIGURES, 0006 TABLES, 0004 REFERENCES

DETECTION AND MEASUREMENT OF THE INFLAMMABLE VAPOURS IN AIRCRAFT

by

WYETH, H.W.G.
TIMMINS, G.W.

09/00/65

-ABSTRACT-

Catalytic combustion techniques of detecting low concentrations of flammable vapors in aircraft void spaces appear to be promising. Specifications for a vapor detector for use in an aircraft compartment include: accuracy within 10 percent of true reading, warning signal at 20 percent of lower explosive limit, a linear realtionship between vapor concentration and sensor output, 90 percent response to a step change in the gas concentration in less than 3 sec. and full response within 5 sec., pressure range from 1 to 30 psia, temperatures from -26 to 200 deg. C., and a proof acceleration of 17 g without residual damage. Catalytic combustion techniques of vapor detection have been used in other fields successfully and should be suitable for measuring low vapor concentrations. Higher vapor concentrations could be better measured by use of an ionization efficiency detector.

-PERTINENT FIGURES-

TAB. 1 INFLAMMABILITY LIMITS OF VARIOUS VAPOURS AND GASES AT ATMOSPHERIC PRESSURE PAGE 33//TAB. 2 HYDROCARBON COMPOSITION OF GASOLINE PAGE 34//TAB. 3 HYDROCARBON COMPOSITION OF MID-CONTINENTAL PETROLEUM PAGE 35//TAB. 4 COMPOSITION OF AIRCRAFT FUELS PAGE 39//TAB. 5 GAS IONISATION POTENTIALS PAGE 40

-BIBLIOGRAPHY-

WYETH, H.W. AND MILLER, R.E.: THE DETECTION AND MEASUREMENT OF OXYGEN IN AIRCRAFT FUEL TANKS. RAE TECH. NOTE, MECH. ENG. 393/CPM.41, NOV. 1963// MACDONALD, J.A. AND WHITE, R.G.: SPONTANEOUS IGNITION OF KEROSENE (AVTUR) FUEL VAPOUR WITHIN A FOUR INCH CYLINDRICAL VESSEL. RAE TECH. NOTE, MECH. ENG. 379, JUNE 1963//LEWIS, B. AND VON ELBE, G.: COMBUSTION, FLAMES AND EXPLOSIONS OF GASES. 2ND ED., ACADEMIC PRESS, LONDON, 1961//GOODGER, E.M., CADMAN, P., AND MURCHIE, I.T.: PROTECTION OF AIRCRAFT FUEL TANKS USING INERT COMBUSTION PRODUCTS. COLL. OF AERONAUT. REP. NO. 85, OCT. 1955// WINTER, K.: PORTABLE APPARATUS FOR THE UNDERGROUND DETERMINATION OF FIRE-DAMP IN BITUMINOUS COAL MINES. 8TH INTERN. CONF. OF DIRECTORS OF SAFETY IN MINES RES., PAPER NO. 33, U.D.C. 622-412, DORTMUND-D, GERMANY, 1954

-SOURCE INFORMATION-

CORPORATE SOURCE -
ROYAL AIRCRAFT ESTABLISHMENT, FARNBOROUGH (ENGLAND).
REPORT NUMBER -
AD-477232//TR-65191
OTHER INFORMATION -
0075 PAGES, 0029 FIGURES, 0005 TABLES, 0072 REFERENCES

THERMODYNAMIC PROPERTIES DUPONT FE 1301 FIRE EXTINGUISHING AGENT

-ABSTRACT-

The thermodynamic properties of the fire extinguishing agent, Freon 1301, (bromotrifluoromethane) are tabulated. The data include a pressure-enthalpy diagram of the compound. Saturation properties are given for the temperature range -160 deg. F. to 152.6 deg. F., which is the critical temperature. Properties of the superheated vapor are tabulated over a broad temperature range for absolute pressures of from 3.0 to 600 lb./sq. in.

-SOURCE INFORMATION-

CORPORATE SOURCE -
    DUPONT DE NEMOURS (E.I.) AND CO., WILMINGTON, DEL.
REPORT NUMBER -
    T-1301
OTHER INFORMATION -
    0025 PAGES, 0001 FIGURES, 0002 TABLES, 0000 REFERENCES

FUEL FIRE PROTECTION DEVICE FOR SMALL HEI PROJECTILE THREAT

by

THIBODEAU, J.E.

08/00/69

-ABSTRACT-

A study was conducted to determine nitrogen pressure required in a given thickness of purge mat to prevent fuel cell fires when impacted with 20 mm. high explosive incendiary (HEI) projectiles. A fuel tank test structure was fabricated with a window in one of the vertical faces. An expandable fixture adapted to accept purge mats of varying thickness was fastened to the window side of the structure. Self-sealing test cubes of approximately 60 gal. capacity were used as fuel containers. The purge mat was placed in the window and pressurized to the desired pressure with nitrogen. The purge mat was constructed of a nylon fabric woven with drop threads holding the top and bottom plies a predetermined distance apart. This fabric construction is called AIRMAT. The AIRMAT fabric is coated with Goodyear VITHANE rubber, cut to the desired configuration, and then sealed around the periphery with an inflation valve added. From the results of the tests, it was apparent that a purge mat system could be devised to decrease the vulnerability of aircraft from fires caused by HEI ammunition. This system could take advantage of voids as small as one inch in depth and could be adapted to ground vehicles as well as aircraft. To prevent ignition of fuel, nitrogen pressures of 20 psi are required with purge mat thickness of 1 to 6 in. Lower pressures can be used with thicker purge mats, thereby decreasing the possibility of structural damage due to high pressures.

-PERTINENT FIGURES-

-SOURCE INFORMATION-

CORPORATE SOURCE -
GOODYEAR TIRE AND RUBBER CO., AKRON, OHIO. AVIATION PRODUCTS DIV.
REPORT NUMBER -
AD-859970//REP. NO. 19-607
SPONSOR -
BALLISTIC RESEARCH LABS., ABERDEEN PROVING GROUND, MD.

CONTRACT NUMBER -
CONTRACT DA-33-019-AMC-322 (X)
OTHER INFORMATION -
0014 PAGES, 0008 FIGURES, 0002 TABLES, 0000 REFERENCES

key 679

HIGH TEMPERATURE INFRARED DETECTORS FOR AIRCRAFT FIRE DETECTION

by

ENTINE, G.
MITCHELL, C.R.
WALD, F.V.
COCKS, F.H.

12/00/71

-ABSTRACT-

Cadmium telluride photodetectors capable of operating continuously at 750 deg. F. were developed. The detectors at temperature could detect a photosignal of 100 mu w/sq. cm. with a signal to noise ratio of fourteen to one with an output impedance of 500 ohms. The detectors had peak sensitivity near 0.9 mu and were quite insensitive above 1.2 mu, making them ideal for operation as aircraft engine fire detectors. The detectors were of two types: photoconductive and contact barrier. Other types of photodetectors which were explored included transparent contact photodetectors, cadmium sulfide-cadmium telluride heterojunctions, and a capacitively coupled cadmium telluride photoconductor. The heterojunction may be the first power generating semiconductor device to operate at 750 deg. F. The capacitively coupled device may make possible the fabrication of photodetectors operable at temperatures much higher than 900 deg. F.

-PERTINENT FIGURES-

FIG. 1 RADIATION INCIDENT ON A 1 SQ. CM. DETECTOR FROM: (A) BLACK BODY AT 1000 DEG. F. 10 FT. AWAY, 60 DEG. FIELD OF VIEW, AND (B) WHITE GASOLINE-AIR FLAME 6 IN. IN DIA. PAGE 2//FIG. 10 PYROLYTIC QUARTZ DEPOSITION UNIT PAGE 19//FIG. 13 THE TRANSMITTANCE OF TELLURIUM ON QUARTZ AFTER VARYING AMOUNTS OF TIME AT 750 DEG. F. PAGE 24//FIG. 26 PHOTOSIGNAL GENERATED BY FIRST IR CONTACTED DEVICE OPERATING AT 400 DEG. C. UNDER HIGH LIGHT INTENSITY PAGE 46//FIG. 30B DESIGN FOR MOUNTING THIN DETECTORS EMPLOYING NO TACKING AGENT PAGE 53//TAB. 1 EFFECTS OF HEATING AT 750 DEG. F. ON THE RESISTANCE AND TRANSMITTANCE OF GOLD FILMS ON QUARTZ PAGE 21

-BIBLIOGRAPHY-

BELL, R.O., HEMMAT, N., AND WALD, F.: CADMIUM TELLURIDE GROWN FROM TELLURIUM SOLUTION AS A MATERIAL FOR NUCLEAR RADIATION DETECTORS. PHYS. STATUS SOLDI, VOL. 1, NO. 9, 375, 1970//WOLFF, G.A., LABELLE, JR., H.E., AND DAS, B.N.: SOLUTION GROWTH OF (ZINC, MERCURY) TELLURIDE AND GALLIUM (PHOSPHORUS, ARSENIC) CRYSTALS. TRANS. TMS-AIME, 242, 435, 1968//HEMMAT, N., LAMPORT, C.B., MENNA,

A.A., AND WOLFF, G.A.: SOLUTION GROWTH OF ELECTRONIC COMPOUNDS AND THEIR SOLID SOLUTIONS. AICHE CONF. ON MATERIALS ENG., ATLANTA, GA., FEB. 1970//DIBENEDETTO, B. AND CRONAN, C.J.: SINGLE CRYSTALS OF LEAD SELENIUM TITANIUM OXIDE GROWN BY TRAVELING HEATER METHOD. J. AM. CERAMICS SOC., VOL. 51, 364-368, 1968//VAN VLIET, K.M.: NOISE LIMITATIONS IN SOLID STATE PHOTODETECTORS. APPL. OPTICS, VOL. 6, 1145, 1967//BELL, R.O., HEMMAT, N., AND WALD, F.: NUCLEAR DETECTORS FROM CADMIUM TELLURIDE GROWN FROM A TELLURIDE SOLVENT. TRANS. IEEE ON NUCL. SCI., NS-17, NO. 3 241, JUNE 1970

-SOURCE INFORMATION-

CORPORATE SOURCE -
TYCO LABS., INC., WALTHAM, MASS.
REPORT NUMBER -
C-111//AFAPL-TR-71-89
SPONSOR -
AIR FORCE AERO PROPULSION LAB., WRIGHT-PATTERSON AFB, OHIO.
CONTRACT NUMBER -
CONTRACT F33615-71-C-1084
OTHER INFORMATION -
0095 PAGES, 0049 FIGURES, 0009 TABLES, 0042 REFERENCES

AIRCRAFT INTERIOR FIRE PROTECTION SYSTEMS 1971, TENTATIVE RECOMMENDED PRACTICE ON

by

NATIONAL FIRE PROTECTION ASSOCIATION

05/00/71

-ABSTRACT-

The installation of fixed or portable automatic aircraft interior fire detection and suppression systems to control fires during aircraft construction, maintenance, and servicing under conditions where the hazards or environment make such protection desirable are recommended. These systems are independent of any structural or external fire protection when the aircraft is in an aircraft hangar, an aircraft manufacturing building, at an aircraft maintenance dock, or on an airport ramp. General requirements are given for preactuation alarm system and actuating alarm system equipment. Requirements, advantages, and precautions are also included for fire suppression systems based on halogenated extinguishing agent systems and high expansion foam systems. The appendix gives brief summaries of case histories of aircraft cabin fires.

-SOURCE INFORMATION-

CORPORATE SOURCE -
NATIONAL FIRE PROTECTION ASSOCIATION, BOSTON, MASS.
REPORT NUMBER -
NFPA NO. 421-T
OTHER INFORMATION -
0032 PAGES, 0000 FIGURES, 0000 TABLES, 0025 REFERENCES

FIRE EXTINGUISHERS. VOL. 1 OF 2 VOLS. DEC. 1960-DEC. 1968

by

DEFENSE DOCUMENTATION CENTER

10/00/69

-ABSTRACT-

The 53 references in this bibliography, which are unclassified and have unlimited distribution, are arranged in AD number sequence. They are the result of a DDC computer search of materials prepared between January 1953 and August 1969, and they are included under one of three topic headings: (1) extinguishers for aircraft, spacecraft, and ships; (2) chemical extinguishing agents; and (3) extinguishers and miscellaneous information. Extinguishing agents covered include foams, powders, inert gases, and water. Computer-generated indexes covering Corporate Author/Monitoring Agency, Subject, and AD number are provided. In addition, each reference includes index terms and an abstract of the document.

-SOURCE INFORMATION-

CORPORATE SOURCE -
DEFENSE DOCUMENTATION CENTER, ALEXANDRIA, VA.
REPORT NUMBER -
AD-696900//DDC-TAS-69-61-1
OTHER INFORMATION -
0069 PAGES, 0000 FIGURES, 0000 TABLES, 0053 REFERENCES

FIRE EXTINGUISHERS. VOL. 2. FEB. 1953-MAR. 1969

by

DEFENSE DOCUMENTATION CENTER

10/00/69

-ABSTRACT-

This bibliography, Volume 2 of two volumes, comprises 189 unclassifed references arranged in AD number sequence under one of four headings: extinguishers for aircraft, spacecraft, and ships; chemical extinguishing agents; and extinguishers and miscellaneous information. Computer generated indexes covering Corporate Author/Monitoring Agency, Subject, and AD number are provided. The materials cited in this bibliography cover the period January 1953 to August 1969. Some documents in this volume require release approval from the authority cited. Those in Volume 1 are unlimited in distribution.

-SOURCE INFORMATION-

CORPORATE SOURCE -
DEFENSE DOCUMENTATION CENTER, ALEXANDRIA, VA.
REPORT NUMBER -
AD-862201//DDC-TAS-69-61-11//AD-696900-VOL. 1
OTHER INFORMATION -
0235 PAGES, 0000 FIGURES, 0000 TABLES, 0189 REFERENCES

AIRCRAFT CRASH FIRE PROTECTION SYSTEM. SUPPLEMENTAL REPORT COVERING TURBO- JET AND TURBO-PROP POWERED AIRCRAFT

by

JONES, R.B.
DIQUATTRO, R.G.
FRITSCH, K.

04/11/55

-ABSTRACT-

From consideration of the effect of residence time on spontaneous ignition temperatures, study of air flow through the turbojet engine, determination of operating metal temperatures, and supported by experimental data, the feasibility was demonstrated of inerting the jet engine as a possible source of ignition during survivable crashes by keeping the engine filled with an inert atmosphere while cooling the hot metal surfaces with water. Several test crashes of jet engine powered aircraft proved conclusively the effectiveness of the inerting technique. The design details are described that would be required to inert the jet engine as an ignition source during a survivable type crash. Since there is little difference in the techniques of crash-fire prevention between reciprocating engine powered aircraft and turbojet or turboprop powered aircraft as far as the initiating system and the shut-off system are concerned, the minor modifications required to transpose these systems of the reciprocating engine aircraft are described. Inerting and cooling the engine, however, is different; there is no identical equipment to be transferred. The method of inerting one jet engine on an experimental basis pointed out and it is shown that the same methods can be applied to any jet engine. The actual components that would permit the construction of an integrated inerting system for a jet engine have not been developed; thus this report deals mainly in generalities.

-PERTINENT FIGURES-

FIG. 1 CRASH FIRE INERTING SYSTEM FOR TURBOJET ENGINE PAGE 8

-SOURCE INFORMATION-

CORPORATE SOURCE -
KIDDE (WALTER) AND CO., BELLEVILLE, N.J.
REPORT NUMBER -
AD-887326//SEE ALSO F7100498 (AD-887325)
SPONSOR -
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION, CLEVELAND, OHIO. LEWIS RESEARCH CENTER.

CONTRACT NUMBER -
    CONTRACT AF-18(600)-167
OTHER INFORMATION -
    0009 PAGES, 0001 FIGURES, 0000 TABLES, 0000 REFERENCES

INVESTIGATION OF FIRE EXTINGUISHING SYSTEM REQUIREMENTS FOR ADVANCED FLIGHT VEHICLES

by

LANDESMAN, H.
KLUSMANN, E.B.
MINICH, J.
CHRISTIANSEN, G.

01/00/66

-ABSTRACT-

Extinguishing system in-flight operating environment requirements were defined as a function of parameters such as Mach number, altitude, and flight duration. The limits of usefulness of conventional halogenated hydrocarbon extinguishants were determined in the Mach 3 to 8 regime, along with the extent to which these extinguishants can be used in this regime by the application of insulation, cooling, and heavier agent storage containers. The system weight penalties involved were determined. New agents were investigated with the possibility of increasing agent thermal stability with additives and improving surface tension and viscosity- temperature characteristics with additives; the physical properties of the agents were determined and the feasibility of utilizing metallic salts as extinguishing agents for conditions of extreme environmental temperatures was examined. Data are provided on aircraft surface temperatures and extinguishant heating at supersonic speeds and on thermal stability limits for model structures of fluorinated chloro- and bromo-carbons suitable for use as fire extinguishing agents.

-PERTINENT FIGURES-

FIG. 15 EFFECT OF INHIBITORS ON FLAMMABILITY OF N-HEPTANE-AIR MIXTURES PAGE 37//FIG. 17 VAPOR PRESSURES OF AGENTS PAGE 49//TAB. 3 VISCOSITIES OF HALOGEN CONTAINING COMPOUNDS PAGE 40//TAB. 5 SURFACE TENSIONS OF AGENTS WITH SURFACTANTS PAGE 45//TAB. 8 INSULATION WEIGHT PENALTIES PAGE 54

-SOURCE INFORMATION-

CORPORATE SOURCE -
NATIONAL ENGINEERING SCIENCE CO., PASADENA, CALIF.
REPORT NUMBER -
AD-477549//AFAPL-TR-65-124//SN-229
SPONSOR -
AIR FORCE AERO PROPULSION LAB., WRIGHT-PATTERSON AFB, OHIO
CONTRACT NUMBER -
CONTRACT AF-33(615)-2357

OTHER INFORMATION -
0334 PAGES, 0279 FIGURES, 0008 TABLES, 0036 REFERENCES

EXTINCTION OF EXPERIMENTAL AIRCRAFT FIRES WITH LIGHT WATER

by

FITTES, D.W.
GRIFFITHS, D.J.
NASH, P.

11/00/69

-ABSTRACT-

Experiments were carried out to assess the fire performance of light water and protein foam on full-scale simulated aircraft fires. Fires up to 3,500 sq. ft. in area and containing up to 1,000 gal. of aviation fuel were used in the experiments. In comparision with regular protein foam, light water foam was generally up to twice as effective in controlling major aircraft fires, i.e., it required about half the weight of fire fighting solution to control the same fire when both agents were applied at their most economic rate. Light water was, in general, found to be proportionatel more effective than protein foam in achieving a rapid initial reduction of heat radiation from the fire. Re-sealing of small areas with light water was good, but its resistance to the re-establishment of the fire, once a sizeable area of flame has been reopened, was only about one-third that of protein based foams. Light water can be used in certain unmodified protein foam making equipment, but in others modifications may be necessary to suit its higher viscosity.

-BIBLIOGRAPHY-

RASBASH, D.J., THORNE, P.F., AND WOOLEY, W.D.: SLURRIES OF SOLID CARBON DIOXIDE AS EXTINGUISHING AGENTS. FIRE RES. NOTE 717, JOINT FIRE RES. ORG., 1968//RASBASH, D.J., ET AL.: PRODUCTION OF HIGH-EXPANSION FOAM FOR FIRE- FIGHTING USING A JET ENGINE. FIRE INTERN., VOL. 1, NO. 9, 61-76, 1965// FITTES, D.W., GRIFFITHS, D.J., AND NASH, P.: THE USE OF LIGHT WATER FOR MAJOR AIRCRAFT FIRES. FIRE RES. NOTE 762, JOINT FIRE RES. ORG., 1969

-SOURCE INFORMATION-

CORPORATE SOURCE -
FIRE RESERACH STATION, BOREHAM WOOD (ENGLAND).
JOURNAL PROCEEDINGS -
FIRE, VOL. 62, NO. 773 (NOV. 1969)
OTHER INFORMATION -
0002 PAGES, 0001 FIGURES, 0000 TABLES, 0007 REFERENCES

keys 733 through 735

AIRCRAFT RESCUE AND FIRE FIGHTING VEHICLES 1970, STANDARD FOR

by

NATIONAL FIRE PROTECTION ASSOCIATION

00/00/70

-ABSTRACT-

A guide for airport operators intending to purchase aircraft rescue and fire fighting equipment is presented. Features are outlined for an efficient and capable major fire fighting vehicle for both on- and off- pavement performance. Off-pavement performance is given special attention, since a vehicle must contend quickly with situations where highway equipment might be halted or delayed. Features are also given for rescue vehicles and tank vehicles for servicing on-line fire fighting equipment. Four basic categories of vehicles are described: (1) major fire fighting vehicles, (2) light rescue vehicles, (3) tank vehicles, and (4) combined agent vehicles. Vehicles must have all-wheel drive, rapid acceleration, maximum mobility on and off pavements under all weather conditions, ease of operation, safety, reliability, and accessibility for repairs and maintenance. A questionnaire is provided to evaluate fire fighting equipment.

-SOURCE INFORMATION-

CORPORATE SOURCE -
NATIONAL FIRE PROTECTION ASSOCIATION, BOSTON, MASS.
REPORT NUMBER -
NFPA NO. 414
OTHER INFORMATION -
0124 PAGES, 0001 FIGURES, 0005 TABLES, 0000 REFERENCES

key 736

ENGINEERING OBSERVATIONS ON AN MB-5 AIRCRAFT FIRE-FIGHTING AND RESCUE VEHICLE

by

PETERSON, H.B.
GIPE, R.L.

10/28/66

-ABSTRACT-

A production MB-5 aircraft fire-fighting and rescue vehicle was taken from the manufacturer and instrumented to record simultaneously engine speed, road speed, and foam pump speed. The vehicle was then subjected to maximum acceleration runs and simulated fire-fighting operations wherein the vehicle was maneuvered while the foam system was being operated. With the vehicle in its as-received condition, the fire-fighting system was erratic in performance and completely unsatisfactory. Adjustments by the vehicle manufacturer and the engine manufactuer greatly improved performance. Operation is still not fully satisfactory because of low water feed rate to the foam pump, hazardous overspeeding of the foam pump, and engine surging while operating on the pumping governor. Numerous other items not in compliance with the purchase specification were found. Improved specifications and inspection procedures are desirable for future procurements.

-PERTINENT FIGURES-

FIG. 5 FREE VEHICLE SPEED WHILE PUMPING (AS-RECEIVED CONDITION) PAGE 15// FIG. 7 ENGINE, FOAM PUMP, AND VEHICLE SPEEDS DURING ENGAGEMENT OF TRANSMISSION WITH FOAM PUMP OPERATING PAGE 17//FIG. 8 ENGINE, FOAM PUMP, AND VEHICLE SPEEDS PAGE 18//FIG. A6 RECENT MEASUREMENTS OF ENGINE, FOAM PUMP, AND VEHICLE SPEEDS DURING A FIRE-FIGHTING OPERATION PAGE 26

-SOURCE INFORMATION-

CORPORATE SOURCE -
NAVAL RESEARCH LAB., WASHINGTON, D.C.
REPORT NUMBER -
AD-644580//NRL REP. 6461
OTHER INFORMATION -
0028 PAGES, 0013 FIGURES, 0000 TABLES, 0007 REFERENCES

key 737

APPLICATION OF LIGHT WATER ON AIRCRAFT CARRIER FLIGHT DECKS, INTERIM REPORT.

by

PETERSON, H.B.
GIPE, R.L.
NEILL, R.R.

07/00/69

-ABSTRACT-

A number of commercially available and especially modified water and foam nozzles were examined for their discharge rates, density of ground patterns, and light water foam output characteristics. Most work was done under no wind conditions, although some runs were made under 30 knot crosswind conditions. Water spray nozzles are effective for extinguishing JP-5 fuel fires with light water solutions even though the quality of foam produced is not as high as that from conventional foam making nozzles. The nozzles were studied as to their suitability for use on hose lines for the flight and hangar decks and for use as fixed nozzles mounted around the edge of the flight deck, pre-set to discharge toward the center. The best angle of discharge for the deck edge type nozzles has been selected as 10 deg. above the horizontal. This represents a compromise between maximum reach of the stream and excessive losses from windage. A modification for the existing 1 in. solid stream recessed nozzles has been designed to lower their angle of discharge from 45 deg. to 10 deg. to minimize wind losses and reduce the flow.

-PERTINENT FIGURES-

FIG. 11 WATER FLOW RATES FOR VARIED FLOW SETTINGS AND VARIED INLET PRESSURES - ELKHART 1 1/2 IN. SFL PAGE 31//FIG. 16 GROUND PATTERN OUTLINES OF 2 1/2 IN. FFF PRODUCED WITH AND WITHOUT SCREEN PAGE 36//FIG. 20 SELECT- O-FLOW NOZZLE MOUNTED FOR CROSSWIND PATTERN TEST WITH COLLECTION PAN ARRAY IN BACKGROUND PAGE 40//FIG. 28 LIGHT WATER SOLUTION DENSITIES IN GAL./MIN. FT. SQ. WITHIN GROUND OF SOLID STREAM RECESSED (CANNON) NOZZLE; (A) AS PRESENTLY INSTALLED WITH 45 DEG. DISCHARGE; (B) AS MODIFIED BY NRL WITH 10 DEG. DISCHARGE PAGE 48//TAB. 1 CANDIDATE NOZZLE DESCRIPTION PAGE 4//TAB. 2 LIGHT WATER FOAM CHARACTERISTICS PAGE 8

-BIBLIOGRAPHY-

PETERSON, H.B., TUVE, R.L., JABLONSKI, E.J., NEILL, R.R., BERTSCHY, A.W., AND GIPE, R.L.: FIRE EQUIPMENT TESTS ABOARD THE CVA-62 RELATED TO IMPROVED CARRIER SAFETY. NRL MEMO REP. 1851, JAN. 30, 1968

-SOURCE INFORMATION-

CORPORATE SOURCE -
NAVAL RESEARCH LAB., WASHINGTON, D.C.
REPORT NUMBER -
AD-858800IL//NRL-MR-2020
OTHER INFORMATION -
0051 PAGES, 0029 FIGURES, 0002 TABLES, 0001 REFERENCES

PROPOSED INITIATING SYSTEM CRASH-FIRE PREVENTION SYSTEMS

by

MOSER, J.C.
BLACK, D.O.

12/00/56

-ABSTRACT-

The initiating system described was designed to meet the requirements of a crash fire prevention system as determined by a study of data obtained from full-scale experimental and accidental airplane crashes. The initiating system detects when conditions for crash fire exist and turns on an inerting system, which suppresses the ignition sources that can ignite spilled combustibles. An example of the application of these requirements in the design of an initiating system for a twin-engined piston powered airplane is given. The proposed system meets the requirements for rapid and reliable actuation of the inerting system while largely avoiding the hazards associated with accidental functioning. The initiating system is based upon the use of mechanically simple switches that detect linear movement or contact pressure and avoid the use of inertia and frangible switches. This system is selective in that it inerts only those damaged zones where combustibles are spilled. The proposed system can be modified to meet the special needs of various airplane configurations, whether they are powered by reciprocating, turboprop, or turbojet engines.

-PERTINENT FIGURES-

FIG. 1 BLOCK DIAGRAM SHOWING HOW INITIATING SWITCHES ARE INCORPORATED INTO CRASH-FIRE-PREVENTION SYSTEM FOR TWIN-ENGINED AIRPLANE PAGE 12//FIG. 2 SWITCH INSTALLED BETWEEN ENGINE MOUNTING RING AND ENGINE TO DETECT ENGINE BREAKOUT PAGE 13//FIG. 4 SWITCH INSTALLED ON MAIN LANDING GEAR TO DETECT TEARING OUT OF LANDING GEAR FROM AIRPLANE PAGE 15//FIG. 5 FUEL TANK PENETRATION SWITCH PAGE 16//FIG. 6 FUEL TANK PENETRATION SWITCH INSTALLED INSIDE WING PAGE 17//FIG. 7 LOCATION OF FUSELAGE BELLY CONTACT SWITCHES ON TWIN-ENGINED AIRPLANE PAGE 18

-BIBLIOGRAPHY-

BLACK, D.O. AND MOSER, J.C.: FULL-SCALE PERFORMANCE STUDY OF A PROTOTYPE CRASH-FIRE PROTECTION SYSTEM FOR RECIPROCATING-ENGINE-POWERED AIRPLANES. NACA-RM-E55B11, 1955//PINKEL, I.I., PRESTON, G.M., AND PESMAN, G.J.: MECHANISM OF START AND DEVELOPMENT OF AIRCRAFT CRASH FIRES. NACA REP. 1133, 1953

-SOURCE INFORMATION-

CORPORATE SOURCE -
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION, CLEVELAND, OHIO. LEWIS RESEARCH CENTER.

REPORT NUMBER -
NACA-TN-3774//AD-116234

OTHER INFORMATION -
0018 PAGES, 0007 FIGURES, 0000 TABLES, 0002 REFERENCES

INTRODUCTORY REMARKS ON THE DEVELOPMENT OF FIRE PROTECTIVE SYSTEMS

by

GOODWIN, G.

02/27/68

-ABSTRACT-

Two developments of fire protective systems are discussed and described: the use of a low density polyurethane-based foam material to suppress a fire and to provide protection for the structure of an aircraft or spacecraft, and the use of an intumescent paint which, when activated by the heat of a fire, reacts to form a thick, low density, polymeric coating that protects the substructure upon which it has been applied by virtue of its extremely low thermal conductivity and by the release of water vapor during the intumescent reaction. The basic chemistry upon which these protective mechanisms depend is described, and the preliminary material formulation and screening tests, process and material specifications are presented, along with limited evaluation tests in fuel fires. The intumescent intermediate synthesized was p-nitroaniline bisulfate which was mixed with methyl ethyl ketone, nitrocellulose, ethyl alcohol, and sulfuric acid to form the intumescent coating.

-PERTINENT FIGURES-

FIG. 3 PICTORIAL PRESENTATION OF THE MECHANISM OF FIRE PROTECTION, SHOWING THE PYROLYSIS OF AN UNMODIFIED POLYMERIC CHAR-FORMING LOW DENSITY FOAM PAGE 5//FIG. 5 PICTORIAL PRESENTATION OF THE MECHANISM OF FOAM-FIRE INTERACTION BY ADDING THE ACTION OF AN INORGANIC SALT, POTASSIUM TETRAFLOROBORATE, TO THE FOAM PAGE 6//FIG. 15 THERMOCHEMICAL INTERACTIONS OF POLYURETHANE FOAM AND POLYVINYLCHLORIDE ACETATE COPOLYMER DETERMINED FROM A THERMOGRAM PAGE 11//FIG. 39 ILLUSTRATION OF USE OF PRE-MOLDED PANELS, GLUED OR FASTENED IN PLACE PAGE 23//FIG. 44 COMPARISON OF PROTECTION AFFORDED AN ALUMINUM ALLOY PLATE (1/8 IN. THICK 2024-T4) BY 1 IN. THICK SLABS OF VARIOUS COMPOSITY FOAM SYSTEMS AND MILP-46111 FOAM PAGE 25//FIG. 61 TABER ABRASION RESISTANCE TEST OF INTUMESCENT COATING. THE ABRASION RESISTANCE OF THE INTUMESCENT PAINT IS COMPARABLE TO THAT OF A COMMERCIAL LACQUER PAGE 34

-SOURCE INFORMATION-

CORPORATE SOURCE -
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION, MOFFETT FIELD, CALIF. AMES RESEARCH CENTER.
JOURNAL PROCEEDINGS -

PRELIMINARY DATA FROM STUDIES OF FIRE RETARDANT MATERIALS, MOFFETT FIELD, CALIF., FEB. 27-28, 1968

OTHER INFORMATION -

0038 PAGES, 0070 FIGURES, 0000 TABLES, 0000 REFERENCES

key 772

FLAME ARRESTER MATERIALS FOR FUEL TANK EXPLOSION PROTECTION

by

KUCHTA, J.M.
CATO, R.J.
GILBERT, W.H.

07/00/70

-ABSTRACT-

An investigation was conducted to extend the data on the flame arrester effectivness of reticulated polyurethane foams proposed for explosion protection of aircraft fuel tanks. Foams of 10, 15, 20, and 25 pore/in. were evaluated in small- or large-scale experiments using various arrester packing configurations. Results from small-scale experiments indicated that the ability of the foams to suppress n-pentane-air explosions does not vary noticeably when the foam bulk density is reduced from 1.86 to 1.35 lb./cu. ft. Other light-weight arresters that were evaluated included crimped or honeycomb aluminum and Nomex materials which proved to be more effective than 100 ppi polyurethane foam; samples of reticulated aluminum foam were also investigated. Large-scale gun-firing experiments made in a 74 gal. fuel tank showed that a cored arrester model of the dry 20 pore/in. polyurethane foam, having 2 in. dia. cores, can be a suitable design configuration for integral fuel tank applications at pressures up to 5 psig; however, some arrester burning can be expected. Data are also given from other large-scale experiments in which the fuel tank was fully packed with the foam (dry or wet) and the effects of tank ullage and addition of air after ignition were investigated.

-PERTINENT FIGURES-

FIG. 1 EXPERIMENTAL SETUP FOR FLAME ARRESTER EXPERIMENTS IN A 1 CU. FT. CYLINDRICAL STEEL VESSEL (6 IN. DIA. BY 60 IN. LONG) PAGE 2//FIG. 5 NOMEX AND ALUMINUM FLAME ARRESTERS PRIOR TO IGNITION PAGE 9//FIG. 6 DOWNSTREAM END VIEW OF NOMEX AND ALUMINUM FLAME ARRESTER MATERIALS AFTER IGNITION OF 2.5 PERCENT N-PENTANE-AIR MIXTURES AT INITIAL PRESSURES THAT RESULTED IN ARRESTER FAILURE (6-IN. DIAMETER VESSEL) PAGE 11//FIG. 8 EFFECT OF INITIAL MIXTURE PRESSURE ON PRESSURE RISES IN FLAME ARRESTER EXPERIMENTS WITH RETICULATED ALUMINUM AND POLYURETHANE FOAMS AND 2.5 PERCENT N-PENTANE-AIR MIXTURES (6 IN. DIA. VESSEL) PAGE 15//FIG. 7 EFFECT OF IGNITION VOID LENGTH ON PRESSURE RISE IN FLAME ARRESTER EXPERIMENTS WITH RETICULATED ALUMINUM AND POLYURETHANE FOAMS AND 2.5 PERCENT N-PENTANE-AIR MIXTURES AT ATMOSPHERIC PRESSURE (6 IN. DIA. VESSEL) PAGE 13//TAB. 7 DATA FROM LARGE-SCALE FLAME ARRESTER EXPERIMENTS WITH 10 AND 20 PPI POLYURETHANE FOAM (WET AND DRY) FULLY-PACKED IN A TANK WITH 3 PERCENT N-BUTANE-AIR MIXTURES AT

VARIOUS INITIAL PRESSURES PAGE 25

-SOURCE INFORMATION-

CORPORATE SOURCE -
BUREAU OF MINES, PITTSBURGH, PA. SAFETY RESEARCH CENTER.
REPORT NUMBER -
AFAPL-TR-70-40//SRC REP. S4138
SPONSOR -
AIR FORCE AERO PROPULSION LAB., WRIGHT-PATTERSON AFB, OHIO.
CONTRACT NUMBER -
CONTRACT F33615-69-M-5002
OTHER INFORMATION -
0033 PAGES, 0012 FIGURES, 0007 TABLES, 0003 REFERENCES

THE USE OF A SALT OF P-NITROANILINE AS A COMPONENT FOR INTUMESCENT COATINGS

by

PARKER, J.A.
FOHLEN, G.M.
SAWKO, P.M.
GRIFFIN, JR., R.N.

05/02/68

-ABSTRACT-

The synthesis and thermochemistry of intumescent intermediates (salts derived from certain nitro substituted aromatic amines and sulfuric acid) are described. Chemical evidence is presented which suggests that the acid sulfate salts of certain nitro substituted aromatic amines polymerize thermally to yield thermally and oxidatively resistant heterocyclic polymers with quinoxaline-like structures. Intumescence of coatings formulated from the acid sulfate salt of p-nitroaniline produces between a 40- and 200-fold expansion with the evolution of water and sulfur dioxide as flame quenching species. The black, essentially closed cell polymeric foam formed by this process has a density in the range of between 0.1 to 0.3 lb./cu. ft. These properties result in a very low thermal conductivity. Methods for formulating, applying, and evaluating practical fire resistant coating deriv from the amine salt are discussed. The coating properties such as abrasion resistance, adhesion, and durability are described. Test results obtained by immersing test panels protected with this coating in JP-4 fuel fires are compared with those obtained by laboratory simulation of heating environment with radiant energy sources. The efficiency of this coating derived from p-nitroaniline in terms of coating thickness is defined.

-PERTINENT FIGURES-

FIG. 2 INTUMESCENT REACTIONS OF NITRO SUBSTITUTED AROMATIC AMINES PAGE 6// FIG. 5 TYPICAL THERMOGRAM OF P-NITROANILINE BISULFATE PAGE 10//FIG. 9 PROPOSED POLYMERIZATION MECHANISM FOR P-NITROANILINE BISULFATE PAGE 14//FIG. 13 EFFECT OF INTUMESCENT COATING THICKNESS ON BACKFACE TEMPERATURE RISE PAGE 22//TAB. 1 COMPOSITION OF INTUMESCENT COATING BASED ON P-NITROANILINE PAGE 16//TAB. 3 EFFECT OF SOME ENVIRONMENTS ON THE INTUMESCENT COATING ON CR- STEEL, WITH A ZINC CHROMATE PRIMER AND NITROCELLULOSE TOP COAT PAGE 18

-BIBLIOGRAPHY-

ALYEA, H.N.: TESTED DEMONSTRATIONS IN GENERAL CHEMISTRY. J. CHEM.

ED., VOL. 3, 3(4), 15A, 1956

-SOURCE INFORMATION-

CORPORATE SOURCE -
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION, MOFFETT FIELD, CALIF. AMES RESEARCH CENTER.//APPLIED SPACE PRODUCTS, INC., PALO ALTO, CALIF.

JOURNAL PROCEEDINGS -
SOCIETY OF PLASTICS INDUSTRY, INC., 25TH ANNUAL WESTERN SECTION, SAN FRANCISCO, CALIF., MAY 2-3, 1968

OTHER INFORMATION -
0026 PAGES, 0015 FIGURES, 0003 TABLES, 0009 REFERENCES

AFAPL AIRCRAFT FIRE TEST PROGRAM WITH FAA 1967-1970

by

SOMMERS, D.E.
O'NEILL, J.H.

04/00/71

-ABSTRACT-

A number of aircraft propulsion and fuel system fire protection test programs were conducted. Prototypes of a "Fibercell" overheat detector and a hazardous vapor detector and an ultraviolet fire detection system underwent limited evaluation in a jet powerplant fire test environment. A pyrotechnic generated gas discharge fire extinguishing agent container and a high expansion foam/bromotrifluoromethane extinguishing agent combination fire extinguishing system were evaluated in a simulated aircraft powerplant nacelle. Fire resistance tests in a standard 2000 deg. F. flame test environment were conducted on stainless steel tubing and assemblies with several combinations of stainless steel and aluminum connectors. Evaluation of a Fenwal Explosion Suppression System for an aircraft fuel tank involved the measurement of relative concentration of an extinguishing agent discharge by the system into the fuel tank cavity to determine agent distribution in the cavity. The vulnerability of JP-4 and JP-8 fuel, contained in a fuel tank, to ignition by incendiary gunfire was investigated Dynamic incediary gunfire tests were conducted varying the following parameters: standoff distance between the fuel cavity and test article skin, airflow over the test article surface, and ventilation rate in standoff space.

-PERTINENT FIGURES-

FIG. 2 LOCATION OF ULTRAVIOLET, FIBERCELL AND VAPOR DETECTIONS IN C-140 POWERPLANT PAGE 5//FIG. 12 HIGH EXPANSION FOAM IN INSTALLATION PAGE 26// FIG. 13 TUBING FIRE RESISTANCE TEST SETUP PAGE 29//FIG. 40 GUNFIRE TEST ARTICLE WITH 10-PORE POLYURETHANE FOAM IN TANK AREA PAGE 96//TAB. 1 SUMMARY OF UV DETECTOR TEST RESULTS PAGE 13//TAB. 2 TEST CONDITIONS AND RESULTS OF FIRE RESISTANCE TESTS ON TUBING ASSEMBLIES PAGE 36

-SOURCE INFORMATION-

CORPORATE SOURCE -
NATIONAL AVIATION FACILITIES EXPERIMENTAL CENTER, ATLANTIC CITY, N.J.
REPORT NUMBER -
AFAPL-TR-70-93//FAA-NA-71-6

SPONSOR -
AIR FORCE AERO PROPULSION LAB., WRIGHT-PATTERSON AFB, OHIO.
CONTRACT NUMBER -
CONTRACT F33615-67-M-5000
OTHER INFORMATION -
0112 PAGES, 0044 FIGURES, 0014 TABLES, 0000 REFERENCES

DANISH RAF FIRE FIGHTING TESTS CONDUCTED AT ESBJERG, DENMARK, 19 AND 20 NOVEMBER 1969

by

HOPKINS, W.A.

12/03/69

-ABSTRACT-

Tests were conducted to evaluate the effectiveness of various foaming agents on large scale JP-4 fires. In general, the foaming agents tested were comparable in terms of initial extinguishing capability; those used were protein foam (Tutogen T), synthetic base foam (Hi-Ex), a mixture of Hi-Ex and a halide (Fluobrene B-2), and light water. In general there was no significant difference in the time required for initial fire extinguishing for any of the four foams. The addition of Fluobrene, however, prevented reignition. Separate demonstrations of Fluobrene, which are discussed in an addendum, were spectacular, in that jet engine and spillage fires were extinguished practically instantaneously. The relatively high wind velocities encountered during the second day of testing were comparable to those experienced on the flight deck of a carrier underway. These tests, therefore, confirmed the capabilities of the agents for flight deck conditions. It was concluded that synthetic foam, when combined with Fluobrene, provided significant additional control of reignition on large scale fuel fires. It was recommended that Fluobrene be compared with such products as Purple K and other chemical extinguishers, both as a single agent and in combination with light water foam.

-PERTINENT FIGURES-

-SOURCE INFORMATION-

CORPORATE SOURCE -
OFFICE OF NAVAL RESEARCH, LONDON (ENGLAND).
REPORT NUMBER -
AD-862223//N-23-69
OTHER INFORMATION -
0021 PAGES, 0005 FIGURES, 0001 TABLES, 0000 REFERENCES

FIRE-FIGHTER PROTECTIVE CLOTHING CONCEPTS AND CONFIGURATIONS

by

MEADE, J.P.

09/27/70

-ABSTRACT-

Evaluations of fire fighters' proximity clothing revealed the following deficiencies: excessive weight and bulk of suits which decrease efficient functioning of personnel, coats too long, lack of durability of the suit material, poor ventilation, lack of hard-hat protection, and less than optimum visibility. Another area of concern was the lack of communication between the fire control coordinator and the fire fighters. The fire fighting operations in an aircraft crash are directed at preventing the spread of fire to the fuselage or fuel tanks, extinguishing the fire, and concurrently rescuing or assisting in the evacuation of occupants. The fire fighters need a suit of protective clothing of modern design to reduce total weight and to avoid loose flapping items. The hoods should cover and head and neck, possess hard-hat skull protection, and provide optimum visibility while self-contained breathing equipment is being worn. Overall, the protective clothing, excluding the boots, should not weigh more than 10 lb. per suit, should afford adequate protection for at least 18 months of service life, and must provide a combination of noncombustibility and heat reflectance so that the wearer is protected against 1800 deg. F. radiated heat for at least 2 min.

-SOURCE INFORMATION-

CORPORATE SOURCE -
DIRECTORATE OF AEROSPACE SAFETY, NORTON AFB, CALIF.
JOURNAL PROCEEDINGS -
FLIGHT SAFETY SURVIVAL AND PERSONAL EQUIPMENT SYMP., 8TH, LAS VEGAS, NEV., SEPT. 27-OCT. 1, 1970
OTHER INFORMATION -
0008 PAGES, 0000 FIGURES, 0000 TABLES, 0000 REFERENCES

AIRCRAFT WELDING OPERATIONS IN HANGARS 1970, RECOMMENDED SAFE PRACTICES FOR

by

NATIONAL FIRE PROTECTION ASSOCIATION

00/00/70

-ABSTRACT-

Specific safety recommendations are presented for welding in aircraft hangars. Only gas shielded-arc welding should be performed on aircraft. Aircraft welding operations should be performed outdoors whenever possible; if done indoors, a written special permit should be obtained for each welding operation with a safety checklist attached to the permit. The work area should be screened and the aircraft should be in a towable condition. Only qualified welders should be permitted to do any work. Other people in the area should be notified and no other work permitted within 20 ft. No flammable liquids or any container that was used to store flammable liquids should be in the vicinity. No electrical components other than flexible lea cables should be within 18 in. of the floor. The hangar should have fixed fire protection equipment and there should be a fire watcher behind the welder with a fire extinguisher.

-SOURCE INFORMATION-

CORPORATE SOURCE -
NATIONAL FIRE PROTECTION ASSOCIATION, BOSTON, MASS.
REPORT NUMBER -
NFPA NO. 410E
OTHER INFORMATION -
0007 PAGES, 0000 FIGURES, 0000 TABLES, 0000 REFERENCES

keys 798 through 806

MAJOR AIRCRAFT FIRES. PROC. OF SYMPOSIUM NO. 1. FIRE RESEARCH STATION, BOREHAM WOOD, HERTS. DEC. 9, 1966.

by

FIRE RESEARCH STATION

00/00/67

-ABSTRACT-

Contents: Fry, J.F., Aircraft Fire Statistics (see F7200571)//Nash, P., Research on Aircraft Fires (see F7200572)//Williams, E.J.C., Fires Involving Military Aircraft On The Ground--Problems and Possibilities For The Future (see F7200573)//Lodge, J.E., Fire-Fighting And Rescue Problems With Future Civil Aircraft (see F7200574)//Humphrey, R., The Design Of Aircraft Fire- Fighting Equipment For The Future, Part 1 (see F7200575)//Shapland, J.D., The Design Of Aircraft Fire-Fighting Equipment For The Future, Part 2 (see F7200576)//Miller, R.E., Some Aspects Of Aircraft Fuel Safety (see F7200577) //Lydiard, W.G. and MacDonald, J.A., Design Aspects Relating To Aircraft Fires (see F7200578)//Pardoe, J.G.M., The Safety Of Air Transport Of The Future (see F7200579)

-SOURCE INFORMATION-

CORPORATE SOURCE -
FIRE RESEARCH STATION, BOREHAM WOOD (ENGLAND).
OTHER INFORMATION -
9999 PAGES, 9999 FIGURES, 9999 TABLES, 9999 REFERENCES

key 808

RESEARCH ON AIRCRAFT FIRES

by

NASH, P.

00/00/67

-ABSTRACT-

The present and potential effectiveness of external fire fighting was examined in terms of the research that has been carried out in England and in the United States, on the assumption that a serious but survivable crash has occurred and has resulted in a large fuel spillage and a major fire. Summaries are given of the research carried out on the development of major aircraft fires, i.e., data on the initiation and growth of aircraft crash fires; the research into the extinction of major aircraft fires using protein foams; and research of other agents, such as light water, dry powders, and liquid nitrogen, for aircraft fire fighting. The conclusions which were drawn regarding the future of aircraft fire fighting are: (1) The fire resistance of modern aircraft is not high enough to ensure the safety of the occupants from a major fire incident. The fire must either be avoided by rendering the fuel safe, or the aircraft must be given additional fire resistance to enable it to withstand the effect of a major fire for a period of several minutes. (2) Land borne fire appliances under today's conditions are really only effective for incidents on or immediately adjacent to the airfield. (3) Full-scale aircraft fire tests have led NAFEC to suggest that greater rates of foam output may be necessary per appliance.

-PERTINENT FIGURES-

FIG. 2.3 EFFECT OF APPLIANCE SPEED ON ITS EFFECTIVE RANGE PAGE 11//FIG. 2.4 FAA (NAFEC) C-97 AIRCRAFT FIRES, 1964--STANDARD TEST CONDITIONS FROM FEDERAL AVIATION AGENCY REP. NO. R.D.-65-50 PAGE 13//FIG. 2.6 TYPICAL FIRE RESEARCH STATION SIMULATED AIRCRAFT FIRE PAGE 16//FIG. 2.7 FLOW DIAGRAM-- GAS-TURBINE FOAM GENERATOR PAGE 18//FIG. 2.8 APPLICATION OF FOAM GENERATOR TO TWIN-ROTOR HELICOPTER PAGE 18//TAB. 2.3 RESULTS OF NAFEC C-97 TESTS (1964 USING LAND-BORNE FOAM APPLIANCES PAGE 14

-BIBLIOGRAPHY-

PINKEL, I.I., PRESTON, G.M., AND PESMAN, G.J.: MECHANISM OF START AND DEVELOPMENT OF AIRCRAFT CRASH FIRES. RM.E52F06, NAT. ADVISORY COMM. FOR AERONAUT., WASHINGTON, D.C., 1952//CONLEY, D.W.: POST-CRASH FIRE-FIGHTING STUDIES ON TRANSPORT CATEGORY AIRCRAFT. RD-65-50, FAA, NEW JERSEY, 1965// MIDDLESWORTH, C.M., ET AL.: FEDERAL AVIATION AGENCY'S CRASH FIRE TESTS. M.P. 65-2, NFPA,

BOSTON, MASS., 1965//NASH, P.: FIRE-RESISTANT LIFEBOATS FOR OIL TANKERS. ENG. VOL. 221, 508-510, LONDON, 1966//NASH, P., FITTES, D.W., AND RICHARDSON, D.D.: FOAM FOR AIRCRAFT CRASH FIRES (3). F.R. NOTE 615, JOINT FIRE RES. ORG., 1966//TUVE, R.L., ET AL.: A NEW VAPOR-SECURING AGENT FOR FLAMMABLE LIQUID FIRE EXTINGUISHMENT. REP. 6057, U.S. NAVAL RES. LAB., WASHINGTON, D.C., 1964

-SOURCE INFORMATION-

CORPORATE SOURCE -
FIRE RESEARCH STATION, BOREHAM WOOD (ENGLAND).

JOURNAL PROCEEDINGS -
IN ITS: MAJOR AIRCRAFT FIRES. BOREHAM WOOD, HERTS. DEC. 9, 1966. (SEE F7200570)

OTHER INFORMATION -
0012 PAGES, 0008 FIGURES, 0005 TABLES, 0017 REFERENCES

key 809

FIRES INVOLVING MILITARY AIRCRAFT ON THE GROUND-PROBLEMS AND POSSIBILITIES FOR THE FUTURE

by

WILLIAMS, E.J.C.

00/00/67

-ABSTRACT-

The broad features of fighter aircraft as a fire fighting problem can be stated thus: (1) The life risk is concentrated in the cockpit. This influences the tactical positioning of crash fire trucks. (2) The only means of access to the cockpit is the canopy. (3) There is little separatio between the cockpit and the fuel tanks. Fire fighting techniques for the military aircraft survivable crash are reconsidered: should the action of the fire fighter be one of suppression with zero time loss or control in the vicinity of the rescue path. Improvements are noted in the use of crash, fire and rescue trucks, and fire extinguishing agents, such as foam, dry powder, and light water. The use of helicopters and hovercraft is considered as an alternative transport for rescue personnel and fire fighting equipment in the case of an aircraft accident.

-SOURCE INFORMATION-

CORPORATE SOURCE -
MINISTRY OF DEFENCE, LONDON (ENGLAND).
JOURNAL PROCEEDINGS -
IN: MAJOR AIRCRAFT FIRES. PROC. OF SYMPOSIUM NO. 1, FIRE RESEARCH STATION, BOREHAM WOOD, HERTS. DEC. 9, 1966 (SEE F7200570)
OTHER INFORMATION -
0006 PAGES, 0000 FIGURES, 0000 TABLES, 0000 REFERENCES

FIRE-FIGHTING AND RESCUE PROBLEMS WITH FUTURE CIVIL AIRCRAFT

by

LODGE, J.E.

00/00/67

-ABSTRACT-

A comparison is made of the fire fighting and rescue problems with the Boeing 707 and 747 aircraft. It is argued that for large future aircraft, since airports are not provided with protection to a common standard, an adjustment must be made to meet the operational requirements of fire fighting, i.e., selection of media and rates of application, for these futur civil aircraft crashes. The 747 has a fire ground plan of three times the area of that for the 707, in which control must be achieved by rapid application of extinguishants if the occupants are to survive a crash accident. The other aspects of fire safety considered for future aircraft service are: (1) the amount and rate of extinguishing agents used, specifically foam; (2) the availability of supplementary agents; (3) the plan of rescue steps; (4) casualty handling after rescue; and (5) the selection and training of fire and rescue personnel.

-PERTINENT FIGURES-

FIG. 4.1 COMPARISON BETWEEN BOEING 707 AND 747 PAGE 32//TAB. 1 COMPARATIVE DIMENSIONS OF BOEING 707 AND 747 AIRCRAFT PAGE 31

-SOURCE INFORMATION-

CORPORATE SOURCE -
CIVIL AVIATION DEPT., LONDON (ENGLAND).
JOURNAL PROCEEDINGS -
IN: MAJOR AIRCRAFT FIRES. PROC. OF SYMPOSIUM NO. 1. FIRE RESEARCH STATION, BOREHAM WOOD, HERTS. DEC. 9, 1966 (SEE F7200570)
OTHER INFORMATION -
0006 PAGES, 0001 FIGURES, 0001 TABLES, 0000 REFERENCES

key 811

THE DESIGN OF AIRCRAFT FIRE-FIGHTING EQUIPMENT FOR THE FUTURE. PART 1.

by

HUMPHREY, R.

00/00/67

-ABSTRACT-

With the development of larger and faster aircraft, problems of crash rescue will be increased. Since the main objective of aircraft crash fire fighting is saving life, speed in reaching the fire and in dealing with it when reached is of the utmost importance. The secondary aim will be to save as much of the aircraft as possible and to protect adjacent buildings, etc. Thus, complete extinguishment of the fire is highly desirable. This leads to a consideration of whether any of the existing fire fighting agents are likely to remain suitable for use in the future; whether some preferred combination of these should be specified; or whether there is scope for development of something new. Protein foams, dry powder, and light water agents alone, or in combination, are compared in their effectiveness as fire fighting agents. It was concluded that foam of some sort will be important for fighting aircraft fires in the future. A discussion is included on foam-making equipment and the developments and improvements that are likely to be required. Light water and dry powder equipment are also considered, along with trends in fire fighting vehicle developments.

-PERTINENT FIGURES-

FIG. 5.3 PYRENE BLOWER FOAM SYSTEM PAGE 40//FIG. 5.4 HIGH PRESSURE FOAM SYSTEM (BRITISH PATENT 863439) PAGE 41//FIG. 5.5 JET REACTION PROPORTIONER (PATENT PENDING) PAGE 42//FIG. 5.7 PYRENE-BIRO DRY POWDER FIRE TRUCK PAGE 44//FIG. 5.8 PYRENE CRASH TRUCK ON NUBIAN MAJOR CHASSIS PAGE 44//FIG. 5.9 A POSSIBLE FUTURE 30 TON CRASH VEHICLE PAGE 44

-SOURCE INFORMATION-

CORPORATE SOURCE -
PYRENE CO., LTD., BRENTFORD (ENGLAND).
JOURNAL PROCEEDINGS -
IN: MAJOR AIRCRAFT FIRES. PROC. OF SYMPOSIUM NO. 1. FIRE RESEARCH STATION, BOREHAM WOOD, HERTS. DEC. 9, 1966 (SEE F7200570)
OTHER INFORMATION -
0010 PAGES, 0009 FIGURES, 0000 TABLES, 0000 REFERENCES

THE DESIGN OF AIRCRAFT FIRE-FIGHTING EQUIPMENT FOR THE FUTURE. PART 2

by

SHAPLAND, J.D.
BURDEN, K.A.H.

00/00/67

-ABSTRACT-

Overall efficiency of current fire fighting vehicles as a fast and efficient fire fighting appliance is questioned. Pending the development and introduction of a new, highly versatile and efficient extinguishing agent suitable for combatting aircraft fires, the design of aircraft expected to be in service during the next fire years will call for new thinking in terms of usage of currently familiar agents (dry powder and foams) due to the size and load carrying capacity of the aircraft. Future application rates for dry powder will probably range from 45 lb./sec. to 75 lb./sec.; monitors will be required having an optimum range of 150 ft. minimum and the appliance capacity will range from 2 1/2 to 4 tons, to meet a 2 min. duration of operation. Foam application monitors will require a foam output in the region of at least 5000 gpm in order to achieve an optimum jet range of 250 ft. As far as foam qualities are concerned, it is unlikely that a foam of greater than 10:1 expansion will be suitable. To achieve this, the percentage of foam liquid in the water must be about 7 to 8 percent. To meet these higher outputs, vehicles of larger capacities will be needed and the operators will have to decode the type of performance necessary from a chassis and determine whether the advantages of high cross country performance justify the equally high cost.

-PERTINENT FIGURES-

TAB. 1 MINIMUM QUANTITIES OF EXTINGUISHING MEDIA CATEGORY 9 AIRFIELD PAGE 52

-SOURCE INFORMATION-

CORPORATE SOURCE -
MERRYWEATHER AND SONS, LTD., GREENWICH (ENGLAND).
JOURNAL PROCEEDINGS -
IN: MAJOR AIRCRAFT FIRES. PROC. OF SYMPOSIUM NO. 1. FIRE RESEARCH STATION, BOREHAM WOOD, HERTS. DEC. 9, 1966 (SEE F7200570)
OTHER INFORMATION -
0003 PAGES, 0000 FIGURES, 0001 TABLES, 0000 REFERENCES

DESIGN ASPECTS RELATING TO AIRCRAFT FIRES

by

LYDIARD, W.G.
MACDONALD, J.A.

00/00/67

-ABSTRACT-

Statistics are reviewed on the frequency and causes of aircraft fires. Data are presented in some detail on the process of ignition by heated surfaces. Fire precautions, adopted in aircraft, are discussed and include segregation of combustibles from ignition sources, fire detection, and control and extinction of fire by aircraft equipment. Measures which could reduce damage and casualties due to crash fire are considered to be those which reduce the likelihood of appreciable fuel and oil leakage, reduce the number of ignition sources, make the aircraft fluids less ignitable and slower burning to reduce the intensity of fire, isolate the passengers from the effects of fire, and improve the rescue techniques. It is concluded that the greatest benefit in crash fires would come from improved containment of the fuel or from the use of a variety of fuel or a treated fuel which had a low rate of flame spread and heat release under crash conditions.

-PERTINENT FIGURES-

FIG. 8.1 STATISTICS ON ACCIDENTS INVOLVING FIRE IN U.K. CIVIL AIRCRAFT PAGE 68//FIG. 8.3 SPARK AND SPONTANEOUS IGNITION LIMITS FOR AVTUR PAGE 71//FIG. 8.4 THE EFFECT OF SIZE ON THE MINIMUM SPONTANEOUS IGNITION TEMPERATURE OF AVTUR VAPOUR IN UNIFORMLY HEATED VESSELS PAGE 71//FIG. 8.11 THE RATE OF FLAME PROPAGATION FOR A NUMBER OF FLUIDS PAGE 79//TAB. 8.2 MAJOR BRITISH MILITARY JET AIRCRAFT FIRES (OTHER THAN CRASH FIRES) PAGE 70//TAB. 8.4 IGNITION CHARACTERISTICS OF AIRCRAFT FLUIDS PAGE 72

-BIBLIOGRAPHY-

ANON.: SYMPOSIUM ON AIRCRAFT FIRE HAZARDS. R.A.E. REP. R.P.D. NO. 31, AUG. 1955//MACDONALD, J.A. AND WHITE, R.G.: SPONTANEOUS IGNITION OF KEROSENE FUEL VAPOUR: THE EFFECT OF VESSEL SIZE. R.A.E. REP. NO. 65138, JULY 1965//ANON.: FIRE RESISTANT AND CRASHPROOF COVERING FOR ALUMINIUM ALLOY FUEL AND OIL TANKS OF LESS THAN 50 GAL. CAPACITY. SPEC. NO. D.T.D. 1100, MINISTRY OF SUPPLY, AUG. 11, 1950//PESMAN, G.J.: MULTICELLULAR FUEL TANKS AS A MEANS OF REDUCING AIRCRAFT FIRE HAZARD. NASA, OCT. 1963//LANSDOWN, A.R.: MICROBIOLOGICAL ATTACK IN AIRCRAFT FUEL SYSTEM. J. ROY. AERONAUT. SOC., VOL. 69, 659, NOV. 1965//GREER, BREENEN, AND HEID, T.L.: CRASHWORTHY DESIGN PRINCIPLES. FAA, T.R., A.D.S., SEPT. 24, 1964

-SOURCE INFORMATION-

CORPORATE SOURCE -
ROYAL AIRCRAFT ESTABLISHMENT, FARNBOROUGH (ENGLAND)

JOURNAL PROCEEDINGS -
IN: MAJOR AIRCRAFT FIRES. PROC. OF SYMPOSIUM NO. 1. FIRE RESEARCH STATION, BOREHAM WOOD, HERTS. DEC. 9, 1966 (SEE F7200570)

OTHER INFORMATION -
0014 PAGES, 0011 FIGURES, 0005 TABLES, 0026 REFERENCES

THE SAFETY OF AIR TRANSPORT OF THE FUTURE

by

PARDOE, J.G.M.

00/00/67

-ABSTRACT-

The question of affording safety of air transport is explored, followed by discussion on how best to spend to increase safety. While large sums can be justified to make scheduled air transport safer, these should be used to produce safety without great increase in operating cost. Since only about 10 percent of fatalities occur in accidents which might be survivable, it is some ten times more worthwhile to avoid serious accidents than to mitigate their results. It is reasonable to scale the safety effort to the number of passengers to be carried, e.g., not only to increase fuel and structure weight in larger aircraft but also the navigational equipment, etc., as well. While it is desirable to reduce the fatalities due to fire, it is also necessary not to take the present statistics for granted, but to ensure that future aircraft with changed configuration and operating conditions do not increase the fire hazard.

-SOURCE INFORMATION-

CORPORATE SOURCE -
AIR REGISTRATION BOARD, REDHILL (ENGLAND).
JOURNAL PROCEEDINGS -
IN: MAJOR AIRCRAFT FIRES. PROC. OF SYMPOSIUM NO. 1. FIRE RESEARCH STATION, BOREHAM WOOD, HERTS. DEC. 9, 1966 (SEE F7200570)
OTHER INFORMATION -
0003 PAGES, 0000 FIGURES, 0000 TABLES, 0000 REFERENCES

keys 820 through 821

ELASTOMERIC COATINGS AID FLAME RETARDANCE

by

HOLMES, R.L.

05/00/71

-ABSTRACT-

Development efforts are reviewed in the compounding and testing of nonflammable materials which have resulted in the discovery of a number of valuable materials that are of especial value for products used in oxygen enriched environments. Preliminary data indicate that substrates such as wood, paper, textiles, metals, organic resins, and elastomers may be made nonflammable under atmospheric conditions by coating these substrates. Thes coatings (REFSET) have been proposed for the fireproofing of military and commercial aircraft. Coated aluminum or epoxy glass laminates, for example, are capable of passing the FAA requirement of no flame penetration when exposed to a 2000 deg. F. flame for 15 min. A modified test method for flammability rating, the Candle Test, is described. The test procedure involves the mounting of the sample in the test fixture, introducing the gas mixture of oxygen and nitrogen under known velocities, igniting the sample with a known heat source, removing the ignition source, and determining whether the test material is nonignitable, self-extinguishing, or burns completely. Some of the variables encountered in this test method include precent oxygen, velocity of gases, ignition temperatures, sample shape and thickness, and the composition of the material being used.

-PERTINENT FIGURES-

TAB. 1 EFFECT OF GAS MIXTURE VELOCITY ON CANDLE TESTER BURN RATE PAGE 67// TAB. 2 EFFECT OF MATERIAL SELECTION ON FLAMMABILITY RATING PAGE 68//TAB. 3 EFFECT OF SAMPLE GAUGE ON FLAMMABILITY RATING, COMPOUND L-3203-6 PAGE 68

-SOURCE INFORMATION-

CORPORATE SOURCE -
RAYBESTOS-MANHATTEN, INC., NORTH CHARLESTON, S.C.
JOURNAL PROCEEDINGS -
RUBWAQ, RUBBER WORLD, VOL. 164, NO. 2, 65-69 (MAY 1971)
OTHER INFORMATION -
0005 PAGES, 0009 FIGURES, 0003 TABLES, 0000 REFERENCES

INHALATION TOXICITY OF PYROLYSIS PRODUCTS OF MONOBROMOMONOCHLOROMETHANE AND MONOBROMOTRIFLUOROMETHANE

by

HAUN, C.C.
VERNOT, E.H.
MACEWEN, J.D.
GEIGER, D.L.
MCNERNEY, J.M. ET AL.

03/00/67

-ABSTRACT-

The toxicities of the pyrolysis products of two fire extinguishant compounds, bromochloromethane and bromotrifluoromethane, were investigated using albino rats; 14 day LC50 values were determined for single 15 min. exposures. Both fire extinguisher compounds, currently used by the U.S. Air Force for aircraft fires, were pyrolyzed at 800 deg. C. in a hydrogen-oxygen flame. The pyrolysis products of each compound were examined and the principal consituents were identified and quantitated. The determined LC50 value of 2300 ppm for pyrolyzed bromotrifluoromethane produced a hydrogen fluoride concentration of 2480 ppm consistent with the reported LC50 value for a single 15 min. exposure to this gas. Bromochloromethane pyrolysis products were found to have a LC50 of 465 ppm under the experimental parameters tested. The toxic response producing this LC50 value appeared to result from a mixture of hydrogen chloride, hydrogen bromide, and bromine gases.

-PERTINENT FIGURES-

FIG. 2 SCHEMATIC OF BROMOTRIFLUOROMETHANE PYROLYSIS SYSTEM PAGE 4//FIG. 4 MORTALITY VS CONCENTRATION OF PYROLYSIS PRODUCTS PAGE 17//FIG. 5 THERMAL DECOMPOSITION CURVES PAGE 21//TAB. 4 CONCENTRATION OF PYROLYSIS PRODUCTS PRODUCED BY IGNITION OF BROMOCHLOROMETHANE PAGE 11//TAB. 6 RESULTS OF EXPOSURE TO THE PYROLYSIS PRODUCTS OF BROMOTRIFLUOROMETHANE MILITARY SPECIFICATION MIL-B-4394-B PAGE 14//TAB. 9 MEAN WEIGHTS OF RATS SURVIVING EXPOSURE TO THE PYROLYSIS PRODUCTS OF BROMOTRIFLUOROMETHANE PAGE 19

-BIBLIOGRAPHY-

CHAMBERS, W.H. AND KRACKOW, E.H.: AN INVESTIGATION OF THE TOXICITY OF PROPOSED FIRE EXTINGUISHING FLUIDS, PART 1. RES. REP. NO. 23, U.S. ARMY CHEMICAL CENTER, MED. DIV., OCT. 1950//COMSTOCK, C.C. AND OBERST, F.W.: COMPARATIVE INHALATION TOXICITIES OF FOUR HALOGENATED HYDROCARBONS TO RATS AND MICE IN THE PRESENCE OF

GASOLINE FIRES. ARCH. IND. HYG. AND OCCUP. MED., VOL. 7, 157, 1953//PRIESTLY, L.J., ET AL.: DETERMINATION OF SUBTOXIC CONCENTRATIONS OF PHOSGENE IN AIR BY ELECTRON CAPTURE GAS CHROMATOGRAPHY. ANAL. CHEM., VOL. 37, 70, 1965//ROGERS, R.N. AND YASUDA, S.K.: RAPID MICRODETERMINATION OF FLUORINE IN ORGANIC COMPOUNDS. ANAL. CHEM., VOL. 31, 616, 1959//TREON, J.F., ET AL.: THE TOXICITY OF A PURIFED BATCH OF MONOBROMOTRIFLUOROMETHANE (FREON 13B1) AND THAT OF ITS PRODUCTS OF ITS PARTIAL THERMAL DECOMPOSITION WHEN BREATHED BY EXPERIMENTAL ANIMALS. KETTERING LAB., CINCINNATI UNIV., OHIO, JUNE 19, 1957//CARSON, T.R., ET AL.: THE RESPONSE OF ANIMALS INHALING HYDROGEN FLUORIDE FOR SINGLE, SHORT EXPOSURES. TR-61-744, 284030, WRIGHT-PATTERSON AFB, OHIO, 1961

-SOURCE INFORMATION-

CORPORATE SOURCE -
AEROJET-GENERAL CORP., DAYTON, OHIO. TOXIC HAZARD RESEARCH UNIT.
REPORT NUMBER -
AD-652850//AMRL-TR-66-240
SPONSOR -
AEROSPACE MEDICAL RESEARCH LABS., WRIGHT-PATTERSON AFB, OHIO.
CONTRACT NUMBER -
CONTRACT AF 33(657)-11305
OTHER INFORMATION -
0030 PAGES, 0005 FIGURES, 0009 TABLES, 0016 REFERENCES

SURVEY OF FUNDAMENTAL KNOWLEDGE OF MECHANISMS OF ACTION OF FLAME- EXTINGUISHING AGENTS

by

FRIEDMAN, R.
LEVY, J.B.

01/00/57

-ABSTRACT-

The current state of knowledge of the physico-chemical mechanisms by which flame extinguishing agents operate is surveyed. This survey has not been limited to any particular class of flammable materials or to any special type of extinguishing agents; however, the emphasis has been on pure substances, i.e., elements and simple compounds. Attention has been devoted to flames of hydrocarbons, magnesium, carbon, and rocket propellant chemicals. The survey concentrates on extinguishment of flames by specific chemical intervention of a third substance in addition to fuel and oxygen; however, some attention is given to studies in which the extinguishment is of a purely physical action. Also, some studies of steadily propagating flames are included. The introduction describes, in a general way, the methods by which flames may be extinguished. Current information on uninhibited and inhibited gaseous flames is next presented along with the extinguishment mechanisms of these flames--covalent halides and salts as inhibitors, and the inhibition of burning liquids and solids. A summary of 345 papers examined and tabulated data on the performance of a number of fire extinguishing compounds are appended.

-PERTINENT FIGURES-

TAB. 1 COMPARISON OF THE EXTINGUISHING POWER OF METHYL BROMIDE, NITROGEN, AND CARBON DIOXIDE PAGE 19//TAB. 2 COMPARISON OF AGENTS ON THE BASIS OF NUMBER OF HALOGEN ATOMS PAGE 21//TAB. 3 COMPARISON OF AGENTS ON BASIS OF TYPE OF HALOGEN PAGE 21//TAB. 5 SUPPRESSION AND QUENCHING POINTS OF SODIUM BICARBONATE POWDERS PAGE 28//APP. 3 SUMMARY OF COMPOUNDS EVALUATED AS FIRE-EXTINGUISHING AGENTS FOR N-HEPTANE-AIR PAGES 88-89

-SOURCE INFORMATION-

CORPORATE SOURCE -
ATLANTIC RESEARCH CORP., ALEXANDRIA, VA.
REPORT NUMBER -
AD-110685//WADC-TR-56-568
SPONSOR -
WRIGHT AIR DEVELOPMENT CENTER, WRIGHT-PATTERSON AFB, OHIO.

CONTRACT NUMBER -
CONTRACT AF 33(616)-3527
OTHER INFORMATION -
0092 PAGES, 0000 FIGURES, 0006 TABLES, 0345 REFERENCES

SMALL-SCALE FIRE TESTS OF HIGH-TEMPERATURE CABIN PRESSURE SEALANT AND INSULATING MATERIALS. FINAL REPORT 1970-1971

by

SARKOS, C.P.

11/00/71

-ABSTRACT-

A two ft. square stainless steel panel was constructed with the same dimensions between the fuselage skin and cabin wall as those of a titanium fuselage previously exposed to an external fuel fire. The panel was subjected to a 2 gal./hr. kerosene burner which simulated the heat flux and temperature from a large JP-4 fuel fire, as existed during the titanium fuselage test. The purpose of the panel tests was to determine if the phenomena observed during the titanium fuselage test could be duplicated on a small scale, and also to test various sealant/insulation combinations superior to those used in the titanium fuselage in order to ascertain the degree of improvement in environmental conditions which would result. Testing of the panel utilizing the same materials found in the titanium fuselage caused phenomena and temperature distribution very similar to those observed during the full-scale test. The titanium fuselage insulation tested without any cabin pressure sealant caused a flash fire. However, two commercially available high temperature insulations also tested without any sealant maintained survivable conditions for at least 15 min. Viton was found not to flame or cause a flash fire under conditions in which silicone did. The propensity of the formation of a flash fire was strongly influenced by the compactness of the insulation and the presence of any voids or passageways between the fuselage skin and cabin wall interface.

-PERTINENT FIGURES-

FIG. 4 SMOKE AND GAS DATA FOR TEST PANEL WITH MICROLITE INSULATION AND RTV-106 SILICONE SEALANT (TEST NO. 1) PAGE 10//FIG. 5 TEMPERATURE DATA FOR TEST PANEL WITH MICROLITE INSULATION (TEST NO. 2) COMPARED WITH FULL-SCALE TEST PAGE 13//FIG. 8 COMPARISON OF SMOKE DATA FROM TEST PANELS WITH SILICONE (TEST NO. 4) AND VITON (TEST NO. 6) PAGE 18//FIG. 9 COMPARISON OF TEMPERATURE DATA FROM TEST PANELS INSULATED WITH MICRO-QUARTZ AND DYNA-FLEX PAGE 19//FIG. 10 COMPARISON OF COMBUSTIBLE GASES FROM MICRO-QUARTZ-INSULATED PANELS WITH SILICONE AND VITON PAGE 21//TAB. 2 SUMMARY OF TEST RESULTS WITH TEST ARTICLE SIMULATING TITANIUM FUSELAGE CROSS SECTION PAGE 8

-BIBLIOGRAPHY-

SARKOS, C.P.: TITANIUM FUSELAGE ENVIRONMENTAL CONDITION IN POST-CRASH FIRES. REP. NO. FAA-RD-71-3, NAFEC, MAR. 1971//SARKOS, C.P.: EVALUATION OF AVCO/ NASA RIGID FOAM AS A FIRE BARRIER FOR CABIN PROTECTION. NA-542, DATA REP. NO. 70, NAFEC, PROPULSION SECTION, APR. 1970

-SOURCE INFORMATION-

CORPORATE SOURCE -
NATIONAL AVIATION FACILITIES EXPERIMENTAL CENTER, ATLANTIC CITY, N.J.

REPORT NUMBER -
AD-731903//FAA-RD-71-67//FAA-NA-71-22

OTHER INFORMATION -
0037 PAGES, 0011 FIGURES, 0002 TABLES, 0004 REFERENCES

FIBER OPTICS HAZARD IDENTIFICATION DEVICE

by

PHILLIPS, B.G.

10/00/69

-ABSTRACT-

One laboratory model fiber optics fire detector system and two flight test systems complete with fire simulators were developed and fabricated. The distal emd of this system, which is located within the aircraft engine compartment, is capable of withstanding temperatures of 1000 deg. F., whereas the rest of the system is capable of withstanding temperatures to 500 deg. F. A review is presented of the work performed in optical design and mechanical configuration, fire simulation, materials investigation, and system evaluation. Several techniques were studied to simulate a fire within the engine compartment, where the emphasis was on simulating flame flicker. It was concluded that these systems offered a lower false alarm than current systems and should be able to detect luminous flame within the engine compartment. Nevertheless, a substantial increase in the optical transmission of the system extending perhaps to the extreme blue and ultraviolet would be desirable. A considerable increase in transmission could be accomplished if the system were designed to accommodate continuous fiber bundles from the engine compartment to the cockpit.

-PERTINENT FIGURES-

TAB. 3 CHARACTERISTICS OF FIBER OPTICS FIRE DETECTION SYSTEM PAGE 42

-SOURCE INFORMATION-

CORPORATE SOURCE -
OPTICS TECHNOLOGY, INC., PALO ALTO, CALIF.
REPORT NUMBER -
AD-697036//AFAPL-TR-69-78
SPONSOR -
AIR FORCE AERO PROPULSION LAB., WRIGHT-PATTERSON AFB, OHIO.
CONTRACT NUMBER -
CONTRACT AF33(615)-3532
OTHER INFORMATION -
0050 PAGES, 0027 FIGURES, 0003 TABLES, 0000 REFERENCES

AIRCRAFT OXYGEN SYSTEM MAINTENANCE, 1971

by

NATIONAL FIRE PROTECTION ASSOCIATION

00/00/71

-ABSTRACT-

Hazards associated with the handling of breathing oxygen aboard aircraft are described, along with the recommended procedures for safe charging and testing aircraft breathing oxygen systems. The three basic types of aircraft breathing oxygen systems, classified according to the type of regulator employed, are: (1) continuous flow, (2) demand, and (3) pressure breathing demand. The regulators are supplied from one of the following fixed or portable breathing oxygen systems: (1) low pressure breathing oxygen systems, (2) high pressure breathing oxygen systems, (3) liquid breathing oxygen converter systems, and (4) portable equipment. Precautions for the handling and use of both gaseous and liquid oxygen systems are given. Safeguarding aircraft breathing oxygen system test and repair operations are discussed, as is fire protection during charging operation. Storage, handling, and usage of equipment are considered.

-SOURCE INFORMATION-

CORPORATE SOURCE -
NATIONAL FIRE PROTECTION ASSOCIATION, BOSTON, MASS.
REPORT NUMBER -
NFPA NO. 410B
OTHER INFORMATION -
0020 PAGES, 0000 FIGURES, 0000 TABLES, 0000 REFERENCES

ULTRA VIOLET DETECTOR FOR AIRCRAFT ENGINES

by

STEVENS, J.R.

03/00/72

-ABSTRACT-

An automatic fire detector was designed for aircraft engine use to detect fire caused by the accidental release and ignition of flammable fluids in the engine bay as well as flame resulting from combustion chamber burnthrough. The significance of the choice of operating in the ultraviolet region of the spectrum is explained in terms of the lack of solar radiation due to atmospheric filtering, the absence of black body radiation, and the availability of a high gain narrow band photocell. The operating principles of a Geiger Mueller tube are established and the effect of varying the constructional parameters explored. An outline of the electronic circuits used is given and the hardward developed for use on the Concorde is illustrated. Continuous service trials of the ultraviolet fire sensor have been carried out.

-SOURCE INFORMATION-

CORPORATE SOURCE -
GRAVINER, LTD., COLMBROCK (ENGLAND).
JOURNAL PROCEEDINGS -
IN: FIRE RESEARCH STATION, SYMPOSIUM ON AUTOMATIC FIRE DETECTION, LONDON, MAR. 8-10, 1972
OTHER INFORMATION -
0013 PAGES, 0007 FIGURES, 0000 TABLES, 0000 REFERENCES

EVALUATION OF FILM FORMING FOAMS FOR THE SUPPRESSION OF FUEL FIRES IN AIRCRAFT HANGARS

by

BREEN, D.E.

04/00/72

-ABSTRACT-

An evaluation of the technical feasibility of employing aqueous foams containing film-forming fluorosurfactants to control aircraft fuel fires in old and new hangars showed that their potential for upgrading sprinkler systems in older hangars protected by the standard sprinkler (SS) or the old style sprinkler (OSS) is promising. Tests were made by burning 900 sq. ft. of JP-4. Foam/Water (F/W), SS, and OSS nozzles were tested at densities (gal./min. per sq. ft.) of 0.20 and 0.16 (F/W), 0.16 and 0.125 (SS), and 0.20 (OSS). The most rapid control was achieved in 105 sec. using an SS system at a density of 0.16. An SS system is 1.3 to 1.6 times as effective on a time basis in achieving extinguishment as an F/W system. The fluorosurfactant foam and a protein foam in 6 percent water solution were compared. Rates of advance were slightly better for the former agent. No significant difference between the two agents was observed in burnback resistance. Fluorosurfactant based foam is approximately equivalent to protein foam in achieving control and extinguishment when discharged through an F/W system, but the fluorosurfactant foam, when discharged through an SS system, appears to be superior to the protein foam discharged through an F/W deluge system.

-PERTINENT FIGURES-

FIG. 1 FREQUENCY OF PERFORMANCE RATIOS OF LIGHT WATER TO PROTEIN FOAMS IN 90 PERCENT FIRE CONTROL PAGE 6//FIG. 2 FREQUENCY OF PERFORMANCE RATIOS OF LIGHT WATER TO PROTEIN FOAMS IN FIRE EXTINGUISHMENT PAGE 7//FIG. 7 BURNBACK RESISTANCE OF 6 PERCENT LIGHT WATER AND PROTEIN FOAMS GENERATED BY A GRINNELL F/W HEAD PAGE 22//TAB. 1 25 PERCENT DRAINAGE TIMES OF 6 PERCENT LIGHT WATER FOAMS PAGE 17//TAB. 3 GENERAL DELUGE SYSTEM TESTS AND OBSERVATIONS PAGE 29//TAB. 4 RADIOMETER AND THERMOCOUPLE DATA PAGE 30

-BIBLIOGRAPHY-

TUVE, R.L., PETERSON, H.B., JABLONSKI, E.J.: A NEW VAPOR-SECURING AGENT FOR FLAMMABLE LIQUID FIRE EXTINGUISHMENT. NRL REP., MAR. 13, 1964//PETERSON, H.B., ET AL.: FULL-SCALE FIRE MODELING TEST STUDIES OF LIGHT WATER AND PROTEIN TYPE FOAMS. NRL REPORT 6573, U.S. NAVAL RES. LAB., WASHINGTON, D.C., AUG. 15, 1967//AQUEOUS FILM FORMING FOAM TESTS. CHANUTE AFB, AUG. 19-20, 1970//MAGUIRE,

H.M.: LIGHT WATER COMES OUT ON TOP IN TESTS BY 3 FIRE DEPARTMENTS. FIRE ENG., VOL. 122 NO. 4, 44-48, APR. 1969//UNPUBLISHED DATA: TESTS CONDUCTED AT ONTARIO, CALIFORNIA, JAN. 1971//MORAN, H.E., BURNETT, J.C., AND LEONARD, J.T.: SUPPRESSION OF FUEL EVAPORATION BY AQUEOUS FILMS OF FLUOROCHEMICAL SURFACTANT SOLUTIONS. NRL REPORT 7247, NAVAL RES. LAB., WASHINGTON, D.C., APR. 1971

-SOURCE INFORMATION-

CORPORATE SOURCE -
FACTORY MUTUAL RESEARCH CORP., NORWOOD, MASS.
REPORT NUMBER -
WSCI-72-16
JOURNAL PROCEEDINGS -
WEST SECT COMBUST INST, SEATTLE, WASH., APR. 24-25, 1972
OTHER INFORMATION -
0044 PAGES, 0011 FIGURES, 0005 TABLES, 0029 REFERENCES

A STUDY OF AIRCRAFT FIRE HAZARDS RELATED TO NATURAL ELECTRICAL PHENOMENA

by

KESTER, F.L.
GERSTEIN, M.
PLUMER, J.A.

06/00/68

-ABSTRACT-

The problems of natural electrical phenomena as fire hazards to aircraft are evaluated. Assessment of the hazard is made over the range of low level electrical discharges, such as static sparks, to high level discharges such as lightning strikes to aircraft. In addition, some fundamental work is presented on the problem of flame propagation in aircraft fuel vent systems. Studies were made of: the ignition energies and flame propagation rates of kerosene/air and JP-6/air foams; (2) the rate of flame propagation of heptane, octane, nonane, and decane in aircraft vent ducts; (3) the damage to aluminum, titanium, and stainless steel aircraft skin materials by lightning strikes; (4) fuel ignition by lightning strikes to aircraft skins; and (5) lightning induced flame propagation in an aircraft vent system. The test results are tabulated and summarized.

-SOURCE INFORMATION-

CORPORATE SOURCE -
DYNAMIC SCIENCE CORP., MONROVIA, CALIF.
REPORT NUMBER -
NASA-CR-1076//N68-26691//SN-9000
SPONSOR -
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION, CLEVELAND, OHIO. LEWIS RESEARCH CENTER.
CONTRACT NUMBER -
CONTRACT NASW-1416
OTHER INFORMATION -
0132 PAGES, 0059 FIGURES, 0013 TABLES, 0003 REFERENCES

key 906

CHEMICALLY INDUCED IGNITION IN AIRCRAFT AND SPACECRAFT ELECTRICAL CIRCUITRY BY GLYCOL/WATER SOLUTIONS

by

DOWNS, W.R.

04/00/68

-ABSTRACT-

Electrical circuitry of military aircraft and spacecraft consists, in part, of insulated silver-covered copper wires and components. This circuitry creates a potential flammability hazard when solutions of glycol/water come in contact with either a bare or a defectively insulated wire or component carrying direct current. The hazard arises from chemical reactivity of the silver-covered copper anode in contact with glycol/water solutions. Similar reactivity does not occur with pure copper, nickel-covered copper, or tin-plated copper elements in electric circuits. Some chemical and physical properties of glycol/water fluids are presented, and glycol-induced corrosion of metals and corrosion inhibitors are discussed. A tentative chemical mechanism for the reactions of glycol/water solutions with silver wire carrying direct current is proposed. A means of detecting reaction by use of a transistorized amplitude-modulation receiver is reported, and a means of preventing reaction of glycol/water solutions with silver wires carrying direct current by adding a silver chelating agent to the glycol/ water fluid is described.

-BIBLIOGRAPHY-

BOIES, D.B. AND NORTHAN, B.J.: DEVELOPMENT OF A CORROSION-INHIBITED HEAT-TRANSFER FLUID FOR ECS SYSTEMS. NASA CR-65485, 1966//BOIES, D.B. AND NORTHAN, B.J.: STUDY OF CORROSION INHIBITORS FOR APOLLO THERMAL TRANSPORT FLUIDS. NASA CR-65775, 1967//SETTY, H.S.: EXAMINATION OF THE CHEMISTRY INVOLVED IN ANODIC OXIDATION OF SILVER IN THE SYSTEM-SILVER: OXYGEN: INHIBITED GLYCOL/WATER SOLUTION. NASA CR-65681, 1967

-SOURCE INFORMATION-

CORPORATE SOURCE -
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION, HOUSTON, TEX. MANNED SPACECRAFT CENTER.
REPORT NUMBER -
NASA-TN-D-4327//N68-22213
OTHER INFORMATION -
0017 PAGES, 0005 FIGURES, 0000 TABLES, 0004 REFERENCES

FIRE DETECTION SYSTEMS, AIRCRAFT. MATERIAL TEST PROCEDURE 7-2-050. FINAL REPORT.

by

ARMY TEST AND EVALUATION COMMAND

12/04/69

-ABSTRACT-

Test methods and techniques are provided which are necessary to determine the technical performance and safety characteristics of aircraft fire detecting systems and their associated tools and equipment, and to determine the system's suitability for service tests. This Materials Test Procedure describes the following tests conducted on aircraft fire detecting systems: (1) preparation for test, (2) false alarms, (3) electrical evaluation, (4) environmental evaluation, (5) performance tests, (6) transportability, (7) safety, (8) human factors, (9) value analysis, (10) maintenance, and (11) quality assurance. The procedures are limited to fire detecting systems employing continuous strip sensing elements. The test items are considered to be composed of a completely assembled, self-contained fire detecting system mounted, after receipt, on a suitable aluminum pallet.

-SOURCE INFORMATION-

CORPORATE SOURCE -
    ARMY TEST AND EVALUATION COMMAND, ABERDEEN PROVING GROUND, MD.
REPORT NUMBER -
    AD-867036//X70-15151
CONTRACT NUMBER -
    CONTRACT DA-18-001-AMC-1045(R)
OTHER INFORMATION -
    0032 PAGES, 0004 FIGURES, 0000 TABLES, 0028 REFERENCES

AIRCRAFT FUELS, LUBRICANTS, AND FIRE SAFETY

by

ADVISORY GROUP FOR AEROSPACE RESEARCH AND DEVELOPMENT

08/00/71

-ABSTRACT-

Contents: Fristrom, R.M. and Sawyer, R.F., Flame Inhibition Chemistry (See F7200659)//Botteri, B.P., Flammability Properties of Jet Fuels and Techniques for Fire and Explosion Suppression (See F7200660)//Sharma, O.P. and Sirignano, W.A., Ignition of Fuels by a Hot Projectile (See F7200661)// Fiala, R., Contribution to the Selection of Fire Extinguishing Systems and Agents for Aircraft Fires (See F7200662)//Strawson, H. and Lewis, A., Electrostatic Charging in the Handling of Aviation Fuels (See F7200663)// Russell, Jr., R.A., Crash-Safe Turbine Fuel Development by the Federal Aviation Administration (1964-1970) (See F7200664)//Weatherford, Jr., W.D. and Schaekel, F.W., Emulsified Fuels and Aircraft Safety (See F7200665)// Kuchta, J.M., Murphy, J.N., Furno, A.L., and Bartkowski, A., Fire Hazard Evaluation of Thickened Aircraft Fuels (See F7200666)//Macdonald, J.A. and Wyeth, H.W.G., Fire and Explosion Protection of Fuel Tank Ullage (See F7200667)//Fiala, R. and Winterfeld, G., Investigation of Fire Extimguishing Powders by Means of a New Measuring Procedure (See F7200668)//Miller, R.E. and Wilford, S.P., Simulated Crash Tests as a Means of Rating Aircraft Safet Fuels (See F7200669)//Tuve, R.L., Surface Active Considerations in Fuel Fires (See F7200670)

-SOURCE INFORMATION-

REPORT NUMBER -
AGARD-CP-84-71//AD-729570//N72-11668
JOURNAL PROCEEDINGS -
ADVISORY GROUP FOR AEROSPACE RESEARCH AND DEVELOPMENT, PROPULSION AND ENERGETICS PANEL, 37TH, THE HAGUE, NETHERLANDS, MAY 10-14, 1971.
PUBLISHER -
TECHNICAL EDITING AND REPRODUCTION LTD.
OTHER INFORMATION -
9999 PAGES, 9999 FIGURES, 9999 TABLES, 9999 REFERENCES

FLAMMABILITY PROPERTIES OF JET FUELS AND TECHNIQUES FOR FIRE AND EXPLOSION SUPPRESSION

by

BOTTERI, B.P.

08/00/71

-ABSTRACT-

Because of the large quantity and dispersed storage of fuel onboard aircraft under combat environment conditions, a high probability exists that gunfire hits will occur in fuel areas with consequent damaging effects of fire, explosion, and/or fuel depletion. Results of investigative efforts to establish the practical flammability envelopes and associated combustion damage potential for conventional jet fuels such as JP-4, JP-8 (similar to JET A-1), and JP-5 under simulated hostile operating environment conditions are presented. Testing included liquid-space gunfire hits to assess external fire hazard and vertical (liquid to vapor) firing trajectories to determine explosion hazard associated with projectile-induced fuel sprays and mists. All tests were performed in instrumented replica target tanks varying in volume from 15 to 90 gal. Principal test variables were fuel temperature, pressure, fuel depth, external void space, and internal and external air flow. All tests were conducted utilizing 0.50 caliber armor piercing incendiary projectiles. These tests indicate a considerable extension in the flammability range of all fuels compared to the equilibrium flammability limit values which are commonly utilized for fire safety analysis. Recent progress in the use of reticulated polyurethane foam, halogenated hydrocarbon chemical extinguishants, and other fuel-tank inerting techniques are reviewed.

-PERTINENT FIGURES-

FIG. 3 EXTENDED LEAN FLAMMABILITY (SLOSHING AT 17 CPM AND 1 ATM. INITIAL ULLAGE PRESSURE) PAGE 13-9//FIG. 6 EXPLOSION HAZARD UNDER VERTICAL GUNFIRE (ATMOSPHERIC PRESSURE, 90 GAL. TANK, 4 IN. FUEL DEPTH) PAGE 13-10//FIG. 10 TYPICAL PRESSURE-TIME PROFILES FOR JP-4, JP-8, AND JP-5 GUNFIRE INDUCED REACTIONS (ATMOSPHERIC PRESSURE, 70 DEG. F., 90 GAL. TANK, 4 IN. FUEL DEPTH) PAGE 13-11//TAB. 2 FIRE PROPERTIES OF JET FUELS PAGE 13-7//TAB. 3 RESULTS OF LIQUID-PHASE FUEL GUNFIRE TESTS PAGE 13-7//TAB. 4 QUALITATIVE COMPARISON OF JP-4 AND JP-8 FOR JET AIRCRAFT OPERATIONS PAGE 13-8

-SOURCE INFORMATION-

CORPORATE SOURCE -
AIR FORCE AERO PROPULSION LAB., WRIGHT-PATTERSON AFB, OHIO.
REPORT NUMBER -
AD-729570//AGARD-CP-84-71//N72-11668
JOURNAL PROCEEDINGS -
IN: AGARD AIRCRAFT FUELS, LUBRICANTS, AND FIRE SAFETY, 197
(SEE F7200658)
OTHER INFORMATION -
0011 PAGES, 0010 FIGURES, 0004 TABLES, 0005 REFERENCES

CONTRIBUTION TO THE SELECTION OF FIRE EXTINGUISHING SYSTEMS AND AGENTS FOR AIRCRAFT FIRES

by

FIALA, R.

08/00/71

-ABSTRACT-

A description of a new fire extinguishing system for aircraft is given, which uses the exhaust gases of a solid propellant gas generator to pressurize the extinguisher bottle. The extinguishing efficiency of this hot bottle system is compared with that of the extinguishing system in present use. Both systems use halons as fire extinguishing agents. Quantitative values were obtained on the mass flow rates of extinguishant which are necessary for both systems to extinguish a flame under realistic conditions. With the hot bottle system the agent is again stored in a container which, however, is pressurized only during the time of discharge. The gas necessary for the discharge is produced by the combustion of a solid fuel which is contained in a small burning chamber situated at the tip of the hot bottle. In conclusion, it was stated that using a hot bottle system instead of the conventional extinguishing system used today would reduce the weight of the extinguishant needed to extinguish a fire by 20 percent. It is also believed that since the extinguishant is stored at low pressure the equipment weight can also be reduced by adapting the hardware to the special demands of the hot bottle system. A comparison of the extinguishing efficiency of halons and dry powders for fuel fires was carried out in a 4 sq. m. test pan.

-PERTINENT FIGURES-

FIG. 2 SCHEMATIC OF THE HOT BOTTLE PAGE 18-7//FIG. 4 INFLUENCE OF MASS FLOW RATE ON THE EXTINGUISHING EFFECT OF THE HOT BOTTLE SYSTEM, WHEN CARBON TETRACHLORIDE IS USED AS AN AGENT PAGE 18-8//FIG. 6 MASS FLOW OF AGENT TO ACHIEVE EXTINGUISHMENT FOR DIFFERENT AGENTS WHEN DISCHARGED WITH THE HOT BOTTLE SYSTEM AND THE NORMAL FIRE EXTINGUISHING SYSTEM PAGE 18-9//FIG. 8 EXTINGUISHING EFFICIENCY OF PYROLYSED AND HOT PYROLYSED BROMOCHLOROMETHANE PAGE 18-9//FIG. 9 AMOUNT OF AGENT PER SQ. M. NEEDED TO EXTINGUISH A FIRE IN A 4 SQ. M. TEST PAN PAGE 18-10//FIG. 10 PREVENTION OF REIGNITION INITIATED BY A HOT SIDE WALL BY HALONS PAGE 18-10

-BIBLIOGRAPHY-

VAN TIGGELEN, A. AND GROGNARD. M.: CONSIDERATIONS THEORIQUES SUR L

ACTION DES INHIBITEURS DANS LES FLAMMES. BULL. SOC. CHIM., 1818-1822, FRANCE, 1959//WILSON, JR., W.E., ODONOVAN, J.T., AND FRISTROM, R.M.: FLAME INHIBITION BY HALOGEN COMPOUNDS. 929-941, 12TH INTERN. SYMP. ON COMBUST., 1969//CONLEY, D.W.: POST-CRASH FIRE-FIGHTING STUDIES ON TRANSPORT CATEGORY AIRCRAFT. REP. RD-65-50, FAA, 1965//PESMAN, G.J.: APPRAISAL OF HAZARDS TO HUMAN SURVIVAL IN AIRPLANE CRASH FIRES. TECH. NOTE 2996, NAT. ADVISORY COMM. FOR AERONAUT., 1953//THORNE, P.F.: INHIBITION OF THE COMBUSTION OF LIQUID AND GASEOUS FUELS BY FINELY DIVIDED ORGANIC SALTS. FIRE RES. NOTE NO. 604, AUG. 1965//BIRCHALL, J.D.: ON THE MECHANISM OF FLAME INHIBITION BY ALKALI METAL SALTS. COMBUST. AND FLAME, VOL. 14, 85-96, 1970

-SOURCE INFORMATION-

CORPORATE SOURCE -
DEUTSCHE FORSCHUNGS- UND VERSUCHSANSTALT FUER LUFT- UND RAUMFAHRT E.V., PORZ-WAHN (WEST GERMANY).
REPORT NUMBER -
AD-729570//AGARD-CP-85-71//N72-11668
JOURNAL PROCEEDINGS -
IN: AGARD AIRCRAFT FUELS, LUBRICANTS, AND FIRE SAFETY, 1971 (SEE F7200658)
OTHER INFORMATION -
0011 PAGES, 0011 FIGURES, 0000 TABLES, 0011 REFERENCES

ELECTROSTATIC CHARGING IN THE HANDLING OF AVIATION FUELS

by

STRAWSON, H.
LEWIS, A.

08/00/71

-ABSTRACT-

Electrostatic charging of the fuel during fuelling can result in the possibility of incendive sparking in aircraft tanks; some of the more recent experimental results on the different phases of this process are presented. These results confirm that, in the absence of special precautions, discharges creating a tank explosion hazard can exist during aircraft refuelling in certain circumstances. Unless the fuel conductivity is controlled, however, these hazardous circumstances cannot be precisely predicted. The use of a static dissipator additive eliminates the hazard. Methods of introducing the additive and of maintaining the correct conductivity during fuel distribution are discussed, as well as possible side effects and interactions with other fuel additives. On the basis of world-wide airline use over many years, supported by many laboratory tests, it is concluded that the additive provides a safe, simple and trouble-free solution to the problem.

-PERTINENT FIGURES-

FIG. 1 FILTER OUTLET CHARGE DENSITY FOR FOUR DIFFERENT AIRCRAFT FUELING FILTERS. AVIATION KEROSINE, CONDUCTIVITY 2.2 TO 3.5 PS/M. AT 5 DEG. C. PAGE 19-8//FIG. 2 FUEL CHARGING IN HYDRANT DISPENSER AT 2.3 CU. M./MIN. (600 US GAL./MIN.) PAGE 19-9//FIG. 4 VARIATION OF FILTER CHARGING WITH FUEL CONDUCTIVITY PAGE 19-10//FIG. 5 EFFECT OF ASA-3 CONCENTRATION ON CHARGE DENSITY IN KEROSENE MEASURED AFTER 2 SEC. RESIDENCE TIME DOWNSTREAM OF 1 MICROLITER PAGE 19-11//FIG. 7 EFFECT OF ADDITIVE A UPON CHARGE DENSITY IN KEROSENE MEASURED AFTER 2 SEC. RESIDENCE TIME DOWNSTREAM OF 1 MICROLITER PAGE 19-11//TAB. 1 CONDUCTIVITY CHANGE DURING OCEAN TRANSPORT PAGE 19-7

-SOURCE INFORMATION-

CORPORATE SOURCE -
SHELL RESEARCH LTD., CHESTER (ENGLAND). THORNTON RESEARCH CENTRE.
REPORT NUMBER -
AD-729570//AGARD-CP-84-71//N72-11668
JOURNAL PROCEEDINGS -
IN: AGARD AIRCRAFT FUELS, LUBRICANTS, AND FIRE SAFETY, 1971

(SEE F7200658)
OTHER INFORMATION -
0011 PAGES, 0007 FIGURES, 0001 TABLES, 0014 REFERENCES

CRASH-SAFE TURBINE FUEL DEVELOPMENT BY THE FEDERAL AVIATION ADMINISTRATION (1964-1970)

by

RUSSELL, JR., R.A.

08/00/71

-ABSTRACT-

One of the approaches being taken to reduce the probability and/or severity of fire in commercial jet transports is the development of a modified aviation turbine fuel that will provide a significant reduction in the crash fire hazard. The modified fuels program, initiated in 1964, brought to light that under small-scale simulated crash conditions the fire reduction benefits of fuel thickeners result from their ability to physically bind the fuel and thus reduce the rate of vaporization and the exposed surface area available to support a fire. Dozens of thickened fuel candidates have undergone cursory screening, and a small percentage of those that appeared promising have been subjected to a crash fire rating system designed to provide relative values of candidate fuels. Subsequent efforts to investigate the compatibility to two of the earlier available thickened fuels with a unmodified commercial jet aircraft fuel system indicated that the fuel system could not effectively utilize the modified fuels. If chemical and physical studies, not underway, on two of the leading fuel candidates successfully improve their fluidic property, as well as retain their fire retardative properties, then FAA plans to demonstrate the safe operation of aircraft using the modified fuel and demonstrate the improvement in crash fire safety by conducting full-scale crash tests.

-PERTINENT FIGURES-

FIG. 1 SAMPLES OF 1.5 PERCENT FAA 1069-1 GELLED FUEL PAGE 20-2//FIG. 2 1 GAL OF JP-4 CONVERTED TO FUEL MIST AND EXPOSED TO OPEN FLAMES PAGE 20-3//FIG. 3 1 GAL. OF GELLED JP-4 FUEL CONVETRED TO FUEL MIST AND EXPOSED TO OPEN FLAMES PAGE 20-3//FIG. 8 J47-GE-25 ENGINE OPERATING ON GELLED FUEL FEED FROM EXTERNAL SUPPLY SYSTEM PAGE 20-4//FIG. 10 RHEOLOGICAL PROFILE OF DOW XD7129. (FAA) GELLED FUEL-ROTOVISCO MVI VOSCOMETER PAGE 20-6

-SOURCE INFORMATION-

CORPORATE SOURCE -
NATIONAL AVIATION FACILITIES EXPERIMENTAL CENTER, ATLANTIC CITY, N.J.
REPORT NUMBER -
AD-729570//AGARD-CP-84-71//N72-11668

JOURNAL PROCEEDINGS -
IN: AGARD AIRCRAFT FUELS, LUBRICANTS, AND FIRE SAFETY, 1971
(SEE F7200658)
OTHER INFORMATION -
0010 PAGES, 0011 FIGURES, 0000 TABLES, 0015 REFERENCES

EMULSIFIED FUELS AND AIRCRAFT SAFETY

by

WEATHERFORD, JR., W.D.
SCHAEKEL, F.W.

08/00/71

-ABSTRACT-

To reduce the helicopter crash fire danger, the US Army has conducted tests of high-internal-phase-ratio aqueous emulsions. A candidate fuel emulsion must render a fuel less flammable without significantly diminishing the engine combustion performance of the fuel. When there is a minimum of applied stress, the high-internal-phase-ratio emulsion retains its shape, but when an applied shear stress exceeds the yield stress, deformation and flow occur. Newtonian-type flow occurs after the applied shear stress at the pipe wall exceeds the yield stress of the emulsion. Flow abnormalities stem from localized demulsification of phase inversion. At extremely high stress levels, the flow properties approach those of the base fuel. A miniature trough used for fuel-surface flame velocity tests showed that in liquid form JP-8 had a 70 fold reduction in flame velocity relative to JP-4; in their emulsified form JP-8 showed a 250 fold reduction in flame velocity relative to JP-4. JP-4 and JP-8 mist showed similar flammability characteristics. The JP-8 emulsion required substantially more air-assisted shear for flashback to occur. A fuel tank containing emulsified JP-8 was impacted at 20 m./sec. against a concrete wall with two steel spikes set in it. No significant fire occurred. Ignition sources included electric sparks, a continuous heat source, and five highway type smudge pots.

-PERTINENT FIGURES-

FIG. 1 CALCULATED INFLUENCE OF EMULSION YIELD STRESS ON MINIMUM TUBE DIAMETER FOR SPONTANEOUS GRAVITY FLOW OF EMULSION IN VERTICALLY ORIENTED TUBE OPEN AT BOTH ENDS PAGE 21-10//FIG. 2 RHEOLOGICAL CHARACTERISTICS OF A TYPICAL AQUEOUS EMULSION CONTAINING 97 PERCENT JP-8 FUEL AS THE INTERNAL PHASE PAGE 21-10//FIG. 3 IMPACT-DISPERSION FIRE PROPERTIES AT 38 DEG. C.--PHOTOGRAPHS OF VIDEOTAPE PLAYBACK PAGE 21-11//FIG. 4 MIST FLASHBACK TEST-- DEFINITION OF CHARACTERISTIC FLAME TYPES PAGE 21-12

-BIBLIOGRAPHY-

TURNBOW, J.W., ET AL.: CRASH SURVIVAL DESIGN GUIDE. TECH. REP. NO. 70-22, US ARMY MATERIEL LAB., AUG. 1969 (AD-695648)//MACKINVEN,

R., HANSEL, J.G., AND GLASSMAN, I.: INFLUENCE OF LABORATORY PARAMETERS ON FLAME SPREAD ACROSS LIQUID FUELS. COMBUST. SCI. AND TECH., VOL. 1, NO. 4, 293-306, 1970

-SOURCE INFORMATION-

CORPORATE SOURCE -
SOUTHWEST RESEARCH INST., SAN ANTONIO, TEX. ARMY FUELS AND LUBRICANTS RESEARCH LAB.//ARMY COATING AND CHEMICAL LAB., ABERDEEN PROVING GROUND, MD.
REPORT NUMBER -
AD-729570//AGARD-CP-84-71//N72-11668
JOURNAL PROCEEDINGS -
IN: AGARD AIRCRAFT FUELS, LUBRICANTS, AND FIRE SAFETY, 1971 (SEE F7200658)
SPONSOR -
DEPARTMENT OF DEFENSE, WASHINGTON, D.C.
CONTRACT NUMBER -
CONTRACT DAAD05-70-C-0250//CONTRACT DAAJ02-69-C-0030
OTHER INFORMATION -
0012 PAGES, 0004 FIGURES, 0000 TABLES, 0003 REFERENCES

FIRE HAZARD EVALUATION OF THICKENED AIRCRAFT FUELS

by

KUCHTA, J.M.
MURPHY, J.N.
FURNO, A.L.
BARTKOWSKI, A.

08/00/71

-ABSTRACT-

Various gelled or emulsified fuels were proposed for reducing the aircraft crash-fire hazard. Results are presented from bench-scale tests for screening the fuels and from large-scale drop tests for evaluating their fire hazard under simulated crash conditions. Jet A and Jet B type thickened fuels were investigated. Their minimum autoignition temperatures and burning rates varied little, whereas their flash points, volatility rates, self-spread rates, and flame spread rates varied noticeably with either the base fuel or thickening agent composition; minimum ignition energies are also compared for liquid sprays. The performance of the thickened fuels, particularly Jet B emulsions, was not very promising under impact conditions. In fuel drops made from a 150 ft. three-tower facility, the fireball size and radiation intensity varied with impact velocity, impact angle, and type of fuel container. Generally, the fireball hazard was greatest for the highest volatility fuels.

-PERTINENT FIGURES-

FIG. 2 VAPOR PRESSURE VS TIME FOR LIQUID AND EMULSIFIED FUELS BY MODIFIED REID VAPOR PRESSURE METHOD PAGE 22-7//FIG. 7 VARIATION OF PEAK FIREBALL WIDTH WITH IMPACT VELOCITY FOR VERTICAL FUEL DROPS WITH 5 GAL. METAL CONTAINERS PAGE 22-10//FIG. 10 IMPACT AND IGNITION OF 5 GAL. JP-4 EMULSION B IN VECTORIAL (60 DEG.) FUEL DROP AT AN IMPACT VELOCITY OF 36 MPH PAGE 22-11//TAB. 1 VARIATION OF YIELD STRESS WITH RELAXATION PERIOD FOR FOUR EMULSIFIED FUELS PAGE 22-1//TAB. 3 SUMMARY OF BENCH-SCALE TEST DATA FOR JET A TYPE BASE FUELS AND EMULSIFIED OR GELLED FUELS PAGE 22-4//TAB. 4 RADIATION FROM FIRES IN VERTICAL FUEL DROPS WITH 5 GAL. OF FUEL (METAL CONTAINERS) AT AN IMPACT VELOCITY OF 60 MPH PAGE 22-6

-BIBLIOGRAPHY-

RUSSELL, R.A.: REDUCING FUEL HAZARDS BY GELLING. FIRE TECH., VOL. 2, NO. 4, 276, NOV. 1966//POSEY, JR., K., SCHLEICHER, R., ET AL.: FEASABILITY STUDY OF TURBINE FUEL GELS FOR REDUCTION OF CRASH FIRE HAZARDS. FINAL REP. FAA-ADS-62 WESTERN CO., FEB. 1966//NIXON, J., BEERBOWER, A., AND WALLACE, T.J.: EMULSIFIED FUELS FOR AIRCRAFT.

MECH. ENG., 27, DEC. 1968//KUCHTA, J.M., FURNO, A.L., MARTINDILL, G.H., AND IMHOF, A.C.: CRASH FIRE HAZARD RATING SYSTEM FOR CONTROLLED FLAMMABILITY FUELS. FAA REP. NA-69-17 (DS-68-25), BUR. OF MINES, MAR. 1969//BURGESS, D. AND ZABETAKIS, M.G.: FIRE AND EXPLOSION HAZARDS ASSOCIATED WITH LIQUIFIED NATURAL GAS. BUR. OF MINES REP. OF INV. 6099, 1962//TURNBOW, J.W., ET AL.: CRASH SURVIVAL DESIGN GUIDE. USAAVLABS TECH. REP. 67-22, DEC. 1967

-SOURCE INFORMATION-

CORPORATE SOURCE -
BUREAU OF MINES, PITTSBURGH, PA. PITTSBURGH MINING AND SAFETY RESEARCH CENTER.
REPORT NUMBER -
AD-729570//AGARD-CP-84-71//N72-11668
JOURNAL PROCEEDINGS -
IN: AGARD AIRCRAFT FUELS, LUBRICANTS, AND FIRE SAFETY, 1971 (SEE F7200658)
OTHER INFORMATION -
0011 PAGES, 0010 FIGURES, 0004 TABLES, 0010 REFERENCES

FIRE AND EXPLOSION PROTECTION OF FUEL TANK ULLAGE

by

MACDONALD, J.A.
WYETH, H.W.G.

08/00/71

-ABSTRACT-

This paper examines the conditions that can lead to an explosion within aircraft fuel tank ullages (spaces above liquid fuel) and reviews the need for protection systems. Principles employed in providing the desired degree of protection are outlined, such as oxygen reduction, vapor or mist inerting and plastics foam fillers, and the results are presented of work at the Royal Aircraft Establishment to develop a suitable system for military aircraft. Relevant studies undertaken in the United Kingdom over the last 30 years are summarized and brief descriptions given of prototype and trial installations fitted to aircraft. Comparisons have been made between the various systems and their relative merits discussed. It is concluded that plastics foam is an effective system provided that the material is compatible with the environment. Liquid nitrogen is also attractive from the weight aspect, but could pose logistics problems.

-PERTINENT FIGURES-

FIG. 1 FLAMMABILITY LIMITS FOR AVTUR FUEL VAPOR AND MIST PAGE 23-5//FIG. 2 SPARK IGNITION LIMITS FOR OXYGEN CONCENTRATION IN OXYGEN/NITROGEN AND OXYGEN CARBON DIOXIDE MIXTURES WITH WIDE CUT AVIATION FUEL PAGE 23-6//FIG. 3 COMBUSTOR GAS PROTECTION SYSTEM PAGE 23-6//FIG. 4 GASEOUS NITROGEN EXPLOSION PROTECTION SYSTEM PAGE 23-7//FIG. 5 EFFECT OF FOAM FILLING ON PEAK EXPLOSION PRESSURE RISE PAGE 23-7//TAB. 1 FUEL TANK PROTECTION SYSTEMS PAGE 23-5

-SOURCE INFORMATION-

CORPORATE SOURCE -
ROYAL AIRCRAFT ESTABLISHMENT, FARNBOROUGH (ENGLAND). ENGINEERING PHYSICS DEPT.
REPORT NUMBER -
AD-729570//AGARD-CP-84-71//N72-11668
JOURNAL PROCEEDINGS -
IN: AGARD AIRCRAFT FUELS, LUBRICANTS, AND FIRE SAFETY, 1971
(SEE F7200658)
OTHER INFORMATION -
0007 PAGES, 0005 FIGURES, 0001 TABLES, 0008 REFERENCES

INVESTIGATION OF FIRE EXTINGUISHING POWDERS BY MEANS OF A NEW MEASURING PROCEDURE

by

FIALA, R.
WINTERFELD, G.

08/00/71

-ABSTRACT-

Fire extingushing systems in aircraft of high flight Mach numbers are exposed to such high temperatures within the aircraft that halogenated hydrocarbons normally used as fire extinguishing agents in aircraft must be replaced by substances which are more thermally stable. The materials considered are fire extinguishing powders which are also used for large aircraft crash fires. In order to optimise fire extinguishing systems, it is necessary to compare the extinguishing efficiency of solid and gaseous (or liquid) extinguishing agents. The relative effectivenesses of dry powders was measured by the decrease of the blow-off-velocity of a flame- holder-stabilized premixed flame caused by the action of the powder. Since the blow-off-velocity is a function of the laminar flame velocity of the combustible mixture, which is given by Damkoehler's first number, the method permits a direct comparison between gaseous and solid extinguishants. The reproductbility of the test results and the simplicity of the apparatus enable this method to be used, also, for routine investigation. In the comparison of different powders the cryolites, sodium hexafluoraluminate and potassium hexafluoroalumminate proved to be of high extinguishing effectiveness, which in the measurements with the test method described, exceeds that of presently used halons, such as bromotrifluoromethane.

-PERTINENT FIGURES-

FIG. 2 SCHEMATIC DIAGRAM OF TEST APPARATUS PAGE 24-10//FIG. 4 RELATIVE BLOW-OFF-VELOCITY PLOTTED AGAINST RELATIVE BURNING VELOCITY FOR INCREASING EXTINGUISHANT CONCENTRATION PAGE 24-11//FIG. 5 DECREASE OF THE BLOW-OFF- VELOCITY OF A STOICIOMETRIC PROPANE-AIR-FLAME UNDER THE ACTION OF INCREASING EXTINGUISHANT CONCENTRATION PAGE 24-12

-BIBLIOGRAPHY-

MCCAMY, C.S., SHOUB, H., AND LEE, T.G.: FIRE EXTINGUISHMENT BY MEANS OF DRY POWDER. 795, 6TH INTERN. SYMP. ON COMBUST., 1957//FRIEDMAN, R. AND LEVY, J.B.: INHIBITION OF OPPOSED-JET METHANE-AIR DIFFUSION FLAMES, THE EFFECTS OF ALKALI METAL VAPOURS

AND ORGANIC HALIDES. COMBUST. AND FLAME, VOL 7, 195, 1963//THORNE, P.F.: INHIBITION OF THE COMBUSTION OF LIQUID AND GASEOUS FUELS BY FINELY DIVIDED INORGANIC SALTS. FIRE RES. NOTE NO. Z604, FIRE RES. STATION, 1965//LAFFITTE, P., DELBOURGO, R., COMBOURIEU, J., AND DUMONT, J.: THE INFLUENCE OF PARTICLE DIAMETER OF THE SPECIFICITY OF FINE POWDERS IN THE EXTINCTION OF FLAMES. COMBUST. AND FLAME, VOL. 9, 357, 1965 //MILNE, T.A., GREEN, C.L., AND BENSON, D.K.: THE USE OF THE COUNTERFLOW DIFFUSION FLAME IN STUDIES OF INHIBITION EFFECTIVENESS OF GASEOUS AND POWDERED AGENTS. COMBUST. AND FLAME, VOL. 15, 255, 1970//BIRCHALL, J.D.: ON THE MECHANISM OF FLAME INHIBITION BY ALKALI METAL SALTS. COMBUST. AND FLAME, VOL. 14, 85, 1970

-SOURCE INFORMATION-

CORPORATE SOURCE -
DEUTSCHE FORSCHUNGS- UND VERSUCHSANSTALT FUER LUFT- UND RAUMFAHRT E.V., PORZ-WAHN (WEST GERMANY).

REPORT NUMBER -
AD-729570//AGARD-CP-84-71//N72-11668

JOURNAL PROCEEDINGS -
IN: AGARD AIRCRAFT FUELS, LUBRICANTS, AND FIRE SAFETY, 1971 (SEE F7200658)

OTHER INFORMATION -
0013 PAGES, 0006 FIGURES, 0000 TABLES, 0023 REFERENCES

SIMULATED CRASH TESTS AS A MEANS OF RATING AIRCRAFT SAFETY FUELS

by

MILLER, R.E.
WILFORD, S.P.

08/00/71

-ABSTRACT-

Two tests are described for assessing the flame resistance of Avtur containing polymeric additives which reduce its ability to form flammable mists. In the standard test, a tank containing 10 or 20 gal. of fuel is propelled on a rocket sled at speeds of 114 or 188 ft./sec. and decelerated after contact with an aircraft arrestor wire. Fuel is allowed to spill from a slit in the tank onto a series of ignition sources. In the run on test, the tank travels at speeds up to 240 ft./sec. past a series of ignition sources while spilling fuel from a slit on the leading edge. Significant variables in these tests included the fuel velocity relative to the air stream and the number and placement of the ignition sources. The addition of 0.5 percent FM3, which is a mist inhibiting additive consisting of a high molecular weight polymer, to Avtur produced a considerable reduction in the incidence and intensity of fires.

-PERTINENT FIGURES-

FIG. 1 VARIATION OF AIRCRAFT VELOCITY AND EXIT VELOCITY WITH TIME FOR THE 95TH PERCENTILE ACCIDENT PAGE 25-10//FIG. 5 FUEL TANK AND LAYOUT OF IGNITION SOURCES PAGE 25-12//FIG. 6 VELOCITY PROFILES FOR STANDARD TESTS (10 GAL. TANK) PAGE 25-12//FIG. 7 TYPICAL DECELERATION PULSES FOR STANDARD TESTS PAGE 25-13//TAB. 1 COMPARISON OF AVTUR WITH MODIFIED FUEL IN SIMULATED CRASH TESTS AT 188 FT./SEC. PAGE 25-5//TAB. 4 EFFECT OF VELOCITY ON IGNITION BEHAVIOUR OF AVTUR AND MODIFIED FUEL PAGE 25-8

-BIBLIOGRAPHY-

TURNBOW, J.W., ET AL.: CRASH SURVIVAL DESIGN GUIDE. USAAVLABS TECH. REP. 67-22//BEERBOWER, A., NIXON, J., PHILIPPOFF, W., AND WALLACE, T.J.: THICKENED FUELS FOR AIRCRAFT SAFETY. S.A.E. PAP. 670634, 1967//BORODIN, V.A. AND DITYAKIN, Y.F.: ATOMISATION OF LIQUIDS. FTD MT 24-97-68

-SOURCE INFORMATION-

CORPORATE SOURCE -

ROYAL AIRCRAFT ESTABLISHMENT, FARNBOROUGH (ENGLAND). MATERIALS DEPT.

REPORT NUMBER -
AD-729570//AGARD-CP-84-71//N72-11668

JOURNAL PROCEEDINGS -
IN: AGARD AIRCRAFT FUELS, LUBRICANTS, AND FIRE SAFETY, 1971
(SEE F7200658)

OTHER INFORMATION -
0013 PAGES, 0007 FIGURES, 0004 TABLES, 0003 REFERENCES

THE HELICOPTER'S ROLE IN FIRE FIGHTING

by

AEROSPACE CORP.

02/15/72

-ABSTRACT-

The use of helicopters by the Los Angeles County Fire Department since 1957 was based on the following factors: (1) Since the County consisted largely of urban and populated areas, the accuracy of helicopters in making retardant drops on brush fires was important to nearby populous areas. (2) The typically shorter runs favored the rapid turn-around time of the helicopter. (3) Finally, the helicopter was more suited to the multi-use applications which included rescue and airborne command needed by the County. Helicopters are used for protection of watershed lands, for reconnaissance and command functions on urban and industrial fires, for initial fire attack on wild land fires, and for the delivery and dropping of vital cargoes and the flexible deployment of hover jumper personnel. When the helicopter is fitted with gyro-stabilized optical systems, it becomes a useful surveillance tool and can be very helpful in acquiring documented information for possible arson investigation or other law enforcement applications. When fitted with infrared surveillance equipment, the helicopter becomes a means of early detection and the mapping of rural fires.

-SOURCE INFORMATION-

CORPORATE SOURCE -
AEROSPACE CORP., EL SEGUNDO, CALIF.
JOURNAL PROCEEDINGS -
NATIONAL COMMISSION ON FIRE PREVENTION AND CONTROL, WASHINGTON, D.C., FEB. 15, 1972
OTHER INFORMATION -
0009 PAGES, 0000 FIGURES, 0000 TABLES, 0000 REFERENCES

key 964

STUDY TO DETERMINE THE APPLICATION OF AIRCRAFT IGNITION-SOURCE CONTROL SYSTEMS TO FUTURE ARMY AIRCRAFT

by

DRUMMOND, J.K.

06/00/71

-ABSTRACT-

Design information applicable to future Army aircraft, on crash sensors, ignition source suppression systems, and circuitry for the automatic activation of the suppression systems was studied. The program involved a comprehensive literature search, the development of requirements for the initiating sybsystem of the overall ignition source control system, and the consideration and comparison of several illustrative activating circuits. The development of a workable ignition source suppression system was found to be feasible. Several systems have already been developed to cool hot surfaces, to inert atmospheres, and to deenergize electical systems. The areas of the ignition source control problem which require development are: the selection and the degree of redundancy of crash sensors, the locations of the sensors on the aircraft, and the complexity of the activating and control circuitry.

-SOURCE INFORMATION-

CORPORATE SOURCE -
DYNAMIC SCIENCE CORP., PHOENIX, ARIZ.
REPORT NUMBER -
N72-14006//AD-729870//USAAMRDL-TR-71-35
SPONSOR -
ARMY AIR MOBILITY RESEARCH AND DEVELOPMENT LAB., FORT EUSTIS, VA.
CONTRACT NUMBER -
CONTRACT DAAJ02-69-C-0030
OTHER INFORMATION -
0053 PAGES, 0021 FIGURES, 0002 TABLES, 0019 REFERENCES

key 983

DEVELOPMENT OF A SILICONE BASE HYDRAULIC FLUID FOR USE IN NAVAL AIRCRAFT

by

JEWELL, E.
HAMMOND, J.L.

12/28/71

-ABSTRACT-

A silicone fluid having excellent lubricating properties and viscosity-temperature characteristics was developed for use as a fire resistant hydraulic fluid in aircraft systems. Wear properties, as indicated by laboratory bench tests, approach those of MIL-H-5606B fluid. Full scale flammability tests have not been conducted on the experimental fluid; however, laboratory tests using FTMS 791, Method No. 352, show it to be approximately twice as resistant to flame as the recently developed synthetic hydrocarbon fluids of the MIL-H-83282 type. Thermal stability data for several of the experimental formulations are given.

-PERTINENT FIGURES-

TAB. 3 COMPARISON OF MIL-H-5606 FLUID WITH VARIOUS SILICONE FORMULATIONS PAGE 7

-SOURCE INFORMATION-

CORPORATE SOURCE -
NAVAL AIR DEVELOPMENT CENTER, JOHNSVILLE, PA. AERO MATERIALS DEPT.
REPORT NUMBER -
NADC-MA-7180//AD-893099L
OTHER INFORMATION -
0016 PAGES, 0005 FIGURES, 0005 TABLES, 0000 REFERENCES

key 984

CRASH SURVIVAL DESIGN GUIDE, REVISED OCT. 1971

by

TURNBOW, J.W.
CARROLL, D.F.
HALEY, JR., J.L.
REED, W.H.

10/00/71

-ABSTRACT-

A design guide was assembled to assist design engineers in understanding the basic problems associated with the development of crashworthy U.S. Army aircraft. Where possible, solutions to specific problems are indicated. In areas in which little design data are available, only the general philosophy appropriate to the problem solution is presented; the details of such solutions, as well as the degree of crashworthiness to be achieved, must be left to the ingenuity of the designer. Data, design techniques, and criteria are presented on aircraft crash kinematic and survival envelopes, airframe crashworthiness design criteria, aircraft seat design criteria (crew and troop/passenger), restraint system design criteria (crew, troop/ passenger, and cargo), occupant environment design criteria, aircraft ancillary equipment stowage design criteria, emergency escape provisions, and postcrash fire design criteria.

-PERTINENT FIGURES-

FIG. 1-20 COMBINED LONGITUDINAL AND VERTICAL IMPACT VELOCITY CHANGES FOR FIXED-WING TRANSPORT AIRCRAFT IN THE 95TH PERCENTILE ACCIDENT PAGE 38//FIG. 2-5 METHOD OF REINFORCING NOSE STRUCTURE TO PROVIDE INCREASED RESISTANCE TO VERTICAL LOADS AND TO REDUCE EARTH SCOOPING PAGE 78//FIG. 2-6 TWO METHODS OF REDUCING EARTH SCOOPING IN ENGINE-MOUNTING AREAS PAGE 80//FIG. 2-9 CAP AND WEB COMBINATION BEAM DESIGN WITH POTENTIAL ENERGY-ABSORBING CAPABILITY (TAKEN FROM REFERENCE 3) PAGE 85//FIG. 2-10 CONCEPTUAL STRUCTURAL CONFIGURATIONS TO ABSORB MAXIMUM ENERGY FOR SIDEWARD, LONGITUDINAL, AND VERTICAL IMPACT FORCES (TAKEN FROM REFERENCE 3) PAGE 86//TAB. 3-II SEAT DESIGN AND STATIC TEST REQUIREMENTS PAGE 152 ARMY TRATSPORTRTION RES° COMMRND: FT. EUSTIS: VR., FEH. 1965 (RD-514582)

-SOURCE INFORMATION-

CORPORATE SOURCE -
DYNAMIC SCIENCE CORP., PHEONIX, ARIZ.
REPORT NUMBER -
AD-733358//USAAMRDL-TR-71-22//DYNAMIC SCIENCE 1500-71-6

SPONSOR -
ARMY AIR MOBILITY RESEARCH AND DEVELOPMENT LAB., FORT EUSTIS, VA.
CONTRACT NUMBER -
CONTRACT DAAJ02-69-C-0030
OTHER INFORMATION -
0373 PAGES, 0152 FIGURES, 0019 TABLES, 0146 REFERENCES

HELICOPTER FLIGHT RESTRICTION AND FIRE SERVICE OPERATIONS

by

THORSELL, E.R.

00/00/71

-ABSTRACT-

Federal Aviation Administration safety regulations concerned with helicopter operations are discussed, specifically parts 91 and 135. These two sections cover the major operational limitations placed on helicopter operations by the FAA. The CAA certificated civilian helicopters in 1946 and they immediately found their way into a wide range of uses. Some of these are enumerated. To develop factual data relative to the use of helicopters in rescue operations, the National Aviation Facilities Experimental Center initiated a test program. The test results are contained in FAA published Report No. 65-50 Post Crash Fire Fighting Studies on Transport Category Aircraft, dated may 1965. Other tests were carried out to determine the helicopters ability in rescue operations. The major conclusions are summarized.

-SOURCE INFORMATION-

CORPORATE SOURCE -
FEDERAL AVIATION ADMINISTRATION, WASHINGTON, D.C.
REPORT NUMBER -
AD-734078
JOURNAL PROCEEDINGS -
IN: NAC-NRC EMPLOYMENT OF AIR OPERATIONS IN THE FIRE SERVICES (1971) (SEE F7200817)
OTHER INFORMATION -
0006 PAGES, 0003 FIGURES, 0000 TABLES, 0000 REFERENCES

key 995

A CASE FOR FUEL TANK INERTING

by

REED, T.O.

06/00/72

-ABSTRACT-

One of the most effective fuel tank inerting methods found to date involves packing fuel tanks with open pore polyurethane foam. The foam arrests flame propagation, whether from a bullet puncture, lightning, or any other ignition source. Incidents attesting to the reliability of foam inerting in preventing fuel tank explosions are revealed. Another effective inerting method involves the use of nitrogen, which replaces the air in the fuel tank. Installations of foam inerting have been completed in over 200 aircraft. The penalty incurred for foam protection is quite nominal at 4 percent fuel loss, of which 1.5 percent is by retention of fuel, and 2.5 is by displacement. The net weight increase in about 0.06 lb./gal. Efforts are under way to reduce this penalty through the use of a lighter weight material and by new voiding concepts. New materials currently being qualified include a nominal 15 ppi yellow foam for fully packed configuraions, and a nominal 25 ppi red foam for voided systems.

-PERTINENT FIGURES-

OVERVIEW OF BURNED FOAM IN THE AREA OF THE NR 3 MAIN TANK FILLER CAP AND DUAL LEVER CONTROL VALVES PAGE 31//SIDE VIEW OF BURNED FOAM PIECE AT FUEL FILLER OPENING PAGE 31//TYPICAL FOAM INSTALLATION INTO OUTBOARD FUEL TANK ON C-130 AIRCRAFT PAGE 31

-SOURCE INFORMATION-

CORPORATE SOURCE -
AERONAUTICAL SYSTEMS DIV., WRIGHT-PATTERSON AFB, OHIO.
JOURNAL PROCEEDINGS -
AEROSP SAFETY, VOL.18, NO.6, 30-31 (JUNE 1972)
OTHER INFORMATION -
0002 PAGES, 0003 FIGURES, 0000 TABLES, 0000 REFERENCES

EMPLOYMENT OF AIR OPERATIONS IN THE FIRE SERVICE. PROC. OF SYMPOSIUM. ARGONNE, ILL., JUNE 9-10, 1971

by

NATIONAL ACADEMY OF SCIENCES-NATIONAL RESEARCH COUNCIL

00/00/71

-ABSTRACT-

Contents: Houts, R., Los Angeles County Operations (F7200818)// Volkamer, C.W., Chicago Fire Department Operations (F7200819)// Pierce, M.K., Forest Fire Air Attack (F7200820)//Chandler, C.C., Helicopter Fire Fighting in Viet Nam (F7200821)//Shields, H.J., Fire-Fighting Accssories for Helicopters (F7200822)//Domanovsky, P., Manufacturers Specifications and Aircraft Performance (F7200823)// Thorsell, E.R., Helicopter Flight Restriction and Fire Service Operations (F7200824)//McCullom, N.R., Communications are Essential (F7200825)//Fergusson, A., Operation and Safety Problems (F7200826)// Hastings, J.S., Integrating Air Attack with Fire-Fighting Strategy (F7200827)//Barrows, J.S., Fire-Fighting Chemicals (F7200828)//Suggs, R.L., Diversified Helicopter Services (F7200829)//Scarff, Jr., J.P., Current Techniques Employed by USAF Helicopters in Crash Fire Operations (F7200830)//Hirsch, S.N., Fire Intelligence (F7200831)

-SOURCE INFORMATION-

CORPORATE SOURCE -
NATIONAL ACADEMY OF SCIENCES-NATIONAL RESEARCH COUNCIL, WASHINGTON, D.C. COMMITTEE ON FIRE RESEARCH.
REPORT NUMBER -
AD-734078
OTHER INFORMATION -
9999 PAGES, 9999 FIGURES, 9999 TABLES, 9999 REFERENCES

key 1023

ADVANCED FLAME ARRESTOR MATERIALS AND TECHNIQUES FOR FUEL TANK PROTECTION. FINAL TECHNICAL REPORT

by

MALMBERG, Q. C.
WIGGINS, E. W.

03/00/72

-ABSTRACT-

Structural and integral isolation concepts were developed and tested for minimizing the weight and volume displacement penalties of polyester foam and polyurethane foam explosion supression system for aircraft fuel tanks. The structural isolation concept utilized natural aircraft structural structural isolation concept utilized natural aircraft structural compartmentization, whereas the integral isolation concept used gross cavities within the foam itself. These voids are very large compared to foam pore dimensions. For unpressurized fuselage tanks, the integral concept of large hollow cylinders offered the greater percentage void (58.5 percent), while the use of voids in the foam lined wall configuration was the better approach for pressurized fuselage tanks. In both instances, fuel tank capacity was significantly increased above that possible with completely foam filled tanks. The most effective foam configurations for small and large simulated wing tank systems were the egg crate and lined wall concepts. Flame arrestor effectiveness, fuel flow resistance, and thermophysical properties of represemtative candidate materials and configurations were also evaluated. Wetting agents and coatings improved arrestor effectiveness to only a small degree but showed that with proper material configuration they could contribute significantly to reduce flame penetration. The material properties of thermal conductivity, specific heat, density, and surface area exhibited only a small effect on material explosion suppression performance.

-PERTINENT FIGURES-

FIG. 5 FUSELAGE FUEL TANK FOAM CONFIGURATIONS PAGE 11//FIG.29 PRESSURE RATIO VERSUS RELIEF TO COMBUSTION VOLUME RATIO 7.5 IN. DIA. CYLINDER FLAT ENDS PAGE 56//FIG.48 DTA TRACE PAGE 91//FIG. 57 FLOW VERSUS PRESSURE DROP- ALUMINUM HONEYCOMB PAGE 114//FIG. 62 PRESSURE RATIO VERSUS RELIEF TO COMBUSTION VOL. RATIO PAGE 133//FIG. 69 FOAM WT. AND VOL. PENALTIES PAGE 147

-SOURCE INFORMATION-

CORPORATE SOURCE -
MCDONNELL AIRCRAFT CO., ST. LOUIS, MO.

REPORT NUMBER -
AFAPL-TR-72-12
SPONSOR -
AIR FORCE AERO PROPULSION LAB., WRIGHT-PATTERSON AFB, OHIO.
CONTRACT NUMBER -
CONTRACT F33615-71-C-1191
OTHER INFORMATION -
0158 PAGES, 0069 FIGURES, 0021 TABLES, 0000 REFERENCES

CURRENT TECHNIQUES EMPLOYED BY USAF HELICOPTERS IN CRASH FIRE OPERATIONS

by

SCARFF, JR., J.P.

00/00/71

-ABSTRACT-

The United States Air Force integrated airborne fire suppression system consists of an h-43 helicopter and an air transportable fire suppression kit. The single engine H-43 is a turbine powered helicopter, capable of speeds up to 105 knots. The fire suppression capability is provided by one of two types of fire suppression kits (FSK) which are suspended beneath the H-43. The first type of FSK is a soft hose kit weighing about 1,000 pounds. This kit has 150 ft. of collapsible dacron and cotton hose which is deployed from a basket attached to the kit frame. The second type of FSK is the hard hose kit which has a reel mounted, 150 ft. rubber hose. This kit weighs about 1,200 lb. Both FSKs contain 78 gal. of water and five gal. of mechanical foam concentrate which is mixed and delivered by a 3,000 psi air supply. This provides approximately 690 gal. of foam which can be delivered at a rate up to 800 gal./min. With the foam nozzle full open, a constant flow of foam can be sustained for 55 sec. The procedures and techniques of employing the H-43 fire suppression system are discussed.

-PERTINENT FIGURES-

FIG. 3 FIRE SUPPRESSION EQUIPMENT (HARD HOSE KIT) PAGE 120

-SOURCE INFORMATION-

CORPORATE SOURCE -
DEPARTMENT OF THE AIR FORCE, WASHINGTON, D.C.
REPORT NUMBER -
AD-734078
JOURNAL PROCEEDINGS -
IN: NAC-NRC EMPLOYMENT OF AIR OPERATIONS IN THE FIRE SERVICES (1971) (SEE F7200817)
OTHER INFORMATION -
0009 PAGES, 0008 FIGURES, 0000 TABLES, 0000 REFERENCES

AIRCRAFT FIRE DETECTION: REPORT OF CONFERENCE

by

ROLLE, S.H.

00/00/71

-ABSTRACT-

Contents: Jones, R.B., Operation and Characteristics of the Kidde Continuous Fire Detector (See F7200766)//Grabowski, G.J., Fenwal Fire Detector Systems (See F7200767)//Winter, J.S., The Lindberg Model 801DRS Fire and Overheat Detector System (See F7200768)//Brown. P.C., Graviner Fire Protection Systems (See F7200769)//Vesuvio, V.J., Edison Type B Fire Detection System (See F72007700)//Hathaway, E.R. Pyrotector Flame and Smoke Detection Systems (See F7200771//Hopkins, G.C., Fire Detection in Boeing Helicopters (See F7200772)//Magri, J.L., Fire Detection Considerations and Practice (See F7200773)//Muller, E.A., Approving a Fire Warning System on Navy Aircraft (See F7200774)//Reida, D.L., Present Systems and Future Trends Engine Burn-Through Characteristics and Means of Detection (See F7200776)// fire detection systems (see F7200775)//Rust, T., investigation of burner-can Trumble, T.m., State-of-the-Art Reivew of Fire and Overheat Detection Techniques Developed by the United States Air Force (See F7200777)

-SOURCE INFORMATION-

CORPORATE SOURCE -
FEDERAL AVIATION ADMINISTRATION, WASHINGTON, D.C.
REPORT NUMBER -
AD-730179
JOURNAL PROCEEDINGS -
FAA AIRCRAFT FIRE DETECTION CONF, WASHINGTON, D.C. (NOV. 16-17, 1970)
OTHER INFORMATION -
9999 PAGES, 9999 FIGURES, 9999 TABLES, 9999 REFERENCES

OPERATION AND CHARACTERISTICS OF THE KIDDE CONTINUOUS FIRE DETECTOR

by

JONES, R.B.

00/00/71

-ABSTRACT-

The Kidde continuous fire detector is a thermal detector; it monitors temperature and responds with a signal whenever the temperature exceeds a pre-set limit. The sensing element is a thermistor device. Fifteen standard variations are available in the thermistor formulation to provide a resistance-temperature curve at least every 100 deg. between about 200 and 1400 deg. F. The principles of operation are reviewed. A system design is considered for aircraft and the first step is to identify the fire hazards in the aircraft. Generally, for the engine, this is locating the fuel components and those areas where hot bleed air leaks can occur. Ambient temperatures must be determined and alarm temperatures established. Consideration must be given to the warning presentation, reliability, and dispatchability. The characteristics of good system design are outlined, along with installation recommendations.

-SOURCE INFORMATION-

CORPORATE SOURCE -
WALTER KIDDE AND CO., INC., BELLEVILLE, N.J.
REPORT NUMBER -
AD-730179
JOURNAL PROCEEDINGS -
IN: FAA AIRCRAFT FIRE DETECTION CONF, WASHINGTON, D.C. (NOV. 16-17, 1970) (SEE F7200765)
OTHER INFORMATION -
0022 PAGES, 0008 FIGURES, 0000 TABLES, 0000 REFERENCES

key 1056

FENWAL FIRE DETECTION SYSTEMS

by

GRABOWSKI, G.J.

00/00/71

-ABSTRACT-

The Fenwal continuous fire detection system consists of a thermal sensing element with associated hardware for attaching to an aircraft structure and a control unit. The thermal sensing element signals an overheat or fire condition by a change of state when the temperature within the area being monitored reaches a preselected temperature. The signal from the sensing element is then modified by the control unit to actuate auxiliary equipment provided by the airframe manufacturer to provide a visual or aural alarm to the aircraft pilot. Sensing element temperatures available are -255 deg., 310, 400, 575, 765, 900, 1050, and 1200 deg. F. The tolerance on these setpoints is about 5 percent. The fire and overheat detection systems can be provided in either a single or dual loop configuration. Beacuse the method of element installation, and the length of loop provided must be tailored to fit the particular area to be protected, Fenwal feels that the best installation can be accomplished by a change in the regulations covering responsibility of installing fire detection systems.

-SOURCE INFORMATION-

CORPORATE SOURCE -
FENWAL, INC., ASHLAND, MASS.
REPORT NUMBER -
AD-730179
JOURNAL PROCEEDINGS -
IN: FAA AIRCRAFT FIRE DETECTION CONF, WASHINGTON, D.C. (NOV. 16-17, 1970) (SEE F7200765)
OTHER INFORMATION -
0010 PAGES, 0000 FIGURES, 0000 TABLES, 0000 REFERENCES

THE LINDBERG MODEL 801DRS FIRE AND OVERHEAT DETECTOR SYSTEM

by

WINTER, J.S.

00/00/71

-ABSTRACT-

The Lindberg model 801DRS fire and overheat detector system is pneumatically operated by heating a small diameter sensor tube which contains an inert gas and a gas filled core material. The application of heat to the sensor causes an increase in gas pressure which operates a pressure diaphragm that closes an electrical contact to actuate the alarm circuit. The pressure diaphragm in the responder is the only moving part in the basic system and serves as one side of the electrical alarm contact. The detector has a dual sensing function and can respond to an overall average temperature or a highly localized discrete temperature caused by impinging flame or hot gases. The detector design, system characteristics, and installation recommendations are summarized. The detector system has had more than 50 million unit hours of flight servide aboard turboprop and jet engine aircraft.

-SOURCE INFORMATION-

CORPORATE SOURCE -
SYSTRON-DONNER CORP., CONCORD, CALIF.
REPORT NUMBER -
AD-730179
JOURNAL PROCEEDINGS -
IN: FAA AIRCRAFT FIRE DETECTION CONF, WASHINGTON, D.C. (NOV. 16-17, 1970) (SEE F7200765)
OTHER INFORMATION -
0022 PAGES, 0006 FIGURES, 0000 TABLES, 0000 REFERENCES

key 1058

GRAVINER FIRE PROTECTION SYSTEMS

by

BROWN, P.C.

00/00/71

-ABSTRACT-

The Graviner continuous fire detector, FIREWIRE, is a heat sensing continuous element system of the logarithmic averaging type. It consists of a series of sensing elements which are 0.08 in. diameter stainless steel tubes containing a center wire and a coaxial filling of a temperature sensitive insulator. An associated control unit supplies low voltage A.C. to the element center wire and monitors the flow of current via the coaxial filling to earth. This current flow is dependent on the temperature of the element, and at a predetermined level, a fire warning is signalled. Another detector, the type UV flame system consists of a number of detector head assemblies which comprise a photosensitive gas filled tube, a quartz protective cover, and a U.V. test emitter. Comments and discussion of detector test methods currently used are included.

-PERTINENT FIGURES-

FIG. 2 RANGE OF ELEMENT OPERATING CHARACTERISTICS IN CURRENT PRODUCTION PAGE 58//FIG. 3 COMPARISON OF SYSTEM CHARACTERISTICS PAGE 59//FIG. 8 CONDUCTION SYSTEM PAGE 64

-SOURCE INFORMATION-

CORPORATE SOURCE -
GRAVINER, LTD., COLMBROOK (ENGLAND).
REPORT NUMBER -
AD-730179
JOURNAL PROCEEDINGS -
IN: FAA AIRCRAFT FIRE DETECTION CONF, WASHINGTON, D.C. (NOV. 16-17, 1970) (SEE F7200765)
OTHER INFORMATION -
0024 PAGES, 0016 FIGURES, 0000 TABLES, 0000 REFERENCES

key 1059

EDISON TYPE B FIRE DETECTION SYSTEM

by

VESUVIO, V.J.

00/00/71

-ABSTRACT-

The Edison Type B continuous cable detection system was developed to meet aircraft requirements for a reliable method of detecting fire or overheat condition with a detecting element sensitive at any and all points along its length. The temperature sensitive element of the system consists of fabricated legnths of a special coaxial cable equipped with hermetically sealed high temperature connector plugs at both ends. The cable is basically a thermistor. The fire detection control is an electromechanical assembly which accepts the fire detection cable resistance input and provides either an output voltage or contact closure at a predetermined fire alarm point. The principles of operation and installation recommendations are presented for the cable and control assembly.

-SOURCE INFORMATION-

CORPORATE SOURCE -
THOMAS A. EDISON INDUSTRIES, WEST ORANGE, N.J.
REPORT NUMBER -
AD-730179
JOURNAL PROCEEDINGS -
IN: FAA AIRCRAFT FIRE DETECTION CONF, WASHINGTON, D.C. (NOV. 16-17, 1970) (SEE F7200765)
OTHER INFORMATION -
0030 PAGES, 0004 FIGURES, 0000 TABLES, 0000 REFERENCES

key 1060

PYROTECTOR FLAME AND SMOKE DETECTION SYSTEMS

by

HATHAWAY E.R.

00/00/71

-ABSTRACT-

Pyrotector flame and smoke detection systems are primarily designed to detect various type fires in aircraft engine nacelle, cargo compartments, and other unattended areas in aircraft. The systems are comprised of three major components: optical flame detectors, light scattering smoke detectors, and a control amplifier that can be used with either type detector. System components can be all flame detectors in the case of engine installations or all smoke detectors in the case of baggage and cargo compartment installations, or a combination of both. The flame detector utilizes two photoconductive cells to analyze the light radiation being received by the detector and provide a signal to a control amplifier. A cell that is responsive to visual infrared is connected in series with a cell that is responsive to the visual blue-white region of the spectrum. The smoke detector operates on the reflective light principle wherein a light beam is directed at right angles to the viewing path of a photoconductive cell inside a small circular chamber which has the ends covered with cup shaped covers mounted on spacers so that smoke can pass freely through the interior by convection. The system design, characteristics, and installation recommendations are summarized.

-SOURCE INFORMATION-

CORPORATE SOURCE -
PYROTECTOR, INC., HINGHAM, MASS.
REPORT NUMBER -
AD-730179
JOURNAL PROCEEDINGS -
IN: FAA AIRCRAFT FIRE DETECTION CONF, WASHINGTON, D.C. (NOV. 16-17, 1970) (SEE F7200765)
OTHER INFORMATION -
0012 PAGES, 0000 FIGURES, 0000 TABLES, 0000 REFERENCES

FIRE DETECTION IN BOEING HELICOPTERS

by

HOPKINS, G.C.

00/00/71

-ABSTRACT-

Fire detection installations on current Boeing twin turbine helicopters, service experience, and areas for possible improvement in fire detection systems are summarized. One system consists of a continuous type overheat detector using two separate circuits. One circuit protects each engine compartment of the helicopter. Each circuit consists of three series connected sensing elements routed around the engine and a control unit mounted on a frame within the fuselage. When either circuit is energized by an abnormal increase in engine compartment temperature, it lights the corresponding fire handle on the center instrument pane. The sensing element is a thin metallic tube with an insulated center wire. Other helicopters use an infrared, flame surveillance, fire detection system employed in each engine compartment with fire warning indication installed in the cockpit. The system is electrically operated and has provisions for checking to ensure that its components and wiring are functioning properly. A variety of smoke detection systems are also used. False alarm indications have been 2.12 indications per 100,000 hours of flight. Most of these have resulted in either forced or precautionary landings. Engine fire rates have been 1.59 fires per 100,000 flight hours.

-PERTINENT FIGURES-

FIG. 3 RCAF ENGINE-FIRE DETECTION SYSTEM AND COCKPIT PRESENTATION PAGE 133

-SOURCE INFORMATION-

CORPORATE SOURCE -
    BOEING CO., MORTON, PA. VERTOL DIV.
REPORT NUMBER -
    AD-730179
JOURNAL PROCEEDINGS -
    IN: FAA AIRCRAFT FIRE DETECTION CONF, WASHINGTON, D.C. (NOV. 16-17, 1970) (SEE F7200765)
OTHER INFORMATION -
    0026 PAGES, 0006 FIGURES, 0003 TABLES, 0000 REFERENCES

FIRE DETECTION CONSIDERATIONS AND PRACTICE

by

MAGRI, J.L.

00/00/71

-ABSTRACT-

sikorsky aircraft experience with fire detection systems in helicopters involved continuous detector systems, optical fire detection systems, or combinations of the two. Considerations entering into the selection of a fire detector system revolved primarily around system reliability and maintainability, system weight, and cost. The operational practice has been to locate the detecting system on a fixed aircraft structure rather than on the engine. Experience indicated that this approach minimizes accidental damage to the system, reduces interference with routine engine compartment maintenance, and simplifies engine removal and installation. In fire detector installations using radiation sensors, only the flame detector is located within the engine compartment. As opposed to continuous detector systems whose sensors should be located in close proximity to anticipated flame areas, with due consideration for engine compartment cooling airflow patterns, radiation sensing optical fire detectors are located to provide volume surveillance of the compartment being monitored. Precise location of flame detectors and their setting is reviewed.

-PERTINENT FIGURES-

FIG. 3 S-65 ENGINE FIRE DETECTION SYSTEM PAGE 158//FIG. 4 FIRE DETECTOR ASSEMBLY PAGE 159//FIG. 6 FLAME DETECTOR LOCATION PAGE 161//FIG. 9 FLAME DETECTOR SCHEMATIC PAGE 164

-SOURCE INFORMATION-

CORPORATE SOURCE -
UNITED AIRCRAFT CORP., STRATFORD, CONN. SKIORSKY AIRCRAFT DIV.
REPORT NUMBER -
AD-730179
JOURNAL PROCEEDINGS -
IN: FAA AIRCRAFT FIRE DETECTION CONF, WASHINGTON, D.C. (NOV. 16-17, 1970) (SEE F7200765)
OTHER INFORMATION -
0026 PAGES, 0009 FIGURES, 0000 TABLES, 0000 REFERENCES

APPROVING A FIRE WARNING SYSTEM ON NAVY AIRCRAFT

by

MULLER, E.A.

00/00/71

-ABSTRACT-

Specification MIL-F-7872, Fire Warning System on Navy Aircraft, describes th requirements for the design, manufacture, testing, and installation of continuous type fire and overheat warning systems for use in aircraft. These requirements are briefly summarized and include a listing of the more important system design and component design requirements, such as fire response time, automatic repeatability, prevention of false warnings, alarm temperature settings, sensing element lengths, and bend radius. Installation requirements which are summarized include zones requiring fire detection, temperature survey, accessibility, and location of sensing elements.

-SOURCE INFORMATION-

CORPORATE SOURCE -
NAVAL AIR SYSTEMS COMMAND, WASHINGTON, D.C.
REPORT NUMBER -
AD-730179
JOURNAL PROCEEDINGS -
IN: FAA AIRCRAFT FIRE DETECTION CONF, WASHINGTON, D.C. (NOV. 16-17, 1970) (SEE F7200765)
OTHER INFORMATION -
0008 PAGES, 0000 FIGURES, 0000 TABLES, 0000 REFERENCES

key 1064

PRESENT SYSTEMS AND FUTURE TRENDS ENGINE FIRE DETECTING SYSTEMS

by

REIDA, D.L.

00/00/71

-ABSTRACT-

The Beech Aircraft Co. turboprop engine fire detection system is called an Optical Surveillance Fire Detection System. It is designed to provide instantaneous alarm by sensing the heavy infrared radiation imposed on the sensor from a remote fire which occurs withing the 120 deg. conical viewing field of each detector. Detector locations are selected to provide direct viewing of those areas determined to be major potential fire sources. The detectors are calibrated to the sensitivity standards of FAA TSO C79 and will provide an instant alarm when such flames are present within their viewing areas. The greatest advantage in using an optical surveillance type system is the ease and simplicity of testing to be confident that the system will detect any probable fire. A ground test using an infrared light bulb is reported adequate to insure a satisfactory system.

-PERTINENT FIGURES-

FIG. 1 FIRE AND SMOKE DETECTION SYSTEM PAGE 182//FIG. 2 PHOTO SHOWS A FIRE DETECTOR IN THE HOT SECTION OF A PT6 ENGINE PAGE 183

-SOURCE INFORMATION-

CORPORATE SOURCE -
BEECH AIRCRAFT CORP., BOULDER, COLO.
REPORT NUMBER -
AD-730179
JOURNAL PROCEEDINGS -
IN: FAA AIRCRAFT FIRE DETECTION CONF, WASHINGTON, D.C. (NOV. 16-17, 1970) (SEE F7200765)
OTHER INFORMATION -
0020 PAGES, 0004 FIGURES, 0000 TABLES, 0000 REFERENCES

NASA TMX-715

BIBLIOGRAPHY ON AIRCRAFT FIRE HAZARDS AND SAFETY

Volume II - SAFETY, Part 3 - Key Numbers 1065 to 2165
(Includes Author Index and Descriptor Index)

Compiled by
James J. Pelouch, Jr. and Paul T. Hacker

Aerospace Safety Research and Data Institute
Lewis Research Center
Cleveland, Ohio 44135

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

262-a

FOREWORD

The mission and objectives of the Aerospace Safety Research and Data Institute are (a) to support NASA, its contractors, and the aerospace industry with technical information and consultation on safety problems; (b) to identify areas where safety problems and technology voids exist and to initiate research programs, both in-house and on contract, in these problem areas; (c) to author and compile state-of-the-art and summary publications in our areas of concern; (d) to establish and operate a safety data bank. As a corollary to its support to the aerospace community, ASRDI is also to establish and maintain a file of specialized information sources (organizations) and recognized, acknowledged experts (individuals) in the specific areas or fields of ASRDI's interest.

To match our resources with our priorties, ASRDI is concentrating on selected areas - fire and explosion; cryogenic systems; propellants and other hazardous materials, with special emphasis on oxygen and hydrogen; aeronautical systems and spacecraft operations; lightning hazards; and the mechanics of structural failure. Staff expertise is backed by a safety library and is further supported by a computerized bank of citations and abstracts built from literature on oxygen, hydrogen, and fire and explosion. Computer files on mechanics of structural failure, fragmentation hazards, and safety information sources are also being established. In addition, ASRDI has two NASA RECON terminals and people adept at querying the system for safety-related information.

Frank E. Belles, Director
Aerospace Safety Research and Data Institute
National Aeronautics and Space Administration

INTRODUCTION

A part of the Aerospace Safety Research and Data Institute's (ASRDI) mission is tc compile and store in a computerized system bibliographic citations on hazards and safety in various areas related to aerospace activities. One of these areas is fire and explosion. The program in this area has been underway for about three years and is continuing. At the present time the computerized data bank contains abcut 2000 bibliographic citations on the subject.

Each citation in the data bank contains many items of information about the document. Some of the main items are title, author, abstract, corporate source, description of figures pertinant to hazards or safety, key references, and descriptors (keywords or subject terms) by which the document can be retrieved. In addition each document is assigned to two main categories that are further divided into subcategories. The two main categories are fire hazards and fire safety. Each document is also further categorized according to its area of applicability such as - aircraft and spacecraft and their associated facilities; aerospace research and develcpment test facilities; buildings; and general applicability.

This report is a compilation of all the document citations in the ASRDI data bank as of April 1974 on fire hazards and fire safety that pertain to aircraft. The report is somewhat preliminary in nature in that input to the data bank is continuing; moreover not all the information contained in the bank has been edited for errors. The report is being published as an illustrative example of the contents of the data dank and to obtain user feedback on the usefulness of such compilations and whether the subject scope should be narrowed in future compilations.

The report is divided into two volumes. Volume I, Hazards, presents bibliographic citations that describe and define the aircraft fire hazards and covers a wide range of subjects such as - combustion characteristics of materials; accidents and incidents reports; causes of fire; methods and techniques of evaluating the fire hazard; and the resulting effects of fire on man and property. Volume II, Safety, presents bibliographic citations that describe and define aircraft fire safety methods, equipment, and criteria. It covers such subjects as prevention, detection, and extinguishment of fire, and codes and standards. Each volume of the report contains, in addition to the citations, an author index and an index of majcr descriptors (keywords or subject terms). The indices are related to the citations by the ASRDI key number, which appears in the upper right hand corner of the first page of each citation. To facilitate binding, both volumes are broken into parts.

Volume I has two parts -

Part 1 - Key Numbers 1 to 817
Part 2 - Key Numbers 818 to 2146, Author Index and Descriptor Index

Volume II has three parts -

Part 1 - Key Numbers 1 to 524
Part 2 - Key Numbers 525 to 1064
Part 3 - Key Numbers 1065 to 2165, Author Index and Descriptor Index

The preparation of this report for printing was essentially accomplished automatically. The search strategy (in this case, subject category) and information on citation content and format was fed into the computer. The output from the computer was placed directly on multilith paper by a high-speed printer.

VOLUME II

PART 3

INVESTIGATION OF BURNER-CAN BURN-THROUGH CHARACTERISTICS AND MEANS OF DETECTION

by

RUST, T.

00/00/71

-ABSTRACT-

The feasibility of detecting burner-can failures through ultraviolet, imfrared, sonic, and other means will be investigated. A review of the Mechanical Reliability Reports for the years 1962 through 1969 revealed that an average of 10 burn-through failures occured each year. About 70 percent were detected by the aircraft engine fire warning system; the pilots received no indication that there was an engine fire in the other 30 percent. The studies will be performed with a J-57 engine. The engine nacelles will be instrumented for temperature, pressure, sound, and light measurements before, during, and after the burn-through occur. The tests will be conducted at takeoff power, climb power, and cruise power. Some work has been performed in the way of an evaluation of an ultraviolet detection system. The system was mounted on the burner-can section of a J-47 engine in a number of different positions to simulate possible in-flight detector configurations. It was concluded that it is feasible to use a surveillance detection system which operates in the ultraviolet light frequency range for detection of burner-can burn-through type fires.

-PERTINENT FIGURES-

TAB. 4 CHARACTERISTICS OF BURN-THROUGH FLAME AT 4 IN. FROM THE BURNER-CAN PAGE 207

-SOURCE INFORMATION-

CORPORATE SOURCE -
NATIONAL AVIATION FACILITIES EXPERIMENTAL CENTER, ATLANTIC CITY, N.J.
REPORT NUMBER -
AD-730179
JOURNAL PROCEEDINGS -
IN: FAA AIRCRAFT FIRE DETECTION CONF, WASHINGTON, D.C. (NOV. 16-17, 1970) (SEE F7200765)
OTHER INFORMATION -
0022 PAGES, 0008 FIGURES, 0004 TABLES, 0000 REFERENCES

STATE-OF-THE-ART REVIEW OF FIRE AND OVERHEAT DETECTION TECHNIQUES DEVELOPED BY THE UNITED STATES AIR FORCE

by

TRUMBLE, T.M.

00/00/71

-ABSTRACT-

An overview is presented of the fire and overheat detection techniques developed by the U.S. Air Force. An optical fire detction system was developed using the first environmentally qualified, coherent 12 1/2 ft. fiber optical bundle, coupled to an electronic light sensor using a 20 hz. low pass electronic filter. The fiber bundles exhibited excellent transmission in the visible spectrum and were qualified for use in 1000 deg. F. areas where existing infrared, ultraviolet, visible sensors could not operate. The feasibility of using ultraviolet sensitive gas multiplication tubes for hydrogen flame detection was proved. Work was done on the way fire and overheat detection could be used best. An integrated fire and overheat system was developed for aircraft. A computer tied together 4 each infrared, ultraviolet, and continuous elements in 5 modes. The normal mode requires one sensor to detect and another sensor to verify the presence of a fire or overheat. A survey was made of the state of the art of fire and overheat sensors.

-PERTINENT FIGURES-

FIG. 1 MICROCIRCUIT COMPUTER FOR INTEGRATED FIRE AND OVERHEAT DETECTION SYSTEM PAGE 229//FIG. 2 TYPICAL SENSOR CHARACTERISTICS PAGE 230

-SOURCE INFORMATION-

CORPORATE SOURCE -
AIR FORCE AERO PROPULSION LAB., WRIGHT-PATTERSON AFB, OHIO.
REPORT NUMBER -
AD-730179
JOURNAL PROCEEDINGS -
IN: FAA AIRCRAFT FIRE DETECTION CONF, WASHINGTON, D.C. (NOV. 16-17, 1970) (SEE F7200765)
OTHER INFORMATION -
0015 PAGES, 0002 FIGURES, 0000 TABLES, 0000 REFERENCES

US/FRG V/STOL TACTICAL FIGHTER PROGRAM. DEFINITION PHASE. FINAL REPORT. PARTR2. VOL. 8. FIRE PROTECTION SUBSYSTEM. DESIGN ANALYSIS AND DESCRIPTIVE DATA (US-283)

by

BROLL, G.J.
BOWERS, W.G.

11/20/67

-ABSTRACT-

The selected approach taken to design a fire protection subsystem for the V/STOL Tactical Fighter Weapon System aircraft is detailed. Generally, fire protection requirements for aircraft were reviewed including fire/overheat and smoke detection systems, aircraft fixed and portable fire extinguishing systems, engine and other fire zone isolation systems and venting systems. The technical approach and design analysis were based on the existence of five fire zones in the aircraft. Each zone should have a fire detection and extinguishing system. The detailed equipment choices made for each zone are described, justified, and priced.

-SOURCE INFORMATION-

CORPORATE SOURCE -
EWR FAIRCHILD INTERNATIONAL, MUNICH (WEST GERMANY).
REPORT NUMBER -
AD-890642L//DP-200-N-262-750//X72-72767
SPONSOR -
AERONAUTICAL SY DIV., WRIGHT-PATTERSON AFB, OHIO.
CONTRACT NUMBER -
CONTRACT F33657 0630
OTHER INFORMATION -
0034 PAGES, 001 RES, 0000 TABLES, 0000 REFERENCES

SAFETY EVALUATION OF EMULSIFIED FUELS. FINAL REPORT

by

SHAW, M.L.

06/00/71

-ABSTRACT-

A series of screening tests was formulated and conducted to obtain fuel characteristics for emulsified and gelled fuels as a function of hot surface ignition, wind shear, and impact dynamics associated with fuel breakup, atomization/dispersion, and ignition. The date obtained from these tests were used to establish emulsified fuel safety evaluation criteria. A simulated full scale experiment was designed to simulate the full scale helicopter crash environment adequately and, in addition, to be reproducibly controllable at minimal cost. The screening tests revealed that for the emulsified fuels, safety was directly dependent upon the fuel yield stress and its internal phase base fuel. A safety evaluation criterion was established in terms of an ignition susceptibility parameter which was shown to be related to an empirical equation containing fuel properties. The data obtained from the simulated full scale tests provided the definition of a nonhazardous limiting value for the ignition susceptibility parameter. Three of the emulsified fuels tested were found to result in a nonhazardous post-crash fire: (1) EF8R-104H emulsion, (2) EF8R-104 emulsion, and (3) Jet- A EXP-4 emulsion. The gelled fuels did not perform as well as the emulsified fuels; however, one gel, Jet-A gel-1, indicated a sizeable advantage over liquid fuels.

-PERTINENT FIGURES-

FIG. 39 IGNITION SUSCEPTIBILITY PARAMETER VERSUS NOZZLE SHEAR FUEL VELOCITY FOR JP-4 BASE EMULSION EF4R-104 PAGE 69//FIG. 71 IGNITION SUSCEPTIBILITY PARAMETER VERSUS WIND SHEAR VELOCITY FOR JP-4 BASE EMULSION EF4R-104 PAGE 94//FIG. 74 IGNITION SUSCEPTIBILITY PARAMETER VERSUS WIND SHEAR VELOCITY FOR JP-4 BASE EMULSION EF4R-104H PAGE 98//FIG. 90 AVERAGE MAXIMUM TEMPERATURE DATA OBTAINED FROM SPARK AND HOT-SURFACE IGNITER TESTS PAGE 125//TAB. 3 SIMULATED POSTCRASH FIRE RESULTS PAGE 141

-BIBLIOGRAPHY-

STUDIES RELATING TO FUEL SAFETY. PAP. 2.F., U.S. ARMY FUELS AND LUBRICANTS RES. LAB., MAR. 1-APR. 1, 1969/ROTHE, V.E.: POSTCRASH FIRE RESEARCH. AVAITION SAFETY ENG. AND RES., A DIV. OF FLIGHT SAFETY FOUNDATION, FLIGHT SAFETY FOUNDATION INTERNATIONAL AIR SAFETY SEMINAR, N.Y. OCT. 1964

-SOURCE INFORMATION-

CORPORATE SOURCE -
DYNAMIC SCIENCE CORP., PHOENIX, ARIZ.
REPORT NUMBER -
AD-729330//N72-14784//USAAMRDL-TR-71-29
SPONSOR -
ARMY AIR MOBILITY RESEARCH AND DEVELOPMENT LAB., FORT EUSTIS, VA.
CONTRACT NUMBER -
CONTRACT DAAJ02-69-C-0030
OTHER INFORMATION -
0207 PAGES, 0102 FIGURES, 0007 TABLES, 0008 REFERENCES

THE FUTURE OF FIRE TECHNOLOGY: UTOPIA OR REALITY? (ZUKUNFSTECHNOLOGIEN DES BRANDSCHUTZES: UTOPI ODER WIRKLICHKEIT?) (L'AVENIR DE LA TECHNOLOGIE INCENDIE: UTOPIE OU REALITE?)

by

ACHILLES, E.

00/00/72

-ABSTRACT-

Efforts to obtain a more effective fire fighting potential in the case of fires in crashed large transport aircraft are suggested to be concentrated on the following points: (1) improved fire prevention measures in aircraft by means of structural measures; (2) improved fire extinguishing media, both as regards effectiveness and their fields of application; (3) improved fire appliances and equipment; (4) revision of regulations and instructions for action in case of fire; and (5) more intensive fire protection research. Emphasis is placed on the improvement of fire appliances and equipment, specifically on an improvement of the effective load and a significant increase in the amount of extinguishing medium carried. Fire fighting systems have been developed using small rockets and repeater launchers, using remote controlled missiles, and using larger rockets. These super-appliances with 6,000, 12,000, 18,000, and 24,000 liters of extinguishing media have been successful at fires, making an essential contribution towards extinguishing aircraft fires quickly. The technical aspects of these rocket systems are detailed.

-PERTINENT FIGURES-

FIG. 2 THE FLIGHT PATH OF THE ROCKET LEADS ABOVE AND ACROSS THE SEAT OF THE FIRE PAGE 39

-SOURCE INFORMATION-

JOURNAL PROCEEDINGS -
FIRE INT, SPECIAL ISSUE, 30-45 (1972)
OTHER INFORMATION -
0012 PAGES, 0006 FIGURES, 0003 TABLES, 0000 REFERENCES

key 1101

PIPE FLOW TESTS WITH NORMAL AND ANTI-MISTING (FM4) AVTUR FUEL

by

TIMBY, E.A.
WELLS, R.F.

10/00/72

-ABSTRACT-

Pipe flow tests were conducted to compare the flow indexed of normal AVTUR fuel and anti-misting (FM4) kerosene fuel, over a temperature range 24 deg. C. to -40 deg C. The anti-misting kerosene (FM4 fuel) increases the fire suppression properties of aviation kerosene. The pipe used in the tests was a 12.7 mm. bore jointless Perspex tube. Measurements were made of pressure and flow rate of the two fuels. The results were treated by the standard method for the flow of non-Newtonian fluids, and the theoretical explanation of this method is presented in the article. Conclusions drawn from the experimental results were: (1) within the laminar regime, at ambient temperatures, FM4 (anti-misting kerosene) behaves as a power law fluid with a flow index of 0.9 and an effective viscosity of 5,000ths Newton -sec./sq. m. at ambient temperature; (2) the flow resistance (pressure drop per unit length at any velocity) of FM4 is approximately twice that of AVTUR and this factor is maintained down to -40 deg. c.; (3) in the turbulent regime, at room temperature, the flow resistance of FM4 is less than that of AVTUR.

-BIBLIOGRAPHY-

CANSDALE, J.T., AND WELLS, R.F.: SIMULATED CRASH FIRE TESTING OF A LOW MIST AIRCRAFT FUEL. RAE TECH. REP. 70114, 1970//MILLER, R.E., AND WILFORD, S.P.: SIMULATED CRASH FIRE TESTS AS A MEANS OF RATING AIRCRAFT SAFETY FUELS. RAE TECH. REP. 71130, 1971

-SOURCE INFORMATION-

CORPORATE SOURCE -
ROYAL AIRCRAFT ESTABLISHMENT, FARNBOROUGH (ENGLAND).
REPORT NUMBER -
AD-907166//RAE-TR-72146
OTHER INFORMATION -
0052 PAGES, 0016 FIGURES, 0011 TABLES, 0007 REFERENCES

key 1103

AIRCREW AND PASSENGER FIRE PROTECTION

by

MEADE, J.P.

10/26/69

-ABSTRACT-

The inflight and post-crash hazard, the human tolerance to fire, and the current status of personnel clothing fire protection and fire suppression systems are defined so that future research and development requirements may be more clearly seen. The total U.S. Air Force inflight fires for the period 1965 to 1967 are summarized; only 4 percent occurred in cockpit/ cabin environment, most were caused by engine/systems. The cause factors for initiating these inflight fires, and contributing factors which sustained the fires are also tabulated for the same period. The post-crash fire hazard accounted for 48 percent of all major aircraft accidents, and is considered the most serious threat to personnel involved in aviation. Flammability factors, fuel, liquid oxygen, and ignition sources were considered in the post-crash environment. Under crash conditions, the fuel on board is the greatest fire hazard. Fire prevention and control factors, both from a material and a human protection standpoint, were also discussed.

-SOURCE INFORMATION-

CORPORATE SOURCE -
DEPUTY INSPECTOR GENERAL FOR INSPECTION AND SAFETY, NORTON AFB, CALIF. LIFE SCIENCES DIV.
JOURNAL PROCEEDINGS -
NATIONAL SAFE SYMP, 7TH, LAS VEGAS, NEVADA (OCT. 26-30,1969)
OTHER INFORMATION -
0016 PAGES, 0000 FIGURES, 0005 TABLES, 0000 REFERENCES

SURVIVA N EMERGENCY ESCAPE FROM PASSENGER AIRCRAFT

by

SNOW, C.C.
CARROLL, J.J
ALLGOOD, M.A.

10/00/70

-ABSTRACT-

A biobehaviora pproach is used to study several human factors in 3 aircraft acc nts. In all, 261 passengers were involved, 105 of whom lost the: ives. The aircrafts were jet transports of types still in servi and likely to be used for some years to come. In each acciden deceleratīve forces were mild and structural deformation i: ing escape was minimal. Fractures and other mechanical trauma, with few exceptions, were minor and sustained during escape rather than at impact; all deaths and major injuries were caused by fire and smoke. Thus, variables introduced by crash forces were insignificant and survival was largely determined by the ability of uninjured passengers to leave their seats and find an exit before succumbing to fire or smoke. The ineffectiveness of inflatable aircraft escape slides, indeed their contribution to burn injuries, is the most important technical finding of this comprehensive study.

-SOURCE INFORMATION-

CORPORATE SOURCE -
FEDERAL AVIATION ADMINISTRATION, WASHINGTON, D.C. OFFICE OF AVIATION MEDICINE.
REPORT NUMBER -
AD-735388//AM-70-16
OTHER INFORMATION -
0058 PAGES, 0040 FIGURES, 0024 TABLES, 0016 REFERENCES

POST-CRASH FIRE-FIGHTING STUDIES ON TRANSPORT CATEGORY AIRCRAFT, DATA SUPPLEMENT

by

CONLEY, D.W.

04/00/65

-ABSTRACT-

A fire test program was carried out to provide information on: (1) The escape time and survival time for occupants of a large transport. (2) To what extent, if any, and how, the downwash effect of helicopter rotors can extend the escape and survival times for crash survivors. (3) To what extent, and how, ground fire fighting, rescue equipment, and helicopters can extend the escape and survival times for crash survivors. The survivors in each instance are uninjured from impact forces, but are exposed to post crash heat and toxic gas hazards. (4) The minimum standards for a rescue path for providing safe entry and exit for rescue personnel or aircraft occupants when aided by ground support equipment and helicopter downwash. (5) The ability of a helicopter and ground fire fighting equipment to jointly establish and maintain a safe rescue path by employing one handline from a 1500 gal. water foam truck, and both the turret and handlines from a 1500 gal. water foam truck. Escape and survival times are defined relative to human tolerance parameters. The aircraft used in the simulated crash fire tests was C-97.

-PERTINENT FIGURES-

FIG. 2 THERMAL AND TOXIC GAS DATA-TEST NO. 1 PAGE 13//FIG. 5 HELICOPTER TIME POSITION DATA AND AMBIENT WIND CONDITIONS-TEST NO. 2 PAGE 19//FIG. 22 EFFECT OF HELICOPTER DOWNWASH ON THE THERMAL CONDITIONS IN A RESCUE PATH-TEST 5 SERIES PAGE 46//FIG. 24 THERMAL DATA AND TEST ARRANGEMENT FOR TEST 6 SERIES//TAB. 7 EXTINGUISHING DATA OF TEST SERIES 7 AND 8 PAGE 52

-BIBLIOGRAPHY-

TARBELL, L.E.: REVIEW OF TRANSPORT AIRCRAFT CRASH FIRE EXPERIENCE AND SURVIVABILITY. PRELIMINARY DRAFT OF PROPULSION BRANCH, REP. NO. 5, FEDERAL AVIATION AGENCY, JUNE 12, 1961//BUETTNER, K.: EFFECTS OF EXTREME HEAT ON MAN. J. OF AMERICAN MED. ASSOC., VOL. 144, NO. 9, 732-738, OCT. 28, 1950// PESSMAN, G.J.: APPRAISAL OF HAZARDS TO HUMAN SURVIVAL IN AIRPLANE CRASH FIRES. NACA T.N. 2996, SEPT. 1953//MARCY, J.F., NICHOLAS, E.B., DEMAREE, J.E.: FLAMMABILITY AND SMOKE CHARACTERISTICS OF AIRCRAFT INTERIOR MATERIALS. AIRCRAFT DEVELOPMENT SERVICE TECH. REP. ADS-3, FEDERAL AVIATION AGENCY, JAN. 1964//SIMMS, D.L., AND HINKLEY, P.L.:

PROTECTIVE CLOTHING AGAINST FLAMES AND HEAT. FR SPECIAL REP. NO. 3, HER MAJESTY STATIONERY OFFICE, LONDON, 1960//DOMINIC, R.J.: INSTRUMENTATION FOR FAA C-97 FIRE TEST PROGRAM. TECH. REP. 64-112, UNIV. OF DAYTON RES. INST., SEPT. 1964

-SOURCE INFORMATION-

CORPORATE SOURCE -
FEDERAL AVIATION AGENCY, WASHINGTON, D.C. SYSTEMS RESEARCH AND DEVELOPMENT SERVICE.
REPORT NUMBER -
REP. NO. RD-65-50
OTHER INFORMATION -
0098 PAGES, 0037 FIGURES, 0008 TABLES, 0023 REFERENCES

key 1153

POST-CRASH FIRE-FIGHTING STUDIES ON TRANSPORT CATEGORY AIRCRAFT. FINAL REPORT

by

CONLEY, D.W.

05/00/65

-ABSTRACT-

Information was obtained on the effectiveness of helicopter downwash and ground foam equipment in extending the escape time for aircraft occupants in a post crash fire environment by burning five C-97 aircraft under similar conditions. Additional tests were conducted relative to rescue path studies. Test data indicated that helicopter downwash extended the escape time when fire existed solely on the upwind side of a C-97 fuselage, but reduced the escape time when fire was on both sides or solely on the downwind side of the fuselage. It was also found that helicopter downwash provided a considerable reduction in the radiant heat and air temperature in a simulated rescue path. For the standard fire condition used and the equipment employed, the ability of ground crews to extend the escape time was found to be dependent upon the preburn time and the fuselage integrity with respect to emergency doors open or closed. An escape time of 50 sec. was computed for a C-97 with emergency doors open as compared to 138 sec. with emergency doors closed.

-PERTINENT FIGURES-

-SOURCE INFORMATION-

CORPORATE SOURCE -
FEDERAL AVIATION AGENCY, WASHINGTON, D.C. SYSTEMS RESEARCH AND DEVELOPMENT SERVICE.
REPORT NUMBER -
REP. NO. RD-65-50
OTHER INFORMATION -
0037 PAGES, 0022 FIGURES, 0000 TABLES, 0007 REFERENCES

FLAMMABILITY AND DESIGN CONSIDERATIONS FOR COMMERCIAL AIRPLANE INTERIOR MATERIALS

by

CHEATHAM, R.G.
PERKOWSKI, W.S.

00/00/71

-ABSTRACT-

A general discussion is presented on the approved flammability test methods for establishing the flammability properties of plastic materials and the three types of aircraft fire ignition sources which are: small in-flight observed and attended fires, unobserved and unattended small ignition sources, and large fuel ignited and fuel fed fires associated with airplane accidents. The state of the art of nonflammable materials is then reviewed. After this background data, design considerations are outlined for use in chosing materials for aircraft interiors. The materials specifications, flammability requirements, and usage zones are then discussed.

-SOURCE INFORMATION-

CORPORATE SOURCE -
BOEING CO., RENTON, WASH.
REPORT NUMBER -
N71-23232
OTHER INFORMATION -
0016 PAGES, 0004 FIGURES, 0002 TABLES, 0000 REFERENCES

key 1159

FLIGHT TEST EVALUATION OF A TB-25N AERIAL TANKER. FINAL REPORT

by

JORDAN, K.E.
KLUEVER, E.E.

09/00/62

-ABSTRACT-

A limited performance, stability and control test was conducted in conjunction with a retardant drop survey on a North American TB-25N Monoplane. A standard TB-25N was modified to accommodate a 1240 gallon capacity tank, consisting of two sections of approximately the same capacity, in the bomb bay. The test airplane was powered by two R-2600-20 engines. With one exception, the stability and control characteristics of the modified plane met the stability requirements of Specification MIL-F-8785 (ASG). The exception was the aft center of gravity stick force gradients. The tested airplane was unsatisfactory for use as a retardant bomber because it was not stressed to withstand the loads imposed on it by dropping retardant from the bomb bay. The amount of retardant that can be dropped from the plane without inducing loads too great for the strength of the airframe is limited to 3000 pounds or less with the airspeed kept within a narrow range of recommended drop airspeeds. No satisfactory escape system is provided.

-SOURCE INFORMATION-

CORPORATE SOURCE -
ARMY TRANSPORTATION MATERIAL COMMAND, EDWARDS AFB, CALIF. AVIATION TEST OFFICE.
REPORT NUMBER -
ATO-TR-62-8//AD-884877//X71-80148
OTHER INFORMATION -
0101 PAGES, 0064 FIGURES, 0000 TABLES, 0000 REFERENCES

key 1170

OPERATIONAL TEST AND EVALUATION OF FIRE RESISTANT FLIGHT COVERALLS, CWU-20/P. FINAL REPORT

by

KASSON, H.D.

07/07/70

-ABSTRACT-

A total of 83 summer flight coveralls made from polybenzimidazole (PBI), a fiber which is highly flame resistant, were tested for a 5 month period by aircrew members while participating in regularly scheduled missions. Data were collected by the use of monthly questionnaires and a final questionnarie on the subjects of comfort, acceptability, and compatibility of the PBI summer flight suit while performing aircrew duties. Seventy-one percent of the test subjects recommended adopting the coverall as a replacement item for other coveralls in use. However, the majority of the test participants also recommended that an entirely new flight suit be developed for transport aircrew members, emphasizing comfort, appearance, and durability.

-SOURCE INFORMATION-

CORPORATE SOURCE -
MILITARY AIRLIFT COMMAND, SCOTT AFB, ILL. OPERATIONAL TEST AND EVALUATION DIV.
REPORT NUMBER -
AD-883487L//X71-78588//MAC OTR-7-7-70
OTHER INFORMATION -
0009 PAGES, 0000 FIGURES, 0001 TABLES, 0000 REFERENCES

key 1175

EXPERIMENTAL DETERMINATION OF THE IGNITION LIMITS OF JP-4 FUEL WHEN EXPOSED TO CALIBER .30 INCENDIARY PROJECTILES

by

PEDRIANI, C.M.

07/00/71

-ABSTRACT-

Experiments were carried out to define the ignition limits of JP-4 vapors subject to 0.30 caliber incendiary projectiles. A test fixture was fabricated which allowed a functioning incendiary projectile to pass through a known, uniform fuel/air mixture. The resultant reaction was observed using high speed photography. Ignitions between fuel/air ratios of 0.5 and 3.0 percent JP-4 volume were observed. Additional tests were conducted to observe the flame suppression properties of reticulated polyurethane foam and to determine the fact that the impact flash from inert projectiles can ignite combustible fuel/air vapor. It was concluded that reticulated foam is an effective method of suppressing explosions of flammable mixtures which would be extremely hazardous in an unprotected tank. It was also found the flammable mixtures could be ignited by the impact flash caused by an otherwise inert projectile. Comparison with spark ignition shows the upper limit to be lower for the projectiles.

-SOURCE INFORMATION-

CORPORATE SOURCE -
ARMY AIR MOBILITY RESEARCH AND DEVELOPMENT LAB., FORT EUSTIS, VA.
REPORT NUMBER -
N72-17964//AD-730343//USAAMRDL TR-71-48//PROJ. 1F162203A150
OTHER INFORMATION -
0030 PAGES, 0014 FIGURES, 0000 TABLES, 0006 REFERENCES

key 1179

MINIMUM NEEDS FOR AIRPORT FIRE FIGHTING AND RESCUE SERVICES

by

COHN, B.M
CAMPBELL, J.A.

01/00/71

-ABSTRACT-

In order to develop minimum standards for airport fire fighting and rescue services complying with the intent of the Airport and Airway Development Act of 1970, a study was made of the needs for different categories of airports serving air carriers certified by the Civil Aeronautics Board. The study consisted of a review of the state of the art, analysis of accident reports, extrapolation of data from various sources, and discussions concerning these services with various owner and user oriented organizations. Recommendations are presented for adoption as the minimum requirements covering quantities and application rates for fire extinguishing agents, the number of vehicles to transport the agents, vehicle response times, manning, and other related elements which comprise these services.

-PERTINENT FIGURES-

FIG. 1 EFFECT OF THERMAL RADIATION EXPOSURE ON UNPROTECTED HUMAN SKIN PAGE 38//FIG. 4 CONTROL TIME FOR LARGE JET FUEL FIRES PAGE 50// FIG. 5 DISTANCE FROM FIRE STATION TO FARTHEST POINT ON RUNWAY AND TIME REQUIRED TO REACH FARTHEST POINT ON RUNWAY//TAB. 1 INCIDENTS REQUIRING FIRE-RESCUE SERVICES AT AIRPORTS PAGE 5//TAB. 2 AIRCRAFT CRASH FIRE INFORMATION FROM NFPA FILES AND OTHER SOURCES PAGE 16//TAB. 3 U.S. CERTIFICATED AIR CARRIER INCIDENTS, 1964-68, WITH FIRE OR WITH DAMAGE HAVING FIRE POTENTIAL PAGE 19

-BIBLIOGRAPHY-

A SURVEY OF AIRPORT FIRE AND RESCUE FACILITIES. AIR LINE PILOTS ASSOC., WASHINGTON, D.C., 1970//RECOMMENDED PRACTICE FOR AIRCRAFT RESCUE AND FIRE FIGHTING SERVICES AT AIRPORTS AND HELIPORTS. PAMPHLET NO. 403, NATIONAL FIRE PORTECTION ASSOC., BOSTON, MASS., 1970//AIRCRAFT FIRE AND RESCUE FACILITIES AND EXTINGUISHING AGENTS. ADVISORY CIRCULAR 150/5210-6A, FEDERAL AVIATION ADMINISTRATION, WASHINGTON, D.C., 1970// STANDARD OPERATING PROCEDURES-AIRCRAFT RESCUE AND FIRE FIGHTING. PAMPHLET NO. 402, NATIONAL FIRE PROTECTION ASSOC., BOSTON, MASS., 1969// SALZBERG, F., AND CAMPBELL, J: AIRCRAFT GROUND FIRE SUPPRESSION AND RESCUE SYSTEMS-CURRENT TECHNOLOGY REVIEW. IIT RES. INST. TECH. REP. AGFSRS-70-1, WRIGHT-PATTERSON AFB, DAYTON, OHIO, OCT. 1969//CONLEY, D.W.: POST CRASH FIRE FIGHTING STUDIES ON TRANSPORT

CATEGORY AIRCRAFT-DATA SUPPLEMENT. REP. SRDS RD-65-60, FEDERAL AVIATION ADMINISTRATION, WASHINGTON, D.C., MAY 1965

-SOURCE INFORMATION-

CORPORATE SOURCE -
GAGE-BABCOCK AND ASSOCIATES, INC., WESTCHESTER, ILL.
REPORT NUMBER -
AD-720512//N71-19426//AS-71-1
SPONSOR -
FEDERAL AVIATION ADMINISTRATION, WASHINGTON, D.C.
CONTRACT NUMBER -
CONTRACT DOT-FA71WA-2487
OTHER INFORMATION -
0094 PAGES, 0008 FIGURES, 0007 TABLES, 0035 REFERENCES

THE INFLUENCE OF FIRE AND SMOKE EMISSION PROPERTIES ON THE SELECTION OF MATERIALS FOR AIRCRAFT INTERIORS

by

DENNEY, M.A.
BROADLEY, D.

11/03/71

-ABSTRACT-

Six major hazards which arise from an aircraft fire are identified and discussed. Regulations relating to flammability of materials are defined, together with test methods for determining the smoke emission characteristics of the materials under direct flame and radiant heating conditions. The influence of smoke and fire regulations on selection of materials is illustrated in a number of areas within civil passenger aircraft. Some of the requirements for ideal new plastics materials for use in aircraft are given. The ideal material will be required to (1) be non-burning or rapidly self-extinguishing; (2) have low smoke emission characteristics if involved in a fire; (3) evolve no highly toxic gases when heated; (4) have low fabricating costs; and (5) still maintain the low weight targets set and achieved with presently used materials.

-PERTINENT FIGURES-

TAB. 1 GASES EVOLVED BY ORGANIC MATERIALS DURING FIRE PAGE 6//TAB. 2 DATA ON TOXIC GASES PAGE 9//TAB. 3 REGULATIONS GOVERING ACCEPTANCE STANDARDS RELATIVE TO FLAMMABILITY OF MATERIALS USED WITHIN CONCORDE AIRCRAFT ARE SUMMARISED PAGE 13

-BIBLIOGRAPHY-

DENNEY, M.A.: THE USE OF LOW FLAMMABILITY MATERIALS IN AIRCRAFT. FLAME RESISTANCE WITH POLYMERS, PLASTICS INST. CONF., MAR. 1966//AIR REGISTRATION BOARD SPECIFICATION NO. 8. FLAME RESISTANCE TESTING OF AIRCRAFT FURNISHING MATERIALS, JULY 11, 1956//A.R.B. CIVIL AIRCRAFT INSPECTION PROCEDURES BL/10-2, FEB. 15, 1961//WOOLLEY, W.D.: A STUDY AND TOXIC EVALUATION OF THE PRODUCTS FROM THE THERMAL DECOMPOSITION OF P.V.C. IN AIR AND NITROGEN. FIRE RES. ASSOC. NOTE 769, JULY 1969

-SOURCE INFORMATION-

CORPORATE SOURCE -
BRITISH AIRCRAFT CORP., WEYBRIDGE (ENGLAND).
JOURNAL PROCEEDINGS -

PLASTICS INST, PLASTICS IN FIRE CONF, LONDON, ENGLAND (NOV. 2-3, 1971)
OTHER INFORMATION -
0016 PAGES, 0000 FIGURES, 0003 TABLES, 0007 REFERENCES

DEVELOPMENT OF CRASH-RESISTANT AIRCRAFT FLAMMABLE FLUID SYSTEMS. PART 1. DELINEATION OF THE PROBLEM

by

BENNETT, C.V.
RODGERS, JR., R.R.

03/00/59

-ABSTRACT-

A study was carried out on reports and data pretaining to on-the-scene aircraft accidents. Particular attention in this study was devoted to determining the contribution of post crash fires to aircraft accident fatality rates. It was found that the fatality rate in crashes of fixed and rotary-wing aircraft, when such crashes are followed by fire, is approximately 25 and 39 percent greater, respectively, than in crashes not followed by fire. A recent investigation was conducted using some helicopter drop crash tests. Two types of investigations were pursued in an effort to establish a criteria for the severity of crash impact which could be used (1) in the design of crash resistant flammable fluid system (particularly fuel tanks and their appendages), and (2) in determining the safest location on a fixed or rotary wing aircraft in respect to fire protection. It was concluded that a crash load factor in the order of 35 may be considered likely in aircrafts under severe but survivable crash conditions. Therefore, a load factor of 35 is recommended for the design of crash-resistant flammable fluid systems installed in fuselages of fixed and rotary-wing aircraft. In respect to location on fixed-wing aircraft it is recommended (1) that fuel tanks be located in the outboard portion of the wings, (2) that fuel tanks be located and/or protected such to prevent ground scraping action, and (3) that fuel tanks not be located forward of the plane of the wing front spar. In the case of helicopters (rotary-wing aircraft) almost any location appears to be suitable for the aircrafts crash-resistant flammable fluid system. The design of crash-resistant fuel tanks for interval fluid pressure loads resulting from squashing conditions is now recognized as being feasible. They should be equipped with accessories and components which will not tear the cell and which are capable of sealing the fuel inside the cell.

-PERTINENT FIGURES-

FIG. 4 SIDE ELEVATION REFERENCE FOR ACCELERATION MEASUREMENTS ON H05S-1 HELICOPTER. FULL-SCALE GRID SPACING IS 1 FT.//FIG. 5 SIDE ELEVATION REFERENCE FOR ACCELERATION MEASUREMENTS ON SIMULATED H-13 HELICOPTER FULL-SCALE GRID SPACING IS ONE HALF FT.//FIG. 6 ANTHROPOMORPHIC DUMMY NO. 1 ACCELERATIONS EXPERIENCED DURING TEST NO. 2 ANTHROPOMORPHIC DUMMY NO. 2 ACCELERATIONS EXPERIENCED

DURING H05S-1 DROP CRASH TEST NO. 2//TAB. 1 SUMMARY OF FATALITIES IN SCHEDULED PASSENGER AIR CARRIER OPERATION PAGE 18//TAB. 2 RESULTS OF SOME DROP-CRASH TESTS OF SIKORSKY H05S-1 HELICOPTERS AND SIMULATED H-13 HELICOPTER STRUCTURES PAGE 19//TAB. 3 RESULTS OF ON-THE-SCENE STUDIES OF HELICOPTER ACCIDENTS BY TDC INVESTIGATORS PAGE 21//TAB. 4 ACCIDENT DATA RECEIVED FROM ON-THE-SCENE MILITARY INVESTIGATIONS PAGE 22/TAB. 5 FLIGHT-PATH ANGLES AND VELOCITIES AND FUSELAGE ATTITUDES AT A POINT 50 FT. ABOVE THE GROUND FOR 4 HELICOPTERS MAKING AUTOROTATIVE LANDINGS TO A PANEL PAGE 24

-SOURCE INFORMATION-

CORPORATE SOURCE -
FEDERAL AVIATION AGENCY, INDIANAPOLIS, IND. TECHNICAL DEVELOPMENT CENTER.
REPORT NUMBER -
FAA-TDR-397
SPONSOR -
ARMY TRANSPORTATION RESEARCH COMMAND, FORT EUSTIS, VA.
CONTRACT NUMBER -
CONTRACT 21X2040 709-9062 P5030-07 S 44-019
OTHER INFORMATION -
0035 PAGES, 0010 FIGURES, 0005 TABLES, 0000 REFERENCES

key 1204

PERFORMANCE OF PROTEIN-BASED FOAMS ON VARIOUS FUELS

by

FITTES, D.W.
RICHARDSON, D.D.

00/00/00

-ABSTRACT-

A study was made of the performance of representative protein based foams on the extinction of fires of various flammable liquid aviation fuels. Fire test results are included and the following conclusions were made: (1) Fires in aviation kerosene (AVTUR) were more readily controlled than fires in AVTAG (wide cut aviation fuel), AVGAS (aviation gasoline), AVPIN (isopropyl nitrate), and motor fuels. (2) A stiff foam will control fires in aviation starter fuel (AVPIN) more readily than a more fluid foam. (3) Fires in motor fuels are generally more difficult to control than fires in aviation fuels. (4) Some fuels, especially when burning, may cause accelerated foam breakdown, but the results show that this is generally not more than 1.35 times the breakdown with narrow boiling point range motor fuel, the reference fuel. Serious deterioration in foam performance in the field is unlikely to be due to the effect of the fuel, and other sources of variation need to be considered.

-PERTINENT FIGURES-

TAB. 3 PERFORMANCE OF FOAM ON AVIATION FUELS PAGE 5//TAB. 4 PERFORMANCE OF FOAM ON MOTOR FUELS PAGE 5

-SOURCE INFORMATION-

CORPORATE SOURCE -
FIRE RESEARCH STATION, BOREHAM WOOD (ENGLAND).
REPORT NUMBER -
FR NOTE 608
OTHER INFORMATION -
0009 PAGES, 0005 FIGURES, 0004 TABLES, 0001 REFERENCES

SOME NOTES ON THE PROPERTIES OF FOAMS PRODUCED BY A GAS TURBINE OPERATED FOAM GENERATOR

by

FITTES, D.W.

06/00/67

-ABSTRACT-

The physical characteristics of protein foams, produced by the gas turbine operated foam generator, were measured by standard methods which included the properties of expansion, critical shear stress, and foam drainage. The following conclusions were reached: (1) The overall critical shear stress range of foams made by the generator at three discharge rates and three expansion values of 50, 125, and 200 gal./min., and 6, 13, and 20 respectively, used in the simulated aircraft fire test program, was between 150 and 1,400 dyne/sq.cm. (2) Independent variation of foam drainage and critical shear stress could not readily be achieved with the generator, but there was a general relation between the two properties over the whole expansion range examined. (3) Experiments with the generator using ammonium lauryl sulfate, a detergent normally used to make high expansion foam, showed that this agent may also be suitable for the manufacture of low expansion form for fire fighting.

-SOURCE INFORMATION-

CORPORATE SOURCE -
FIRE RESEARCH STATION, BOREHAM WOOD (ENGLAND).
REPORT NUMBER -
FR NOTE 668
OTHER INFORMATION -
0012 PAGES, 0005 FIGURES, 0000 TABLES, 0007 REFERENCES

ADVANCED FIRE EXTINGUISHERS FOR AIRCRAFT HABITABLE COMPARTMENTS

by

ATALLAH, S.
HAGOPIAN, J.H.
KALELKAR, A.S.

08/00/72

-ABSTRACT-

Results are described of a program at developing and optimizing portable one-quart and two-gallon size extinguishers for use with a new foamed halon agent (Halon Foam). The program involved several tasks including the study of material compatibility of common materials of construction with Halon Foam; comparative effects of Halon Foam and CB (bromochloromethane) on electronic circuits; optimization of the extinguisher system and subsequent testing on several fire configurations; and appropriate specification development. Prototype extinguishers were constructed in both the desired sizes and the new system was found to be far more effective in fire control than the equivalent CB systems. It was also found that the constituents of Halon Foam are individually less toxic than CB in both their neat and pyrolyzed forms. The Halon Foam system is also less detrimental than CB as far as damage to electronic circuits is concerned.

-SOURCE INFORMATION-

CORPORATE SOURCE -
LITTLE, (ARTHUR D.), INC., CAMBRIDGE, MASS.
REPORT NUMBER -
AFAPL-TR-72-62//AD-747496//ADL-73663
SPONSOR -
AIR FORCE AERO PROPULSION LAB., WRIGHT-PATTERSON AFB, OHIO
CONTRACT NUMBER -
CONTRACT F33615-71-C-1756
OTHER INFORMATION -
0149 PAGES, 0038 FIGURES, 0015 TABLES, 0000 REFERENCES

key 1254

EVALUATION OF INSULATION FOR CRASH FIRE PROTECTION FOR NEW FLIGHT RECORDERS

by

RUST. JR., T.

09/00/72

-ABSTRACT-

New flight data and voice recorder insulation arrangements were evaluated relative to their ability to provide adequate thermal protection for record tapes under conditions of crash fire. Flame and simulated fire testing encompassed 10 experimental insulated boxes at 3 different time-temperature fire environments. All boxes were fabricated with a 1/8 in. thick stainless steel shell, the interior of which was lined with a 1 in. 2000 deg. F. insulating material pad. Inside this pad, Style A box had 1 in. of gelled water heat sink material; Style B had 1 in. of commercial paraffin; Style C had 1 in. of a low cost stable insulation material; and Style D had 1 in. thick solid material capable of evolving water when heated. It was found that a combination of high temperature insulation and a heat sink material employing water as the heat absorber, provided the best protection for the record tapes when exposed to a realistic severe thermal environment.

-PERTINENT FIGURES-

FIG. 1 RECOMMENDED TIME-TEMPERATURE TEST PROFILES FOR FLIGHT RECORDERS PAGE 15//FIG. 2 DRAWING OF EXPERIMENTAL BOX INSULATION ARRANGEMENT PAGE 16//TAB. 1 EXPERIMENTAL BOX WEIGHT LOSS AND TAPE TEST RESULTS PAGE 6

-BIBLIOGRAPHY-

RUST, JR., T., AND BORIS, P.N.: FIRE TEST CRITERIA FOR RECORDERS. FAA-DS-70-16, JULY 1970//HULETT, R.B.: PARAMETRIC STUDY OF THERMAL PROTECTION CONCEPTS FOR AIRBORNE RECORDED TAPES IN A SEVERE CRASH ENVIRONMENT. DS-69-11, SEPT. 1969

-SOURCE INFORMATION-

CORPORATE SOURCE -
NATIONAL AVIATION FACILITIES EXPERIMENTAL CENTER, ATLANTIC CITY, N.J.
REPORT NUMBER -
FAA-RD-72-75//FAA-NA-72-49
SPONSOR -

FEDERAL AVIATION AGENCY, WASHINGTON, D.C. SYSTEMS RESEARCH AND DEVELOPMENT SERVICE.

CONTRACT NUMBER -

PROJ. 215-721-01X

OTHER INFORMATION -

0038 PAGES, 0025 FIGURES, 0001 TABLES, 0006 REFERENCES

key 1271

AQUEOUS FILM-FORMING FOAMS, FACTS AND FALLACIES

by

MELDRUM, D.N.

01/00/72

-ABSTRACT-

The practical differences in the flammable liquid petroleum product fire fighting capabilities are discussed for conventional protein base mechanical foams, fluoroprotein foams, aqueous film forming foams (AFFF), and miscellaneous other synthetic foams. The advantages of the mechanical hydrolized protein foams are their flexibility, relatively low cost, and the existence of world wide standards. Their main disadvantages are relatively poor resistance to burnoff from fuel saturation if the foam is plunged into a depth of fuel, and relative incompatibility with several of the dry chemical agents. Fluoroprotein foams have the advantage of regular type foams as well as good resistance to saturation by hydrocarbon fuels, and better compatibility with dry chemicals. Although slightly more expensive, the fluoroprotein foams have been found to be better than both the regular protein foams and the AFFF for securing fuel against reflash, and resistance to overhead water application and radiant heat. Tests made with AFFF toillustrate how rapidly an AFFF can knock down a spill fire are discussed at length. Comparison data are depicted for the various foams on tank fire control and extinguishment. An AFFF has the advantage of speed of spill fire knockdown and is best with dry chemicals; its disadvantages include fast draining, relatively poor long range fuel security, and high cost. Various extinguishment experiments with AFFF are described in detail.

-SOURCE INFORMATION-

CORPORATE SOURCE -
NATIONAL FOAM SYSTEMS, INC., WEST CHESTER, PA.
JOURNAL PROCEEDINGS -
FIJOAU, FIRE J, VOL. 66, NO. 1, 57-64 (JAN. 1972)
OTHER INFORMATION -
0008 PAGES, 0015 FIGURES, 0000 TABLES, 0004 REFERENCES

SUPER "GARAGES" FOR JUMBO JETS REQUIRE SUPER FIRE PROTECTION SYSTEMS

by

AVERILL, C.F.

03/00/72

-ABSTRACT-

A typical hangar for the jumbo jets can accommodatefour 747s at the same time. There are two 230 ft. by 448 ft. hangar areas separated by a 100 ft. by 448 ft. core area for offices and shops. The tremendous cost of the building and the aircraft requires careful consideration of fire protection. Low expansion protein foam was chosen as the extinguishing agent by one airline. Foam/water sprinkler systems at the roof provided the principal protection, supplemented by monitor nozzles mounted on the core wall to cover areas shielded from overhead discharge, such as under the wings. Wet pipe sprinkler systems are used in the core area where occupancy requires protection. All systems were designed to meet Factory Mutual standards and City of Los Angeles requirements. The applicable NFPA Standards were also used as design guides. The fire protection systems are completely independent of outside utilities. There are 16 systems protecting the hangar areas with a total of 2,480 foam/water sprinklers. Each sprinkler covers an average of 85 to 90 sq. ft. of floor area and discharges foam at an equivalent solution rate of 0.2 gpm/sq. ft. The Los Angeles Fire Department requested actual fire testing of the detection system, because of the lack of experience with buildings of that height, and the results of the tests are described.

-SOURCE INFORMATION-

CORPORATE SOURCE -
GRINNELL CORP., PROVIDENCE, R.I. SPECIAL HAZARDS DEPT.
JOURNAL PROCEEDINGS -
FIJOAU, FIRE J, VOL. 66, NO 2, 24-29 (MAR. 1972)
OTHER INFORMATION -
0006 PAGES, 0013 FIGURES, 0000 TABLES, 0000 REFERENCES

PROTECTION OF AIRCRAFT IN GROUND CRASH FUEL FIRES

by

NEEL, C.B.
FISH, R.H.

05/27/71

-ABSTRACT-

Passengers caught in an aircraft ground accident that has resulted in fire have only a very short time to escape. Those failing to exit quickly probably will die from exposure to heat and fumes. A concept for passenger survival was directed toward the approach of surrounding the passenger compartment with a fire retardant shell that would protect the occupants long enough for the fire to burn out or for fire fighting equipment to reach the airplane and extinguish the fire. The approach was made possible by the recent development of 2 new fire retardant materials: a lightweight foam plastic, polyisocyanurate foam, and an intumescent paint. Tto demonstrate their use in a full scale application, an airplane fuselage was fitted with the materials and tested in a jet fuel fire. The fire tests are described and the results analyzed.

-SOURCE INFORMATION-

CORPORATE SOURCE -
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION, MOFFETT FIELD, CALIF. AMES RESEARCH CENTER.
JOURNAL PROCEEDINGS -
IN: UNIV OF SOUTHERN CALIF FIREPROOFING AND SAFETY SYMP PROC, 59-67 (MAY 27, 1972) (SEE F7201045)
OTHER INFORMATION -
0009 PAGES, 0000 FIGURES, 0000 TABLES, 0000 REFERENCES

key 1311

OTHER NASA-DEVELOPED MATERIALS AND SOME INDUSTRIAL APPLICATIONS

by

RADNOFSKY, M.I.

05/27/71

-ABSTRACT-

Some of the fire retardant materials which NASA has available for nonspace applications include beta fiberglass, Durette and Fypro (aromatic polyamide fibers), Scheufelem paper (nonflammable paper), Fluorel elastomers, Viton elastomers, nonflammable insulating foams, polyquinoxalate, and polymide. Specific applications of these materials include ceiling and wall panels, interior furmishings, floor coverings, paper products, and protective clothing. A brief description is given on the fire suit fabrication program. To demonstrate the many possibilities for use of these materials in the building and interior furnishings industries, NASA as constructed 5 miniature housing modules to be used in a controlled flammability test program. A brief description is also given om NASA aircraft refurbishment with these new mataeials.

-SOURCE INFORMATION-

CORPORATE SOURCE -
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION, HOUSTON, TEX. MANNED SPACECRAFT CENTER.
REPORT NUMBER -
N72-15899
JOURNAL PROCEEDINGS -
IN: UNIV OF SOUTHERN CALIF FIREPROOFING AND SAFETY SYMP PROC, 109-129 (MAY 27, 1971) (SEE F7201045)
OTHER INFORMATION -
0019 PAGES, 0000 FIGURES, 0000 TABLES, 0000 REFERENCES

key 1334

U.S. ARMY AIRCRAFT IN-FLIGHT FIRE DETECTION AND AUTOMATIC SUPPRESSION SYSTEMS

by

DE ROUVILLE, M.
JONES, R.B.

07/00/72

-ABSTRACT-

In-flight Army combat reports and non-combat reports for UH-1, AH-1, and CH-47 helicopters were studied to determine the cause and location of helicopter compartment fires. Two Army helicopter operating bases were visited for first hand information. The in-flight fires were divided into groups, and from the number of incidents in each group, a priority was established to secure the most effective results toward the development of automatic suppression systems. A survey was made of fire detectors and methods of extinguishment and suppression, and the characteristics of such systems were evaluated for possible use in the fire suppression systems. System concepts were developed and methods of detection and extinguishment/suppression were selected as most suited for integration into the aircraft system. Design criteria for the various concepts were developed and recommendations made as to systems to be used in the test phase. Simulations of engine, oil cooler, and electronics compartments were fabricated, and selected systems were tested.

-SOURCE INFORMATION-

CORPORATE SOURCE -
KIDDE (WALTER) AND CO., INC., BELLEVILLE, N.J.
REPORT NUMBER -
AD-746630//USAAMRDL TR-72-27
SPONSOR -
ARMY AIR MOBILITY RESEARCH AND DEVELOPMENT LAB., FORT EUSTIS, VA.
CONTRACT NUMBER -
CONTRACT DAAJ02-70-C-0056
OTHER INFORMATION -
0102 PAGES, 0027 FIGURES, 0005 TABLES, 0030 REFERENCES

key 1346

FIRE DETECTION SYSTEM PERFORMANCE IN USAF AIRCRAFT

by

DELANEY, C.L.

08/00/72

-ABSTRACT-

Data on false fire warnings and aircraft engine nacelle fires was taken from Air Force accident/incident reports. This data included the time period 1965 through 1970 and is restricted to noncombat related accidents. Analysis of the data showed that false fire warnings are a major problem in the majority of USAF aircraft (83 percent of all reported alarms are false). These false fire warnings resulted in damage or destruction to aircraft as well as crew injuries and fatalities. In addition, it was found that in approximately 50 percent of the engine nacelle fires, where the performance of the detection system could be determined, the system did not provide an alarm. It was also found that the fire detection system in a number of aircraft had been partially or totally removed to reduce or eliminate the false fire warning problem. As a consequence the majority of the fires which occurred in these aircraft were not detected.

-SOURCE INFORMATION-

CORPORATE SOURCE -
AIR FORCE AERO PROPULSION LAB., WRIGHT-PATTERSON AFB, OHIO.
REPORT NUMBER -
AFAPL-TR-72-49
OTHER INFORMATION -
0021 PAGES, 0000 FIGURES, 0006 TABLES, 0000 REFERENCES

EVALUATION OF AIRCRAFT GROUND FIREFIGHTING AGENTS AND TECHNIQUES

by

GEYER, G.B.

02/00/72

-ABSTRACT-

A summary, based on previous research and on full-scale and laboratory tests, is presented of the effectiveness of agents, equipment, and techniques used in aircraft ground crash fire fighting and rescue operations. The agents selected for study were categorized in 2 major groups, depending upon their principal function in the extinguishment of Class B fires: (1) foam vapor-securing and blanketing agents, and (2) auxiliary fire fighting agents (dry chemicals, dry powders, vaporizing liquids, carbon dioxide, and magnesium agents). Several kinds of chemical and mechanical foams were tested, and the results are reported. Special attention was given to the performance of aqueous film forming foam (AFFF) and to the compatibility of foams and powders in fire extinguishing systems. The chief results and conclusions were: (1) the most effective fuel vapor and blanketing agents are AFFF and 6 percent protein-type foam, (2) there is no incompatibility between protein foam and AFFF when they are dispensed from separate nozzles, and (3) both AFFF and 6 percent protein agents demonstrate acceptable degrees of compatibility when paired with dry chemicals. Evaluations of various foam dispensers are reported, and comparisons are made between the effectiveness of protein foam and AFFF in extinguishing JP-4 jet fuel fires. Recommendations are made for the kinds and uses of foam dispensers which will be most effective in applying fire fighting agents to crash fires.

-PERTINENT FIGURES-

FIG. 10 THE EFFECT OF SOLUTION CONCENTRATION ON FIRE CONTROL TIME USING PROTEIN FOAM AND AFFF PAGE 58//TAB. 11 EFFECT OF WATER HARDNESS ON FIRE PERFORMANCE EMPLOYING PROTEIN FOAM AND AFFF (MANUFACTURER E-3) PAGE 34

-BIBLIOGRAPHY-

CONLEY, D.W.: POST-CRASH FIRE-FIGHTING STUDIES ON TRANSPORT CATEGORY AIRCRAFT. REP. RD-65-50, FAA, NAT. AVIATION FACILITIES EXPERIMENTAL CENTER, SYSTEMS RES. AND DEV. SERVICE, ATLANTIC CITY, N.J., MAY 1966// TUVE, R.L., PETERSON, H.B., JABLONSKI, E.J., AND NEILL, R.R.: A NEW VAPOR-SECURING AGENT FOR FLAMMABLE LIQUID FIRE EXTINGUISHMENT. AD 435-612, NRL REP. 6057, MAR. 13, 1964//TUVE,

R.L., AND JABLONSKI, E.J.: METHOD OF EXTINGUISHING LIQUID HYDROCARBON FIRES, U.S. PATENT NO. 3,258,423, JUNE 23, 1966//MELDRUM, D.N., AND WILLIAMS, J.R.: THE EFFECT OF WATER SPRAY ON FIRE-FIGHTING FOAM. NAT. FIRE PROTECTION ASSSOC. FIRE J., VOL. 64, NO. 1, JAN. 1970

-SOURCE INFORMATION-

CORPORATE SOURCE -
NATIONAL AVIATION FACILITIES EXPERIMENTAL CENTER, ATLANTIC CITY, N.J.
REPORT NUMBER -
AD-741881//AGFSRS 71-1//FAA-RD-71-57//FAA-NA-72-20
SPONSOR -
AIRCRAFT GROUND FIRE SUPPRESSION AND RESCUE, WRIGHT-PATTERSON AFB, OHIO. TRI-SERVICE SYSTEM PROGRAM OFFICE.
CONTRACT NUMBER -
CONTRACT F33657-67-F-1538
OTHER INFORMATION -
0264 PAGES, 0092 FIGURES, 0045 TABLES, 0057 REFERENCES

key 1369

A SELF-GENERATING OVERHEAT DETECTION SYSTEM FOR USE ON USAF AIRCRAFT

by

RIEMER, O.

08/00/72

-ABSTRACT-

A self-generating overheat detection system for USAF aircraft was developed, designed, fabricated, and tested. The system consisted of a loop of sensor cable connected by way of a junction box and thermocouple type extension wires to a control unit. The developed sensor consisted of a continuous coaxial cable which changes its electrical properties as cable temperature is changes. Cable thermo-electric voltage as well as impedance is utilized in establishing alarm signal levels. Theoretical work involving such factors as thermocouple signal transmission and detection, together with an investigation of cable materials and electronic componentry available for aircraft use is described. Test results of the sensors and associated electronics used for the prototype systems together with a description of operation is supplied. The performance testing of two completed systems under simulated environmental conditions is reported. A set of installation instructions and engineering drawings for the system are appended. It is concluded that, from the standpoints of long term cable stability, discrete alarm detection, and false alarm free operation, the use of cable voltage as well as impedance in establishing alarm levels provides an effective means of overheat detection.

-SOURCE INFORMATION-

CORPORATE SOURCE -
EDISON (THOMAS A.) INDUSTRIES, WEST ORANGE, N.J. INSTRUMENT DIV.
REPORT NUMBER -
AD-749474//AFAPL-TR-72-73
SPONSOR -
AIR FORCE AERO PROPULSION LAB., WRIGHT-PATTERSON AFB, OHIO.
CONTRACT NUMBER -
CONTRACT F33615-70-C-1271
OTHER INFORMATION -
0131 PAGES, 0020 FIGURES, 0005 TABLES, 0000 REFERENCES

AN APPRAISAL OF HALOGENATED FIRE EXTINGUISHING AGENTS.

by

NATIONAL ACADEMY OF SCIENCES-NATIONAL RESEARCH COUNCIL

00/00/72

-ABSTRACT-

Contents: Bauman, M.R., Comparative Effectiveness of Halogenated Agents and Other Extinguishants (See F7300023)//Stokinger, H.E., Principles and Procedures for Toxicologic and Physiologic Evaluation of the Safety of Materials (See F7300024)//Stewart, R.D., Use of Human Volunteers for the Toxicological Evaluation of Materials (See F7300025)//Zikria, B.A., Inhalation Injuries in Fires (See F7300026)//MacEwen, J.D., Toxicology of Pyrolysis Products of Halogenated Agents (See F7300027)//Clark, D.G., Toxicology of Halon 1211 (See F7300028)//Reinhardt, C.F., and Reinke, R.E., Toxicology of Halogenated Fire Extinguishing Agents, Halon 1301 (Bromotrifluoromethane)(See F7300029)//Rainaldi, N., Appraisal of Halogenated Fire Extinguishing Agents (See F7300030)//Back, K.C., and Van Stee, E.W., Cardiovascular and Nervous System Effects of Bromotrifluoromethane: A Short Review (See F7300031)//Harris, W.S., Cardiac Effects of Halogenated Hydrocarbons (See F7300032)//Call, D.W., Human and Rat Exposures to Halon 1301 Under Hypobaric Conditions (See F7300033)// Ford, C.L., Extinguishment of Surface and Deep-Seated Fires With Halon 1301 (See F7300034)//Gassmann, J.J., and Marcy, J.F., Application of Halon 1301 to Aircraft Cabin and Cargo Fires (See F7300035)//Steinberg, M., Toxic Hazards from Extinguishing Gasoline Fires Using Halon 1301 Extinguishers in Armored Personnel Carriers (See F7300036)//McDaniel, D.E., Evaluation of Halon 1301 for Shipboard Use (See F7300037)//Botteri, B.P., Cretcher, R.E., and Kane, W.R., Aircraft Applications of Halogenated Hydrocarbon Fire Extinguishing Agents (See F7300038)//Carhart, H.W., and Fielding, G.H., Applications of Gaseous Fire Extinguishants in Submarines (See F7300039)// Kuchta, J.M., and Burgess, D., Effectiveness of Halogenated Agents Against Gaseous Explosions and Propellant Fires (See F7300040)//Edmonds, A., Use of Halon 1211 in Hand Extinguishers and Local Application Systems (See F7300041)//Languille, E., Applications of Halon 1211 Fixed Systems in Normally Occupied Area (See F7300042)//Wickham, R.T., Engineering and Economic Aspects of Halon Extinguishing Equipment (See F7300043)//Grabowski, G.J., Fire Detection and Actuation Devices for Halon Extinguishing Systems (See F7300044)//Kerr, J.W., Practicalities of Halons from the Firefighter's Viewpoint (See F7300045)//Wands, R.C., Toxicology of Halogenated Agents (Halon 2402)(See F7300046)//Yamashika, S., Dependence of Extinction Time and Decomposition of Halogenated Extinguishing Agent on Its Application Rate (See F7300047)

-SOURCE INFORMATION-

CORPORATE SOURCE -
NATIONAL ACADEMY OF SCIENCES-NATIONAL RESEARCH COUNCIL, WASHINGTON, D.C. COMMITTEE ON FIRE RESEARCH.//NATIONAL ACADEMY OF SCIENCES-NATIONAL RESEARCH COUNCIL, WASHINGTON, D.C. COMMITTEE ON TOXICOLOGY.

REPORT NUMBER -
AD-753218

JOURNAL PROCEEDINGS -
SYMP ON AN APPRAISAL OF HALOGENATED FIRE EXTINGUISHING AGENTS, PROC, WASHINGTON, D.C. (APR. 11-12, 1972) (SEE F7300023-F7300047)

OTHER INFORMATION -
9999 PAGES, 9999 FIGURES, 9999 TABLES, 9999 REFERENCES

key 1392

APPLICATION OF HALON 1301 TO ARICRAFT CABIN AND CARGO FIRES

by

GASSMANN, J.J
MARCY, J.F.

00/00/72

-ABSTRACT-

Test procedures and test results are summarized on the application of Halon 1301 to aircraft cabin and cargo fires. Based on an analysis of the results of the cabin mockup tests, it was determined that: (1) a high rate discharge system utilizing Halon 1301 at a concentration of 5.8 percent in air is effective in rapidly extinguishing a Class A fire in urethane seat padding; (2) prolonged exposure in a cabin fire to flames and heat from incandescent hot bodies can cause pyrolysis of Halon 1301 into extremely toxic gases in concentrations that may be harmful; and (3) although Halon 1301 concentrations as low as 3 to 4 percent in air were sufficient to extinguish Class A fires, the propane gas burner could still be ignited to flame by electrical sparking. It was concluded from the cargo compartment tests that: (1) the use of Halon 1301 released at the time of detection of a cargo fire can prevent the occurrence of flash fire, greatly reduce the maximum temperatures, and provide effective fire control for periods of at least 2 hours; and (2) the use of as little as 3 percent by volume of Halon 1301 can effectively control cargo fires in a compartment with a 10 percent and a 50 percent load configuration.

-PERTINENT FIGURES-

FIG. 2 REGULAR URETHANE FOAM FIRE PARAMETERS IN CLOSED CABIN PAGE 181

-SOURCE INFORMATION-

CORPORATE SOURCE -
NATIONAL AVIATION FACILITIES EXPERIMENTAL CENTER, ATLANTIC CITY, N.J.

JOURNAL PROCEEDINGS -
IN: NAS-NRC. AN APPRAISAL OF HALOGENATED FIRE EXTINGUISHING AGENTS. PROC OF A SYMP, WASHINGTON, D.C. (APR. 11-12, 1972) (SEE F7300022)

OTHER INFORMATION -
0015 PAGES, 0007 FIGURES, 0001 TABLES, 0000 REFERENCES

AIRCRAFT APPLICATIONS OF HALOGENATED HYDROCARBON FIRE EXTINGUISHING AGENTS

by

BOTTERI, B.P.
CRETCHER, R.E.
KANE, W.R.

00/00/72

-ABSTRACT-

In analyzing the applications of halogenated hydrocarbon fire extinguishants to the aircraft fire problems found in engine and auxiliary power installations, fuel tanks, and habitable and cargo compartments, the nature of the fire problem in each area is defined, the state of the art fire suppression techniques which could be applicable is reviewed, the preferred technique and the basis for its selection is identified, and, in those cases where use of halogenated hydrocarbon extinguishants is preferred, their overall practical performance record is reviewed. Halon agents presently offer the greatest advantage for the following aircraft fire protection applications: extinguishment of engine installation fires; suppression of fuel tank explosions induced by point type ignition sources, although complexity of internal fuel tank configuration may pose an installation problem; fire suppression in large cargo and habitable compartments by means of total flooding; and first aid fire extinguishers for Class A, B, and C fire protection capability. Halon fire extinguishing agents were not recommended for fuel tank inerting or multipoint ignition explosions caused by, e.g., gunfire.

-PERTINENT FIGURES-

TAB. 6 TYPICAL A/C ENGINE FIRE EXTINGUISHER SYSTEMS PAGE 224

-SOURCE INFORMATION-

CORPORATE SOURCE -
AIR FORCE AERO PROPULSION LAB., WRIGHT-PATTERSON AFB, OHIO.
JOURNAL PROCEEDINGS -
IN: NAS-NRC. AN APPRAISAL OF HALOGENATED FIRE EXTINGUISHING AGENTS. PROC OF A SYMP, WASHINGTON, D.C. (APR. 11-12, 1972) (SEE F7300022)
OTHER INFORMATION -
0024 PAGES, 0000 FIGURES, 0011 TABLES, 0012 REFERENCES

key 1405

STUDIES OF MECHANICAL FOAMS FOR AIRCRAFT CRASH FIRE EXTINGUISHMENT, PROGRESS REPORT

by

PETERSON, H.B.
NEILL, R.R.
JABLONSKI, E.J.
TUVE, R.L.

12/00/52

-ABSTRACT-

Studies are reported of the effectiveness of some mechanical foams used in aircraft crash fire fighting. The equipment used in dispensing the foams were tested to determine the optimum kind for rapid fire control, which is necessary for rescue of the trapped occupants of the aircraft. gasoline fires were used in the fires tests, and measurements were made of the rate of diminution of heat radiation from the burning gasoline as mechanical foams were applied. Results showed that the higher expansion foams produced an extremely rapid flame knockdown power while the low expansion foams had a much slower initial effect. The higher expansion foams are known to be much more stable foams with respect to their water-holding capacity than are the low expansion types, thus increasing the burn-back resistance of the higher expansion foams when actually in contact with the gasoline surface. It was concluded that high expansion, high water stability foams, when applied in a dispersed, wide area coverage pattern, achieve a quick rate of gasoline fire knockdown and control time which cannot be attained by the lower expansion foams applied in the same coverage pattern. It was recommended that foam generating equipment be developed capable of producing foams of expansions of 10 to 12, and projecting it in dispersed and straight stream patterns.

-SOURCE INFORMATION-

CORPORATE SOURCE -
NAVAL RESEARCH LAB., WASHINGTON, D.C.
REPORT NUMBER -
AD-749159//NRL MEMO REP. NO. 92//NRL PROBLEM 32C07-09
OTHER INFORMATION -
0026 PAGES, 0014 FIGURES, 0002 TABLES, 0002 REFERENCES

key 1417

DEVELOPMENT OF HALOGENATED HYDROCARBON FOAM (HALOFOAM) EXTINGUISHANTS

by

ATALLAH, S.
BUCCIGROSS, H.L.

00/00/71

-ABSTRACT-

Several halogenated hydrocarbon foams were developed which were found more effective than bromochloromethane (Halon 1011), the agent presently used in aircraft compartment fire extinguishers. Several criteria were established for the new agent: (1) effectiveness on Class A, B, and C fires in confined spaces; (2) equivalent fire extinguishing capability when compared to Halon 1011; (3) low toxicity; (4) capability of preventing ignition of combustibles for least 6 min.; (5) compatibility with construction materials in the compartments; and (6) minimum generation of visibility-impairing smoke and/or vapors under fire conditions. Several halons (Halons 1301, 1211, 2402, and 122) were selected on the basis of their toxic and other physical and chemical properties. In addition, several additives which could serve as foaming agents were selected. Several hundred foam formulations were prepared and tested for foaming action, foam stability, solution stability, resistance to freezing, viscosity, electrical conductivity, chemical stability after long storage, and compatibility with materials of construction. Comparative fire tests were conducted with the following fuels: cotton waste, JP-4 jet fuel, hydraulic oil, gasoline, and cellulosic sponge sheets (simulating walls and ceilings). The results showed that three foams were more effective fire fighters than Halon 1011 and that Halon 1211 foam/C was the best of all the formulations. It was concluded that it is possible to foam halon liquids (and mixtures thereof) with commercially available surfactants and to produce a fire extinguishing agent with low toxicity which is more effective than Halon 1011.

-SOURCE INFORMATION-

CORPORATE SOURCE -
LITTLE (ARTHUR D.), INC., CAMBRIDGE, MASS.
JOURNAL PROCEEDINGS -
FITCAA, FIRE TECHNOL, VOL. 7, NO. 4, 307-320 (1971)
OTHER INFORMATION -
0014 PAGES, 0000 FIGURES, 0008 TABLES, 0003 REFERENCES

key 1427

FACTORS WHICH GOVERN THE CHOICE OF MATERIALS FOR AIRCRAFT INTERIORS

by

DENNEY, M.A.
BROADLEY, D.

03/00/72

-ABSTRACT-

The development of the Concorde aircraft will bring new safety regulations in Great Britain to control not only the flammability but also the smoke emission characteristics of materials within aircraft. Tthe flammability regulations will employ a test based on the vertical strip test (method 5902) and the horizontal strip test (Method 5906) of American Fede-al Specification CCC- -191 b. Smoke emission regulations have not been issued yet, but it is generally accepted that smoke emission characteristics of burning materials will be assessed using the Aminco-NBS smoke density chamber. The current widespread use of rigid polyvinyl chloride (PVC), polyester or epoxy resins, and polyurethane foams in aircraft cabin interiors will change completely when the smoke emission standards go into effect. Both PVC and polyvinylidene emit hydrogen chloride in fires and their use is likely to be banned. Polyester and epoxy resin laminates emit considerable smoke. Materials which use flame resistant coatings to meet the flammability standards may not meet the smoke emission standards because the added halogen compounds in the coating increase smoke emission to an unacceptable level. Some materials, still in the development stage, which may be able to meet both flammability and smoke emission standards are aromatic polyamides, polyimides, fluorocarbons and perhaps certain grades of silicones. There are no plans for standards for the toxicity of gases evolved from burning materials; data are presented on the relative toxicity of gases.

-PERTINENT FIGURES-

TAB. 1 GASES EVOLVED BY ORGANIC MATERIALS DURING FIRE PAGE 19//TAB. 2 DATA ON TOXIC GASES PAGE 21//TAB. 3 SUMMARY OF REGULATIONS GOVERNING ACCEPTANCE STANDARDS RELATIVE TO FLAMMABILITY OF MATERIALS USED WITHIN CONCORDE AIRCRAFT. THE BRITISH AIRCRAFT CORP. AND SNIAS HOPE TO AVOID USE OF ANY MATERIALS IN GRADE 4, AND TO CHOOSE MOST MATERIALS MEETING THE CRITERIA REQUIRED FOR GRADES 1 AND 2 PAGE 35

-BIBLIOGRAPHY-

WOOLLEY, W.D.: A STUDY AND TOXIC EVALUATION OF THE PRODUCTS FROM

THE THERMAL DECOMPOSITION OF P.V.C. IN AIR AND NITROGEN. FIRE RES. ASSOC. NOTE 769, JULY 1969

-SOURCE INFORMATION-

CORPORATE SOURCE -
BRITISH AIRCRAFT CORP., WEYBRIDGE (ENGLAND).
JOURNAL PROCEEDINGS -
FIRE INT, VOL. 35, 16-26 (MAR. 1972)
OTHER INFORMATION -
0011 PAGES, 0000 FIGURES, 0003 TABLES, 0006 REFERENCES

FIRE RETARDANT FLEXIBLE URETHANE FOAM

by

BAUMANN, G.F.
SZABAT, J.F.

00/00/72

-ABSTRACT-

Technology is reviewed on fire retardant flexible urethane slabstock foam based on Mobay raw Materials Mondur TD-80, Multranol 7100, special additives E-9200 and E-9402 with Monsanto's nonreactive fire retardant Phosgard 2XC20. Special emphasis is also given to the self-extinguishing (S.E.) high resilient foams that can be produced in different grades without the use of any phosphorous halogen containing fire retardant. A summary is presented of the major fire safety regulations presently proposed as standards for home furnishings, carpets and rugs, bedding, automotive interior components, aircraft applications, and furnishings for offices and other public places. Several flame retardant foam grades are described as to their suitability in satisfying the flammability specifications of the standards for carpet underlay, automotive interior components, bedding, and other applications. A high resilient foam is also described; they offer latex like feel and are suitable for luxurious seating and bedding applications. They can pass a wide variety of flame tests without the use of any phosphorus halogen containing fire retardant and have a very low flame spread.

-SOURCE INFORMATION-

CORPORATE SOURCE -
MOBAY CHEMICAL CO., PITTSBURGH, PA.
JOURNAL PROCEEDINGS -
IN: ADVANCES IN FIRE RETARDANTS. PART 1 (PROG. IN FIRE RETARDANCY SER., VOL. 2) (SEE: F7300165)
OTHER INFORMATION -
0014 PAGES, 0000 FIGURES, 0004 TABLES, 0000 REFERENCES

INVESTIGATION AND EVALUATION OF NONFLAMMABLE, FIRE-RETARDANT MATERIALS, FINAL REPORT

by

ATALLAH, S.
BUCCIGROSS, H.L.

11/00/72

-ABSTRACT-

A TEST PROGRAM WAS UNDERTAKEN TO EVALUATE FIRE PROTECTIVE MATERIALS AND TO TEST THEM IN FULL-SCALE HELICOPTER FIRES. THE GOAL WAS TO CONTAIN OR RESTRICT IN-FLIGHT OR POSTCRASH HELICOPTER FIRES TO ALLOW THE CREW AND PASSENGERS TO ESCAPE OR REMAIN WITHIN A LIVABLE ENVIRONMENT UNTIL THE FIRE COULD BE EXTINGUISHED OR THE BURNING FUEL CONSUMED. LABORATORY TESTS SHOWED THAT INTUMESCENT PAINTS PROVIDE INADEQUATE FIRE PROTECTION TO EXTERIOR WALLS IN HELICOPTER FIRES AND MOST OF THEM PRODUCE NOXIOUS FUMES. A NUMBER OF COMPOSITE MATERIAL SYSTEMS WERE FOUND PROMISING FOR INTERIOR WALL PROTECTION IN THE HELICOPTERS. VARIOUS COMBINATIONS OF ISOCYANURATE FOAMS, SODIUM SILICATE HYDRATE PANELS, A MINERAL INSULATION, AND INTUMESCENT MASTIC PAINTS WERE APPLIED TO THE WALLS OF TWO TEST HELICOPTERS AND FULL-SCALE FIRES SIMULATING IN-FLIGHT AND POSTCRASH FIRES WERE OBSERVED. THE IN-FLIGHT TESTS INDICATED THAT SODIUM SILICATE HYDRATE PANELS PLACED ON THE FIRE SIDE PROVIDED SUFFICIENT PROTECTION FOR A HABITABLE COMPARTMENT AGAINST A FIRE OCCURING IN AN ADJACENT COMPARTMENT. POSTCRASH FIRE TESTS SHOWED THAT TOTAL WALL PROTECTION OF EXISTING HELICOPTERS COULD NOT BE OBTAINED. PENETRATIONS OCCURRED IN THE CH-47 WALLS WHERE THE PRESENCE OF WIRING, AIR DUCTS AND HYDRAULIC OIL TUBES HAD PREVENTED THE APPLICATION OF ISOCYANURATE FOAM, AND IN THE UH-1D WALLS WHERE THE SODIUM SILICATE HYDRATE PANELS COLLAPSED BECAUSE OF THE ABSENCE OF STRUCTURAL SUPPORT. HEAT FLUXES AFTER 5 MIN. WERE TOO HIGH FOR HUMAN TOLERANCE, AND CONCENTRATIONS OF SMOKE AND TOXIC GASES WERE HIGH.

-PERTINENT FIGURES-

FIG. 34 LIGHT TRANSMISSION AT THE 4-FT AND 1-FT LEVELS DURING THE CH-47 POSTCRASH FIRE TEST PAGE 58//TAB. 1 FURNACE TEST RESULTS FOR PAINTS AND COATINGS PAGE 10//TAB. 2 FURNACE TEST RESULTS FOR INORGANIC INSULATIONS PAGE 13//TAB. 3 FURNACE TEST RESULTS FOR ORGANIC FOAMS PAGE 14

-SOURCE INFORMATION-

CORPORATE SOURCE -
LITTLE (ARTHUR D.), INC., CAMBRIDGE, MASS.
REPORT NUMBER -

AD-906699//USAAMRDL TECH. REP. 72-52//ADL-73588
SPONSOR -
ARMY AIR MOBILITY RESEARCH AND DEVELOPMENT LAB., FORT EUSTIS, VA. EUSTIS DIRECTORATE.
CONTRACT NUMBER -
CONTRACT DAAJ02-71-C-0042
OTHER INFORMATION -
0096 PAGES, 0045 FIGURES, 0014 TABLES, 0000 REFERENCES

key 1542

FIGHTING FUEL STORAGE FIRES WITH SUBSURFACE FOAM

by

FIRE INTERNATIONAL

10/00/69

-ABSTRACT-

tESTS OF SUBSURFACE FOAMS ON CRASH FIRES AND OTHER KINDS OF FUEL FIRES WERE CARRIED OUT. tHE GOALS OF THE TESTS WERE TO FIND A FIRE EXTINGUISHING AGENT WHICH COULD HOLD FUEL PICK-UP TO A MINIMUM AND PRODUCE A FOAM THAT WOULD NOT IGNITE WHEN USED IN BULK STORAGE FUEL CONTROL. FOAM PRODUCED FROM A pURPLE k AND LIGHT WATER MIXTURE, WAS MORE LIKE A LATHER THAN A TRUE FOAM AND SOME DIFFICULTY WAS EXPERIENCED AT THE RIM OF THE FUEL TANK WHERE VIOLENT BOILING OF THE PRODUCT TOOK PLACE DUE TO THE HOT TANK WALL. tHE NEXT TYPE OF FOAM TO BE TESTED WAS AN AQUEOUS LIQUID BASED ON HYDROLIZED AND PURIFIED NATURAL PROTEIN POLYMERS CONTAINING SPECIFIC FLUOROCHEMICAL SURFACE ACTIVE AGENTS AND OTHER COMPOUNDS. tHE PRESENCE OF OLEOPHOBIC FLUOROCARBON CHAINS PROVIDED PROTECTION AGAINST FUEL PICK-UP BY THE FOAM AND PERMITTED BURN-OFF OF PETROLEUM PRODUCTS TRAPPED IN THE FOAM WITHOUT DESTROYING THE FOAM ITSELF. uP TO 25 PERCENT OF FUEL IN THE FOAM CAN BE TOLERATED AND STILL PRODUCE SUCCESSFUL RESULTS FROM THE STANDPOINT OF EXTINGUISHMENT. a FIRE CAN BE CONTROLLED WITH UP TO 40 PERCENT FUEL PICK-UP IN THE FOAM. iT WAS FOUND THAT THE PERCENTAGE OF FUEL ACTUALLY PICKED UP IN ITS TRAVEL THROUGH THE FUEL FIRE RANGE FROM 35 TO 49 PERCENT IN ONE TEST, AND FROM 14 TO 27 PERCENT IN ANOTHER. tESTS WERE ALSO CARRIED OUT ON A FLOATING ROOF TANK, AND IT WAS FOUND THAT THE FOAM TRAVELED THROUGH APPROXIMATELY 50 FT. OF GASOLINE WITH ONLY 22.9 PERCENT FUEL PICK-UP. iT WAS CONCLUDED THAT THE SUBSURFACE FOAM, INJECTED AT THE PROPER VELOCITY AND CONSISTENCY, WILL EFFECTIVELY EXTINGUISH FUEL FIRES WITH LITTLE OR NO EXPOSURE OF PERSONNEL.

-SOURCE INFORMATION-

JOURNAL PROCEEDINGS -
FIRE INT, VOL. 26, 25-29 (OCT. 1969)
OTHER INFORMATION -
0005 PAGES, 0000 FIGURES, 0000 TABLES, 0000 REFERENCES

key 1549

FIRE AND EXPLOSION DETECTION FOR ADVANCED FLIGHT VEHICLES

by

ABRAHAM, J.
GUMNICK, J.L.

05/00/66

-ABSTRACT-

a FIRE AND EXPLOSION DETECTOR FOR ADVANCED FLIGHT VEHICLES WAS DEVELOPED THAT USES RADIATION IN THE ULTRAVIOLET BELOW 2900 a. tHE RADIATION TRIGGERS A GAS MULTIPLICATION TUBE. tHE DETECTOR USES A LIGHT TRANSMITTING PHOTOCATHODE OF PURE METAL WITH OPTIMUM FILM THICKNESS TO MAXIMIZE YIELD. mOLYBDENUM WAS CHOSEN AS THE METAL FOR IDEAL RESPONSE MATCH TO THE TYPE OF SIGNAL EXPECTED IN ORDER TO IMPROVE SIGNAL-TO-NOISE RATIO. a FILLER GAS OF HYDROGEN WAS USED TO PRODUCE ELECTRON MULTIPLICATION IN THE DEVICE SO THAT YIELD APPROACHED OR EXCEEDED THAT OF CONVENTIONAL ULTRAVIOLET DETECTORS. aN ALL QUARTZ ENVELOPE WAS USED FOR MAXIMUM THERMAL STABILITY. tHE DETECTOR WAS FOUND TO OPERATE SUCCESSFULLY AT TEMPERATURES UP TO 590 DEG. c.

-SOURCE INFORMATION-

CORPORATE SOURCE -
ITT INDUSTRIAL LABS., FORT WAYNE, IND.
REPORT NUMBER -
AD-484614//AFAPL-TR-66-19
SPONSOR -
AIR FORCE AERO PROPULSION LAB., WRIGHT-PATTERSON AFB, OHIO.
CONTRACT NUMBER -
CONTRACT AF 33(615)-2479
OTHER INFORMATION -
0050 PAGES, 0026 FIGURES, 0000 TABLES, 0009 REFERENCES

HUMAN AND RAT EXPOSURES TO HALON 1301 UNDER HYPOBARIC CONDITIONS, FINAL REPORT

by

CALL, D.W.

07/19/72

-ABSTRACT-

hALON 1301 (BROMOTRIFLUOROMETHANE) HAS BEEN PROPOSED AS A FIRE EXTINGUISHING AGENT IN OCCUPIED AIRCRAFT SECTIONS. tO TEST POSSIBLE TOXICITY OF THIS GAS UNDER HYPOBARIC CONDITIONS, SUCH AS WOULD ACCOMPANY ITS USE IN-FLIGHT, MALE cHARLES rIVER RATS AND HUMAN VOLUNTEERS WERE EXPOSED FOR THREE MINUTES TO VARIOUS AIR-MIXTURES OF hALON 1301 IN A HYPOBARIC CHAMBER MAINTAINED AT 760 TORR (SEA LEVEL), 632 TORR (5,000 FT.), AND 380 TORR (18,000 FT.). eLECTROCARDIOGRAMS (ecgS) AND LUNG HISTOLOGY DATA WERE COLLECTED FROM THE RATS. pHYSICAL EXAMINATIONS, PULMONARY FUNCTION MEASUREMENTS, PSYCHOMOTOR PERFORMANCE EVALUATIONS AND ecgs WERE OBTAINED FROM THE HUMAN SUBJECTS. rESULTS INDICATE THAT EXPOSURE TO BROMOTRIFLUOROMETHANE UNDER REDUCED ATMOSPHERIC PRESSURES IS NO MORE HARMFUL THAN SIMILAR EXPOSURES AT SEA LEVEL. tHEREFORE, hALON 1301 MAY BE A SAFE FIRE SUPPRESSANT FOR USE IN OCCUPIED CABIN SECTIONS.

-BIBLIOGRAPHY-

HINE, C.H., ELLIOTT, H.W., KAUFMAN, J.W., LEUGN, S., AND HARRAH, M.D.: CLINICAL TOXICOLOGIC STUDIES ON FREON FE1301. PAPER NUMBER 11. AMRL TR 68-175, AEROSPACE MED. RES. LAB., PROC. 4TH ANNUAL CONF. ATMOS. CONTAMINATES IN CONFINED SPACES, WPAFB, OHIO, DEC. 1968//MACFARLAND, H.N.: ACUTE INHALATION EXPOSURE-MONKEYS, RABBITS, GUINEA PIGS AND RATS-FREON FE1301. FINAL REPORT. HAZLETON LAB., INC., FALLS CHURCH, VA., NOV. 7, 1967//STEE, E.W., AND BACK, K.C.: SHORT-TERM INHALATION EXPOSURE TO BROMOTRIFLUOROMETHANE. TOXICOLOGICAL APPLIED PHARMACOLOGY, VOL. 15, 164-174, 1969

-SOURCE INFORMATION-

CORPORATE SOURCE -
NAVAL AIR DEVELOPMENT CENTER, WARMINSTER, PA.
REPORT NUMBER -
AD-747958//NADC-72125-CS
OTHER INFORMATION -
0015 PAGES, 0001 FIGURES, 0000 TABLES, 0012 REFERENCES

key 1616

THE FEASIBILITY OF BURNER-CAN BURN-THROUGH THERMAL DETECTION PRIOR TO ENGINE CASE RUPTURE. FINAL REPORT.

by

HILL, R.

01/00/73

-ABSTRACT-

FIRE TESTS WERE PERFORMED TO DETERMINE THE FEASIBILITY OF DETECTING A BURNER-CAN BURN-THROUGH PRIOR TO AN ENGINE CASE RUPTURE BY MONITORING JET- ENGINE DIFFUSER CASE AND BURNER CASE SKIN TEMPERATURES. A J57 ENGINE WAS MOUNTED IN A B57 AIRPLANE, AND HOLES WERE CUT IN THE DIFFUSER CASE AND IN THE FUEL LINES, ALLOWING FUEL TO FLOW INTO PARTS OF THE ENGINE NOT DESIGNED FOR COMBUSTION. FOUR THERMOCOUPLES WERE SPACED 90 DEG. APART AROUND THE DIFFUSER CASE. THE ENGINE WAS THEN ACCELERATED TO FULL POWER AND SHORTLY AFTER BURN-THROUGH THE ENGINE WAS SHUT DOWN. THE RESULTS SHOWED THAT THE THERMOCOUPLES IN THE GENERAL PROXIMITY (WITHIN 45 DEG.) OF THE BURN-THROUGH RECORDED A RAPID AND LARGE INCREASE IN TEMPERATURE BEGINNING 40 SEC. PRIOR TO BURN-THROUGH. THE THERMOCOUPLES LOCATED APPROXIMATELY 150 DEG. AROUND THE ENGINE FROM THE BURN-THROUGH ALSO SHOWED AN INCREASE IN SKIN TEMPERATURE, BUT OF A MUCH LOWER MAGNITUDE. EVEN IN A FULLY-COWLED-ENGINE TEST, A RAPID TEMPERATURE RISE SHORTLY BEFORE BURN-THROUGH WAS FOUND. IT WAS CONCLUDED THAT IT IS POSSIBLE TO DETECT A BURNER-CAN BURN-THROUGH PRIOR TO ENGINE CASE RUPTURE BY MONITORING DIFFUSER CASE AND/OR BURNER CAN CASE SKIN TEMPERATURE. AS FEW AS 4 THERMOCOUPLES SPACED 90 DEG. APART ON THE DIFFUSER CASE, AND/OR THE BURNER-CAN CASE, CAN DETECT A BURNER-CAN BURN-THROUGH PRIOR TO ENGINE CASE RUPTURE.

-BIBLIOGRAPHY-

RUST, T.: INVESTIGATION OF JET ENGINE COMBUSTION CHAMBER BURN-THROUGH-FIRE. FINAL REPORT. REP. NO. FAA-RD-70-68, MAR. 1971

-SOURCE INFORMATION-

CORPORATE SOURCE -
NATIONAL AVIATION FACILITIES EXPERIMENTAL CENTER, ATLANTIC CITY, N.J.
REPORT NUMBER -
FAA-NA-72-92//FAA-RD-72-134
OTHER INFORMATION -
0036 PAGES, 0030 FIGURES, 0000 TABLES, 0001 REFERENCES

key 1625

A NEW DEVELOPMENT IN DRY POWDER EXTINGUISHANTS

by

HARPUR, W.W.

00/00/70

-ABSTRACT-

TESTS WERE PERFORMED WHICH DEMONSTRATED THE EFFECTIVENESS OF MONNEX, A NEW DRY POWDER FIRE EXTINGUISHING AGENT, IN EXTINGUISHING FUEL FIRES. UNLIKE POTASSIUM OXALATE, WHICH IS HIGHLY TOXIC, MONNEX IS NON-TOXIC. IT READILY DECOMPOSES IN A FLAME PRODUCING SUB-MICRON PARTICLES WHICH QUICKLY KNOCK DOWN THE FLAME. POOL FIRES WERE USED TO MEASURE THE DISCHARGE RATE FOR MONNEX IN EXTINGUISHING CERTAIN SIZES OF FIRES. RESULTS SHOWED THAT MONNEX HAS A CRITICAL RATE OF APPLICATION ABOUT 10 TIMES LOWER THAN THAT OF SODIUM BICARBONATE, A WIDELY-USED FIRE EXTINGUISHING AGENT. TESTS WERE ALSO PERFORMED TO MEASURE THE EFFECTIVENESS OF MONNEX IN EXTINGUISHING FIRES IN WHICH THE FUEL IS IN MOTION, SUCH AS GAS LEAKING FROM A PIPE FLANGE. WHILE THE SODIUM BICARBONATE EXTINGUISHER COULD RARELY EXTINGUISH THE FIRE, THE MONNEX EXTINGUISHER QUICKLY EXTINGUISHED THE FIRE WITH COMPARATIVELY SMALL AMOUNTS OF POWDER. IT WAS FOUND THAT MONNEX IS COMPATIBLE WITH PROTEIN FOAM, WHICH MAKES IT USEFUL IN AIRCRAFT CRASH FIRES. TESTS SHOWED THAT POWDER APPLIED ON TOP OF A BLANKET OF FOAM FORMED AN EXTINGUISHANT WHICH EFFECTIVELY CONTAINED AND EXTINGUISHED THE TEST FIRES. IT WAS ALSO FOUND THAT MONNEX HAS GOOD STORAGE STABILITY, RETAINING ITS EFFECTIVENESS EVEN AFTER 6 MONTHS.

-PERTINENT FIGURES-

FIG. 5 APPLICATION RATE EXPERIMENTS WITH MONNEX AND SODIUM BICARBONATE POWDERS ON 800 AND 1200 SQ. FT. FIRES PAGE 61

-SOURCE INFORMATION-

CORPORATE SOURCE -
IMPERIAL CHEMICAL INDUSTRIES LTD., BIRMINGHAM (ENGLAND).
JOURNAL PROCEEDINGS -
FIRE INT, VOL. 3, NO. 29, 57-63 (1970)
OTHER INFORMATION -
0007 PAGES, 0005 FIGURES, 0002 TABLES, 0008 REFERENCES

REMOTE-CONTROLLED MINI-TANK GIVES CLOSE APPROACH TO AIRCRAFT FIRES

by

WITT, W.

00/00/70

-ABSTRACT-

A REMOTE-CONTROLLED MINI-TANK HAS BEEN CONCEPTUALIZED TO INITIATE FIRE FIGHTING DURING AIRCRAFT CRASH FIRES. THE BATTERY-POWERED VEHICLE WOULD MEASURE 1.2 M. BY 1.5 M. AND WOULD PULL A FIRE HOSE REEL WHICH WOULD UNWIND AS THE VEHICLE APPROACHES THE BURNING FUEL, THUS LAYING DOWN A FOAM CARPET AS A RESCUE PATH THROUGH THE FLAMES. BECAUSE OF THE SMALL SIZE OF THE MINI-TANK, ONLY MEDIUM EXPANSION FOAM NOZZLES ARE ENVISAGED. THE NOZZLES ON THE TANK WOULD PROJECT FOAM TO THE SEAT OF THE FIRE, THUS REDUCING THE EXTINCTION TIME AND INCREASING THE PASSENGERS CHANCE OF SURVIVAL. TESTS CONDUCTED WITH FUEL FIRES HAVE SHOWN HOW MUCH FOAM IS NECESSARY TO EXTINGUISH FIRES OF CERTAIN SURFACE AREAS. OTHER TESTS LED TO RECOMMENDATIONS CONCERNING THE FOLLOWING VARIABLES: (1) QUANTITY OF EXTINGUISHING AGENT, (2) FLOW RATE, (3) FOAM NOZZLES, (4) HOSE-TOWING, (5) MOTOR AND BATTERY SPECIFICATIONS, (6) CONTROL FUNCTIONS, (7) REQUIRED QUANTITY OF COOLING WATER, (8) WINDING CAPACITY OF HOSE REEL, AND (9) KIND AND QUANTITY OF FOAM GENERATION.

-SOURCE INFORMATION-

CORPORATE SOURCE -
MINIMAX AG, BAD OLDESLOE (WEST GERMANY).
JOURNAL PROCEEDINGS -
FIRE INT, VOL. 3, NO. 30, 26-36 (1970)
OTHER INFORMATION -
0011 PAGES, 0009 FIGURES, 0000 TABLES, 0000 REFERENCES

key 1678

THE ACUTE TOXICITY OF BRIEF EXPOSURES TO HYDROGEN FLOURIDE; HYDROGEN CHLORIDE, NITROGEN DIOXIDE, AND HYDROGEN CYANIDE SINGLY AND IN COMBINATION WITH CARBON MONOXIDE

by

DIPASQUALE, L.C.
DAVIS, H.V.

12/00/71

-ABSTRACT-

THE TOXICITY OF PYROLYSIS PRODUCTS PRODUCED DURING THE COMBUSTION OF AIRCRAFT INTERIOR MATERIALS SUCH AS POLYURETHANE FOAMS WAS STUDIED IN EXPERIMENTS WITH RATS AND MICE. THE TOXIC GASES USED IN THE EXPERIMENTS WERE HYDROGEN CHLORIDE, HYDROGEN FLUORIDE, HYDROGEN CYANIDE, AND NITROGEN DIOXIDE, USED BOTH SINGLY AND IN COMBINATION WITH CARBON MONOXIDE. RESULTS ENABLED THE DETERMINATION OF LETHAL DOSE VALUES FOR FIVE-MIN. EXPOSURES TO EACH OF THE TOXIC GASES. THE FOLLOWING LIST RANKS THE TOXIC GASES IN ORDER OF THEIR FIVE-MIN. LETHAL DOSE VALUES, FROM MOST TOXIC TO-LEAST TOXIC: (1) HYDROGEN CYANIDE, (2) NITROGEN DIOXIDE, (3) HYDROGEN FLOURIDE, AND (4) HYDROGEN CHLORIDE. IT WAS CONCLUDED THAT BY KNOWING THE RELATIVE AMOUNTS PER UNIT MASS OF SPECIFIC TOXIC PRODUCTS, ONE CAN COMPARE THE HAZARDS OF VARIOUS AIRCRAFT CABIN MATERIALS. THE RESULTS ALSO SHOWED THAT CARBON MONOXIDE CONCENTRATIONS WHICH ARE NOT HAZARDOUS TO LIFE DO NOT ENHANCE THE TOXICITY OF THE FOUR COMPOUNDS AS TESTED.

-SOURCE INFORMATION-

CORPORATE SOURCE -
AEROSPACE MEDICAL RESEARCH LABS., WRIGHT-PATTERSON AFB, OHIO.
REPORT NUMBER -
AMRL-TR-71-120 PAP. 20//AD-751442
SPONSOR -
AEROSPACE MEDICAL RESEARCH LABS., WRIGHT-PATTERSON AFB, OHIO.
CONTRACT NUMBER -
CONTRACT F33615-70-C-1046
OTHER INFORMATION -
0013 PAGES, 0009 FIGURES, 0002 TABLES, 0008 REFERENCES

key 1686

MODIFICATION OF JET FUELS TO DECREASE THE FIRE HAZARD IN SURVIVABLE AIRCRAFT CRASHES

by

ERICKSON, R.E.
KRAJEWSKI, R.M.
COHRS, W.E.

03/26/72

-ABSTRACT-

SOME HIGHLIGHTS OF THE DEVELOPMENT OF MODIFIED JET FUELS TO REDUCE THEIR FIRE HAZARDS ARE BRIEFLY REVIEWED. THE SPECIFIC FUEL MODIFIED WAS BASED ON JET A-1, THICKENED WITH A HYDROCARBON POLYMER. THE MISTING TENDENCY WAS REDUCED IN THE SHEAR RANGE ASSUMED TO BE ENCOUNTERED IN A SURVIVABLE AIRCRAFT CRASH ENVIRONMENT. THE CALORIFIC VALUE OF THE FUEL WAS NOT DECREASED. PRELIMINARY TESTS SHOWED ADEQUATE COMBUSTION IN THE BURNER CAN. FLOW RATES WERE INCREASED SIGNIFICANTLY COMPARED TO THE FORMER THICK GELS AND EMULSIONS. PREVIOUS CORROSION TEST DATA SHOWED NO PROBLEMS WITH VARIOUS GRADES OF ALUMINUM, MAGNESIUM, BRASS, TITANIUM, AND STEEL. A NOTICEABLE DECREASE IN FLAME SPREAD RATE IS ACHIEVED. THE POLYMER ADDITIVE IS A FINE POWDER AND CAN READILY BE DISPERSED IN THE JET FUEL WITH AGITATION AT AMBIENT TEMPERATURE. NO ADDITIONAL ECOLOGICAL PROBLEMS ARE ANTICIPATED SINCE THE FUEL MODIFIERS WILL PRODUCE CARBON MONOXIDE AND WATER WHEN DECOMPOSED DURING COMBUSTION. PRELIMINARY FIRE FIGHTING TESTS INDICATED NO CHANGE REQUIRED IN CONVENTIONAL METHODS.

-SOURCE INFORMATION-

CORPORATE SOURCE -
DOW CHEMICAL CO., MIDLAND, MICH.
JOURNAL PROCEEDINGS -
GAS TURBINE AND FLUIDS ENG CONF AND PRODUCTS SHOW, SAN FRANCISCO, CALIF. (MAR. 26-30, 1972)
OTHER INFORMATION -
0015 PAGES, 0016 FIGURES, 0008 TABLES, 0005 REFERENCES

INVESTIGATION OF FREON FIRE-EXTINGUISHING SYSTEMS WITH A NUCLEONIC GAGE

by

NOTEA, A.
SEGAL, Y.

07/00/72

-ABSTRACT-

THE DYNAMIC PROPERTIES OF THE FIRE EXTINGUISHING SYSTEM IN AN AIRCRAFT WERE EXAMINED USING A 3 CHANNEL-GAMMA ATTENUATION GAGE CONNECTED TO EACH OUTLET OF THE SYSTEM. THE EXTINGUISHING AGENT WAS HALON 1301, AND THE TUBE SELECTED BY OPTIMIZATION OF THE STANDARD DEVIATION DUE TO STATISTICAL COUNTING FLUCTUATIONS. THE COLLIMATOR ARRANGEMENT ALLOWED CHECKING OF 65 PERCENT OF THE TUBE CROSS SECTION. THE RESULTS OF MASS CHANGES WITH TIME DURING DISCHARGE OF THE SYSTEM ARE SHOWN. THE CHANGES OF CHARACTERISTIC PARAMETERS (DISCHARGE TIME AND FULL WIDTH HALF MAXIMUM TIME) ARE PRESENTED FOR DIFFERENT NOZZLE CONFIGURATIONS. THE MEASUREMENTS OF THE DISCHARGE TIME OF THE AGENT AND OF THE DENSITY VARIATIONS AT EACH NOZZLE CAN BE USED TO VERIFY DESIGNER DETERMINATIONS AND TO OPTIMIZE FLOW THROUGH THE SYSTEM OUTLETS. THE SAME RUNS WERE ALSO INVESTIGATED BY USING HIGH PRESSURE TRANSDUCERS, MINIATURE THERMOCOUPLES, AND HIGH SPEED CAMERAS. THE NUCLEAR GAGE GAVE THE MOST RELIABLE RESULTS.

-SOURCE INFORMATION-

CORPORATE SOURCE -
TECHNION-ISRAEL INST. OF TECH., HAIFA.
REPORT NUMBER -
A72-36674
JOURNAL PROCEEDINGS -
MATERIALS EVALUATION, VOL. 30, 153-156 (JULY 1972)
OTHER INFORMATION -
0004 PAGES, 0005 FIGURES, 0002 TABLES, 0003 REFERENCES

key 1729

LIGHT WATER QUELLS FATAL JET FUEL FIRE

by

WOOLLEY, R.

12/00/68

-ABSTRACT-

A JET FUEL FIRE IS DESCRIBED IN WHICH LIGHT WATER WAS USED SUCCESSFULLY TO CONTROL AND EXTINGUISH THE FIRE IN EXCEPTIONALLY FAST TIME. A TANK TRUCK WAS BEING LOADED WITH JP-5 JET FUEL WHEN AN ELECTROSTATIC SPARK IGNITED THE FUEL. TWO MEN DIED AS A RESULT OF THE EXPLOSION AND FUEL FIRE. THE FIRE DEPT. RESPONDED WITHIN 90 SEC. AND USED LIGHT WATER, PURPLE K, AND CARBON DIOXIDE POWDER TO EXTINGUISH THE FIRE. THE FIRE WAS KNOCKED DOWN AND CONTROLED IN 45 SEC. AND EXTINGUISHED IN 3 MIN. RESULTS OF INVESTIGATIONS SHOWED: (1) THE FILL PIPE HAD NOT BEEN INSERTED ALL THE WAY TO THE BOTTOM OF THE TANK LOADED; (2) THE DISCHARGE VELOCITY IN THE FILL PIPE WAS NOT LIMITED TO 3 FT./SEC., WHICH IS RECOMMENDED WHEN THE PIPE DOES NOT REACH THE TANK BOTTOM; (3) A SAMPLING CONTAINER WAS BEING MOVED IN THE TANKER DURING FILLING OPERATIONS; (4) THE FILTER USED IN THE TANK DID NOT PERMIT ENOUGH RELAXATION TIME AFTER THE FUEL PASSED THROUGH THE FILTER; AND (5) THE FUELING SAFETY VALVE WAS WIRED OPEN, PREVENTING ITS OPERATION DURING THE FIRE. IT WAS CONCLUDED THAT THE FIRST 4 FACTORS CONTRIBUTED TO THE STATIC IGNITION OF THE FUEL, AND THE LAST FACTOR PREVENTED SHUTDOWN OF THE FUEL WHEN THE EMERGENCY OCCURED.

-SOURCE INFORMATION-

JOURNAL PROCEEDINGS -
FIENA2, FIRE ENG, VOL. 121, NO. 12, 38-39 (DEC. 1968)
OTHER INFORMATION -
0002 PAGES, 0003 FIGURES, 0000 TABLES, 0000 REFERENCES

AIRCRAFT GROUND FIRE SUPPRESSION AND RESCUE SYSTEMS-BASIC RELATIONSHIPS IN MILITARY FIRES. PHASES 1 AND 2. INTERIM REPORT-12 JANUARY TO 1 SEPTEMBER 1971

by

ALGER, R.S.
CAPENER, E.L.

04/00/72

-ABSTRACT-

EXPERIMENTAL POOL FIRES OF JP-5 JET FUEL 3 FT. AND 10 FT. IN DIA. WERE INSTRUMENTED TO MEASURE HEAT FLUXES, BURNING RATES, AND SUPPRESSION CHARACTERISTICS. TEST SUBSTRATES INCLUDED WATER, SAND, AND GRAVEL. IN THESE TESTS THE IDEAL EXTINGUISHMENT SYSTEM WAS DESIGNED TO GIVE A UNIFORM RATE OF APPLICATION OVER THE BURNING FUEL SURFACE. THE SUPPRESSANT SPRAY WAS CHARACTERIZED AS TO UNIFORMITY, AVERAGE DROP SIZE, AND INTERACTION KINETICS WITH THE FUEL SURFACE. RADIATION FLUXES AT VARYING DISTANCES FROM THE FIRE WERE AFFECTED BY WIND VELOCITY, LOCATION OF MEASURING STATION, TYPE OF SUBSTRATE AND THE WATER CONTENT OF THE SUBSTRATE. FUEL BURNING RATES WERE INFLUENCED BY WIND VELOCITY AND SUBSTRATE CHARACTERISTICS. SUPPRESSION WITH 6 PERCENT AQUEOUS FILM FORMING FOAM SOLUTION WAS FOUND TO BE INFLUENCED PRIMARILY BY THE FIRE SIZE AND, SECONDLY, BY THE TYPE OF SUBSTRATE. TEST PLANS FOR THE 50 FT. BY 50 FT. FIRES WERE COMPLETED AND THE WORK INITIATED. SITE PREPARATIONS HAVE BEGUN FOR THE 100 FT. BY 100 FT. FIRES.

-PERTINENT FIGURES-

FIG. 2.2 FLAME TEMPERATURES IN JP5 FIRE-POOL SIZE 8 BY 16 FT. PAGE 10//FIG. 2.3 BURNING RATES AND FLAME HEIGHTS OF LIQUID FUEL FIRES PAGE 15//FIG. 2.13 EFFECT OF APPLICATION RATE ON THE AREA EXTINGUISHED AS A FUNCTION OF TIME FOR A 35 FT. BY 63 FT. TEST FIRE PAGE 36//TAB. 4.3 AQUEOUS FILM FORMING FOAM SUPPRESSANT RATE VS POSITION OF SAMPLING BEAKERS IN 3 FT. PAN PAGE 98//TAB. 4.7 EXTINGUISHMENT OF 10 FT. FIRES ON SAND SUBSTRATES PAGE 108

-BIBLIOGRAPHY-

BLINOV, V.I., AND KHUDIAKOV, G.N.: CERTAIN LAWS GOVERNING DIFFUSIVE BURNING OF LIQUIDS. FIRE RES. ABST AND REV., VOL. 1, NO. 41, 1959

-SOURCE INFORMATION-

CORPORATE SOURCE -
NAVAL ORDNANCE LAB., WHITE OAK, MD.//STANFORD RESEARCH INST.,

MENLO PARK, CALIF.
REPORT NUMBER -
AD-745122//AGFSRS 72-1
SPONSOR -
AIRCRAFT GROUND FIRE SUPPRESSION AND RESCUE, WRIGHT-PATTERSON AFB, OHIO. TRI-SERVICE SYSTEM PROGRAM OFFICE.
CONTRACT NUMBER -
CONTRACT MIPR FX 2826-71-05233
OTHER INFORMATION -
0128 PAGES, 0054 FIGURES, 0011 TABLES, 0016 REFERENCES

key 1732

EVALUATION OF CRYOGENIC NITROGEN AS A FIRE-EXTINGUISHING AGENT FOR AIRCRAFT POWERPLANT INSTALLATIONS

by

CHAMBERLAIN, G.
KLUEG, E.P.

11/00/71

-ABSTRACT-

PROPOSALS HAVE BEEN MADE TO CARRY RELATIVELY LARGE QUANTITIES OF LIQUID NITROGEN ABOARD COMMERCIAL AIRCRAFT FOR THE PURPOSE OF FUEL TANK INERTING. SECONDARY USES, SUCH AS POWERPLANT FIRE EXTINGUISHMENT, HAVE BEEN SUGGESTED. TESTING WAS CONDUCTED AT THE NATIONAL AVIATION FACILITIES EXPERIMENTAL CENTER TO DETERMINE THE FEASIBILITY OF USING LIQUID NITROGEN AS AN AIRCRAFT POWERPLANT FIRE-EXTINGUISHING AGENT AND ALSO TO DETERMINE THE CHARACTERISTICS OF LIQUID NITROGEN WHEN USED AS AN EXTINGUISHANT. THE TESTS WERE CONDUCTED USING A FULL-SCALE AIRCRAFT TURBOJET ENGING AND NACELLE FOR SUBSONIC LOW-ALTITUDE FLIGHT CONDITION SIMULATION AND ALSO IN A MOCKUP ENGINE/NACELLE FACILITY WHERE NACELLE VOL. AND AIRFLOW COULD BE VARIED. FOR ALL TESTS, THE LIQUID NITROGEN WAS DELIVERED FROM A DEWAR WHERE IT WAS STORED UNDER PRESSURE AS A SATURATED LIQUID. ALL FIRE TESTS WERE CONDUCTED USING JP-4 JET FUEL WHICH WAS SPRAY RELEASED AND SPARK IGNITED. IT WAS CONCLUDED THAT IT IS FEASIBLE TO USE CRYOGENIC NITROGEN AS A FIRE EXTINGUISHING AGENT FOR AIRCRAFT POWERPLANT FIRES. THE EFFECTIVENESS OF THE EXTINGUISHANT DEPENDS UPON THE APPLICATION RATE OF THE LIQUID NITROGEN.

-SOURCE INFORMATION-

CORPORATE SOURCE -
NATIONAL AVIATION FACILITIES EXPERIMENTAL CENTER, ATLANTIC CITY, N.J.
REPORT NUMBER -
AD-732622//FAA-RD-71-58//FAA-NA-71-3
OTHER INFORMATION -
0148 PAGES, 0031 FIGURES, 0008 TABLES, 0002 REFERENCES

HANGAR FIRE PROTECTION WITH AUTOMATIC AFFF SYSTEMS

by

BREEN, D.E.

05/00/73

-ABSTRACT-

PREVIOUS RESEARCH HAD SHOWN THAT AQUEOUS FILM-FORMING FOAM (AFFF) IS APPROXIMATELY TWICE AS RAPID IN ACHIEVING CONTROL AND 2-1/2 TIMES AS RAPID IN ACHIEVING EXTINGUISHMENT AS PROTEIN FOAM. HOWEVER, THERE WAS NO PERFORMANCE EVALUATION FOR HIGH-CEILING SYSTEMS IN BUILDINGS SUCH AS AIRCRAFT HANGARS. TESTS WERE CONDUCTED TO COMPARE AFFF AND PROTEIN FOAM IN A HIGH-CEILING TEST BUILDING. THE FUEL USED WAS JP-4 JET FUEL. THREE TYPES OF SPRINKLER SYSTEMS WERE USED IN BOTH THE AFFF AND PROTEIN FOAM TESTS: (1) THE GRINNELL FOAM/WATER-UPRIGHT; (2) THE GRINNELL STANDARD SPRINKLER-UPRIGHT; AND (3) THE GRIMES OLD SYTLE SPRINKLER-UPRIGHT. RESULTS SHOWED THAT THE GRINNELL STANDARD SPRINKLER-UPRIGHT WAS SUPERIOR TO THE GRINNELL FOAM/WATER-UPRIGHT, PROBABLY DUE TO MORE EFFECTIVE PLUME PENETRATION AFFORDED BY HIGHER FOAM PARTICLE DENSITY. AFFF IS 1.3 TO 1.6 TIMES QUICKER IN SUPPRESSING A FIRE WHEN DISCHARGED THROUGH THE STANDARD SPRINKLER SYSTEM THAN WHEN DISCHARGED THROUGH A FOAM-WATER SYSTEM, AT APPLICATION RATES OF 0.16 GPM/SQ. FT. IT WAS CONCLUDED THAT THE CONTROL AND EXTINGUISHMENT OF FUEL FIRES USING AFFF DEPENDS NOT ONLY ON APPLICATION RATE BUT ALSO ON THE TYPE OF DISCHARGING DEVICE. IT WAS ALSO FOUND THAT IT IS MORE EFFECTIVE TO APPLY THE SUPPRESSANT DIRECTLY TO THE BURNING FUEL SURFACE THAN TO DEPEND ON FLOW OF A FOAM BLANKET INTO THE FIRE FROM THE PERIMETER.

-PERTINENT FIGURES-

FIG. 4 CONTROL AND EXTINGUISHMENT TIMES VS APPLICATION RATE FOR LIGHT WATER AFFF AND PROTEIN FOAM PAGE 129

-SOURCE INFORMATION-

CORPORATE SOURCE -
FACTORY MUTUAL RESEARCH CORP., NORWOOD, MASS.
JOURNAL PROCEEDINGS -
FITCAA, FIRE TECHNOL, VOL. 9, NO. 2, 119-131 (MAY 1973)
OTHER INFORMATION -
0013 PAGES, 0004 FIGURES, 0001 TABLES, 0026 REFERENCES

key 1785

A STUDY OF HALON 1301 TOXICITY UNDER SIMULATED FLIGHT CONDITIONS

by

CALL, D.W.

02/00/73

-ABSTRACT-

HALON 1301, A FIRE SUPPRESSANT COMMONLY USED IN UNOCCUPIED AIRCRAFT SECTIONS, HAS BEEN PROPOSED FOR SIMILAR USE IN OCCUPIED CABIN SECTIONS. TO TEST POSSIBLE TOXICITY OF THIS GAS UNDER HYPOBARIC CONDITIONS, SUCH AS WOULD ACCOMPANY ITS USE IN FLIGHT, 8 MALE MILITARY PERSONNEL (AGES 20-35 YEARS) WERE EXPOSED FOR 3 MIN. TO EITHER 4 PERCENT OR 7 PERCENT HALON 1301 IN AIR IN A HYPOBARIC CHAMBER MAINTAINED AT 760 TORR (SEA LEVEL), 632 TORR (58000 FT.), OR 380 TORR (18,000FT.). ELECTROCARDIOGRAMS OF THE SUBJECTS OBTAINED DURING AND AFTER EXPOSURES SHOWED NO CHANGES FROM CONTROL TRACINGS. POST-EXPOSURE PHYSICAL EXAMINATION RESULTS AND PULMONARY FUNCTION MEASUREMENTS WERE SIMILAR TO PRE-EXPOSURE VALUES. MEAN REACTION TIMES OF THE SUBJECTS, AS MEASURED BY A COMPLEX REACTION TIME TASK ADMINISTERED BEFORE, DURING, AND AFTER ALL EXPOSURES, WERE SIGNIFICANTLY INCREASED DURING INHALATION OF 4 PERCENT OR 7 PERCENT HALON 1301. HOWEVER, NO HALON 1301-RELATED PERFORMANCE CHANGES WERE NOTED ON MAZE TRACKING TASKS. RESULTS OF THIS STUDY CORROBORATE THE FINDINGS OF OTHER TESTS CONDUCTED AT ONE ATM. AND SUPPORT THE CONTENTION THAT HALON 1301 MAY BE A SAFE FIRE EXTINGUISHING AGENT FOR USE IN OCCUPIED AIRCRAFT SECTIONS.

-SOURCE INFORMATION-

CORPORATE SOURCE -
NAVAL AIR DEVELOPMENT CENTER, WARMINSTER, PA.
JOURNAL PROCEEDINGS -
AEMEAY, AEROSP MED, VOL. 44, NO. 2, 202-204 (FEB. 1973)
OTHER INFORMATION -
0003 PAGES, 0001 FIGURES, 0000 TABLES, 0011 REFERENCES

key 1797

HUMAN EXPOSURE TO HALON 1301 DURING SIMULATED AIRCRAFT CABIN FIRES

by

SMITH, D.G.
HARRIS, D.J.

02/00/73

-ABSTRACT-

HALON 1301 WAS TESTED FOR USE AS A FIRE SUPPRESSION AGENT IN OCCUPIED AIRCRAFT CABINS. A NAVY E-2B HAWKEYE AIRPLANE WAS PROVIDED FOR THE TESTS. BECAUSE OF THE KNOWN INCIDENCE OF CARDIAC ARRHYTHMIAS AND CENTRAL NERVOUS SYSTEM DEPRESSION CAUSED BY EXPOSURE TO HALON 1301, A CAREFUL BUILD-UP PROGRAM WAS ESTABLISHED FOR THE INSTALLATION, GROUND TESTING, AND FLIGHT TESTING OF THE AGENT IN THE AIRPLANE. FLIGHT TESTS CULMINATED IN EXPOSURE OF 3 VOLUNTEER SUBJECTS TO 4 PERCENT TO 7 PERCENT HALON 1301 IN AIR MIXTURES IN-FLIGHT. CONTINUOUS ELECTROCARDIOGRAPH (ECG) MONITORING AND VERBAL NARRATION BY THE SUBJECTS ON THEIR WELL-BEING WERE MADE DURING THE EXPOSURES. DURING THE GROUND AND INITIAL FLIGHT TESTS THE OPTIMUM METHOD OF MIXING, DISTRIBUTING, AND MAINTAINING ADEQUATE AGENT CONCENTRATIONS WAS DETERMINED. ANALYSIS OF ECG RECORDINGS, AND EXAMINATION OF THE VOLUNTEER SUBJECTS DURING AND AFTER EXPOSURE TO THE AGENT IN-FLIGHT, REVEALED NO CARDIAC ARRHYTHMIAS OR ADVERSE BIOMEDICAL EFFECTS. IT WAS CONCLUDED THAT AIRCREW AND PASSENGER SAFETY WILL NOT BE COMPROMISED BY BRIEF EXPOSURE TO THE AGENT IN-FLIGHT.

-SOURCE INFORMATION-

CORPORATE SOURCE -
NAVAL AIR TEST CENTER, PATUXENT RIVER, MD.
JOURNAL PROCEEDINGS -
AEMEAY, AEROSP MED, VOL. 44, NO. 2, 198-201 (FEB. 1973)
OTHER INFORMATION -
0004 PAGES, 0008 FIGURES, 0001 TABLES, 0004 REFERENCES

key 1815

EXTINGUISHING AGENTS FOR HYDROCARBON FUEL FIRES

by

GEYER, G.B.

00/00/69

-ABSTRACT-

A DESCRIPTION IS PRESENTED OF THE FIRE EXTINGUISHING AGENTS AVAILABLE FOR COMBATING HYDROCARBON FUEL FIRES. THE AGENTS ARE CATEGORIZED INTO 3 MAJOR GROUPS, DEPENDING UPON THE PRINCIPAL FUNCTION IN THE EXTINGUISHMENT OF CLASS B FIRES: (1) FOAM VAPOR-SECURING AND BLANKETING AGENTS: CHEMICAL FOAMS AND MECHANICAL FOAMS, INCLUDING LOW EXPANSION PROTEIN FOAMS, FLUOROCARBON MODIFIED PROTEIN BASE AGENTS, HIGH EXPANSION SYNTHETIC FOAMS, AND LIGHT WATER; (2) AUXILIARY AGENTS, USED WITH FOAM TO EXTINGUISH FIRES, INCLUDING DRY CHEMICAL POWDERS (SUCH AS POTASSIUM BICARBONATE BASED PURPLE K) AND LIQUID VAPORIZING AGENTS; AND (3) NEW TYPES OF AGENTS, INCLUDING PARTICULATED GEL FOAM, THIN WATER, AND DRY WATER. THIS CATEGORIZATION OF EXTINGUISHING AGENTS PRECEDES TESTS TO EVALUATE THE PERFORMANCE AND OTHER PROPERTIES OF THE AGENTS.

-SOURCE INFORMATION-

CORPORATE SOURCE -
FEDERAL AVIATION ADMINISTRATION, WASHINGTON, D.C.
JOURNAL PROCEEDINGS -
FITCAA, FIRE TECHNOL, VOL. 5, NO. 2, 151-159 (1969)
OTHER INFORMATION -
0009 PAGES, 0000 FIGURES, 0000 TABLES, 0000 REFERENCES

FIRE PROTECTION OF THE CONCORDE

by

FIRE INTERNATIONAL

07/00/68

-ABSTRACT-

THE DESIGN OF THE FIRE PROTECTION SYSTEM FOR THE OLYMPUS ENGINES OF THE ANGLO-FRENCH CONCORDE SUPERSONIC TRANSPORT HAS REQUIRED THE STUDY OF CONDITIONS NOT PREVIOUSLY ENCOUNTERED IN ANY COMMERCIAL AIRLINES AND THE EQUIPMENT FINALLY CHOSEN CONSISTS OF SEPARATE FIRE AND OVERHEAT DETECTION SYSTEMS AND A FIRE EXTINGUISHING SYSTEM SUPPLIED BY GRAVINER LTD., OF GREAT BRITAIN. THE DETECTION SYSTEMS NOW FITTED ARE BASED ON A CONTINUOUS DETECTOR KNOWN AS FIREWIRE TRIPLE FD WHICH IS SERVICE-PROVEN. THE EXTINGUISHING SYSTEM CONSISTS OF A REMOTELY OPERATED EXTINGUISHED FOR EACH ENGINE SUPPLYING A NUMBER OF SPRAY NOZZLES FITTED IN SUITABLE POSITIONS IN EACH ENGINE BAY. IN OPERATION, THE ELECTRICAL IMPEDANCE OF THE DETECTOR'S SENSING ELEMENT IS SUCH THAT UNDER NORMAL TEMPERATURE CONDITIONS THERE IS A SMALL CURRENT FLOWING BETWEEN THE CENTER ELECTRODE AND THE CAPILLARY WHICH IS INSUFFICIENT TO CAUSE THE WARNING CIRCUIT TO OPERATE. WHEN THE ELEMENT BECOMES HEATED ABOVE A CERTAIN TEMPERATURE, ITS IMPEDANCE IS LOWERED, CAUSING AN INCREASED CURRENT TO FLOW WHICH OPERATES A RELAY TO INITIATE THE WARNING. WHEN A FIRE WARNING IS RECEIVED BY MEANS OF THE FIRE INDICATION LIGHTS AND THE AUDIBLE ALARM, THE APPROPRIATE FIRE CONTROL HANDLE ABOVE THE PILOT'S CONTROL PANEL IS PULLED ALLOWING ACCESS TO PUSH BUTTONS BEHIND THE HANDLE WHICH INITIATE EXTINGUISHANT DISCHARGE. THE EXTINGUISHANTS ARE CONTAINED IN SPHERICAL BOTTLES HAVING DUAL OUTLETS TO THE SPRAY NOZZLES MOUNTED ON THE ENGINE. THE BOTTLES CONTAIN BROMOCHLORODIFLUOROMETHANE (BCF), A MATERIAL WITH HIGH EFFICIENCY, HIGH STABILITY, LOW TOXICITY, LOW CORROSIVENESS, LOW COST, AND AFTER USE EVAPORATES TO LEAVE NO DEPOSIT.

-PERTINENT FIGURES-

FIG. 3 DIAGRAMMATIC ARRANGEMENT OF THE GRAVINER FIREWIRE TRIPLE FD FIRE DETECTION SYSTEM FOR THE OLYMPUS POWER PLANTS OF THE CONCORDE PAGE 25

-SOURCE INFORMATION-

JOURNAL PROCEEDINGS -
FIRE INT, VOL. 2, NO. 21, 20-25 (JULY 1968)
OTHER INFORMATION -
0006 PAGES, 0003 FIGURES, 0000 TABLES, 0000 REFERENCES

key 1878

FIRE DETECTION BY OBSERVATION

by

PETERSEN, R.C.

07/00/70

-ABSTRACT-

INFRARED SYSTEMS FOR FIRE DETECTION IN HANGARS AND OTHER LARGE BUILDINGS HAVE BEEN DEVISED THAT OPERATE BY RESPONDING TO INFRARED RADIATION AND FREQUENCY VARIATION BY MEANS OF A ROTATING REFLECTOR THAT SCANS 360 DEG. HORIZONTALLY AND 200 DEG. OF THE VERTICAL EVERY 10 SEC. WHEN ONE OF THE SYSTEMS HAS DETECTED AND IDENTIFIED A FIRE, A FIRE CALL OPERATES WHICH ACTUATES TRANSMITTERS, ALARM BELLS, OR OTHER ALERTING DEVICES. THE SYSTEMS, CALLED INFRASCAN 400 AND INFRASTAT 200 ARE BEST USED IN THE LARGE OPEN AREAS OF AIRCRAFT SERVICING OR STORAGE HANGARS, BUT OTHER POSSIBLE APPLICATIONS ARE IN OPEN-AREA CHEMICAL PLANTS, OIL REFINERIES, HIGH ONE-STORY ASSEMBLY BUILDINGS, OPEN YARD STORAGE (COMMON TO LUMBER YARDS), AND MARINE TERMINAL CONTAINER FACILITIES. HAVING UNDERGONE A SERIES OF TESTS, THE DEVICES ARE NOW BEING OBSERVED AND MONITORED UNDER ACTUAL AIRCRAFT SERVICE AND HANGAR OPERATIONS AT KENNEDY INTERNATIONAL AIRPORT. THIS METHOD OF DETECTION IS A DECIDED ADVANCE IN THE ART, AND, WHILE IT IS INITIALLY APPLIED FOR QUICK FIRE DETECTING AND ALERTING, IT WILL UNDOUBTEDLY FIND USE TO ACTUATE VARIOUS FORMS OF PROTECTIVE SYSTEMS WHERE SPEED IN APPLICATION OF THE MEDIA IS OF UTMOST IMPORTANCE AND WHERE OTHER HEAT-CREATING CONDITIONS, EXTREME CEILING HEIGHT, OR SEVERE DRAFT CONDITIONS TEND TO RENDER THERMALLY OPERATED SYSTEMS UNSUITABLE.

-SOURCE INFORMATION-

CORPORATE SOURCE -
NATIONAL FIRE PROTECTION ASSOCIATION, BOSTON, MASS.
JOURNAL PROCEEDINGS -
FIJOAU, FIRE J, VOL. 64, 15-17 (JULY 1970)
OTHER INFORMATION -
0003 PAGES, 0002 FIGURES, 0000 TABLES, 0001 REFERENCES

FIRE RESEARCH IN HANGAR 2 OF THE AIRFIELD REAL ESTATE COMPANY ZURICH-KLOTEN ON 3RD TO 5TH MAY 1961

by

CERBERUS LTD.

00/00/00

-ABSTRACT-

THESE EXPERIMENTS WERE DESIGNED TO DETERMINE THE SPREAD OF HEAT AND COMBUSTION GASES RESULTING FROM A LIQUID FIRE IN A VERY HIGH HALL AND TO ESTABLISH ESSENTIAL DATA FOR THE DEVELOPMENT OF FIRE PROTECTION PROJECTS WITH RESPECT TO INSTALLATIONS WITH COMBUSTION GAS DETECTORS IN VERY HIGH HALLS. THE IMPORTANT PARAMETERS WERE THE DIMENSIONS OF THE HALL, THE POSITIONING OF THE MEASURING EQUIPMENT AND OF THE DETECTORS, AS WELL AS THE LOCATION OF THE FIRES. THE EQUIPMENT INCLUDED COMBUSTION GAS DETECTORS, COMBUSTION GAS MEASURING ELEMENTS, AND TEMPERATURE SENSITIVE ELEMENTS FOR THE MEASUREMENT OF AIR TEMPERATURE WITHOUT THE EFFECTS OF THERMAL INERTIA. IN EACH EXPERIMENT THE DETECTOR IN THE GABLE GAVE AN ALARM SINCE THE COMBUSTION GASES TENDED TO CONCENTRATE IN THIS AREA. BASED ON THESE EXPERIMENTS IT WAS POSSIBLE TO PUT FORWARD A SCHEME FOR THE OPTIMUM LAYOUT OF A FIRE ALARM INSTALLATION USING CERBERUS COMBUSTION GAS DETECTORS. SHOULD AN INSTALLATION BE CARRIED OUT ACCORDING TO THIS PROPOSAL A BURNING AREA OF 0.5 SQ. M. OF KEROSENE CAN BE EXPECTED TO GIVE AN ALARM IN APPROXIMATELY 2 MIN.

-PERTINENT FIGURES-

FIG. 1 PHOTOGRAPH OF AIRCRAFT HANGAR SHOWING BEGINNING OF KEROSENE FIRE PAGE 5

-SOURCE INFORMATION-

CORPORATE SOURCE -
CERBERUS LTD., MANNEDORF (SWITZERLAND).
OTHER INFORMATION -
0012 PAGES, 0008 FIGURES, 0000 TABLES, 0000 REFERENCES

EVALUATION OF A FLAME SURVEILLANCE-TYPE DETECTOR. FINAL REPORT

by

RAMMELSBURG, M.F.
DIERDORF, P.R.

04/00/60

-ABSTRACT-

TESTS WERE CONDUCTED TO EVALUATE THE PERFORMANCE OF THE SURVEILLANCE-TYPE FLAME DETECTOR SYSTEM OF THE PYROTECTOR DESIGN. FIRE DETECTORS WERE EXPOSED TO MORE THAN 250 JP-4 JET FUEL TEST FIRES OF SMALL MAGNITUDE IN A MODIFIED KC-135 NACELLE HAVING A COMPARATIVELY LOW INTERNAL AIRFLOW. DURING THE LAB. TESTING, A SINGLE UNIT WAS USED TO ASCERTAIN ITS MAXIMUM FIELD OF VISION AND THE EFFECT OF AMBIENT LIGHT ON THE DETECTOR'S SENSITIVITY TO ACTUAL FIRE. RESULTS OF THE LAB. BENCH-TYPE TESTS INDICATED THAT THE SENSITIVITY DECREASED AS THE AMBIENT LIGHT INCREASED. THE EFFECTIVE FIELD OF VISION OF A SENSING UNIT WAS A SPHERICAL SECTOR HAVING AN INCLUDED ANGLE OF 120 DEG. INCREASED AMBIENT LIGHT REDUCED THE SENSITIVITY OF THE SYSTEM TO FLAME. SIX STRATEGICALY LOCATED SENSING ELEMENTS IN THE BOEING KC-135/707 NACELLE PROVIDED RAPID DETECTION OF SMALL, LOW-INTENSITY FIRES.

-SOURCE INFORMATION-

CORPORATE SOURCE -
    NATIONAL AVIATION FACILITIES EXPERIMENTAL CENTER, ATLANTIC CITY, N.J.
REPORT NUMBER -
    AD-255460
OTHER INFORMATION -
    0030 PAGES, 0008 FIGURES, 0003 TABLES, 0000 REFERENCES

key 1886

SOLID STATE ULTRAVIOLET DEVICES FOR FIRE DETECTION IN ADVANCED FLIGHT VEHICLES

by

CAMPBELL, R.B.
CHANG, H.C.

05/00/67

-ABSTRACT-

IMPROVEMENT HAS BEEN MADE IN BOTH THEORETICAL ANALYSES AND FABRICATION TECHNIQUES OF SILICON CARBIDE PHOTOVOLTAIC DIODES FOR USE IN SOLAR-BLIND FIRE DETECTION DEVICES. A P-I-N JUNCTION THEORY OF PHOTODIODES HAS BEEN DEVELOPED WHICH INCLUDES ALL CARRIER TRANSPORT PARAMETERS. THIS GENERAL THEORY IS COMPARED WITH THE SIMPLE MODEL DEVELOPED PREVIOUSLY FOR THE EXPLANATION OF THE DEPENDENCES OF THE PEAK RESPONSE WAVELENGTH ON THE JUNCTION DEPTH AND TEMPERATURE. DURING THIS PROGRAM, 8 SILICON CARBIDE ULTRAVIOLET DETECTORS WERE FABRICATED. USING IMPROVED FABRICATION TECHNIQUES, THESE DETECTORS HAD A LOWER ELECTRICAL IMPEDANCE AND HIGHER RESPONSE THAN DETECTORS PREVIOUSLY FABRICATED. RISE TIME OF 10-100 MICROSECONDS WERE MEASURED AT 30 DEG. C., WITH A SLIGHT DECREASE AT 500 DEG. C. AN ALUMINA ENCAPSULATION WITH A QUARTZ WINDOW WAS USED FOR THESE DEVICES. THE FEASIBILITY OF USING ALUMINUM NITRIDE, A HIGH TEMPERATURE SEMICONDUCTOR WITH A BAND GAP WIDER THAN SILICON CARBIDE, IN THE FABRICATION OF ULTRAVIOLET DETECTORS WAS ALSO STUDIED. THE SUBLIMATION TECHNIQUE WAS USED TO GROW SMALL HEXAGONAL CRYSTALS ABOUT 2 MM. ACROSS, AND SEVERAL EPITAXIAL METHODS WERE USED TO GROW SINGLE CRYSTAL LAYERS OF ALUMINUM NITRIDE ON BOTH SILICON CARBIDE AND ALUMINUM NITRIDE. DEFINITIVE ELECTRICAL PROPERTIES WERE NOT OBTAINED ON THESE CRYSTALS, POSSIBLY DUE TO LOW MOBILITY IN THE SAMPLES. THE DETECTOR STRUCTURES PREPARED SHOWED NO PHOTOCONDUCTIVE OR PHOTOVOLTAIC EFFECT UP TO 800 DEG. C.

-SOURCE INFORMATION-

CORPORATE SOURCE -
WESTINGHOUSE ELECTRIC CORP., PITTSBURGH, PA. RESEARCH AND DEVELOPMENT CENTER.
REPORT NUMBER -
AD-815895//AFAPL-TR-67-23
SPONSOR -
AIR FORCE AERO PROPULSION LAB., WRIGHT-PATTERSON AFB, OHIO.
CONTRACT NUMBER -
CONTRACT AF 33(615)-3624
OTHER INFORMATION -
0123 PAGES, 0041 FIGURES, 0000 TABLES, 0018 REFERENCES

THE EXTINGUISHING THING

by

WILSON, R.

01/00/70

-ABSTRACT-

A PORTABLE AUTOMATIC FIRE EXTINGUISHING SYSTEM HAS BEEN DEVELOPED FOR USE IN AIRCRAFT CABINS WHILE STATIONARY EQUIPMENT IS INACTIVE, AS DURING CONSTRUCTION. THE PRIMARY CAUSE OF PROPERTY LOSS IN AIRCRAFT FIRES IS HEAT, SINCE MOST SMOKE DAMAGE CAN BE REPAIRED BY CLEANING OR REPLACEMENT OF FINISHING MATERIALS. THE AGENT SELECTED FOR THE SYSTEM WAS HALON 1301 BECAUSE: (1) IT WAS PEOPLE-COMPATIBLE; (2) IT WAS CLEAN AND COULD CONTROL FLAME, HEAT, SMOKE, AND AGENT DAMAGE; AND (3) IT WAS STABLE, WITH A GOOD WEIGHT-EFFECTIVENESS RATIO. AFTER MANY EXPERIMENTS, AN IONIZATION-TYPE SMOKE DETECTOR WAS SELECTED AS THE PREALARM DETECTION DEVICE AND A RATE -COMPENSATED THERMAL DETECTOR WAS CHOSEN FOR AGENT RELEASE. THE COMPLETE UNIT IS 2 CU. FT. IN VOL., CONTAINING 30 LB. OF HALON 1301. UNITS CAN BE CONNECTED TO OTHER UNITS BY A FLEXIBLE CABLE AS SIGNAL TRANSMITTER, AND ALL UNITS ARE CONNECTED TO THE ALARM STATION WHERE TROUBLE SIGNALS, SMOKE AND THERMAL PREALARM SIGNALS, AND DISCHARGE ALARM SIGNALS ARE RECEIVED. SEVERAL INDUSTRIAL OPERATIONS WHICH THE FIREPAC UNIT CAN PROTECT ARE SUGGESTED: WELDING AND CUTTING ACTIVITIES REMODELING AND CONSTRUCTION WORK AND COMPUTER SYSTEMS. THE ADVANTAGES OF THE SYSTEM ARE ITS PORTABILITY, FLEXIBILITY, AND ABILITY TO CONTROL ALL DAMAGE-CAUSING FACTORS.

-SOURCE INFORMATION-

CORPORATE SOURCE -
FENWAL, INC., ASHTON, MASS.
JOURNAL PROCEEDINGS -
FIJOAU, FIRE J, VOL. 64, NO. 1, 17-21, 28 (JAN. 1970)
OTHER INFORMATION -
0006 PAGES, 0010 FIGURES, 0000 TABLES, 0003 REFERENCES

key 1961

RESULTS OF THE ESBJERG EXTINGUISHING TESTS

by

FIRE INTERNATIONAL

00/00/70

-ABSTRACT-

FIRE TESTS WERE CARRIED OUT ON AIRCRAFT FIRES TO COMPARE THE EFFECTIVENESS OF THE FOLLOWING FOAM EXTINGUISHANTS: (1) PROTEIN-BASED LOW EXPANSION FOAM, (2) SYNTHETIC LOW EXPANSION FOAM, (3) SYNTHETIC LOW EXPANSION FOAM WITH HALON 2402, AND (4) LOW EXPANSION FOAM BASED ON FC-194 (LIGHT WATER). JP-4 JET FUEL WAS USED IN THE TESTS, AND OBSERVATIONS WERE MADE OF THE EXTINCTION TIME AND OF RE-IGNITION, IF IT OCCURRED. THE SAME KINDS OF FOAM EQUIPMENT AND EXTINGUISHING TECHNIQUES WERE USED IN EACH TEST. TENTATIVE RESULTS SHOWED THAT: (1) THERE WAS NO ESSENTIAL DIFFERENCE BETWEEN LOW EXPANSION FOAM PRODUCED FROM A PROTEIN-BASED FOAM COMPOUND AND THAT PRODUCED FROM A SYNTHETIC FOAM COMPOUND, (2) THE CONCENTRATIONS OF 3 PERCENT FOR THE PROTEIN FOAM COMPOUNDS AND 5 PERCENT FOR THE SYNTHETIC FOAM COMPOUNDS WERE SUFFICIENT TO ACHIEVE EXTINGUISHMENT BUT COULD NOT PREVENT RE-IGNITION, (3) THE LIGHT WATER DID NOT COME UP TO EXPECTATIONS, (4) EXTINGUISHING TIMES ACHIEVED WITH A SOLUTION OF SYNTHETIC FOAM COMPOUND AND HALON 2402 WERE NOT AS CONVINCING AS THOSE ACHIEVED IN PREVIOUS TESTS CARRIED OUT ON A SMALLER SCALE, AND (5) LOW EXPANSION FOAM CAN BE CONSIDERED MOST EFFECTIVE. FURTHER TESTS WERE RECOMMENDED TO MEASURE OTHER CHARACTERISTICS OF FOAM EXTINGUISHANTS, INCLUDING FOAM STABILITY AND EFFECTIVENESS ON METAL AND FUEL FIRES.

-SOURCE INFORMATION-

JOURNAL PROCEEDINGS -
FIRE INT, VOL. 3, NO. 30, 69-73 (1970)
OTHER INFORMATION -
0005 PAGES, 0001 FIGURES, 0002 TABLES, 0000 REFERENCES

key 1969

PRODUCTION OF HIGH EXPANSION FOAM FOR FIRE-FIGHTING, USING A JET ENGINE

by

RASBASH, D.J.
LANGFORD, B.
STARK, G.W.

00/00/69

-ABSTRACT-

FIRE TESTS WERE CONDUCTED TO COMPARE THE EFFECTIVENESS OF AIR FOAM AND DE-OXYGENATED FOAM IN EXTINGUISHING SOLID AND LIQUID FUEL FIRES. THE HIGH EXPANSION FOAM PRODUCED BY A FAN HAS AIR BUBBLES IN IT WHICH CAN SUSTAIN BURNING IF THE FOAM BREAKS DOWN. THE DE-OXYGENATED FOAM IS PRODUCED BY A JET ENGINE INERT GAS GENERATOR AND DOES NOT PRESENT THE PROBLEM ASSOCIATED WITH AIR FOAM. TESTS WERE CONDUCTED USING 2 FOAMING AGENTS, WOOD AND LIQUID FIRES. RESULTS SHOWED THAT BOTH FOAMS COULD EXTINGUISH THE WOOD FIRE IN APPROXIMATELY THE SAME TIME. HOWEVER, IN THE LIQUID FIRE TESTS, THE HIGH EXPANSION FOAM PRODUCED BY THE INERT GAS GENERATOR WAS SUPERIOR IN EXTINGUISHING THE FIRES. THE QUANTITY OF WATER REQUIRED FOR BOTH GASOLINE AND ALCOHOL FIRES WAS APPROXIMATELY 0.007 GAL./SQ. FT. THIS IS FAR LESS THAN THE 0.03 GAL. SQ. FT. REQUIRED WHEN THE TRADITIONAL AIR FOAM IS USED. IN ADDITION TO THE ADVANTAGES IN EXTINGUISHING FIRES WITH JET ENGINE HIGH EXPANSION FOAM, THE APPARATUS USED IN THE PRODUCTION OF SUCH FOAM HAS ADVANTAGES WHEN COMPARED WITH THE AIR FAN.

-PERTINENT FIGURES-

FIG. 6 APPARATUS FOR MAKING HIGH EXPANSION FOAM USING GAS FROM JET ENGINE PAGE 68//TAB. 1 PERFORMANCE OF DIFFERENT HIGH EXPANSION FOAMS AGAINST FIRES PAGE 71

-BIBLIOGRAPHY-

RASBASH, D.J.: INERT GAS GENERATOR FOR CONTROL OF FIRES IN LARGE BUILDINGS. ENG., VOL. 215, LONDON, 1963

-SOURCE INFORMATION-

CORPORATE SOURCE -
FIRE RESEARCH STATION, BOREHAM WOOD (ENGLAND).
JOURNAL PROCEEDINGS -
FIRE INT, VOL. 1, NO. 9, 61-76 (1965)
OTHER INFORMATION -
0016 PAGES, 0010 FIGURES, 0001 TABLES, 0008 REFERENCES

THE PERFORMANCE OF SOME PORTABLE GAS DETECTORS WITH AVIATION FUEL VAPOURS AT ELEVATED TEMPERATURE. PART 2. TESTS WITH AVCAT, KERO B AND AVTUR VAPOURS

by

FARDELL, P.J.

01/00/73

-ABSTRACT-

TESTS WERE CONDUCTED TO MEASURE THE PERFORMANCE OF SOME PORTABLE GAS DETECTORS WITH AVIATION FUEL VAPORS AT ELEVATED TEMPERATURES. THE FUEL USED WERE AN AVIATION TURBINE FUEL (AVCAT), A KEROSENE FUEL (KERO B) AND JP-1 JET FUEL (AVTUR). THE TESTS WERE CONDUCTED AT 65 DEG. C. VARIOUS CONCENTRATIONS OF FUEL VAPOR IN AIR WERE PASSED INTO AN EXPLOSION LIMITS TUBE AND SUBJECTED TO AN ELECTRICAL SPARK. WHEN A VAPOR CONCENTRATION WAS FOUND WHICH, WHEN EXCEEDED, GAVE RISE TO A SELF-PROPAGATING FLAME, THIS WAS TAKEN AS THE LOWER EXPLOSION LIMIT (LEL) CONCENTRATION. THE LEL MIXTURE WAS THEN PASSED THROUGH THE DETECTOR AND THE READING CHECKED IN EACH CASE. RESULTS SHOWED THAT THE RESPONSE OF THE DETECTORS WAS LOW. IT WAS RECOMMENDED THAT A VAPOR BE FOUND WHICH, WHEN USED TO CALIBRATE THE DETECTORS, WOULD INSURE CORRECT OR HIGH (AND THUS ERRING ON THE SIDE OF SAFETY) READINGS WITH THESE FUELS.

-BIBLIOGRAPHY-

FARDELL, P.J.: THE PERFORMANCE OF SOME PORTABLE GAS DETECTORS WITH AVIATION FUEL VAPOURS AT ELEVATED TEMPERATURES. PART 1. TESTS WITH N-HEXANE, AVTAG AND CIVGAS VAPOURS. FIRE RES. NOTE 938, JOINT FIRE RES. ORG., JULY 1972

-SOURCE INFORMATION-

CORPORATE SOURCE -
FIRE RESEARCH STATION, BOREHAM WOOD (ENGLAND).
REPORT NUMBER -
FR NOTE 957
OTHER INFORMATION -
0013 PAGES, 0008 FIGURES, 0003 TABLES, 0001 REFERENCES

key 2002

HEAT SHIELDS FOR AIRCRAFT-A NEW CONCEPT TO SAVE LIVES IN CRASH FIRES

by

NEEL, C.B.
PARKER, J.A.
FISH, R.H.
RENSHAW, J.
NEWLAND, J.H.
ET. AL.

11/00/71

-ABSTRACT-

A HEAT SHIELD WAS DEVELOPED AND TESTED TO PROTECT PASSENGERS IN AIRCRAFT CRASH FIRES. THE SHIELD USES 2 NEW FIRE RETARDANT MATERIALS: A VERY LIGHTWEIGHT FOAM PLASTIC, CALLED ISOCYANURATE FOAM, AND AN INTUMESCENT PAINT. EXPOSED TO HEAT, THE INTUMESCENT PAINT ABLATES AND INSULATES THE SURFACE UNDERNEATH IT. AS THE FOAM IS HEATED, A STABLE CHAR IS FORMED WHICH GENERATES GASES THAT BLOW OUTWARD, COOLING THE CHAR BY TRANSPIRATION. THE GASES ALSO CHEMICALLY INTERFERE WITH THE FLAMES. IN THE TEST, A 26 FT. PIECE FROM THE FUSELAGE OF A C-47 AIRCRAFT WAS DIVIDED IN HALF AND CAPPED ON EACH END BY STEEL BULKHEADS. ONE HALF WAS LEFT UNCHANGED WHILE THE OTHER HALF WAS FITTED WITH THE HEAT SHIELD CONSISTING OF LAYERS OF INTUMESCENT PAINT, WOVEN FIBER GLASS MATTING, AND POLYISOCYANURATE FOAM. A JP-4 JET FUEL POOL FIRE WAS USED IN THE TEST. MEASUREMENTS WERE MADE OF TEMPERATURE RISE, TOXIC GAS EVOLUTION, SMOKE PRODUCTION, AND BURNTHROUGH WITHIN THE CABINS. WITHIN 1/2 MIN. AFTER IGNITION, THE FIRE WAS FULLY DEVELOPED AND SMOKE HAD ALREADY STARTED TO PENETRATE THE UNPROTECTED SECTION. WITHIN 2 MIN. THE UNPROTECTED SECTION WAS DESTROYED. HOWEVER, BY 5 MIN. AFTER IGNITION THE TEMPERATURE HAD CHANGED VERY LITTLE IN THE PROTECTED SECTION, THERE WERE NO TOXIC GASES, AND NO SMOKE HAD BEEN PRODUCED. THE FIRE BURNED OUT AFTER 12 MIN., AND THE TEMPERATURE IN THE PROTECTED CABIN REACHED ONLY 300 DEG. F. WHICH WAS JUDGED THE LIMIT OF HUMAN TOLERANCE. HEAT ENTERED THROUGH FISSURES IN THE FOAM AND BURNTHROUGH OCCURRED AFTER 12 MIN. IT WAS RECOMMENDED THAT THE AIRCRAFT BE DESIGNED TO ELIMINATE HEAT LEAKS AND FLOOR LINE FAILURES, WHICH WOULD INCREASE THE FIRE PROTECTION EFFICIENCY OF THE HEAT SHIELD.

-BIBLIOGRAPHY-

CONLEY, D.W.: POST-CRASH FIRE-FIGHTING STUDIES ON TRANSPORT CATEGORY AIRCRAFT. REP. RD-65-50, FAA, WASHINGTON, D.C., MAY 1965//RICCITIELLO, S.R., FISH, R.H., PARKER, J.A., AND GUSTAFSON, E.J.: DEVELOPMENT AND EVALUATION OF MODIFIED POLYISOCYANURATE FOAMS FOR LOW-HEATING-RATE THERMAL PROTECTION. J. CELL. PLASTICS, VOL. 7, NO. 2, 91-96, MAR./APR. 1971

-SOURCE INFORMATION-

CORPORATE SOURCE -
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION, MOFFETT FIELD, CALIF. AMES RESEARCH CENTER.//AVCO CORP., NASHVILLE, TENNN.
REPORT NUMBER -
A72-13484
JOURNAL PROCEEDINGS -
ASAEA4, ASTRONAUT AERONAUT, VOL. 9, 18-26 (NOV. 1971)
OTHER INFORMATION -
0009 PAGES, 0018 FIGURES, 0001 TABLES, 0015 REFERENCES

WHAT FIREFIGHTERS SHOULD KNOW ABOUT DRY CHEMICAL EXTINGUISHING SYSTEMS. PART 7

by

BAHME, C.W.

05/00/69

-ABSTRACT-

DRY CHEMICAL EXTINGUISHING SYSTEMS ARE DESCRIBED. IT IS NOTED THAT DRY POWDERS ARE GRAPHITE AND SPECIAL COMPOUNDS USED IN EXTINGUISHING FIRES IN SODIUM, MAGNESIUM, AND SIMILAR METALS, WHILE DRY CHEMICALS ARE USUALLY SODIUM BICARBONATE, POTASSIUM BICARBONATE (PURPLE K), MONOAMMONIUM PHOSPHATE, AND POTASSIUM CHLORIDE (SUPER K). DRY CHEMICALS CAN BE USED ON FLAMMABLE LIQUIDS FIRES AND ON ELECTRICAL EQUIPMENT FIRES. WHILE POTASSIUM CHLORIDE IS COMPATIBLE WITH ALL KINDS OF FOAM, THE COMPATIBILITY OF EACH DRY CHEMICAL USED WITH FOAM SIMULTANEOUSLY SHOULD BE CHECKED. TYPES OF DRY CHEMICALS SHOULD NEVER BE MIXED BECAUSE THEY MAY PRODUCE DANGEROUS GAS PRESSURES AND REDUCE THEIR EFFECTIVENESS. IT IS RECOMMENDED THAT CAREFUL INSPECTION AND MAINTENANCE OF DRY CHEMICAL SYSTEMS BE CARRIED OUT REGULARLY TO INSURE THAT ALL MECHANISMS ARE OPERABLE. IN FIGHTING A FIRE IN WHICH A DRY CHEMICAL SYSTEM HAS OPERATED, IT IS RECOMMENDED THAT THE FIRE AREA NOT BE OPENED UNTIL THE DRY CHEMICAL HAS FULLY EXTINGUISHED THE FIRE. FINALLY, IT IS RECOMMENDED THAT THE EXTINGUISHING SYSTEM BE REACTIVATED AS SOON AS POSSIBLE AFTER A FIRE IN ORDER TO PROTECT AGAINST REIGNITION.

-SOURCE INFORMATION-

CORPORATE SOURCE -
NATIONAL FIRE PROTECTION ASSOCIATION, BOSTON, MASS.
JOURNAL PROCEEDINGS -
FIREMEN, VOL. 36, NO. 5, 37-39 (MAY 1969)
OTHER INFORMATION -
0003 PAGES, 0001 FIGURES, 0000 TABLES, 0000 REFERENCES

key 2033

FOAM GENERATOR FOR AIRCRAFT FIRE CONTROL

by

NASH, P.
FITTES, D.W.

03/26/65

-ABSTRACT-

A GAS-TURBINE-OPERATED FOAM GENERATOR HAS BEEN DEVELOPED TO GIVE A RANGE OF PHYSICAL PROPERTIES AND APPLICATION RATES OF FOAM. THE PHYSICAL PROPERTIES WHICH ARE IMPORTANT TO THE EFFECTIVENESS OF FOAM ARE: (1) FOAM EXPANSION, WHICH IS THE RATIO OF THE VOL. OF FOAM TO THAT OF THE AQUEOUS SOLUTION FROM WHICH IT IS PRODUCED; (2) CRITICAL SHEAR STRESS, WHICH IS THE STIFFNESS OF THE FOAM, CONTROLLED BY THE ENERGY SUPPLIED IN FORMING THE BUBBLE STRUCTURE; (3) QUARTER DRAINAGE TIME, A MEASURE OF FOAM STABILITY; AND (4) APPLICATION RATE, EXPRESSED IN TERMS OF GALLONS OF FOAMING SOLUTION PER MIN. PER UNIT AREA OF FIRE. FIRE TESTS WERE CONDUCTED WITH SIMULATED AIRCRAFT FIRES IN ORDER TO DEMONSTRATE THE PERFORMANACE OF THE FOAM GENERATOR. IN THE TESTS, THE CONTROL TIME WAS MEASURED AS THE TIME UNTIL THE INTENSITY OF HEAT RADIATION FROM THE FIRE WAS REDUCED TO ONE-TENTH OF ITS INITIAL VALUE AT THE START OF FOAM APPLICATION. IT WAS FOUND THAT THE FOAM GENERATOR PROVIDES FLEXIBILITY IN SUPPRESSING AIRCRAFT FUEL FIRES. THE EQUIPMENT COULD BE USED, FOR EXAMPLE, IN HELICOPTERS WHICH COULD FLY STRAIGHT TO THE SCENE OF A CRASH AND USE AN AIR-BLEED SYSTEM FROM THEIR GAS-TURBINE DRIVING UNITS FOR FOAM-MAKING.

-PERTINENT FIGURES-

FIG. 1 DIAGRAMMATIC ARRANGEMENT OF FOAM GENERATOR PAGE 537

-BIBLIOGRAPHY-

NASH, P.: RESCENT RESEARCH ON FOAM IN THE UNITED KINGDOM. QUART INST. FIRE ENG., VOL. 21, NO. 41, 14-33, 1961

-SOURCE INFORMATION-

CORPORATE SOURCE -
JOINT FIRE RESEARCH ORGANIZATION, BOREHAM WOOD (ENGLAND).
JOURNAL PROCEEDINGS -
THE ENGINEER, VOL. 219, NO. 5696, 537-538 (MAR. 26, 1965)
OTHER INFORMATION -
0002 PAGES, 0004 FIGURES, 0001 TABLES, 0005 REFERENCES

key 2037

FIRE-WALL AND LOCAL OVERHEATING FAILURE PROTECTION APPARATUS AND SYSTEMS

by

LINDBERG, J.E.

11/25/70

-ABSTRACT-

A FIRE WALL AND DETECTION SYSTEM HAS BEEN DEVELOPED WHICH PROTECTS AGAINST OVERHEATING FAILURE IN JET ENGINES. THE INVENTION INCLUDES: (1) A FIRE WALL (SOMETIMES KNOWN AS A FIRE BULKHEAD) HAVING AT LEAST ONE OF ITS SIDES SUBSTANTIALLY COEXTENSIVE IN AREA WITH A HOLLOW CHAMBER WHICH IS HERMETICALLY SEALED; (2) A PRESSURE-SENSITIVE DETECTION MEANS ARRANGED TO BE OPERATED BY VARIATION OF PRESSURE IN THE CHAMBER CAUSED BY FAILURE DUE TO LOCAL OVERHEATING; AND (3) A SIGNALLING MEANS ACTUATED BY THE DETECTION MEANS. IF A LOCAL OVERHEATING FAILURE OCCURS, THE PRESSURE IN THE CHAMBER IMMEDIATELY CHANGES TO ATMOSPHERIC OR AMBIENT (VERY LOW IN HIGH-ALTITUDE FLYING), AND THIS CHANGE IS USED TO SET OFF THE ALARM.

-SOURCE INFORMATION-

REPORT NUMBER -
BRITISH PATENT 1,213,537
OTHER INFORMATION -
0005 PAGES, 0006 FIGURES, 0000 TABLES, 0000 REFERENCES

key 2042

PRINCIPLES OF FIGHTING AIRCRAFT FIRES

by

LEE, W.R.

09/00/68

-ABSTRACT-

THE FIRE FIGHTING PRINCIPLES USED BY THE PORT OF NEW YORK AUTHORITY AT THE NEW YORK AIRPORTS ARE MADE FOR THE MOST SEVERE CONDITIONS: THE LARGEST AIRCRAFT, FULLY OCCUPIED, IN A BURNING POOL OF HYDROCARBON FUEL. THREE MIN. ARE ALLOWED FOR EMERGENCY EQUIPMENT TO REACH AN AIRCRAFT DOWNED AT AN AIRPORT. THIS CRITERION IS CONDITIONED BY THE REASONABLE FACTORS OF OPTIMUM VISIBILITY AND SURFACE CONDITIONS. TWO MIN. ARE ALLOWED TO BRING THE CRITICAL FIRE AREA UNDER CONTROL, IN ORDER TO RESCUE PASSENGERS BEFORE FIRE REACHES THEM. EACH OF THE FIRE HOUSES AT KENNEDY AIRPORT IS EQUIPPED WITH A 3,000 GALLON FOAM TRUCK, A 2,750 GALLON SUPPLEMENTARY FOAM TRUCK, AND A QUICK RESPONSE VEHICLE CARRYING 900 LB. OF PURPLE K POWDER AND 125 GALLONS OF LIGHT WATER. THE WORST CASE FOR AN AIRCRAFT CRASH FIRE WOULD REQUIRE THE CONTROL IN 2 MIN. OF AN AIRCRAFT 150 FT. LONG, WITH A FUSELAGE DIA. OF 18 FT., AND A WING SPAN OF 40 FT. ON EACH SIDE. TO ESTABLISH CONTROL, A 2.4-IN. THICK BLANKET OF FOAM MUST BE APPLIED AT 0.15 GPM/SQ. FT. FOR 2 MIN. IN ORDER TO COVER THE TOTAL AREA, 4,400 GALLONS OF FOAM MIXTURE WOULD BE REQUIRED, EXPANDED AT A RATIO OF 8:1. AFTER THE FIRE IS EXTINGUISHED, HAND LINES MUST BE USED TO PATCH AND MAINTAIN THE FOAM BLANKET WHILE PASSENGERS ARE REMOVED, REQUIRING AN ADDITIONAL 2,600 GALLONS OF FOAM.

-SOURCE INFORMATION-

CORPORATE SOURCE -
PORT OF NEW YORK AUTHORITY, NEW YORK.
JOURNAL PROCEEDINGS -
FIENA2, FIRE ENG, VOL. 121, NO. 9, 114-115 (SEPT. 1968)
OTHER INFORMATION -
0002 PAGES, 0001 FIGURES, 0000 TABLES, 0000 REFERENCES

FIRE-FIGHTING AND RESCUE AT AIRCRAFT ACCIDENTS

by

LODGE, J.E.

10/00/68

-ABSTRACT-

LIFE SAFETY MEASURES AND FIRE EXTINGUISHING AGENTS FOR AIRCRAFTS FIRES ARE DESCRIBED. IT IS NOTED THAT 80 PERCENT OF ALL AIRCRAFT ACCIDENTS OCCUR AT OR NEAR AIRPORTS, AND IT IS RECOMMENDED THAT EFFECTIVE TRAINING AND FIRE FIGHTING EQUIPMENT BE PROVIDED. THE HUGE SIZES OF MODERN AIRCRAFT INCREASE THE DIFFICULTY OF FIRE FIGHTING BECAUSE OF THE LACK OF VISIBILITY FROM ONE SIDE TO THE OTHER, AND BECAUSE OF THE NEED TO APPLY THE EXTINGUISHING AGENT AT A MUCH HIGHER RATE IN ORDER TO SUPPRESS THE FIRE. IT IS ANTICIPATED THAT FOAM GENERATORS WILL HAVE TO HAVE RANGES OF 250 FT. OR MORE AND A LIQUID CAPACITY OF 1500 GPM IN ORDER TO DEAL WITH LARGE AIRCRAFT FIRES. NEW EXTINGUISHING AGENTS, SUCH AS FLUOROPROTEIN FOAMS AND LIGHT WATER, ARE SUGGESTED FOR USE IN AIRCRAFT FIRES. AN APPLIANCE IS BEING DEVELOPED WHICH HAS A DRY-POWDER MONITOR CAPABLE OF RANGES UP TO 120 FT., DELIVERING THE AGENT AT OUTPUT UP TO 88 LB. PER SEC. OTHER FACTORS TO BE CONSIDERED INCLUDE THE HAZARDS POSED BY JUMBO-JETS, THE NEED FOR LIGHTING EQUIPMENT, POWERED RESCUE TOOLS, COMMUNICATIONS EQUIPMENT, AND EFFECTIVE TRAINING OF FIRE FIGHTERS.

-SOURCE INFORMATION-

CORPORATE SOURCE -
BOARD OF TRADE (ENGLAND).
JOURNAL PROCEEDINGS -
FIRE, VOL. 61, NO. 760, 227-228, 232 (OCT. 1968)
OTHER INFORMATION -
0003 PAGES, 0000 FIGURES, 0000 TABLES, 0000 REFERENCES

key 2060

AIRCRAFT CABIN FIRE ON THE GROUND

by

FIRE JOURNAL

03/00/70

-ABSTRACT-

A FIRE IN AN AIRCRAFT CABIN STARTED FROM AN ELECTRICAL FAULT IN A RAZOR OUTLET AND CONSUMED INTERIOR FINISHES WHICH HAD PASSED FEDERAL FLAMMABILITY STANDARDS. THE IGNITION SOURCE WAS A LAVATORY RAZOR OUTLET WHICH HAD CAUSED A SHORT CIRCUIT WHEN WETTED DURING A ROUTINE CABIN-CLEANING OPERATION. THE FIRE BEGAN IN THE LAVATORY AND SPREAD THROUGH THE CONCEALED SPACE ABOVE THE CABIN CEILING WITHOUT ANY FIRE DIVISIONS. THE COMBUSTIBLES INCLUDED ABS OR VINYL-TYPE THERMOPLASTICS, WIRING INSULATION, WOOD FRAMES FOR THE VERTICAL AND CEILING PANELS, AND THE NEOPRENE/NYLON VAPOR BARRIER COVERING OVER THE INSULATION BLANKETS. THE INTERIOR FINISHES HAD PASSED THE REQUIREMENTS OF FEDERAL AIR REGULATIONS FLAMMABILITY STANDARDS (FAR 25.853). ACRID SMOKE PRODUCED BY THE CABIN-LINING MATERIALS AND THE WIRING INSULATION PREVENTED ACCESS FOR FIRE CONTROL. IT WAS RECOMMENDED THAT: (1) BETTER SHIELDING BE PROVIDED FOR LAVATORY ELECTRICAL CONNECTIONS TO PREVENT WETTING; (2) NONCOMBUSTIBLE FIRE BULKHEADS BE PROVIDED AT INTERVALS IN THE CONCEALED SPACE ABOVE THE CEILING; AND (3) INTERIOR FINISHING MATERIALS BE MORE FLAME RESISTANT, SINCE THE FAA FLAME RESISTANCE CRITERIA WERE OBVIOUSLY INADEQUATE.

-PERTINENT FIGURES-

FIG. 2 THE EXTENT OF DAMAGE IN THE LEFT-HAND AFT LAVATORY, WHERE THE FIRE STARTED PAGE 6//FIG. 4 THE CONCEALED CEILING SPACE ABOVE THE LEFT-HAND AFT LAVATORY AROUND THE WATER TANK PAGE 6//FIG. 7 IN THE FIRST CLASS CABIN AREA THE DAMAGE WAS LESS SEVERE, LARGELY OF A FLASH-FIRE NATURE, ALTHOUGH THE SOOT AND SMOKE DAMAGE EXTENDED INTO THE COCKPIT PAGE 7

-SOURCE INFORMATION-

JOURNAL PROCEEDINGS -
FIJOAU, FIRE J, VOL. 64, NO. 2, 5-7, 9 (MAR. 1970)
OTHER INFORMATION -
0004 PAGES, 0007 FIGURES, 0000 TABLES, 0000 REFERENCES

key 2062

THE PERFORMANCE OF SOME PORTABLE GAS DETECTORS WITH AVIATION FUEL VAPOURS AT ELEVATED TEMPERATURES. PART 1. TESTS WITH N-HEXANE, 'AVTAG' AND 'CIVGAS' VAPOURS

by

FARDELL, P.J.

07/00/72

-ABSTRACT-

TESTS WERE CONDUCTED TO EVALUATE THE PERFORMANCE OF 5 PORTABLE FLAMMABLE GAS DETECTORS AT ELEVATED TEMPERATURES. THE CATALYTIC-FILAMENT TYPE FLAMMABLE GAS DETECTORS WERE BASED ON THE PHENOMENON OF CATALYTIC OXIDATION. THEY COULD GIVE AN INDICATION OF THE EXPLOSIVE NATURE OF A MIXTURE OF FLAMMABLE GAS OR VAPOR AND AIR IN MANY SITUATIONS, INCLUDING NEWLY EMPTIED AVIATION FUEL STORAGE TANKS. THE DETECTORS WERE CALIBRATED IN PERCENTAGES OF THE LOWER EXPLOSION LIMIT CONCENTRATION OF FLAMMABLE GASES. THE FUELS USED IN THESE EXPERIMENTS WERE N-HEXANE, AVTAG (JP-4 JET FUEL), AND CIVGAS. N-HEXANE WAS TESTED AT 25 DEG. C. AND AT 65 DEG. C. TO DETERMINE TEMPERATURE EFFECT. ALL OTHER TESTS WERE CONDUCTED AT 65 DEG. C. IT WAS FOUND THAT FOR N-HEXANE GAS, 4 OF THE DETECTORS WERE LESS SENSITIVE AT 65 DEG. C. THAN AT 25 DEG. C. THE GAS-AIR MIXTURES WERE VARIED FROM 100 PERCENT OF THE LOWER EXPLOSION LIMIT TO 10 PERCENT. RESULTS SHOWED THAT WHEN WORKING WITH VAPOR CONCENTRATIONS OF LESS THAN 25 PERCENT OF THE LOWER EXPLOSION LIMIT CONCENTRATION, 2 OF THE DETECTORS DID NOT GIVE A STEADY READING. READINGS TAKEN ABOVE 50 PERCENT OF THE LOWER EXPLOSION LIMIT WERE GENERALLY QUITE STEADY AND ALL READINGS WERE REACHED WITHIN 15-25 SEC. OF PASSING THE GAS-AIR MIXTURE THROUGH THE INSTRUMENTS. IT WAS CONCLUDED THAT THE DETECTORS COULD BE USED TO GIVE AN ALARM WHEN THE CONCENTRATION OF A FLAMMABLE GAS EXCEEDS A CERTAIN VALUE, BUT THE DETECTORS ARE NOT RELIABLE BELOW ABOUT 25 PERCENT OF THE LOWER EXPLOSION LIMIT CONCENTRATION.

-SOURCE INFORMATION-

CORPORATE SOURCE -
FIRE RESEARCH STATION, BOREHAM WOOD (ENGLAND).
REPORT NUMBER -
FR NOTE 938
OTHER INFORMATION -
0020 PAGES, 0008 FIGURES, 0003 TABLES, 0010 REFERENCES

key 2076

CHARACTERIZATION AND SUPPRESSION OF AIRCRAFT AND FUEL FIRES

by

CAPENER, E.L.
ALGER, R.S.

10/00/70

-ABSTRACT-

TESTS WERE CONDUCTED WITH FUEL FIRES TO MEASURE HEAT FLUXES, BURNING RATES, AND SUPPRESSION CHARACTERISTICS. THE POOLS OF JP-5 JET FUEL USED IN THE TESTS WERE 3 FT. AND 10 FT. IN DIA. AND 50 FT. X 50 FT. AQUEOUS FILM-FORMING FOAM (AFFF) WAS USED AS A FIRE EXTINGUISHER IN THE TESTS. MEASUREMENTS WERE MADE OF BURNING RATE AND EXTINCTION TIME. A MODEL WAS CONSTRUCTED OF THE IDEAL EXTINGUISHMENT SYSTEM, WHICH WOULD GIVE A UNIFORM RATE OF APPLICATION OVER THE BURNING FUEL SURFACE. THE SUPPRESSANT SPRAY WAS CHARACTERIZED AS TO UNIFORMITY, AVERAGE DROP SIZE, AND INTERACTION KINETICS WITH THE FUEL SURFACE. RADIATION FLUXES AT VARYING DISTANCES FROM THE FIRE WERE AFFECTED BY WIND VELOCITY, LOCATION OF THE MEASURING STATION (VIEW FACTOR), TYPE OF SUBSTRATE, AND THE WATER CONTENT OF THE SUBSTRATE. FUEL BURNING RATES WERE INFLUENCED BY WIND VELOCITY AND SUBSTRATE CHARACTERISTICS. SUPPRESSION WITH 6 PERCENT LIGHT WATER SOLUTION WA. ..FLUENCED PRIMARILY BY THE FIRE SIZE AND, SECONDARILY, BY THE TYPE OF SUBSTRATE.

-PERTINENT FIGURES-

FIG. 4 RADIATION FROM 10 FT. DIA. JP5 FIRES VS RADIOMETER LEVEL ABOVE GROUND PAGE 10//FIG. 5 RADIATION FROM 10 FT. DIA. JP5 FIRES WATER VS SAND SUBSTRATES PAGE 11

-BIBLIOGRAPHY-

BLINOV, V.I., AND KHUDIAKOV, G.N.: CERTAIN LAWS GOVERNING DIFFUSIVE BURNING OF LIQUIDS. FIRE RES. ABST. AND REV., VOL. 1, NO. 41, 1959//WELKER, J.R., AND SLIEPCEVICH, C.M.: BENDING OF WIND-BLOWN FLAMES FROM LIQUID POOLS. FIRE TECH., VOL. 2, NO. 127, 1966

-SOURCE INFORMATION-

CORPORATE SOURCE -
STANFORD RESEARCH INST., MENLO PARK, CALIF.//NAVAL ORDNANCE LAB., CORONA, CALIF.
REPORT NUMBER -
WSCI 72-26

JOURNAL PROCEEDINGS -
WEST SECT, COMBUST INST, FALL MEETING, MONTEREY, CALIF. (OCT. 30-31, 1972)
OTHER INFORMATION -
0034 PAGES, 0018 FIGURES, 0000 TABLES, 0002 REFERENCES

key 2086

SENSOR FOR HEAT OR TEMPERATURE DETECTION AND FIRE DETECTION

by

LINDBERG, JR., J.E.

10/11/66

-ABSTRACT-

A U.S. PATENT IS DESCRIBED CONCERNING A HEAT DETECTOR WHICH DOES NOT REQUIRE ELECTRIC POWER; THUS IT CAN BE USED IN AIRCRAFT FOR ZONE-1 FIRE DETECTION, AHEAD OF THE FIRE WALL OF THE POWER PLANT, SUCH AS THE REGION IN AN ENGINE NACELLE. THE DEVICE CAN BE MADE INDEPENDENT OF THE RATE OF CHANGE OF TEMPERATURE, SO THAT IT DETECTS A PREDETERMINED HIGH TEMPERATURE LEVEL. THIS ELIMINATES A SOURCE OF FALSE ALARMS WHICH WILL SAVE COMMERCIAL AIRLINES THE COST OF LANDING AFTER FALSE ALARMS. THE DEVICE CONSISTS OF AN IMPERFORATE ENCLOSURE FOR A METALLIC HYDRIDE WHICH RELEASES GROSS QUANTITIES OF HYDROGEN WHEN HEATED ABOVE A THRESHOLD TEMPERATURE AND TAKES UP HYDROGEN WHEN COOLED. SEVERAL ILLUSTRATIONS ARE PRESENTED FOR USE OF THE HEAT DETECTOR BOTH IN THE HOME AND IN AIRCRAFT.

-SOURCE INFORMATION-

REPORT NUMBER -
US PATENT 3,277,860
OTHER INFORMATION -
0022 PAGES, 0022 FIGURES, 0002 TABLES, 0009 REFERENCES

key 2132

UNIQUE FIBROUS FLAME ARRESTOR MATERIALS FOR EXPLOSION PROTECTION

by

HOUGH, R.L.
LAVY, M.W.

12/00/72

-ABSTRACT-

TESTS WERE CONDUCTED TO FIND MATERIALS TO REPLACE ORGANIC FOAMS NOW BEING UTILIZED IN AIRCRAFT FUEL CELLS AS FLAME ARRESTORS. THE LIMITATIONS OF THE PRESENT ARRESTORS ARE HYDROLYTIC AND THERMAL INSTABILITY WHILE IN THE FUEL TANK ENVIRONMENT. SEVERAL INORGANIC MATERIALS WHICH CAN WITHSTAND INDEFINITE EXPOSURE TO TEMPERATURES OF 500 DEG. F. TO 1000 DEG. F. WERE TESTED. THE FOLLOWING GEOMETRY-MATERIAL COMBINATIONS WERE EXAMINED: (1) FOAM-NICHROME, CARBON, COPPER, AND ALUMINUM OXIDE; (2) WOVEN FORMS-STAINLESS STEEL, AND SILICA; (3) GRIDS-BORON AND SILICON CARBIDE; (4) MATS-BORON, SILICON CARBIDE, CARBON ALLOY, SILICA, AND ZIRCONIA. THE FABRICATED MATERIALS WERE TESTED IN A CYLINDRICAL FLAME TUBE. THEY WERE ALSO EXAMINED FOR SUCH PROPERTIES AS AIR FLOW AND DENSITY. RESULTS SHOWED THAT NICHROME FOAM, SILICON CARBIDE MAT, BORON MAT, AND WOVEN MULTI-PLY SILICA WERE MORE EFFECTIVE THAN THE CONVENTIONAL POLYURETHANE FOAM IN ARRESTING FLAMES. DATA ARE ALSO REPORTED COMPARING THE PROPERTIES OF AIR FLOW, DENSITY, AND COST OF THE INORGANIC MATERIALS TO POLYURETHANE FOAM. IN MOST RESPECTS, THE INORGANIC MATERIALS WERE SUPERIOR TO POLYURETHANE FOAM.

-SOURCE INFORMATION-

CORPORATE SOURCE -
HOUGH LAB., SPRINGFIELD, OHIO.
REPORT NUMBER -
AFAPL-TR-72-108
SPONSOR -
AIR FORCE AERO PROPULSION LAB., WRIGHT-PATTERSON AFB, OHIO.
CONTRACT NUMBER -
CONTRACT F33615-72-C-2153
OTHER INFORMATION -
0032 PAGES, 0006 FIGURES, 0008 TABLES, 0002 REFERENCES

key 2136

DESIGN CALCULATIONS FOR A HALON 1301 DISTRIBUTION TUBE FOR AN AIRCRAFT CABIN FIRE EXTINGUISHING SYSTEM

by

JONES, J.
SARKOS, C.P.

04/00/73

-ABSTRACT-

THEORETICAL CALCULATIONS WERE PERFORMED TO AID IN THE DESIGN OF A PERFORATED TUBE THAT WILL UNIFORMLY DISTRIBUTE HALON 1301 THROUGHOUT THE UNVENTILATED PASSENGER CABIN OF A COMMERCIAL AIR TRANSPORT. CONDITIONS FOR THE CALCULATIONS WERE THOSE OF A PASSENGER CABIN OF A DC-7 FUSELAGE, WITH A VOLUME OF 4000 CU. FT. AND A LENGTH OF 72 FT., BEING USED AS A TEST ARTICLE FOR EVALUATING THE PERFORMANCE OF SUCH A SYSTEM. FOUR SEPARATE CALCULATIONS WERE MADE TO DETERMINE THE (1) SIZE AND NUMBER OF ORIFICES IN THE TUBE REQUIRED FOR VARIOUS HALON 1301 DISCHARGE RATES; (2) PRESSURE DROP AS A FUNCTION OF TUBE DIA. AND DISCHARGE RATES; (3) TIME REQUIRED TO FILL THE TUBE WITH HALON 1301 FOR VARIOUS TUBE DIA.; AND (4) CABIN TEMPERATURE AND PRESSURE AFTER COMPLETION OF HALON 1301 DISCHARGE. THE FIRST CALCULATIONS INDICATED THAT FOR A GIVEN DISCHARGE TIME, THE REQUIRED ORIFICE DIA. DECREASED SLIGHTLY WITH INCREASING ORIFICE NUMBER FOR A LARGE NUMBER OF ORIFICES (ABOUT 40-50). THE PRESSURE DROP WAS SHOWN TO BE A STRONG FUNCTION OF BOTH TUBE DIA. AND DISCHARGE TIME; HOWEVER, PRACTICAL TUBE DIA. COULD BE SELECTED TO ASSURE A NEGLIGIBLE PRESSURE LOSS. IT WAS DEMONSTRATED THAT THE FILL TIME WOULD BE LESS THAN 10 PERCENT OF MOST NORMALLY USED DISCHARGE TIMES. THERMODYNAMIC CALCULATIONS PREDICTED A 38 DEG. F. CABIN TEMPERATURE AFTER COMPLETE DISCHARGE OF AGENT WITH AN INITIAL CABIN TEMPERATURE OF 70 DEG. F. AND RELATIVE HUMIDITY OF 50 PERCENT.

-BIBLIOGRAPHY-

MANNACK, J.M.: TALKING EXTINGUISHING EQUIPMENT-MORE ABOUT HALON 1301. FIRE J., VOL. 66, NO. 4, JULY 1972//JENSEN, R.H. (CHAIRMAN): REPORT OF COMMITTEE ON HALOGENATED FIRE EXTINGUISHING AGENT SYSTEMS. 1971 NFPA TECH. COMM. REP., VOL. 1, 378-445, 1971

-SOURCE INFORMATION-

CORPORATE SOURCE -
NATIONAL AVIATION FACILITIES EXPERIMENTAL CENTER, ATLANTIC CITY.
REPORT NUMBER -
FAA-RD-73-32

OTHER INFORMATION -
0031 PAGES, 0007 FIGURES, 0001 TABLES, 0006 REFERENCES

IGNITION AND FIRE SUPPRESSION IN AEROSPACE VEHICLES (PHASE 2)

by

CATO, R.J.
MARTINDILL, G.H.
KUCHTA, J.M.

12/00/72

-ABSTRACT-

THE EFFECTIVENESS OF HALONS 1301, 1202, AND 1211 AS POSSIBLE EXPLOSION SUPPRESSANTS FOR AIRCRAFT FUEL TANKS WAS INVESTIGATED IN IGNITIONS WITH SMALL CHARGES OF AN IM-11 INCENDIARY POWDER (BARIUM NITRATE-MG-AL) AND 30 CALIBER INCENDIARY AMMUNITION. IGNITIONS WITH THE POWDER IN A 74 GALLON FUEL TANK INDICATED THAT OVER 8 VOL. PERCENT HALON 1301 IS REQUIRED TO COMPLETELY QUENCH FLAME PROPAGATIONS OF NEAR STOICHIOMETRIC N-PENTANE MIXTURES AND TO LIMIT THE PRESSURE RISES TO LESS THAN 5 PSI; THE SAME CONCENTRATIONS WERE ALSO REQUIRED UNDER GUN FIRING CONDITIONS. THE CRITICAL HALON REQUIREMENTS FOR QUENCHING THE INCENDIARY IGNITION OF N-PENTANE-AIR MIXTURES DID NOT DIFFER GREATLY FOR THE 3 HALONS STUDIED. OTHER EXPERIMENTS WERE CONDUCTED IN A 216 CU. FT. CHAMBER TO EVALUATE THE EFFECTIVENESS AND TOXICITY HAZARD OF HALON 3800 IN EXTINGUISHING CLASS A FIRES BY THE TOTAL FLOODING MODE. THIS AGENT WAS LESS EFFECTIVE AND PRODUCED A GREATER TOXICITY HAZARD THAN HALON 1301 IN EXTINGUISHING COTTON SHEETING OR PAPER SHEETING FIRES. ABOUT 10 TO 12 VOL. PERCENT HALON 3800 WAS REQUIRED FOR EXTINGUISHING COTTON SHEETING FIRES, ALTHOUGH INCANDESCENT BURNING WAS POSSIBLE AFTER EXTINGUISHMENT IN SOME CASES. PRODUCT HF CONCENTRATIONS WERE AS HIGH AS 2500 PPM, DEPENDING UPON THE EXTINGUISHING CONDITIONS. SOME COMPARISON DATA ARE ALSO GIVEN FROM TOTAL FLOODING EXPERIMENTS WITH LIQUID NITROGEN, WHICH WAS LESS EFFECTIVE THAN HALON 3800.

-PERTINENT FIGURES-

FIG. 5 MAXIMUM RATE OF PRESSURE RISE VS HALON CONCENTRATION FOR FUEL TANK IGNITIONS OF NEAR-STOICHIOMETRIC N-PENTANE-AIR MIXTURES (1 ATM.) AND VARIOUS HALONS WITH AN INCENDIARY POWDER PAGE 10//FIG. 6 MAXIMUM RATE OF PRESSURE RISE VS HALON 1301 CONCENTRATION FOR FUEL TANK IGNITIONS OF NEAR-STOICHIOMETRIC N-PENTANE-AIR MIXTURES (1 ATM.) AND HALON 1301 WITH 30 CALIBER INCENDIARY AMMUNITION AND 0.55 GR. CHARGES OF INCENDIARY POWDER PAGE 13//FIG. 7 PRESSURE RISE VS TIME IN LIQUID NITROGEN TOTAL FLOODING EXPERIMENTS WITH AND WITHOUT COTTON SHEETING FIRE IN A 216 CU. FT. CHAMBER PAGE 21

-SOURCE INFORMATION-

CORPORATE SOURCE -
BUREAU OF MINES, WASHINGTON, D.C.
REPORT NUMBER -
AFAPL-TR-72-96//PMSRC REP. 4178
SPONSOR -
AIR FORCE AERO PROPULSION LAB., WRIGHT-PATTERSON AFB, OHIO.
CONTRACT NUMBER -
CONTRACT F33615-72-M-5008
OTHER INFORMATION -
0030 PAGES, 0007 FIGURES, 0007 TABLES, 0000 REFERENCES

INDEX OF AUTHORS NAMES

INDEX OF MAJOR DESCRIPTORS