

# INSTRUCTOR GUIDE

---

## **FIRE CONTROL 5**

### Aircraft Rescue and Fire Fighting

Approved by



Published by

OFFICE OF THE STATE FIRE MARSHAL  
CALIFORNIA FIRE SERVICE TRAINING AND EDUCATION SYSTEM  
7171 BOWLING DRIVE, SUITE 600  
SACRAMENTO, CA. 95823

# CFSTES

The California Fire Service Training and Education System (CFSTES) was established to provide a single statewide focus for Fire Service Training in California. CFSTES is a composite of all the elements that contribute to the development, delivery, and administration of training for the California Fire Service. The authority for the central coordination of this effort is vested in the Training Division of the State Fire Marshal's Office with oversight provided by the State Board of Fire Services.

The role of CFSTES is one of facilitating, coordinating, and assisting in the development and implementation of standards and certification for the California Fire Service. CFSTES manages the California Fire Academy System by providing the following services: standardized curriculum and tests; accrediting courses leading to certification; approving standardized training programs for local and regional delivery; administering the certification system; publishing Career Development Guides, Instructor Guides, Student Manuals, and other related support materials. Another major publication of the Training Division is the bi-monthly publication, SFM Newsletter. It is the official communication tool of CFSTES, and is distributed to all fire chiefs, fire stations, community colleges and CFSTES Instructors.

This system is as successful and effective as the people involved in it. It is a fire service system, developed by the fire service, for the fire service...and we believe it is the best one in the country!

## COPYRIGHT

Copyright 1988, by the Office of the State Fire Marshal and the California Fire Service Training and Education System, 7171 Bowling Drive, Suite 600, Sacramento, California 95823.

No part of this document may be reproduced, stored in a retrieval system, or transmitted in any form by any means, electronic, mechanical, photocopying, microfilming, recording, or otherwise without written permission from the publisher.

## ACKNOWLEDGEMENTS

The material contained in this guide has been developed by the Educational Services Division of the State Fire Marshal's Office and approved by the State Board of Fire Services for fire service personnel and for personnel in related occupations who are pursuing one or more of the certification programs.

JAMES F. McMULLEN, CHIEF  
CALIFORNIA STATE FIRE MARSHAL

KEN WAGNER  
Division Chief, Training Division  
Office of the State Fire Marshal

Special acknowledgement and thanks are extended to the following members of the Educational Services Division for their diligent efforts and contributions that made the final publication of this document possible:

PAUL BECKSTROM

CHRISTY WOODYARD

TERRY KINNEY

The material contained in this document was compiled and organized through the cooperative effort of professionals within, and associated with, the California Fire Service.

We gratefully acknowledge the following individuals and organizations for their contributions in the preparation of this document:

John Carr  
San Jose Fire Department

Les Omans  
San Jose Fire Department

# TABLE OF CONTENTS

Introduction	iv
LESSON PLANS	
LP-1 Course Overview	1
LP-2 Airport Familiarization	15
LP-3 Airport Fire Fighting Communications	24
LP-4 Aircraft Types, Engines and Systems	33
LP-5 Aviation Fuels	55
LP-6 Extinguishing Agents	86
LP-7 Protective Clothing And Breathing Apparatus	168
LP-8 Special Hazards/Hazardous Materials	182
LP-9 Aircraft Fire Fighting Apparatus And Equipment	219
LP-10 Aircraft Fire Fighting And Rescue Procedures	237
LP-11 Aviation Emergency Disaster Pre-Planning	284
LP-12 Post Incident Operations	297
Appendix A - Course Schedule	
Appendix B - Pre-Course Examination And Key	
Appendix C - Exercises I, II, III	
Appendix D - Structured Notes	
Appendix E - Student Handout Material	
Appendix F - Final Examination And Key	

# INTRODUCTION

This publication is intended to serve as an Instructor's Guide. The Guide has been designed to include lesson plans, assignment sheets, and information sheets. Suggested application methods have been identified throughout each lesson for the instructor's use at appropriate times during their presentation.

The success of the students in this course depends greatly on the instructor's conformance to the student behavioral objective prescribed at the start of each lesson. The remaining portions of the lesson plan have been designed to serve only as a guide; and as such, should not preclude instructors from adapting their lesson plans to best meet the needs of the students.

Group activities and direct application of the skills addressed in this curriculum are essential to the success of this course. The various forms, guidelines, and procedures are examples only, and are included as a resource for use where appropriate.

Each page within the Instructor's Guide is identified in the upper left corner with either of two headings (Instructor Guide or Instructor Info) that denote the function of the material contained on the page.

## INSTRUCTOR GUIDE

Material on these pages is intended to serve as an outline of instruction in lesson plan form. For each topic identified in the course outline, a lesson plan has been developed that contains; a level of instruction, time frames, student behavioral objective, references, materials needed, and lesson content.

- o LEVEL OF INSTRUCTION. Identifies the instructional level which the material was designed to fulfill. Obviously, the instructor has the latitude to increase the level, based on time available, local conditions and the student's apperceptive base.
- o TIME ALLOTMENT. The minimum, estimated duration required for "in class" presentation, based on a 36-40 hour, five day course.
- o BEHAVIORAL OBJECTIVES. The behavioral objectives are a statement of the student performance desired at the end of instruction. The instructor must make sure that enough information is given in the presentation to enable the student to perform according to the goal.
- o REFERENCES. These are the specific references that the instructor must study to teach the lesson - books, manuals, bulletins, scripts, visual aid utilization plans, and the like - including page numbers.

- o MATERIALS NEEDED. This should be a complete list of every thing the instructor will need to present the lesson, including handout materials, visual aids, quizzes, examinations, answer sheets, and so on. If the lesson requires the instructor to make any visual preparation, this should be stated.
- o LESSON CONTENT. Includes information utilized in the 4 step method of instruction. Two different terms are used to identify material that appears in the application column of the lesson plan.
  - Discuss or Review. Identifies potential questions or discussion items that the instructor may choose to utilize during the presentation of the lesson to gain feedback and monitor student progress. Although material is included here, instructors are encouraged to develop their own material.
  - Instructor Note. Alerts the instructor of a possible method of conducting instruction, points out items to be covered within discussion, identifies student exercises, and references pages in the student manual.

### INSTRUCTOR INFO

Material on these pages is also found in the Student Manual. They contain information related to specific topics within the curriculum in the form of Information Sheets, Assignment Sheets, charts, and forms.

### CONSIDERATIONS FOR LESSON DELIVERY

With the exception simulation equipment and materials, the information within the course is designed for presentation without the use of commercially or locally developed films, video tapes, and slides. This does not mean that the instructor is prohibited from employing audio visual aids during the course. The instructor is encouraged to utilize any A/V which will assist in the presentation of material and attainment of performance goals.

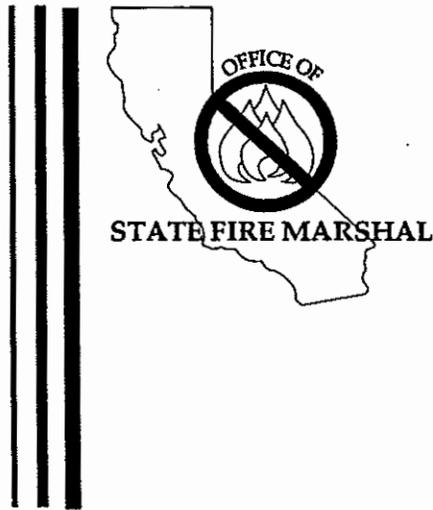
The students should be required to review the material previously covered and scan the material in upcoming class sessions. This will facilitate topic development and provide the instructor with a more receptive student base for class discussions.

Learning can be enhanced if the instructor divides the class into groups totalling 4-7 members. Student exercises can then be completed as group projects within the classroom. Placement into groups should occur within the first few hours of instruction.

The curriculum affords numerous opportunities for student exercises within their groups. Additional development of student exercises is encouraged by the instructor based upon time available and applicability to performance goals.

# **||| FIRE CONTROL 5**

Aircraft Rescue and Fire Fighting



# INSTRUCTOR GUIDE

COURSE OVERVIEW

## AIRCRAFT CRASH FIRE RESCUE

### LESSON PLAN 1

TOPIC: Course Overview

LEVEL: I

TIME: 30 Minutes

BEHAVIORAL OBJECTIVES:

Given: A written or oral examination

Performance: The student be able to identify the major subject areas and objectives of the course

Standard: With 70% accuracy

REFERENCES: IFSTA 206, Aircraft Fire Protection & Rescue Procedures, 2nd Edition, International Fire Service Training Association  
NFPA 1003 - Airport Fire Fighter Qualifications, National Fire Protection Association, 1987

MATERIALS NEEDED: Chalkboard, A/V Equipment and materials

PREPARATION: The student must realize the significance of having the knowledge to perform fire fighting and rescue operations related to aircraft incidents.

# INSTRUCTOR GUIDE

COURSE OVERVIEW

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>I. Introduction - Steps For Presenting The Aircraft/Fire Rescue Course<ul style="list-style-type: none"><li>A. Introduce yourself<ul style="list-style-type: none"><li>1. Educational background</li><li>2. Work experience</li><li>3. Where you're located</li><li>4. Personal hobbies</li></ul></li><li>B. Class introduction<ul style="list-style-type: none"><li>1. Name</li><li>2. Background, work experience</li><li>3. Where from</li></ul></li><li>C. Introductory Remarks<ul style="list-style-type: none"><li>1. Course introduction</li><li>2. Course objectives</li><li>3. Could save your life or others</li></ul></li><li>D. Class standards<ul style="list-style-type: none"><li>1. Course schedule</li><li>2. Class hours</li><li>3. Expected results</li><li>4. Performance evaluation<ul style="list-style-type: none"><li>a) Practical application</li><li>b) Academic tests</li><li>c) Certification</li></ul></li></ul></li></ul></li></ul>	<p>Pass out course schedule</p>

# INSTRUCTOR GUIDE

COURSE OVERVIEW

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>E. Accommodations<ul style="list-style-type: none"><li>1. Coffee breaks</li><li>2. Lunch break</li><li>3. Conveniences, location</li></ul></li> <li>II. Airport Operations<ul style="list-style-type: none"><li>A. Familiarization of airport and surrounding area<ul style="list-style-type: none"><li>1. Airport familiarization<ul style="list-style-type: none"><li>a) Runways, taxiways</li><li>b) Lighting systems<ul style="list-style-type: none"><li>1) Blue lights</li><li>2) White lights</li><li>3) Green lights</li><li>4) Red lights</li><li>5) Amber lights</li></ul></li><li>c) Methods of traffic control<ul style="list-style-type: none"><li>1) Steady green light</li><li>2) Steady red light</li><li>3) Flashing red light or on/off flashing runway lights</li><li>4) Flashing white lights</li></ul></li><li>d) Runway lights</li></ul></li><li>2. Grid maps<ul style="list-style-type: none"><li>a) Airport maps</li></ul></li></ul></li></ul></li></ul>	

# INSTRUCTOR GUIDE

COURSE OVERVIEW

PRESENTATION	APPLICATION
<p>III. Communications</p> <ul style="list-style-type: none"><li>A. Aircraft fire and rescue communications systems<ul style="list-style-type: none"><li>1. Direct communications</li><li>2. Emergency signals</li><li>3. Communications between units</li><li>4. Alerts</li></ul></li><li>B. Telephones<ul style="list-style-type: none"><li>1. Direct line from FAA Tower or Air Traffic Control Agency</li><li>2. Conference circuits</li></ul></li><li>C. Radios<ul style="list-style-type: none"><li>1. Fire station</li><li>2. Vehicle</li><li>3. Radio procedures</li><li>4. Good radio speech</li></ul></li><li>D. Regulations and maintenance</li><li>E. Communications terminology<ul style="list-style-type: none"><li>1. Phonetic alphabet</li><li>2. Standard words and phrases</li></ul></li><li>F. Audible alarms</li><li>G. Hand signals for fighting aircraft fires</li></ul> <p>IV. Aircraft Types, Engines, Systems</p> <ul style="list-style-type: none"><li>A. Types of aircraft<ul style="list-style-type: none"><li>1. Categories of aircraft</li></ul></li></ul>	

# INSTRUCTOR GUIDE

COURSE OVERVIEW

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>a) Light single-engine propeller driven</li><li>b) Two-engine propeller driven</li><li>c) Four-engine propeller driven</li><li>d) Turboprop driven aircraft</li><li>e) Military jet-powered aircraft</li><li>f) Multi-engine jet-powered aircraft</li><li>g) Helicopters</li></ul> <p>2. Structural materials of aircraft</p> <p>B. Engines</p> <ul style="list-style-type: none"><li>1. Piston engines<ul style="list-style-type: none"><li>a) Propeller dangers</li></ul></li><li>2. Turbo props</li><li>3. Jet engines<ul style="list-style-type: none"><li>a) Exhaust danger blast area</li><li>b) Intake danger area</li><li>c) Physical hazards</li></ul></li></ul> <p>C. Systems</p> <ul style="list-style-type: none"><li>1. Fuel systems<ul style="list-style-type: none"><li>a) Gasoline</li><li>b) Jet fuels</li><li>c) Characteristics</li><li>d) Hazards</li><li>e) Fuel tanks</li><li>f) Fuel lines</li></ul></li></ul>	

# INSTRUCTOR GUIDE

COURSE OVERVIEW

PRESENTATION	APPLICATION
--------------	-------------

- g) Fuel flow
- h) Filling fuel tanks
- 2. Aircraft fixed fire extinguisher systems
- 3. Electrical systems
- 4. Hydraulic systems
- 5. Oxygen systems
  - a) Systems hazards
  - b) Liquid oxygen
    - 1) Systems hazards
    - 2) Liquid oxygen
      - o General properties
      - o Fire fighting procedures
- 6. Anti-icing and de-icing systems
  - a) Location of anti-icing tanks
  - b) Anti-icing fluid hazards
- 7. Canopy jettison and seat ejection systems
  - a) Canopy actuator
  - b) Seat ejection
  - c) Explosive ejection devices
- 8. Other escape systems
  - a) Normal doors and hatches
  - b) Emergency doors, hatches and windows
  - c) Emergency cut-in areas
- 9. Installed armament systems

# INSTRUCTOR GUIDE

COURSE OVERVIEW

PRESENTATION	APPLICATION
<p>V. Aviation Fuels</p> <ul style="list-style-type: none"><li>A. Types of fuels<ul style="list-style-type: none"><li>1. Avgas</li><li>2. Jet A</li><li>3. Jet B</li></ul></li><li>B. Fuel hazards<ul style="list-style-type: none"><li>1. Flammability</li></ul></li></ul> <p>VI. Extinguishing Agents</p> <ul style="list-style-type: none"><li>A. Types of agents<ul style="list-style-type: none"><li>1. Chemical foam</li><li>2. Mechanical foam (air foam)<ul style="list-style-type: none"><li>a) Synthetic (high expansion) foam</li><li>b) Protein base foam</li><li>c) Fluorocarbon foam</li><li>d) Fluoroprotein foam</li></ul></li><li>3. Light water</li><li>4. Application of foam</li><li>5. Application of light water</li><li>6. Dry chemical and powder agents</li><li>7. CO<sub>2</sub></li><li>8. Vaporizing liquid (halogenated hydrocarbons)<ul style="list-style-type: none"><li>a) Chlorobromomethane agents</li></ul></li></ul></li></ul>	

# INSTRUCTOR GUIDE

COURSE OVERVIEW

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>b) Monotrifluorobromomethane (<math>\text{CF}_2\text{Br}</math>) (Tribromo)</li><li>c) Bromochlorodifluoromethane (<math>\text{CBrClF}_2</math>) (BCF)</li><li>d) Application</li></ul> <p>9. Water</p> <ul style="list-style-type: none"><li>a) Application</li><li>b) Utilizing conventional apparatus</li></ul> <p>10. Compatibility of agents</p> <p>VII. Protective Clothing/Breathing Apparatus</p> <ul style="list-style-type: none"><li>A. Structural protective clothing</li><li>B. Aluminized aircraft fire fighting protective</li><li>C. Self contained breathing apparatus</li></ul> <p>VIII. Special Hazards/Hazardous Materials</p> <ul style="list-style-type: none"><li>A. Armament and explosive cargo<ul style="list-style-type: none"><li>1. Storage locations on aircraft</li><li>2. Classes of explosive cargo<ul style="list-style-type: none"><li>a) Class "A" explosive</li><li>b) Class "B" explosive</li><li>c) Class "C" explosive</li></ul></li><li>3. Bombs</li><li>4. Rockets</li><li>5. Aircraft pyrotechnics</li><li>6. Munitions fire fighting procedures</li></ul></li></ul>	

# INSTRUCTOR GUIDE

COURSE OVERVIEW

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>7. Emergency procedures for non-fire fighting</li><li>B. Nuclear weapons<ul style="list-style-type: none"><li>1. Nuclear weapons and characteristics</li><li>2. Types of aircraft used to transport nuclear weapons</li><li>3. Time factors</li><li>4. Precautionary measures<ul style="list-style-type: none"><li>a) Sympathetic detonation</li></ul></li><li>5. Fire fighting procedures<ul style="list-style-type: none"><li>a) Radiation symbols</li></ul></li></ul></li><li>IX. Apparatus And Equipment<ul style="list-style-type: none"><li>A. Specialized fire fighting and rescue apparatus<ul style="list-style-type: none"><li>1. Specialized aircraft fire fighting apparatus<ul style="list-style-type: none"><li>a) Turrets</li><li>b) Handlines</li><li>c) Ground sweeps and undertruck nozzles</li><li>d) Agents<ul style="list-style-type: none"><li>1) Foam</li><li>2) Light water</li><li>3) Halon</li></ul></li><li>e) Other specialized apparatus</li><li>f) CO<sub>2</sub> trucks</li><li>g) Dry chemical trucks</li></ul></li></ul></li></ul></li></ul>	

# INSTRUCTOR GUIDE

COURSE OVERVIEW

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>2. Specialized municipal apparatus</li><li>3. Specialized aircraft rescue apparatus</li><li>8. Forcible entry tools<ul style="list-style-type: none"><li>1. Special and conventional tools</li></ul></li><li>X. Using Conventional Apparatus For Aircraft Fire Fighting<ul style="list-style-type: none"><li>A. Converting municipal apparatus</li><li>B. Pre-planning an aircraft crash using conventional apparatus</li></ul></li><li>XI. Aircraft Fire Fighting And Rescue Procedures<ul style="list-style-type: none"><li>A. Types of aircraft incidents<ul style="list-style-type: none"><li>1. In-flight emergencies<ul style="list-style-type: none"><li>a) Vehicle positioning for in-flight emergency</li></ul></li><li>2. Types of crashes<ul style="list-style-type: none"><li>a) Hillside crashes</li><li>b) Water crashes</li><li>c) Nose dive crashes</li><li>d) Crashes into building</li><li>e) Helicopter crashes</li><li>f) No-fire crashes</li></ul></li><li>3. Wheel, brake, and tire fires<ul style="list-style-type: none"><li>a) Braking problems in jetliners</li><li>b) Types of wheel and brake fires</li></ul></li></ul></li></ul></li></ul>	

# INSTRUCTOR GUIDE

COURSE OVERVIEW

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>c) Causes of wheel failures</li><li>d) Fusible tire plugs</li><li>e) Brake or wheel fires</li><li>f) Fire in hydraulic systems</li><li>g) Extinguishing or cooling</li><li>h) Use of dry chemical on wheel fires</li><li>i) Restricted use of water</li></ul> <p>4. Magnesium and titanium fires</p> <ul style="list-style-type: none"><li>a) Hazards</li><li>b) Fire fighting techniques</li></ul> <p>5. Class "A" fires in aircraft</p> <p>B. Fighting aircraft fires</p> <ul style="list-style-type: none"><li>1. Response procedures<ul style="list-style-type: none"><li>a) Undeclared emergency response procedures</li></ul></li><li>2. Size-up and approach</li><li>3. Positioning<ul style="list-style-type: none"><li>a) Wind</li><li>b) Terrain</li><li>c) Type of aircraft</li><li>d) Wreckage</li><li>e) Occupants and rescue areas</li><li>f) Hazardous areas</li><li>g) Equipment and personnel</li></ul></li></ul>	

# INSTRUCTOR GUIDE

COURSE OVERVIEW

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>h) Repositioning</li><li>i) Drive around concept - single vehicle</li><li>4. Control<ul style="list-style-type: none"><li>a) Initial attack</li><li>b) Establishment of rescue or escape areas</li></ul></li><li>5. Rescue<ul style="list-style-type: none"><li>a) Gaining access into aircraft</li><li>b) Releasing of personnel</li><li>c) Removing personnel</li></ul></li><li>6. Extinguishment</li><li>7. Overhaul</li></ul> <p>XII. Coordinated Pre-Fire Disaster Planning</p> <ul style="list-style-type: none"><li>A. Pre-incident planning<ul style="list-style-type: none"><li>1. Pre-fire plan factors</li><li>2. Notification of emergency forces</li><li>3. Type of incident</li><li>4. Type of aircraft involved</li><li>5. Accident site and ground surfaces</li><li>6. Access to accident site, establishing access routes to probable crash sites</li><li>7. Available vehicles and equipment</li><li>8. Communications and maps</li></ul></li></ul>	

# INSTRUCTOR GUIDE

COURSE OVERVIEW

## PRESENTATION

## APPLICATION

9. Support agencies
    - a) Law enforcement and support
    - b) Medical services
    - c) Casualty transportation
    - d) Specialized equipment
    - e) Field hospital
    - f) Mortuary assistance
    - g) N.T.S.B., F.A.A., F.B.I.
  10. Military assistance, if applicable
    - a) Military response to military aircraft incidents
  11. Mutual aid
  12. Reporting of aircraft incident
  13. News media
  14. Photography at the scene
  - B. Student workshop
    1. Develop disaster plan for aircraft incident
- XIII. Post-Incident Operations
- A. Isolation of incident area
  - B. Notification of investigative authorities
    1. Access to and release of aircraft wreckage, records, mail and cargo

### SUMMARY

Aircraft fire protection training is extremely valuable to all types and sizes of fire organizations, with or without a requirement for providing airfield fire protection. Considering the tremendous variety and dispersal of air traffic, an aircraft accident might occur in any location. The effectiveness of responding fire crews will depend upon their understanding and training in the procedures and techniques outlined in this course. It is each fire fighter's responsibility to be prepared mentally and physically for the time he or she is confronted with a large scale aircraft crash. At this time all the fire fighter can rely on is his/her knowledge and experience. Lives will be saved and lost on decisions made at this time.

### EVALUATION

The student will be evaluated by completing a written or oral examination.

### ASSIGNMENT

To be determined by the Instructor(s).

# INSTRUCTOR GUIDE

AIRPORT FAMILIARIZATION

## AIRCRAFT CRASH FIRE RESCUE

### LESSON PLAN 2

TOPIC: Airport Familiarization

LEVEL: I

TIME: 60 Minutes

BEHAVIORAL OBJECTIVES:

Given: A written examination

Performance: The student will be able to identify airport geography, taxiways, runways, lighting systems and general airport operations

Standard: With 70% accuracy

REFERENCES: IFSTA 206, Aircraft Fire Protection & Rescue Procedures, 2nd Edition, International Fire Service Training Association  
NFPA 1003 - Airport Fire Fighter Qualifications, National Fire Protection Association, 1987

MATERIALS NEEDED: Screen, slide projector, video tape player, color monitor and FAA video tape "Red Alert"

PREPARATION: An airport is a self contained city and has all the inherent problems of a city. In addition, airports have various special hazards common to airports alone. This lesson will identify and highlight these factors.



# INSTRUCTOR GUIDE

AIRPORT FAMILIARIZATION

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>1. Commercial aircraft parking</li><li>2. Corporate aircraft parking</li><li>3. General aviation parking (at most airports general aviation aircraft uses the majority of parking space)</li></ul> <p>B. Access to aircraft parking</p> <ul style="list-style-type: none"><li>1. Most airports have high security requirements</li><li>2. Response personnel have to be knowledgeable about these access points</li><li>3. Special passes and keys are used to open access areas</li><li>4. Response personnel must have access to or carry these opening devices</li></ul> <p>C. Most airports have airport police or some form of security agency. Smaller airports use city police</p> <ul style="list-style-type: none"><li>1. It's essential that fire fighters and airport police train together for a better understanding of each departments responses and responsibilities</li></ul>	<p>Slide 4 Corporate Aircraft Parking</p> <p>Slide 5 General Aviation Parking</p> <p>Slide 6 Access Points</p> <p>Slide 7 Airport Police</p>
<p>III. Aircraft Taxiways</p> <ul style="list-style-type: none"><li>A. Have yellow centerlines to guide aircraft</li><li>B. Are designated as either parallel or cross taxiways</li><li>C. Parallel taxiways are numbered 1, 2, 3, 4, etc.</li><li>D. Cross taxiways are designated as Alpha, Bravo, Charlie etc. (these names derived from the phoenetic alphabet)</li></ul>	<p>Slide 8 Taxiways/Yellow Centerline</p> <p>Slide 9 Taxiway Numbering - A, B, C, etc.</p> <p>Slide 10 Phoenetic Alphabet</p>

# INSTRUCTOR GUIDE

AIRPORT FAMILIARIZATION

PRESENTATION	APPLICATION
<p>E. Taxiways are low speed areas</p> <p>F. Vehicle traffic must have permission to use taxiways</p> <p>IV. Runways</p> <p>A. Runways are laid out on compass headings</p> <p>B. If multiple runways are in use and if they are parallel, one is designated as left and the other is the right</p> <p>1. Both runways would share the same numbering (i.e. both would be 28 L and 28 R)</p> <p>C. Runways have reciprocal numbering at opposite ends</p> <p>D. Runway landing patterns change due to wind shifts</p> <p>E. Understanding this concept is critical. This change in landing pattern changes your response and tactics by 180°</p> <p>F. Runways have white centerlines</p> <p>1. Vehicle traffic must have permission to use or cross runways</p> <p>2. Runways are high speed areas (use extreme caution on runways)</p> <p>V. Airport Lighting Systems</p>	<p>Slide 11 Runway Graphic</p> <p>What would the compass heading be for runway 28?</p> <p>Answer: 280</p> <p>Why is this important for responding personnel?</p> <p>Answer: Each runway would require different responses and access procedures</p> <p>Example: 28 L becomes 10 R at the opposite end</p> <p>Formula: <math>280 - 180 = 100</math></p> <p><math>100 + 180 = 280</math></p> <p>Example: Aircraft landing 28 would land on 10</p>

# INSTRUCTOR GUIDE

AIRPORT FAMILIARIZATION

PRESENTATION	APPLICATION
<p>A. Blue lights</p> <ol style="list-style-type: none"><li>1. Used to outline taxi-strips, ramps and/or dispersal areas, usually located along the edges, about 100 ft. apart</li></ol> <p>B. White lights</p> <ol style="list-style-type: none"><li>1. Used to outline the sides of runways and are placed 200 ft. apart</li></ol> <p>C. Green lights</p> <ol style="list-style-type: none"><li>1. Generally are called "threshold lights," these are used to mark the ends of the runways and there are usually five of them equal distances apart. Are also used for center-line lighting on taxiways</li></ol> <p>D. Red lights</p> <ol style="list-style-type: none"><li>1. Used to mark obstructions such as buildings, parked aircraft, unserviceable areas, construction work, etc.</li></ol> <p>E. Amber lights</p> <ol style="list-style-type: none"><li>1. Used to mark the approach end of the runway in use, spaced 200 ft. apart</li></ol>	<p>Slide 12 Taxiway Lights</p> <p>Slide 13 Runway Lighting</p> <p>Slide 14 Entire Runway Lighting System</p>
<p>VI. Vehicle Traffic Areas</p> <p>A. Designated by <u>GREEN</u> striping or other striping other than <u>yellow</u> or white</p> <ol style="list-style-type: none"><li>1. These areas are used by airport vehicles, service, security, etc.</li><li>2. Tower permission is not required while driving in these areas</li><li>3. Exercise caution and slow speeds while operating in these areas</li></ol>	

# INSTRUCTOR GUIDE

AIRPORT FAMILIARIZATION

PRESENTATION	APPLICATION
<p>4. These areas are usually close to aircraft, so beware of prop and jet exhausts</p>	
<p>VII. Fuel Distribution Areas</p> <ul style="list-style-type: none"><li>A. Tanker traffic and off loading areas</li><li>B. Fuel distribution areas (fuel storage, piping)</li><li>C. Fuel storage tanks</li><li>D. Access roads to fuel areas must be shown on airport or grid maps</li><li>E. Fuel transfer areas on the airfield</li><li>F. Fire fighters must be familiar with shut off switches at fuel loading and fuel transfer areas</li><li>G. Cross training with aircraft refuelers is a valuable aid for fire fighters to understand fuel operations</li></ul>	<p>Slide 15 Fuel Tankers</p> <p>Slide 16 Fuel Piping</p> <p>Slide 17 Fuel Loading Areas</p> <p>Slide 18 Fuel Transfer Area</p> <p><u>Instructor Note:</u> More information on fuels, fueling operations will be covered in the fuel section of this course</p>
<p>VIII. Water Distribution Systems</p> <ul style="list-style-type: none"><li>A. The availability of water in mass quantities is critical in aircraft fire fighting. Most airports only have hydrants near the terminal areas and have failed to provide additional hydrants adjacent to major runways. Listed below are the most common water supplies found at airports</li><li>B. Hydrants<ul style="list-style-type: none"><li>1. Above ground hydrants</li><li>2. Below ground hydrants</li><li>3. Water tankers</li></ul></li><li>C. Terminal and hanger protection</li></ul>	<p>Slide 19 Above Ground Hydrant</p> <p>Slide 20 Below Ground Hydrant</p> <p>Slide 21 Water Tankers</p>

# INSTRUCTOR GUIDE

AIRPORT FAMILIARIZATION

PRESENTATION	APPLICATION
1. Sprinklers and standpipes	Slide 22 Sprinklers and Standpipes
IX. Airport Structures	
A. Air freight buildings	
1. Combustible storage	Slide 23 United Air Freight Building
2. Hazardous materials storage	
B. Aircraft hangers (special hazards)	
1. Welding and cutting operations	Slide 24 Aircraft Maintenance Hanger
2. Flammable liquids: aircraft stripping and painting	
3. Aircraft inside with fuel in tanks	
4. Maintenance personnel working in these areas	
5. Office areas incorporated in the hanger (dual occupancy)	
C. Airport terminal areas	
1. High life hazard area	Slide 25 Airport Terminal
2. Baggage & freight loading areas (poor housekeeping, combustible material storage)	
3. Jetways or passenger loading areas adjacent the terminal (avenues of fire spread from aircraft on the ramp to the interior of the terminal)	
D. Aircraft ramp areas (jetways)	
1. Vehicle traffic (loading and off loading baggage, food, etc.)	Slide 26 Airport Aircraft Ramp Loading Areas

# INSTRUCTOR GUIDE

AIRPORT FAMILIARIZATION

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>2. Aircraft fueling operations</li><li>3. Passenger loading and off loading</li><li>E. Airport tower<ul style="list-style-type: none"><li>1. Controlling agency for all movement both aircraft and vehicles on the airport</li><li>2. Fire fighters should arrange tower familiarization tours to understand the operations of the tower</li></ul></li><li>F. Tower traffic control<ul style="list-style-type: none"><li>1. Radio's are the most preferable means of communication. Two way radio communication between all airport vehicles and the tower</li><li>2. The other method of traffic control is by light signals from the tower</li></ul></li></ul>	<p>Slide 27 Airport Tower</p> <p><u>Instructor Note:</u> More on airport communications will be covered in that section</p> <p>What are the two ways of controlling airport traffic?</p> <p>Answer: Radios and light signals</p>
<ul style="list-style-type: none"><li>X. Grid Maps<ul style="list-style-type: none"><li>A. It is essential that a standardized grid map of an area which encompasses a 5 to 15 mile radius from the control tower, including at least the traffic pattern and control zones, be available to all concerned with aircraft fire protection</li><li>B. An effective map locator system is the link which will tie together the operations of all groups that have legitimate interest in aircraft crashes<ul style="list-style-type: none"><li>1. Complete up-to-date copies of such maps must be furnished to the airport control tower, each piece of auxillary equipment, ambulances, medical aid, law enforcement agencies and all others concerned</li></ul></li></ul></li></ul>	<p>Slide 28 Grid Map</p> <p><u>Instructor Note:</u> Hand out samples of grid maps to students</p> <p><u>Instructor Note:</u> Give simulated crash site by grid readings and have students locate the site on the map</p> <p>Slide 29 Blank Slide</p>

# INSTRUCTOR GUIDE

AIRPORT FAMILIARIZATION

## SUMMARY

For students to operate as effective airport fire fighters, they must be intimately familiar with typical airport layouts, including: runways; taxiways; parking areas; runway numbering systems; compass; and directions; and runway, taxi and obstruction lighting.

## EVALUATION

The student will be evaluated by completing a written examination.

## ASSIGNMENT

To be determined by the Instructor(s).

# INSTRUCTOR GUIDE

AIRPORT FIRE FIGHTING  
COMMUNICATIONS

## AIRCRAFT CRASH FIRE RESCUE

### LESSON PLAN 3

TOPIC: Airport Fire Fighting Communications

LEVEL: I

TIME: 30 Minutes

BEHAVIORAL OBJECTIVES:

Given: A written examination

Performance:

1. The student will be able to indicate how airport communications are sent and received via telephone, radio transmission, and light signals
2. The student will be able to list basic radio procedures
3. The student will recall the "Phonetic Alphabet"
4. The student will be able to define the meaning of standard words and phrases relating to airport operations

Standard: With 70% accuracy

REFERENCES: IFSTA 206, Aircraft Fire Protection & Rescue Procedures, 2nd Edition, International Fire Service Training Association

MATERIALS NEEDED: Chalkboard, A/V equipment and materials

PREPARATION: Without proper communication, adequate and efficient operations in aircraft fire fighting and rescue is not possible. Also, the effectiveness of fire fighting and related rescue operations is directly affected by the adequacy of the system for alerting and communicating with emergency personnel.

# INSTRUCTOR GUIDE

AIRPORT FIRE FIGHTING  
COMMUNICATIONS

PRESENTATION	APPLICATION
<p>I. Aircraft Fire And Rescue Communications Systems:</p> <p>Normally, the communications system should include a direct-line telephone, a two-way voice radio and audible alarm. A fire communication center and dispatcher will coordinate messages and instructions to involved vehicles and agencies by means of:</p> <p>A. Direct communications</p> <ol style="list-style-type: none"><li>1. Direct communications between the activating authority and the fire department is required in order to assure prompt dispatch of fire fighting and rescue units in the event of an aircraft emergency</li><li>2. Other agencies which should be included on the primary circuit include the hospital and police</li></ol> <p>B. Emergency Signals</p> <ol style="list-style-type: none"><li>1. Emergency signals are used to alert auxillary personnel and, as necessary, essential related services located on or off the airport</li></ol> <p>C. Communications between units</p> <ol style="list-style-type: none"><li>1. Communications with and between units responding to the emergency is necessary to assist in the effective management of fire and rescue efforts</li></ol> <p>D. Telephones</p> <ol style="list-style-type: none"><li>1. Telephones will provide a secondary means of communications should mechanical difficulty be experienced with the radio facility</li></ol> <p>a) Direct-line</p>	<p>Slide 30 Lesson Plan Title "Airport Communications"</p> <p>Slide 31 Tower Communications</p>

# INSTRUCTOR GUIDE

AIRPORT FIRE FIGHTING  
COMMUNICATIONS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>1) Direct-line circuit should be provided between the FAA tower, or other activating authority and the airport fire department</li><li>2) Direct-line telephone circuits should be electrically supervised so that the operating condition of these circuits can be continuously monitored</li><li>3) Local procedures should be developed which will assure "round-the-clock" maintenance for these circuits</li></ul> <p>b) Normal telephone line</p> <ul style="list-style-type: none"><li>1) Normal telephone line communication is used to alert off-airport mutual aid fire departments</li><li>2) This is also a means of alerting the airport fire department of off-airport aircraft accidents</li></ul> <p>c) Conference circuits</p> <ul style="list-style-type: none"><li>1) A conference circuit is a means by which all units required to respond to aircraft emergency at an airport simultaneously<ul style="list-style-type: none"><li>o Some of these units are the control tower, security guards, airport management, airline managers and military units (joint-use airports)</li></ul></li></ul> <p>E. Radios</p> <ul style="list-style-type: none"><li>1. Proper use of the radio system will enable fire fighters to respond to any type of emergency with the knowledge of the latest events, or conditions</li></ul>	

# INSTRUCTOR GUIDE

AIRPORT FIRE FIGHTING  
COMMUNICATIONS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>2. Radio systems should be checked daily to assure that all units, mobile or fixed, are in perfect operating condition<ul style="list-style-type: none"><li>a) Defective units must be repaired or replaced immediately</li></ul></li><li>3. Fire station<ul style="list-style-type: none"><li>a) The fire station should be equipped with a two-way voice radio so that the activating authority can alert and direct aircraft fire and rescue units, or mutual aid departments, to the scene of the emergency</li></ul></li><li>4. Vehicles<ul style="list-style-type: none"><li>a) Each emergency vehicle should have a means of radio communication by which it can acknowledge, as well as inform the activating authority of its needs and requirements<ul style="list-style-type: none"><li>1) Airport based units should have a means to communicate with the aircraft, control tower, and support agencies</li></ul></li></ul></li></ul> <p>II. Radio procedures</p> <ul style="list-style-type: none"><li>A. Efficient radio communications are essential to effective fire fighting</li><li>B. Of all the communication facilities available to fire fighting forces, the radio is recognized as the most efficient system for directing fire attack and defense<ul style="list-style-type: none"><li>1. Its value in the control, response, mobilization, placement of fire forces, and other factors of fire fighting operations has been well established</li></ul></li></ul>	

# INSTRUCTOR GUIDE

AIRPORT FIRE FIGHTING  
COMMUNICATIONS

PRESENTATION	APPLICATION
<p>C. Good radio speech</p> <ol style="list-style-type: none"><li>1. Good speech habits should be used in radio communications so that the greatest efficiency may be obtained from the radio system</li></ol> <p>III. Fire Service Message Forms</p> <ol style="list-style-type: none"><li>A. Give identifier of unit you are calling</li><li>B. Give identifier of unit from which you are calling</li><li>C. Keep the message brief and to the point</li><li>D. Use procedural words and phrases when possible</li><li>E. Use phonetic spelling when necessary</li></ol> <p>IV. Regulations and maintenance</p> <ol style="list-style-type: none"><li>A. All operations of fire service radio systems shall comply with the rules and regulations of the (FCC) Federal Communications Commission Part 10 - "Rules Governing Public Safety Radio Service"<ol style="list-style-type: none"><li>1. Only a technician licensed by the FCC is permitted to make adjustments to transmitters, including base stations, mobiles, and portables</li><li>2. Indecent, obscene, or profane language and the transmission of unassigned call signals are prohibited</li></ol></li><li>B. The control center dispatcher shall be responsible for:<ol style="list-style-type: none"><li>1. Clearing the air as soon as possible</li><li>2. Maintaining discipline on the air</li></ol></li></ol>	

# INSTRUCTOR GUIDE

AIRPORT FIRE FIGHTING  
COMMUNICATIONS

PRESENTATION	APPLICATION
<p>3. Determining the order of priority on simultaneous transmissions</p> <p>V. Light Signal Communications</p> <p>A. The other method of traffic control is by the means of light signals</p> <p>1. Tower has a device called a light gun which the controller uses to direct a signal beam at the vehicle</p> <p>a) Vehicle operators must memorize the signals before being allowed to operate a vehicle on the runway area</p> <p>2. This is a secondary system at large airports. However, all fire fighters must know these signals because most conventional apparatus are not equipped with aircraft radios</p> <p>a) Steady green light: Clearance to proceed across or down the runway</p> <p>b) Steady red light: STOP! Do not proceed</p> <p>c) Flashing red light, or on and off flashing runway lights: Clear active runway or landing area immediately</p> <p>d) Flashing white light: Return to hanger or starting point</p> <p>e) The universal method of using light signals is:</p> <p>1) Turn apparatus towards the tower, turn on headlights and rotating beacon</p> <p>2) Wait for tower to return signal</p>	<p>Slide 32 Tower Light Gun</p> <p>Slide 33 Light Signal Chart</p> <p>The universal method of using light signals is:</p>

# INSTRUCTOR GUIDE

AIRPORT FIRE FIGHTING  
COMMUNICATIONS

PRESENTATION	APPLICATION
<p>3) Example: Apparatus adjacent runway flashes lights at the tower. Tower returns a steady green light, clear to cross runway</p> <p>VI. Communications Terminology</p> <p>A. A distinctive vocabulary of words, phrases, and terms has been developed for use in radio conversation</p> <ol style="list-style-type: none"><li>1. The use of these terms simplifies and clarifies radio conversation as well as contributing to brevity</li></ol> <p>B. Phonetic alphabet</p> <ol style="list-style-type: none"><li>1. In radio-telephone conversation it is the practice of the operators to identify difficult letters of the alphabet by a word<ol style="list-style-type: none"><li>a) This practice eliminates the confusion of certain letters of the alphabet sounding alike</li></ol></li></ol> <p>C. Standard words and phrases</p> <ol style="list-style-type: none"><li>1. It is important that radio operators use standard words and phrases to ensure accuracy and save time by avoiding the undue repetition of words</li></ol> <p>VII. Audible Alarms</p> <p>A. An alarm bell, siren, claxon horn, or similar system will be activated to alert fire fighters, and to get apparatus in motion to the scene of the emergency</p> <ol style="list-style-type: none"><li>1. Detailed instructions, if necessary, will be given by radio during response to the scene</li></ol>	<p>What does a flashing red light mean?</p> <p>Answer: Clear runway immediately</p> <p>Slide 34 Standard Words And Phrases</p> <p><u>Instructors Note:</u> <u>Refer to list of standard words &amp; phrases IFSTA 206, Aircraft Fire Protection &amp; Rescue Procedures, 2nd Edition, P. 127</u></p>

# INSTRUCTOR GUIDE

AIRPORT FIRE FIGHTING  
COMMUNICATIONS

PRESENTATION	APPLICATION
<p>B. Means of activating an audible alarm at airports without a control tower should be provided in areas where they are accessible to personnel who may observe an emergency situation</p> <p>1. These personnel should be trained to activate the alarm and instructed in the operation of the activating alarm</p>	
<p>VIII. Types of Alerts</p>	
<p>A. Alert I - Incoming inflight emergency i.e., unsafe gear indication, loss of hydraulic pressure, etc.</p> <p>1. Standby at station in full protective gear</p>	<p>Slide 35 Alert I - Standby At Fire Station</p>
<p>B. Alert II - Confirmed problem: Gear up, cabin fire, engine fire</p> <p>1. Standby at adjacent runways</p>	<p>Slide 36 Alert II - Standby At Adjacent Runways</p>
<p>C. Alert III - Unannounced crash</p> <p>1. Respond directly to crash scene</p>	<p>Slide 37 Responding To Crash Situation</p> <p>Slide 38 Blank Slide</p>

# INSTRUCTOR GUIDE

AIRPORT FIRE FIGHTING  
COMMUNICATIONS

## SUMMARY

The success or failure of aircraft fire fighting and rescue operations depends a great deal on adequate communications capability between all parties involved. Normal and emergency channel capability must be considered as well as a suitable means for alerting emergency personnel.

## EVALUATION

The student will be evaluated by completing a written examination.

## ASSIGNMENT

Review the procedures in identifying, sending and receiving information by the use of the two way radios, telephones and light signals. Review the basic radio procedures. Review and recite the "Phonetic Alphabet". Review the definitions of the "Standard Words and Phrases" relating to airport operations.

# INSTRUCTOR GUIDE

AIRCRAFT TYPES,  
ENGINES AND SYSTEMS

## AIRCRAFT CRASH FIRE RESCUE

### LESSON PLAN 4

TOPIC: Aircraft Types, Engines and Systems

LEVEL: I

TIME: 180 Minutes

#### BEHAVIORAL OBJECTIVES:

Given: A written examination

Performance: 

1. The student will be able to list aircraft types
2. The students will be able to indicate types of aircraft engines
3. The students will be able to identify aircraft systems and their hazards

Standard: With 70% accuracy

REFERENCES: IFSTA 206, Aircraft Fire Protection & Rescue Procedures, 2nd Edition, International Fire Service Training Association, Pages 5-37

MATERIALS NEEDED: Slide projector with screen, overhead projector, video player & monitor, video-Light Aircraft Familiarization & United Airlines Aircraft Familiarization

PREPARATION: The details of individual aircraft types, engines and systems will prove essential when dealing with aircraft emergencies. Since many variations exist, knowledge of the characteristics of each will provide a decided edge in mitigating fire and rescue situations.

# INSTRUCTOR GUIDE

AIRCRAFT TYPES,  
ENGINES AND SYSTEMS

PRESENTATION	APPLICATION
<p>I. Types Of Aircraft</p> <p>A. Categories</p> <p>1. It is common practice to categorize aircraft according to their general size, intended purpose, type of engines, number of passengers, fuel capacity, etc. Only size, number and type of engines, and passenger capacities are considered in this manual, since these have the greatest bearing on amounts of extinguishing agents necessary for fire control and evacuation purposes</p> <p>a) Aircraft range in size from the four passenger single-engine air taxi to multi-engine jets, carrying up to several hundred passengers</p> <p>b) General aviation and business aircraft fall into identical categories and, with the exception of jet fighters, so do military aircraft</p> <p>c) Aircraft are divided into the following categories for identification purposes</p> <p>1) Single engine types</p> <ul style="list-style-type: none"><li>o These aircraft are used for training, light reconnaissance, and general aviation</li><li>o The fuselage is usually of light metal-limited construction or a metal frame with fabric covering</li><li>o They are powered with reciprocating engines of 65 to 300 or more horsepower and weigh up to 3,500 lbs.</li><li>o They may carry from two to six passengers</li></ul>	<p>Slide 39 Lesson Plan Title "Aircraft Types, Engines &amp; Systems</p> <p>Slide 40 Single Engine Aircraft Piper Cherokee Six</p> <p>Slide 41 737 Jet Transport</p> <p>Slide 42 727 Jet Transport</p> <p>Slide 43 MD-80 Jet Transport</p> <p>Slide 44 Wide Body 747 Aircraft</p> <p>Slide 45 Single Engine Metal</p>

# INSTRUCTOR GUIDE

AIRCRAFT TYPES,  
ENGINES AND SYSTEMS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>o An example of this type aircraft is a Cessna Ag-Wagon, which is a restricted aircraft</li><li>o Engine material may dislodge, or rupture, inside of fuselage; fuel can leak inside</li><li>o Could have source of ignition from electric lines</li><li>o Disconnect battery, highly volatile fumes may be present</li><li>o Aircraft have overhead wings, some have underplane wings</li><li>o After impact, propeller may continue to run</li><li>o Pilot error 90%</li><li>o Easy to cut into</li></ul> <p>2) Two engine prop driven</p> <ul style="list-style-type: none"><li>o This type aircraft is used for training, reconnaissance, general military transportation, air evacuation, air taxis, local service airlines, and business operations</li><li>o This category includes the small privately owned and operated aircraft and those which are operated commercially</li><li>o Construction features may vary from light to heavy depending upon the size, speed, and altitude (pressurization) requirements</li><li>o Twin engine planes generally have retractable landing gear</li></ul>	<p>Slide 46 Two Engine Prop</p> <p><u>Instructor Note:</u> Ask class for examples of twin engine aircraft using their facilities</p> <p><u>Video Tape #2 Light Aircraft Familiarization</u></p>

# INSTRUCTOR GUIDE

AIRCRAFT TYPES,  
ENGINES AND SYSTEMS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>- Those which are equipped for pressurized flying are constructed of heavier materials and the skin is more resistant to forcible entry</li><li>o Some aircraft of this type are equipped with improved evacuation devices. Passenger loads of up to 60 persons may be expected</li><li>o Although these aircraft have given way to smaller jet aircraft, many are still in service as small commuter aircraft for several major airlines<ul style="list-style-type: none"><li>- These aircraft use a high grade of aviation fuel with fuel quantities from 400 gallons up to 2000</li><li>- Because these aircraft service smaller airports as a shuttle service to major airports, fire fighters who respond to smaller airports must be familiar with these aircraft</li></ul></li></ul>	<p>Slide 47 Large Twin Engine Piston Driven Aircraft</p>
<p>3) Four engine prop driven</p> <ul style="list-style-type: none"><li>o This type of aircraft is used by commercial carrier agencies for local and cross country passenger and cargo service</li><li>o They are also used by the military services to transport cargo and personnel, and as bombers</li></ul>	<p>Slide 48 Four Engine Prop. DC 7 Aircraft</p>

# INSTRUCTOR GUIDE

AIRCRAFT TYPES,  
ENGINES AND SYSTEMS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>o The four-engine, reciprocating powered aircraft are being replaced by the three and four engine turbine-powered aircraft</li><li>o Example: DC-7 which is a commercial passenger type</li><li>o Many of these aircraft are in service today<ul style="list-style-type: none"><li>- some are used for air freight operations, others are chartered for various tours across the country</li></ul></li><li>o Many of these aircraft see duty as air tankers in the western United States</li><li>o These aircraft use a high grade of aviation gasoline and the fuel quantity is usually 5,400 gallons with passenger loads exceeding 100</li></ul>	
<p>4) Turbo-Prop driven aircraft</p> <ul style="list-style-type: none"><li>o Aircraft which are equipped with turbine engines to drive the propellers are commonly called turbo-props</li><li>o Turbine driven propeller engines are used on a great variety of aircraft having either two or four engines</li><li>o This type aircraft is generally constructed to withstand high speed and pressurization</li></ul>	<p>Slide 49 Twin Engine Turbo Prop Aircraft</p>
<ul style="list-style-type: none"><li>o Passenger load may vary from less than 15 to approximately 150</li></ul>	<p>Slide 50 Four Engine Turbo Prop Aircraft Lockheed Electra</p>

# INSTRUCTOR GUIDE

AIRCRAFT TYPES,  
ENGINES AND SYSTEMS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>o Examples of this type aircraft are known as the Beech 99 and the Lockheed Electra</li></ul> <p>5) Military jet powered aircraft</p> <ul style="list-style-type: none"><li>o Many types of jet powered aircraft from single-engine fighters to large multi-engine transports and bombers are utilized by the military services for a variety of functions</li><li>o Extreme altitude, speed, instrumentation, and armament required by the military in the performance of these functions, demands that their aircraft be stronger than comparable aircraft produced for general aviation use</li><li>o As a general rule, fire fighters should anticipate dealing with some type of armament and explosive ejection devices at military aircraft incidents</li></ul> <p>6) Multi-engine jet powered aircraft</p> <ul style="list-style-type: none"><li>o This category may range in size from small business aircraft carrying a few passengers to the giant transports, such as the 747 and C5-A, with passenger capacities up to 500</li><li>o The weight, pressurization, and stress requirements for these aircraft call for the extensive use of magnesium and titanium both in the structural members and in the skin of the aircraft in the form of sheets, beams and honeycomb</li></ul>	<p>Slide 51 Military Jet Fighter Aircraft</p> <p><u>Instructor's Note:</u> Explain briefly:</p> <p>Ejection seats and canopies. Refer students to Pages 29-35 IFSTA #206-<u>Aircraft Fire Protection &amp; Rescue Procedures</u> International Fire Service Training Association</p> <p><u>Caution</u> - Know what you are doing. Extreme danger when opening canopy and evacuating pilot. Safety first</p> <p>Slide 52 Sabreliner</p> <p>Slide 53 Two-Engine Jet Commercial Type - DC-9</p> <p>Slide 54 DC-8-Standard</p>

# INSTRUCTOR GUIDE

AIRCRAFT TYPES,  
ENGINES AND SYSTEMS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>- These metals are also used in the wheels, engine mountings, cover plates and at other points of stress or heat throughout the aircraft</li></ul> <p>7) Helicopters</p> <ul style="list-style-type: none"><li>o Rotary wing aircraft are generally limited in size and capabilities</li><li>o Passenger loads vary from two to 50 persons</li><li>o Helicopters have increased in popularity because of their vertical landing and take-off ability</li><li>o Air taxis now operate out of heliports in several of our larger cities</li><li>o Although the fire size potential is small when compared to large fixed wing aircraft, the probability of fire is great during helicopter crashes because of the under floor location of the fuel tanks and the vertical deceleration forces usually experienced</li><li>o Auto rotation capabilities in engine stall</li></ul>	<p><u>Instructor's Note:</u> Forcible entry becomes more difficult, large amounts of fuel and rescue, jet blast, no glide capabilities, wheel fire danger. You can expect primary and secondary explosions. Caution - evacuation chutes. New commercial jets-the chute will not inflate when the door is opened from outside</p> <p>Slide 55 Helicopter</p> <p>Slide 56 Bell Jet Ranger</p> <p>Slide 57 Bell H-1 Huey</p>

# INSTRUCTOR GUIDE

AIRCRAFT TYPES,  
ENGINES AND SYSTEMS

PRESENTATION	APPLICATION
<p style="text-align: center;">- Rotors should be dead stopped before approach because the rotors drop when they slow down</p> <p>B. Structural material of aircraft</p> <ol style="list-style-type: none"><li>1. The materials forming the major parts of an airplane and the manner in which they are put together should also be known and recognized, since their inherent properties vitally affect fire fighting operations</li><li>2. The following explanations furnish basic information regarding the materials commonly used in most types of aircraft construction</li><li>3. The materials described may be used in any number of combinations<ol style="list-style-type: none"><li>a) For instance, the ailerons, rudders, elevators, or their control surfaces may have a wooden framework covered with a fabric, even in so-called "all metal" aircraft</li><li>b) Likewise, wooden or metal wing construction may be used in the same aircraft with a fuselage of metal tubing</li><li>c) In view of all such possibilities, it is important to note that when surfaces of different materials are uniformly painted, the variation in construction may not be noticeable without close investigation</li></ol></li><li>4. Materials by type<ol style="list-style-type: none"><li>a) Duraluminum<ol style="list-style-type: none"><li>1) Used in sheets for skin surfaces and pressed sections</li></ol></li></ol></li></ol>	<p>Slide 58 Aircraft Parts, Jet Aircraft</p> <p><u>Instructor's Note:</u> Point out ailerons, rudders, elevator, vertical and horizontal stabilizers, cowling, flaps</p> <p><u>Instructor's Note:</u> Point out places where different materials are located</p> <p>Slide 59 Aircraft Materials</p>

# INSTRUCTOR GUIDE

AIRCRAFT TYPES,  
ENGINES AND SYSTEMS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>o Also used as channels for framework, spars</li><li>o Will not withstand heat since it melts at relatively low temperatures</li><li>o Considering forcible entry possibilities, thin Duraluminum sheets are readily pierced</li><li>o Heavy sections can be cut with metal saw or axe</li></ul> <p>b) Magnesium and alloys</p> <ul style="list-style-type: none"><li>1) Used for landing gear wheels, engine mounting brackets, crankcase sections, cover plates, and for other engine parts</li><li>o Magnesium and alloys are not generally used in areas where forcible entry may be required<ul style="list-style-type: none"><li>- Extinguishment of Magnesium by Metalux</li></ul></li></ul> <p>c) Plywood</p> <ul style="list-style-type: none"><li>1) Used in fuselage and wings</li><li>2) Fire hazard potential is essentially the same as that of ordinary wood</li><li>3) Forcible entry is not complicated since it can be cut with an axe or saw or even punctured with a heavy sledge hammer</li></ul> <p>d) Steel</p> <ul style="list-style-type: none"><li>1) Used for engine parts, tubing for structural framing and skin surfaces of stainless steel</li></ul>	<p>Instructor's Note: Point out possible materials:</p> <p>Duraluminum Magnesium Plywood Steel Titanium Wood</p>

# INSTRUCTOR GUIDE

AIRCRAFT TYPES,  
ENGINES AND SYSTEMS

PRESENTATION	APPLICATION
--------------	-------------

- o It is not regarded as a fire hazard
- e) Titanium
  - 1) Metallic element used to reinforce skin surfaces to guard against impinging exhaust flame or heat
  - o Will burn like Magnesium
- f) Wood
  - 1) Used in a variety of ways from heavy beams in wing spars to fragile stringers in control surfaces
  - 2) Wood is considered to be an ordinary combustible, although thick wooden surfaces are particularly difficult to penetrate

## II. Engines

- A. The piston engine was the original means of propulsion
  - 1. A reciprocating engine, radial or in-line, liquid or air cooled, produces power which is transmitted through a reduction gear system to a propeller
  - 2. Similar in operation to most engines used for ground operation (automobiles and trucks)
  - 3. Of lighter construction, however, does not incorporate a muffler in the exhaust system
  - 4. Uses a relatively large amount of oil, which requires an oil tank adjacent to the engine

Slide 60 Piston Engine

# INSTRUCTOR GUIDE

AIRCRAFT TYPES,  
ENGINES AND SYSTEMS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>5. Causes vibrations which can damage fuel lines and thus produce a fire hazard</li><li>6. An accessory section, which is a part of the engine, includes power to operate pumps for the fuel oil and hydraulic systems, and generators for the electrical system</li><li>7. The line drawing in the slide illustrates the principles and relationship of the piston and propeller-driven aircraft</li><li>8. Propeller dangers<ul style="list-style-type: none"><li>a) Since undesirable blast velocities are normally not encountered at breakaway or taxiing thrust requirements, it is relatively safe to approach a propeller-driven aircraft from the rear</li><li>b) Approaching from the front or side relate to the dangers involving the propeller turning at idle thrust and should not be approached closer than 15 ft. from the front, or 15 ft. plus the radius of the propeller from the side</li><li>c) If the propeller is turning at breakaway or taxiing thrust, it should never be approached from the front or side</li><li>d) Piston engines which have recently stopped may restart with any slight movement of the propeller. Therefore, moving the propeller is not recommended.</li></ul></li></ul>	<p>Slide 61 Propeller Dangers</p>

# INSTRUCTOR GUIDE

AIRCRAFT TYPES,  
ENGINES AND SYSTEMS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>e) The exhaust system provides a ready ignition source for spilled fluids on or around the engine<ul style="list-style-type: none"><li>1) On impact with the ground, the propeller and nose casing usually separates from the engine, releasing hot oil upon the exhaust manifold</li><li>2) Propeller fragments may cut holes in the wing fuel tanks, releasing additional flammable liquids</li></ul></li></ul> <p>B. Jet engines</p> <ul style="list-style-type: none"><li>1. The jet engine was developed prior to World War II, but was never used operationally until the late stages of the war</li><li>2. Air is drawn into the jet engine where it is compressed, mixed with fuel, ignited, and expelled to produce thrust</li><li>3. The jet engine needs little lubricating oil and is almost vibration free</li><li>4. It consists of a compressor section, burner cans, and a turbine section</li><li>5. Accessories are attached to the compressor section to perform the same functions as on the piston engine</li><li>6. Three examples of jet type engines are illustrated on Page 15 &amp; 16 of the IFSTA #206 Manual</li><li>7. Jet engine danger<ul style="list-style-type: none"><li>a) Jet engine blast velocities above 30 miles per hour (mph) and 44 ft. per second are considered undesirable for personnel and equipment</li></ul></li></ul>	<p>Slide 62 Jet Engine</p>

# INSTRUCTOR GUIDE

AIRCRAFT TYPES,  
ENGINES AND SYSTEMS

PRESENTATION	APPLICATION
<p>b) Exhausts from jet aircraft may create blast velocities many times greater than 30 mph (747 creates 70 mph winds at idle) at considerable distances from the operating aircraft</p> <ol style="list-style-type: none"><li>1) The jet blast velocity variations are also governed by percentage of engine power being developed</li><li>2) Jet engine blast velocities may cause loose objects lying on the pavement to become potential missiles which may be thrown considerable distances</li><li>3) Therefore, one should avoid blast areas</li></ol> <p>c) After an accident, the jet engine may continue to run if the fuel or ignition is not shut off</p> <ol style="list-style-type: none"><li>1) Engines retain sufficient heat to ignite spilled flammables for up to 20 minutes after shut down</li></ol>	<p>Slide 63 Wind Velocity Chart (Jet Blast Areas)</p>
<p>C. Turbo prop</p> <ol style="list-style-type: none"><li>1. Turbo props are discussed separately for the sole purpose of distinguishing them from jet engines which propel by blast</li><li>2. Turbo props are propellers which are driven by a jet engine. Power for turbo-driven propellers is from the jet exhaust system through a gear reduction</li><li>3. Turbo prop engines develop undesirable thrust velocities similar to those of other jet engines</li><li>4. Therefore, they should not be approached from the rear</li><li>5. The rotation of the engine may draw in vapors from spilled fuel and ignite them</li></ol>	<p>Slide 64 Turbo Prop</p>

# INSTRUCTOR GUIDE

AIRCRAFT TYPES,  
ENGINES AND SYSTEMS

PRESENTATION	APPLICATION
<ol style="list-style-type: none"><li>6. The turbo prop engine is a gas turbine unit which spins a conventional propeller</li><li>7. It also delivers some jet thrust</li><li>8. Air enters the compressor which, acting like a large fan, compresses the air and forces it into combustion chambers</li><li>9. There it is mixed with fuel and ignited and the resulting hot gases spin a turbine wheel</li><li>10. The turbine drives the compressor and turns the propeller</li><li>11. The exhaust gases also eject rearward to give added power</li><li>12. The ratio is about 80% propeller power, 20% jet</li></ol>	
<p>III. Systems</p>	
<p>A. Color codes</p>	<p>Slide 65 Color Code Chart</p>
<p>B. Fuel systems</p>	<p>Slide 66 Color Code Red</p>
<ol style="list-style-type: none"><li>1. Two types of hydrocarbon fuels currently being used in aircraft are gasoline and jet fuel</li></ol>	<p>Slide 67 Fuel Lines With Red Labels</p>
<ol style="list-style-type: none"><li>2. The use of jet fuel has far exceeded the use of gasoline, and the trend is continuing with the changeover to jet engine cargo and passenger type aircraft</li></ol>	
<ol style="list-style-type: none"><li>3. The fuel system of an aircraft stores and distributes fuel to the engines</li></ol>	
<ol style="list-style-type: none"><li>a) Fuel tanks, control valves, pumps and other component parts of the fuel system are spread throughout the aircraft</li></ol>	

# INSTRUCTOR GUIDE

AIRCRAFT TYPES,  
ENGINES AND SYSTEMS

PRESENTATION	APPLICATION
<p>4. When an aircraft crashes, the force of the impact generally ruptures fuel lines and tanks</p> <p>5. Such ruptures are extremely hazardous because of the many possible sources of ignition</p> <ul style="list-style-type: none"><li>a) Sparks caused by friction, static electricity discharge, hot surfaces, and hot exhaust are examples of possible ignition sources</li></ul> <p>6. Fuel tanks</p> <ul style="list-style-type: none"><li>a) Fuel tanks may be separate units installed between the aircraft structural framework or built in as a part of the wing</li><li>b) For all practical purposes, fire fighters may anticipate fuel tanks in the wings, although they may be located elsewhere<ul style="list-style-type: none"><li>1) Upon severe impact, these tanks generally rupture and the entire fuselage may be enveloped in fire</li></ul></li><li>c) Fuel is often carried in the floor area in the fuselage of helicopters</li><li>d) Auxiliary fuel tanks may be installed so that they can be dropped from the aircraft in flight</li><li>e) These tanks are installed on most combat type of aircraft so that they may be jettisoned for more speed or prior to landing emergencies. Fuel loads can vary from 30 gallons in small liaison planes to approximately 50,000 gallons in large jet aircraft</li></ul> <p>7. Fuel lines</p>	<p>Slide 68 Aviation Fuels Burning</p> <p><u>Instructors Note:</u> Explain that aviation fuels will be completely covered in the fuels section of this course</p> <p>Slide 69 Fuel Tanks In Aircraft</p>

# INSTRUCTOR GUIDE

AIRCRAFT TYPES,  
ENGINES AND SYSTEMS

PRESENTATION	APPLICATION
<p>a) Fuel lines may vary in size from 1/8 inch to as large as 4 inches in diameter. Fuel lines are subject to shearing action in crashes because they pass through structural members and are also subject to crimping, bending, and rupturing because of the rigidity of the tubing</p> <p>C. Installed fire extinguishing systems</p> <ol style="list-style-type: none"><li>1. Many modern aircraft are equipped with installed fire protection systems which can be activated by the pilot to extinguish fires in various locations throughout the aircraft</li><li>2. The type and quantity of agent which these systems contain depends upon many variables</li><li>3. The system consists of pressurized containers, tubing to deliver the agent, nozzles, fusible devices, and electrical or mechanical appliances for actuating and controlling the discharge of agent</li></ol> <p>a) Color code Maroon CB Halon 1201 and Halon 1301 - Fr located in or around engine or cowling</p>	<p>Slide 70 Extinguishing Systems</p>
<p>D. Electrical systems</p> <ol style="list-style-type: none"><li>1. The electrical system of an aircraft supplies the current for the engine operation, lights, electronic equipment, hydraulic pumps, fuel system pumps, armament systems, warning systems, and other devices</li><li>2. The larger aircraft contain in excess of 2 miles of wiring and can light a city of 5,000 population</li><li>3. Each aircraft design has its own particular system, and new electrical systems are designed as new aircraft are developed</li></ol>	<p>Slide 71 Electrical System Color Code Brown</p> <p>Slide 72 General Aviation Aircraft Battery Location</p> <p>Slide 73 Large Aircraft Battery Location</p>

# INSTRUCTOR GUIDE

AIRCRAFT TYPES,  
ENGINES AND SYSTEMS

PRESENTATION	APPLICATION
<p>a) If a plane is down, disconnecting of the battery will not always shut down the engine</p> <p>1) Battery locations vary but are all quick disconnect. If you have a plane down and fuel is spilled, battery disconnect is imperative</p> <p>4. Aircraft electrical systems utilize both AC and DC generators to supply electrical power, since some equipment operates more efficiently on one type current than it does on the other type</p> <p>E. Hydraulic systems</p> <p>1. The hydraulic system of an aircraft consists of a reservoir of hydraulic fluid and the pumps, various appliances and the tubing which interconnects the system</p> <p>a) Color code - light blue/light yellow Skydrol, most common hydraulic fluid, when it burns it emits a poisonous toxic - self contained breathing apparatus</p> <p>b) Older planes use flammable hydraulic fluid</p> <p>c) Eye protection must be used when cutting lines</p> <p>2. The hydraulic fluid is piped to a pressure pump which moves the fluid to an accumulator where it is stored under pressure</p> <p>3. This fluid is then ready for instant use without the constant starting and stopping of the pressure pumps</p> <p>4. The accumulator can store this fluid under pressure for a considerable period of time even though the engines have been stopped</p>	<p>Slide 74 Hydraulic Systems</p> <p>Slide 75 Hydraulic Lines With Labels</p>

# INSTRUCTOR GUIDE

AIRCRAFT TYPES,  
ENGINES AND SYSTEMS

PRESENTATION	APPLICATION
<ol style="list-style-type: none"><li>5. Hydraulic fluid under pressure is used to operate a variety of equipment, such as landing gears, brakes &amp; wing flaps</li><li>6. When hydraulic fluid is involved in a fire with gasoline or jet fuel, the amount of fluid does not add significantly to the fire</li><li>7. Pressures up to 3,000 psi may be encountered by most aircraft and this pressure can cause serious injury</li><li>8. If it becomes necessary to cut tubing during rescue operations, extreme caution must be exercised</li></ol>	
<p>F. Oxygen systems</p>	
<ol style="list-style-type: none"><li>1. Oxygen systems on aircraft can present a severe hazard to fire fighters during an emergency</li></ol>	<p>Slide 76 Oxygen System Color Code Green</p>
<ol style="list-style-type: none"><li>2. All aircraft intended for high altitude operation use an extensive and delicate oxygen supply system in the life support system for crew members and passengers</li></ol>	<p>Slide 77 Cascade Oxygen Piped System</p>
<ol style="list-style-type: none"><li>3. This oxygen is stored in either a gaseous or liquid state</li></ol>	
<ol style="list-style-type: none"><li>a) Air Force jets use liquid oxygen for breathing. Commercial jets do not use liquid oxygen</li></ol>	
<ol style="list-style-type: none"><li>b) Some commercial jets have solid fuel oxygen generators mounted in the back of each seat. These reach temperatures of 400-500° when in operation. They have heat shields and can be extinguished by putting in water</li></ol>	
<ol style="list-style-type: none"><li>4. This oxygen is stored in either a gaseous or liquid state</li></ol>	
<ol style="list-style-type: none"><li>5. Most modern commercial aircraft are equipped with an emergency personal oxygen system</li></ol>	



# INSTRUCTOR GUIDE

AIRCRAFT TYPES,  
ENGINES AND SYSTEMS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>a) Normal entrance and exit doors and hatches</li><li>b) Emergency doors, hatches, windows, or other openings<ul style="list-style-type: none"><li>1) Some airlines, i.e. United Airlines offer a course designated to familiarize fire fighters with the doors common to their fleet of aircraft</li></ul></li><li>c) Emergency cut-in areas</li></ul> <p>4. Normal doors and hatches</p> <ul style="list-style-type: none"><li>a) Doors and hatches that are used for normal entry and exit of personnel can be located on either side of the fuselage<ul style="list-style-type: none"><li>1) They can be closed by simple latches similar to those found in a home, or they may be more complicated</li></ul></li><li>b) The newer commercial jet aircraft have inflatable or non-inflatable chutes or slides attached to at least two or more emergency exit doors<ul style="list-style-type: none"><li>1) Slides may be mounted so that they automatically eject and inflate when the door is opened</li><li>2) Fire fighters should use caution when opening or standing close to this type of door</li></ul></li></ul> <p>5. Emergency cut-in areas</p>	<p>Optional: Video #3 United Airlines Aircraft Familiarization Video</p> <p>Reference: Appendix II, IFSTA 206-Aircraft Identification Illustrations, p. 207-229</p> <p>Slide 79 General Aviation Aircraft Door</p> <p>Slide 80 Twin Engine Aircraft Door</p> <p>Slide 81 Pressurized Aircraft Door Corporate Jet</p> <p>Slide 82 727 Jet Door</p> <p>Slide 83 Door Latch 727 Door</p> <p>Slide 84 Door With Slide Attached</p> <p>Slide 85 Inflated Slide</p> <p>Slide 86 Door, Left Side Boeing 727</p> <p>Slide 87 Door, Rear Airstairs 727</p>

# INSTRUCTOR GUIDE

AIRCRAFT TYPES,  
ENGINES AND SYSTEMS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>a) Forcible entry through the skin of the aircraft should be accomplished only after all other means of entry have failed<ul style="list-style-type: none"><li>1) Military cargo and passenger type aircraft have distinctive identification points for forcible entry</li><li>2) They are bordered with yellow markings and are stenciled with the words "Cut Here"<ul style="list-style-type: none"><li>o Some civilian aircraft have "Cut-In" marks painted on the exterior of the fuselage to indicate those points where easiest access can be made for the rescue of trapped personnel</li><li>o The FAA, however, no longer requires that "cut-in" marks be placed on commercial aircraft</li></ul></li></ul></li></ul>	<p>Slide 88 Exits, Over The Wing 727, 737</p> <p>Slide 89 Graphic Cut-In Areas</p> <p>Slide 90 Blank Slide</p>

# INSTRUCTOR GUIDE

AIRCRAFT TYPES,  
ENGINES AND SYSTEMS

## SUMMARY

Aircraft present a complex array of types, engines and systems. A knowledge of these differing configurations is essential for fire fighters to adequately prepare to deal with aircraft emergencies.

## EVALUATION

The student will be evaluated by completing a written examination.

## ASSIGNMENT

To be determined by the Instructor(s).

### AIRCRAFT CRASH FIRE RESCUE

#### LESSON PLAN 5

TOPIC: Aviation Fuels

LEVEL: I

TIME: 120 Minutes

BEHAVIORAL OBJECTIVES:

Given: A written examination

Performance: The student will be able to identify the properties, characteristics, and hazards associated with aircraft fuels, hydraulic, anti-icing, and lubrication fluids; the nature, operation, and construction of aircraft systems that utilize these materials; and the methods and procedures utilized to deal with them under emergency conditions

Standard: With 70% accuracy

REFERENCES: IFSTA 206, Aircraft Fire Protection & Rescue Procedures, 2nd Edition, International Fire Service Training Association  
NFPA 1003 - Airport Fire Fighter Qualifications, National Fire Protection Association, 1987

MATERIALS NEEDED: A/V equipment and materials, video player & monitor, videotape "Characteristics & Properties of Aircraft Fuels"

PREPARATION: The biggest problem facing the aircraft fire fighter is presented by flammable aircraft fuels. Aircraft rescue and fire fighting vehicles are designed to extinguish fuel fires. Aircraft fire fighters must understand the hazards, properties, and characteristics of aircraft flammable liquids in order to safely and effectively perform their job.

# INSTRUCTOR GUIDE

## AVIATION FUELS

PRESENTATION	APPLICATION
<p>I. Aviation Fuels</p> <p>A. Aircraft fuel is the enemy</p> <ol style="list-style-type: none"><li>1. Our primary responsibility is to extinguish aircraft fuel fires<ol style="list-style-type: none"><li>a) Aircraft fuel capacities<ol style="list-style-type: none"><li>1) 30 gallons in small general aviation aircraft</li><li>2) To a maximum of 60,000 gallons in large military refuelers</li></ol></li><li>2. L-1011 can carry up to 23,000 gallons of fuel<ol style="list-style-type: none"><li>a) Enough fuel to push the family car around the world 15 times</li></ol></li><li>3. Commercial jetliners<ol style="list-style-type: none"><li>a) Usually carry from 2000 to 10,000 gallons of fuel</li><li>b) Like dropping a gasoline tank truck out of the sky with people in it when it crashes</li></ol></li><li>4. Aircraft fire fighters must understand aviation fuel's:<ol style="list-style-type: none"><li>a) Properties</li><li>b) Characteristics</li><li>c) Predictable behavior</li><li>d) Control requirements</li></ol></li></ol></li><p>B. When responding to an aircraft incident, you must know three (3) types of information to properly deal with aircraft fuel:</p></ol>	<p>Slide 91 Lesson Plan Title "Aviation Fuels"</p> <p>Slide 92 Aircraft Fuel</p> <p>Slide 93 Lockheed L1011</p> <p>Slide 94 Boeing 737</p> <p>Slide 95 Fuel Handling Book</p> <p>Slide 96 ARFF Apparatus Responding To Fire</p>





# INSTRUCTOR GUIDE

## AVIATION FUELS

PRESENTATION	APPLICATION
a) Vapors & liquid are toxic	
12. Use fuel every day, tend to become over-familiar, too casual with	Slide 104 Gasoline On Hands
a) Take fuels for granted	Slide 105 Putting Fuel In Apparatus
b) We forget how dangerous they are	
13. Aircraft fuels will win the battle if they get the chance	Slide 106 Fire Fighter In Burning Fuel
a) No second chance	
b) Something goes wrong, it goes wrong fast	
14. Aircraft fire fighters must know how to use fire fighting equipment & extinguishing agents	Slide 107 ARFF Vehicle Using Foam
D. Avgas - aviation gasoline	
1. Called Avtag in England	Slide 108 Chart Of Aircraft Fuels
2. Fuel for reciprocating (piston) engine aircraft	Slide 109 Avgas, Chris Manual
3. Manufactured to comply with ASTM & military specifications	Slide 110 Piston Driven Aircraft
a) Distilled from crude oil	Slide 111 Oil Refinery
b) Blends of selected natural & synthetic hydrocarbon fractions	
c) Small amount of additives	
1) Tetraethyl lead	
2) Inhibitors	
3) Lubricants	
4) Dyes	
4. Color coded, dyed	Slide 112 Chart Of Avgas Colors

# INSTRUCTOR GUIDE

AVIATION FUELS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>a) To aid in identification</li><li>b) To prevent misuse<ul style="list-style-type: none"><li>1) Wrong fuel could cause engine failure</li></ul></li><li>c) To help find leaks<ul style="list-style-type: none"><li>1) Dye remains after fuel evaporates</li></ul></li></ul> <p>5. Color established by international agreement</p> <ul style="list-style-type: none"><li>a) Grade 80/87<ul style="list-style-type: none"><li>1) Dyed red</li><li>2) Used in low compression engines</li><li>3) Found around antique, older aircraft</li></ul></li><li>b) Grade 100LL (low lead)<ul style="list-style-type: none"><li>1) Dyed blue</li><li>2) Most commonly used in general aviation aircraft</li></ul></li><li>c) Grade 100/130<ul style="list-style-type: none"><li>1) Dyed green</li><li>2) Used in high compression engines</li></ul></li><li>d) Grade 115/145<ul style="list-style-type: none"><li>1) Dyed purple</li><li>2) Used in highest compression engines</li></ul></li></ul> <p>6. Two numbers refer to lean &amp; rich mixtures</p>	<p>Slide 113 Avgas 80/87</p> <p>Slide 114 Avgas 100LL</p> <p>Slide 115 Avgas 100/130</p> <p>Slide 116 Avgas 115/145</p> <p>Slide 117 Samples Of Four Avgases</p>

# INSTRUCTOR GUIDE

AVIATION FUELS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>a) Performance numbers usually designated by lean number<ul style="list-style-type: none"><li>1) Grades 80, 100LL, 100, &amp; 115</li></ul></li><li>b) Variances are due to different icing, ignition, power, &amp; performance requirements</li></ul> <p>7. The higher the octane, the higher the:</p> <ul style="list-style-type: none"><li>a) Flash point</li><li>b) Flammable limits</li><li>c) Ignition temperature</li></ul> <p>8. Fuel handling equipment is also color coded for the corresponding fuel it handles (usually)</p> <p>9. Avgas has a strong tendency to vaporize</p> <ul style="list-style-type: none"><li>a) Will always have considerable vapor mixed with air over the surface of the fuel</li><li>b) Anywhere in California, spilled outside, will always have an ignitable vapor air mixture over the spill<ul style="list-style-type: none"><li>1) No matter what the weather conditions are</li><li>2) The warmer it is, the greater the vapor pressure, the more vapor will be present</li></ul></li></ul> <p>10. It is a flammable liquid</p> <ul style="list-style-type: none"><li>a) Its flash point is below 100° F</li><li>b) Avgas is always ready to burn</li><li>c) All that is needed is an ignition source</li></ul>	<p>Slide 118 Fuel Handling Equipment</p> <p>Slide 119 Fuel Tank &amp; Vapors</p> <p>Slide 120 Spilled Gasoline</p> <p>Slide 121 Flammable Liquid Placard</p> <p>Slide 122 Gasoline Igniting</p>

# INSTRUCTOR GUIDE

AVIATION FUELS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"> <li>d) Avgas vapors actively go looking for an ignition source</li> <li>e) There are many ignition sources present at an aircraft incident</li> <li>f) Exception is in a closed container                             <ul style="list-style-type: none"> <li>1) Usually too rich to burn</li> </ul> </li> </ul> <p>11. Flame spread</p> <ul style="list-style-type: none"> <li>a) 12 ft. per second</li> <li>b) Faster than fire fighters can run</li> </ul> <p>12. Dangerous stuff</p> <ul style="list-style-type: none"> <li>a) Under right conditions, same as dynamite</li> </ul> <p>E. Jet A (also Jet A-1)</p> <ul style="list-style-type: none"> <li>1. Military designation JP-5</li> <li>2. Type of aircraft engines used in                             <ul style="list-style-type: none"> <li>a) Turbojet, pure jet</li> <li>b) Propjet or turboprop</li> <li>c) U.S. transport airlines and corporate jet aircraft use Jet A</li> <li>d) A lot of military aircraft use Jet A</li> </ul> </li> <li>3. Closely fractionalized kerosene fuel                             <ul style="list-style-type: none"> <li>a) Low tendency to vaporize</li> <li>b) Even in a closed container (fuel tank) will usually be too lean a mixture to burn</li> <li>c) Flash point is approximately 140° F</li> </ul> </li> <li>4. It is a combustible liquid                             <ul style="list-style-type: none"> <li>a) Its flash point is above 100° F</li> </ul> </li> </ul>	<p>Slide 123 Gasoline Is Made To Explode</p> <p>Slide 124 Jet A</p> <p>Slide 125 Jet Engine</p> <p>Slide 126 Propjet</p> <p>Slide 127 Commercial Jet Aircraft</p> <p>Slide 128 Airforce C-5</p> <p>Slide 129 Kerosene Can</p> <p>Slide 130 Combustible Liquid Placard</p>



# INSTRUCTOR GUIDE

AVIATION FUELS

PRESENTATION	APPLICATION
<p>d) It is possible to ignite a spill of Jet A without heating the entire spill to its flash point or ignition temperature</p> <ol style="list-style-type: none"><li>1) Called "wicking"</li><li>2) Heating locally (hot spot) until entire surface ignites</li><li>3) Flame spread - 1 ft. per second</li><li>4) A hot engine part or burning combustible material in an unignited Jet A spill may eventually ignite the entire spill</li></ol>	<p>Slide 134 Igniting A Pool Of Jet A</p>          <p>Slide 135 Fire Spreading Across Same Pool</p>
<p>e) Under aircraft crash impact conditions often wing tanks break apart throwing a mist of fuel into the air</p> <ol style="list-style-type: none"><li>1) All combustible liquid is explosively flammable under mist conditions</li><li>2) More surface area, less mass, the droplets are easier to raise to ignition temperature</li><li>3) Presents a hazard equal to liquid reaching its flammable limits</li></ol>	<p>Slide 136 Crashed DC-10</p>          <p>Slide 137 Burning Fuel Mist</p>
<p>F. When dealing with large amounts of aircraft fuels at an incident, constant treat of ignition, reignition, &amp; flashback</p> <ol style="list-style-type: none"><li>1. Some possible ignition sources include friction<ol style="list-style-type: none"><li>a) Runways are no longer foamed<ol style="list-style-type: none"><li>1) Could only use protein foam, only foam whose bubble would last long enough on the runway</li><li>2) Aircraft usually missed or slid off foam blanket</li></ol></li></ol></li></ol>	<p>Slide 138 Crashed Aircraft</p>

# INSTRUCTOR GUIDE

AVIATION FUELS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>3) Studies indicated that foam did not eliminate friction sparks</li><li>2. Electrical short circuits<ul style="list-style-type: none"><li>a) Extensive wiring in jet aircraft<ul style="list-style-type: none"><li>1) A large commercial jet has approximately 25 miles of wire</li><li>2) Enough power to light a town of 170 single family homes</li><li>3) Electrical arc - 2000° F</li></ul></li><li>b) Plan down, fuel spilled, switch electrical power off in cockpit<ul style="list-style-type: none"><li>1) Location varies, be familiar with aircraft that frequent your area</li></ul></li><li>c) Consider disconnecting battery<ul style="list-style-type: none"><li>1) Battery locations vary, usually have to unscrew a panel to access</li><li>2) Quick disconnect hand wheel</li><li>3) Shutting down power may not always stop engine</li></ul></li></ul></li><li>3. Hot exhaust gases, hot engine surfaces can ignite a fuel spill up to 20 to 30 minutes after shutdown<ul style="list-style-type: none"><li>a) 30 minutes, turbine engines</li><li>b) 10 minutes, piston (recip) engines</li></ul></li><li>4. Static electrical discharges<ul style="list-style-type: none"><li>a) Will talk more about shortly</li></ul></li><li>5. Fire apparatus engines &amp; electrical systems can be ignition sources</li></ul>	<p>Slide 139 Electrical Connection On Aircraft</p> <p>Slide 140 Power Shutdown In Cockpit</p> <p>Slide 141 Aircraft Battery</p> <p>Slide 142 Jet Engine</p> <p>Slide 143 Burning Fire Engine</p>

# INSTRUCTOR GUIDE

AVIATION FUELS

PRESENTATION	APPLICATION
a) Try to approach or work from up wind, up hill	
6. Flash, video camaras, or lights	Slide 144 Camara & Flash
a) Control scene access	
7. Dropped flashlight can cause an arc	Slide 145 Dropped Flashlight
8. Telephones are not intrinsicly safe	Slide 146 Mobile Telephone
9. Radios may not be intrinsicly safe	Slide 147 Portable Radio
10. Combustible gas detector can ignite fumes	
11. Dropping a tool can cause a spark	Slide 148 Dropped Tool
12. Operating aircraft auxillary & ground power units, heaters, other support equipment can be ignition sources	Slide 149 Ground Power Unit
13. Flares, smoking materials	Slide 150 Burning Flare
14. Static electricity caused by flowing liquids, clothing	Slide 151 Flowing Jet A
15. Energy from radar equipment	Slide 152 Aircraft Radar
a) Source of ignition that is often overlooked	
b) Similar to a microwave oven	
G. Jet B aircraft fuel	Slide 153 JP 4
1. Military designation - JP-4	
a) Used primarily by Air Force, Army uses in helicopters	
b) When greater power, performance needed	

# INSTRUCTOR GUIDE

AVIATION FUELS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>2. Worldwide fuel shortages &amp; refining problems may increase the usage of Jet B<ul style="list-style-type: none"><li>a) Easier to produce</li><li>b) More available per barrel of crude oil</li><li>c) Also a push to lower the flash point of Jet A</li></ul></li><li>3. Broad cut fuel made from unleaded gasoline &amp; kerosene type fractions<ul style="list-style-type: none"><li>a) Basically a blend of 65% gasoline (Avgas) &amp; 35% kerosene (Jet A)</li><li>b) Jet B has worst characteristics of both materials<ul style="list-style-type: none"><li>1) In a closed tank may be neither too rich or too lean, could have an ignitable vapor air mixture inside a fuel tank</li><li>2) Could draw a flame inside a tank</li><li>3) Flammable limits are slightly wider</li><li>4) Auto-ignition temperature is low</li><li>5) Flame spread is almost as fast as Avgas</li><li>6) Will always have an ignitable vapor air mixture over a spill at normal temperatures &amp; pressures</li></ul></li></ul></li><li>4. Like Avgas, a spill of Jet B (JP-4) is always ready to burn<ul style="list-style-type: none"><li>a) All that is needed is an ignition source</li></ul></li></ul>	<p>Slide 154 - Explode In Tank</p> <p>What is the flame spread of Avgas?</p> <p>Answer: 12 ft. per second</p> <p>Slide 155 Igniting Jet B</p>

# INSTRUCTOR GUIDE

## AVIATION FUELS

PRESENTATION	APPLICATION
<p>b) As we have discussed, there are plenty of ignition sources at an aircraft incident</p> <p>H. Other important principles &amp; characteristics of aircraft fuels</p> <ol style="list-style-type: none"><li>1. There is very little difference in heat of combustion among the different fuels<ol style="list-style-type: none"><li>a) Avgas, 19,000 BTUs per lb. at 1500° F</li><li>b) Jet A, 18,600 BTUs per lb.</li></ol></li><li>2. Aircraft fuels will burn away at 6-12 inches per hour<ol style="list-style-type: none"><li>a) One inch of aviation gasoline will burn away in five to ten minutes</li><li>b) One ft. (12 inches) of gasoline will burn away in one (1) hour</li><li>c) Eight (8) inches of kerosene (Jet A) will burn away in one (1) hour</li></ol></li><li>3. Vapor density<ol style="list-style-type: none"><li>a) Air is rated at (equals) one (1)<ol style="list-style-type: none"><li>1) If the density of vapor is less than one, the vapor is lighter than air</li><li>2) If the density of vapor is more than one, the vapor is heavier than air</li></ol></li></ol></li><li>4. All aircraft fuel vapors have a vapor density greater than one &amp; are heavier than air<ol style="list-style-type: none"><li>a) Aviation gasoline is 3 1/2 times heavier than air</li><li>b) Aircraft fuel vapors will travel or migrate along the ground, down wind</li></ol></li></ol>	<p>Slide 156 Burning Fuel</p> <p>Slide 157 Vapor Density</p> <p>What is vapor density?</p> <p>Answer: Relative density of a vapor or gas compared to air</p> <p>Slide 158 Vapors Flowing Downward</p>

# INSTRUCTOR GUIDE

## AVIATION FUELS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>1) Will seek &amp; collect in low places</li><li>2) Fuel vapors will actively seek/look for an ignition source</li><li>3) Do not give fuel vapors an opportunity to find one</li><li>c) Unless fire fighters blanket aircraft fuel spills with foam, the fuel will continue to give off enough vapors to ignite or reignite (flashback)</li><li>d) Under right weather &amp; atmospheric conditions, vapors can travel considerable distance from a spill<ul style="list-style-type: none"><li>1) Many fire fighters &amp; citizens have been seriously burned or killed when caught in vapor clouds when it ignited</li></ul></li><li>e) When possible approach flammable liquids from upwind (wind at back) &amp; uphill<ul style="list-style-type: none"><li>1) If fire fighters approach from downwind, they are betting their life against a vapor cloud</li><li>2) Always foam flammable &amp; combustible liquid spills &amp; maintain foam blanket with frequent inspection &amp; reapplication (every 5-10 minutes)</li></ul></li><li>f) Always wear full turnouts when dealing with flammable &amp; combustible liquids<ul style="list-style-type: none"><li>1) Boots, pants, gloves, collar up, helmet flap down, coat completely buttoned up</li><li>2) With proximity suits if available</li></ul></li></ul>	<p>Slide 159 Applying Foam On A Fuel Spill</p> <p>Slide 160 Vapor Cloud</p> <p>Slide 161 ARFF Apparatus Approaching Spill Fire</p>

# INSTRUCTOR GUIDE

AVIATION FUELS

PRESENTATION	APPLICATION
<p>5. Specific gravity</p> <ul style="list-style-type: none"><li>a) Weight of a liquid substance compared to equal volume of water</li><li>b) Water equals one (1)<ul style="list-style-type: none"><li>1) If the weight of the liquid is less than one, it will float on water</li><li>2) If the weight of the liquid is more than one it will sink</li></ul></li><li>c) All aircraft fuels are less than one (lighter) &amp; will float on water</li><li>d) All aircraft fuels are nonsoluable &amp; nonmiscible in water<ul style="list-style-type: none"><li>1) They will not mix with water</li></ul></li><li>e) Misuse of water can cause problems at an aircraft fuel spill and/or fire</li></ul>	<p>Slide 162 Fuel Floating On Water</p> <p>What is specific gravity?</p>          <p>Slide 163 Fuel Burning On Water</p> <p>What are some problems that misuse of water can cause at a fuel spill and/or fire?</p> <p>Answer: 1. Spread the (burning) fuel over a greater area 2. Destroy an established foam blanket 3. Disturb burning fuel &amp; fire to flare up or intensify</p>
<p>II. Other Aircraft Systems That Use Flammable Or Combustible Liquids</p> <p>A. Hydraulic fluids</p> <ul style="list-style-type: none"><li>1. All modern aircraft, from simple to complex, use hydraulics to operate landing gear, wing flaps, brakes, etc.</li></ul>	<p>Slide 164 List Of Other Aircraft Flammable Materials</p>  <p>Slide 165 Hydraulic Piping Identification Colors</p> <p>Slide 166 Hydraulic System Chart</p>

# INSTRUCTOR GUIDE

AVIATION FUELS

PRESENTATION	APPLICATION
2. Hydraulic fluids do not contribute much to a large aircraft fire	
a) They can significantly complicate a wheel fire	Slide 167 Wheel Fire
3. Hydraulic fluids are also colored for identification	
4. Skydrol	Slide 168 Skydrol Hydraulic Fluid
a) Most commonly used in large jet aircraft	
b) Synthetic	
c) Purple in color	
d) Will destroy most materials except metals & butyl rubber	
e) It will destroy your turnout gear	
f) Flash point of 440° F	
g) Will ignite at room temperature in a mist form	
5. Mineral oil hydraulic fluids	Slide 169 Mil-H-5606 Fluid
a) Color red	
b) Medium sized to general aviation aircraft	
c) Petroleum based	
d) Referred to as Mil (spec)-H-5606	
6. Vegetable oil hydraulic fluids	Slide 170 Vegetable Oil Fluid
7. Hydraulic tubing is color coded every 2-3 ft.	Slide 171 Hydraulic Tubing
8. Hydraulic pumps & reservoirs, called accumulators, can be found anywhere on aircraft	Slide 172 Hydraulic Accumulator

# INSTRUCTOR GUIDE

AVIATION FUELS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>a) Often accessed through an inspection panel on fuselage</li></ul> <p>9. Hydraulic fluids are stored under pressure</p> <ul style="list-style-type: none"><li>a) Must be ready for instant use</li><li>b) No starting or stopping of pumps is necessary</li></ul> <p>10. Avoid cutting a high pressure hydraulic line</p> <ul style="list-style-type: none"><li>a) Fluid could penetrate skin or get in eyes</li><li>b) Could cause component served by line to spring open, closed, or operate in some way</li><li>c) Always wear full protective gear</li><li>d) Always pin aircraft landing gear and avoid working under an aircraft is possible or unless stabilized</li></ul>	<p>Slide 173 Skydrol, 1500 psi</p> <p>Slide 174 Cutting Into An Aircraft</p>
<p>B. Lubricating oils</p> <ul style="list-style-type: none"><li>1. Mainly used in reciprocating (piston) engines<ul style="list-style-type: none"><li>a) Up to 45 gallons per engine</li><li>b) Some aircraft, total of 500 gallons</li></ul></li><li>2. Very little used in jet aircraft</li><li>3. Piping also color coded</li></ul>	<p>Slide 175 Lubricating Oil Color Identification</p>
<p>C. De-icing systems &amp; fluids</p> <ul style="list-style-type: none"><li>1. Usually a mixture of 85% alcohol &amp; 15% glycerine</li></ul>	<p>Slide 176 De-icing Fluid Identification Colors</p>

# INSTRUCTOR GUIDE

AVIATION FUELS

## PRESENTATION

## APPLICATION

- a) Some systems use 100% alcohol
  2. Anti-icing prevents ice from forming on aircraft surfaces
  3. De-icing removes ice after it forms
  4. Alcohol type fluids love to mix with water & will destroy regular AFFF foams
  5. Storage tanks & fluids
  6. Piping color coded
- D. Prist
1. Added in small amounts to aircraft fuels to prevent moisture in fuel from freezing or forming ice crystals
  2. Also prevents growth of micro organisms & fungus in fuel
  3. Two (2) types of prist
    - a) One for aviation gasolines
    - b) One for turbine fuels
- E. Hypergolic mixtures
1. Rocket propellant
  2. Mixture or combination of:
    - a) Fuel, usually Hydrazine, ammonia, hydrogen, aniline, furfuryl alcohol
    - b) Oxidizer, usually fluorine, chlorine tri-fluoride, nitric acid, hydrogen peroxide, or nitrogen tetroxide
    - c) Four (4) mixtures of above materials used in missile & rocket propulsion systems

Slide 177 Prist Tank On Fuel Truck

Slide 178 C-130 JATO Takeoff

# INSTRUCTOR GUIDE

AVIATION FUELS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>3. Used a lot in jet assisted takeoff (JATO systems)<ul style="list-style-type: none"><li>a) Military aircraft</li></ul></li><li>4. May cause frostbite, poisoning (very toxic), and/or burns</li><li>5. Normal, regular turnouts not adequate protection</li></ul>	
<p>III. Aircraft Fuel Servicing</p> <ul style="list-style-type: none"><li>A. Fuel transfer can be accomplished several ways<ul style="list-style-type: none"><li>1. Tank vehicle</li><li>2. Hydrant vehicle</li><li>3. Fueling island<ul style="list-style-type: none"><li>a) Much like a gas station</li><li>b) Attendant fills aircraft with fuel</li></ul></li><li>4. Fueling pit</li></ul></li><li>B. Two (2) fueling methods<ul style="list-style-type: none"><li>1. Overwing</li><li>2. Underwing</li></ul></li><li>C. Overwing fuel servicing<ul style="list-style-type: none"><li>1. Usually accomplished with a hand held nozzle</li><li>2. Filler holes on top of wings which fill directly into individual tanks</li><li>3. Flow &amp; splashing of fuel can cause generation of static electricity &amp; production of flammable mists &amp; vapors</li></ul></li></ul>	<p>Slide 179 NFPA Standard On Fuel Servicing</p> <p>Slide 180 Fuel Tank Truck</p> <p>Slide 181 Oakland Airport Hydrant Fueler</p> <p>Slide 182 Fueling An Aircraft At An Island</p> <p>Slide 183 Aircraft &amp; Fueler</p> <p>Slide 184 Overwing Fueling</p>

# INSTRUCTOR GUIDE

AVIATION FUELS

PRESENTATION	APPLICATION
4. Used on medium & general aviation aircraft	
D. Underwing fueling	Slide 185 Underwing Fueling
1. Used on large jet aircraft	
2. Single point fueling	Slide 186 Single Point Fueling
a) All tanks are filled through a single point/connection	
b) Valves direct fuel to tank that needs filling	
c) Automatically stops (usually) when tank(s) are full	
E. Several types of wing tanks	
1. Separate units installed between aircraft structural framework	Where will fuel tanks usually be found on aircraft?
2. Built as part of wing	Answer: In the wings
a) Called integral tanks or "wetwing"	Slide 187 Fuel Tanks
b) Skin of aircraft is actually part of tank	
3. Anticipate fuel tanks in the wings	Slide 188 DC-10 Crash Chart
a) May be found elsewhere	
1) Floor area of fuselage	
2) Temporary tanks lashed down in cabin or baggage areas	
4. May find multiple tanks	Slide 189 F-4 Crash Chart
5. Wingtip tanks	Slide 190 Wingtip Tanks
6. Some auxiliary fuel tanks on military aircraft can be dropped or jettisoned	Slide 191 Auxiliary Tank On F-4
7. Fuel tanks on helicopters can be found in overhead or floor area fuselage	Slide 192 Helicopter Chart



# INSTRUCTOR GUIDE

AVIATION FUELS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>a) DC-10, L1011, 727, DC-9, MD80</li><li>b) A lot of corporate aircraft</li><li>c) Fuel lines run through fuselage from wings to engines</li><li>d) Damage to fuselage may allow fuel to flow into belly of aircraft resulting in internal fires</li><li>e) May cause problems when performing cutting in operations</li></ul>	
<p>5. Aircraft fuel tanks are vented</p> <ul style="list-style-type: none"><li>a) Changes in temperature can cause expansion &amp; contraction of fuel in tanks<ul style="list-style-type: none"><li>1) Expansion may cause overflow or dripping from vents</li><li>2) Under normal conditions fuel vapors from vents quickly dissipate &amp; dilute, causing little problem</li></ul></li></ul>	<p>Slide 195 Fuel Tank Vents</p>
<ul style="list-style-type: none"><li>b) Drain cocks<ul style="list-style-type: none"><li>1) To withdraw fuel samples for evaluation</li><li>2) To drain off accumulated water, moisture, or sediment</li></ul></li><li>c) Always park clear of aircraft fuel tank vent &amp; drain areas (under wings)</li></ul>	
<p>6. Any time an aircraft experiences engine problems which leads to an aircraft incident the usual procedure is to take a sample of the fuel used from airport fuel system</p>	<p>Slide 196 Fuel Tank Drain</p>

# INSTRUCTOR GUIDE

AVIATION FUELS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>a) Immediately after aircraft crashes, often, the fueling vehicle will be impounded until the fuel is evaluated</li><li>7. Most aircraft are equipped with manual shutoff valves to stop fuel to engines<ul style="list-style-type: none"><li>a) Usually within reach of pilot</li><li>b) Usually marked and/or painted red</li><li>c) Often have fuel selector valves &amp; cross feed systems so pilot can selectively use certain tanks or balance aircraft fuel weight/load</li><li>d) Fuel shut offs may not function when master switch is in "off" position or batteries are disconnected<ul style="list-style-type: none"><li>1) Shut down fuel system before shutting down aircraft electrical power</li></ul></li><li>e) Aircraft fire fighters must be familiar with aircraft that frequent their areas</li></ul></li></ul>	<p>Slide 197 Fuel Shutoffs In Cockpit</p>
<ul style="list-style-type: none"><li>G. Fire prevention measures during fuel servicing are mainly directed towards prevention of fuel spillage &amp; elimination or control of potential ignition sources</li></ul>	<p>Slide 198 Fueling Operation</p>
<ul style="list-style-type: none"><li>1. Portable extinguishers are required on aircraft service ramps<ul style="list-style-type: none"><li>a) Not more than 100 ft. from plane</li><li>b) Extinguishers not more than 250 ft. apart</li><li>c) Minimum of 20 BC</li><li>d) Usually large wheeled units are used</li></ul></li></ul>	<p>Slide 199 Extinguishers On Airport Ramp</p>

# INSTRUCTOR GUIDE

AVIATION FUELS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>e) Often the individual airlines provide &amp; maintain their own extinguishers on airport ramps<ul style="list-style-type: none"><li>1) Aircraft fire fighters should provide training for airport &amp; airline employees on how to use extinguishers</li></ul></li><li>2. Fuel spillage<ul style="list-style-type: none"><li>a) Stop flow if possible</li><li>b) Minimize surface area of spill by diking or absorbents</li><li>c) Foam spill if ignition is possible (especially if spilled material is aviation gasoline or JP-4, Jet B)</li><li>d) Hose lines could be used to direct spilled fuel away from endangered aircraft, people, or other exposures<ul style="list-style-type: none"><li>1) Where it can be dealt with easier &amp; safer</li></ul></li><li>e) If leaking from fuel servicing equipment activate emergency shutoffs<ul style="list-style-type: none"><li>1) Shutoffs are usually located at front &amp; rear of fueling vehicles</li></ul></li><li>f) If leaking from aircraft filler opening, fuel line(s), seams, or vents, stop fueling operation by releasing deadman switch</li><li>g) If necessary evacuate and/or move aircraft<ul style="list-style-type: none"><li>1) Shut off electrical power in and around aircraft</li><li>2) Check concealed wing or fuselage areas for entrance of flammable liquids or vapors</li></ul></li></ul></li></ul>	<p>Slide 200 Fuel Spilled Under Aircraft</p> <p>Slide 201 Emergency Shutoff</p> <p>Slide 202 Deadman Switch</p> <p>Slide 203 Passengers Deplaneing</p>

# INSTRUCTOR GUIDE

AVIATION FUELS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>h) Use absorbent agents to absorb spill<ul style="list-style-type: none"><li>1) Especially if spill material is kerosene (Turbine/jet fuel)</li><li>2) Does not readily evaporate</li></ul></li><li>i) Decontaminate aircraft baggage or cargo if necessary</li><li>j) If necessary, move mobile fueling or aircraft support equipment<ul style="list-style-type: none"><li>1) These are decisions of the officer in charge</li><li>2) Equipment can be a source of ignition</li><li>3) Depends on hazard to personnel &amp; other people</li><li>4) Make sure nothing is connected to aircraft</li></ul></li></ul>	<p>Slide 204 Absorbent Materials</p>
<p>3. Major fuel spill</p> <ul style="list-style-type: none"><li>a) Greater than ten (10) ft. in any dimension</li><li>b) Fifty (50) square ft. or more or continuous in nature</li><li>c) Use good judgment, when in doubt, cover it with a foam blanket</li></ul>	<p>Slide 205 Fuel Spill</p>
<p>H. Static electricity</p> <ul style="list-style-type: none"><li>1. Aircraft is similar to any rubber tired vehicle<ul style="list-style-type: none"><li>a) Has the ability to build up a static charge when in movement or at rest</li><li>b) Generated at the point of separation of tires from pavement</li></ul></li></ul>	<p>Slide 206 Bonding &amp; Grounding</p> <p>Slide 207 Aircraft On Taxiway</p>

# INSTRUCTOR GUIDE

AVIATION FUELS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>2. Static charges build up by air currents passing over aircraft surfaces<ul style="list-style-type: none"><li>a) Particularly when air carries dust, dry snow, or ice crystals</li><li>b) Generation of static charges is greater in low humidity</li></ul></li><li>3. Certain maintenance operations can produce static charges<ul style="list-style-type: none"><li>a) Fueling</li><li>b) Fuel filtering<ul style="list-style-type: none"><li>1) Using nonconducting plastic funnels or chamois is extremely hazardous</li></ul></li><li>c) Spraying, painting</li><li>d) Buffing, cleaning</li></ul></li><li>4. Elimination of static electricity is paramount during fueling operations<ul style="list-style-type: none"><li>a) Static electricity cannot be seen or detected</li><li>b) Allow a minimum of two (2) minutes to elapse after aircraft lands or after filling tank before opening tank cover to allow for relaxation of static charge</li><li>c) Use bonding wire of adequate size<ul style="list-style-type: none"><li>1) #8 copper wire</li><li>2) Aircraft control cable</li></ul></li><li>d) Keep wire in good condition<ul style="list-style-type: none"><li>1) Keep clips &amp; plugs free of corrosion &amp; paint</li></ul></li></ul></li></ul>	<p>Slide 208 Fuel Filters</p> <p>Slide 209 Fueling Operation</p> <p>Slide 210 Bonded Aircraft</p>

# INSTRUCTOR GUIDE

AVIATION FUELS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>2) Periodically check wires for continuity (low resistance)</li><li>3) Replace wires that are kinked, frayed, or in poor condition</li><li>e) Before fueling, connect bonding wires in proper sequence<ul style="list-style-type: none"><li>1) Fueler to plane</li><li>2) Fueler to ground electrode</li><li>3) Nozzle to plane</li><li>4) Sequence different in IFSTA 206 (military sequence)</li></ul></li><li>f) Military aircraft are bonded when parked at all times</li><li>g) Static ground electrode<ul style="list-style-type: none"><li>1) Deep enough into ground to reach permanent moisture</li><li>2) Usually six (6) ft.</li><li>3) Tested annually for resistance</li></ul></li><li>5. Degree static charge build up depends on several variables<ul style="list-style-type: none"><li>a) Fuel type</li><li>b) Amount of fuel</li><li>c) Linear velocity when moving through lines, hoses</li><li>d) Type &amp; condition of separating surface</li><li>e) Presence of impurities &amp; extraneous materials in fuel</li></ul></li></ul>	<p>Slide 211 Connecting Bonding Wires</p> <p>Slide 212 Bonded &amp; Grounded Military Aircraft</p> <p>Slide 213 Static Ground Electrode</p> <p>Slide 214 Pouring Fuel From A Hose</p>

# INSTRUCTOR GUIDE

AVIATION FUELS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>1) Water</li><li>2) Sludge</li><li>3) Air</li><li>4) Tank scale</li><li>5) Treating reagents</li><li>6) Types of filters &amp; separators used</li></ul> <p>f) Turbine fuels more prone to acquiring a static charge because usually has more impurities</p> <p>I. Radar ignition hazards</p> <ul style="list-style-type: none"><li>1. A radar beam can cause ignition of flammable vapor by two (2) methods<ul style="list-style-type: none"><li>a) Inductive heating of flammable material<ul style="list-style-type: none"><li>1) Like a microwave oven</li></ul></li><li>b) Electrical arcs from chance resonant conditions</li></ul></li><li>2. Intensity or peak power output of radar unit is key factor<ul style="list-style-type: none"><li>a) Most commercial weather mapping airborne radar operates at peak outputs of 25 to 90 kilowatts<ul style="list-style-type: none"><li>1) Normally not operated on ground</li><li>2) A beam of this magnitude could operate flashbulbs at a considerable distance (50 ft.)</li></ul></li></ul></li><li>3. Some military aircraft have much higher outputs</li></ul>	<p>Slide 215 Jet A, Turbine Fuel</p> <p>Slide 216 F-4 Radome</p> <p>Slide 217 Radar Unit In Nose Cone Of Jet Fighter</p> <p>Slide 218 Large Military Radome</p>

# INSTRUCTOR GUIDE

AVIATION FUELS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>a) Identification by large radomes atop or below fuselage</li><li>b) Radar is an often overlooked ignition source</li></ul>	<p>Slide 219 Blank Slide</p> <p>Show video #4 <u>Characteristics Of Aviation Fuels</u></p>

## SUMMARY

Problems created by aircraft flammable and combustible liquids will usually be the primary concern facing fire fighters. In order to perform effectively, safely, and successfully, aircraft fire fighters must understand the properties and characteristics of flammable materials used onboard aircraft. When responding to an aircraft incident, fire fighters need to know the type and how much fuel is on board the aircraft, and wind direction. Whenever possible, approach aircraft incidents from the upwind and uphill, wearing full protective gear.

## EVALUATION

The student will be evaluated by completing a written examination.

## ASSIGNMENT

To be determined by the Instructor(s).

# INSTRUCTOR GUIDE

EXTINGUISHING AGENTS

## AIRCRAFT CRASH FIRE RESCUE

### LESSON PLAN 6

TOPIC: Extinguishing Agents

LEVEL: I

TIME: 180 Minutes

#### BEHAVIORAL OBJECTIVES:

Given: A written examination

Performance: The student will identify the different extinguishing agents, application techniques, and application equipment utilized in extinguishing aircraft fires

Standard: With 70% accuracy

REFERENCES: IFSTA 206, Aircraft Fire Protection & Rescue Procedures, 2nd Edition, International Fire Service Training Association  
NFPA 1003 - Airport Fire Fighter Qualifications, National Fire Protection Association, 1987  
Fire Protection Handbook, 16th Edition  
NFPA Standard #403-Aircraft Fire Fighting Services At Airports, Fire Protection Association, 1988

MATERIALS NEEDED: A/V, slide projector, screen, video tape player & videotapes  
Van Nuys DC-6 Crash & Hawaii Tank Fire, Table Top Demonstration Of Foam Properties & Characteristics

PREPARATION: The threat of fire is common at aircraft incidents. The ability to extinguish an aircraft fire determines the success or failure of aircraft incident operations. The aircraft fire fighter must understand the characteristics, properties, and application equipment for halons, carbon dioxide, dry powder, and water in order to effectively and efficiently save lives and property.

# INSTRUCTOR GUIDE

EXTINGUISHING AGENTS

## PRESENTATION

## APPLICATION

- I. Extinguishing Agents - Foam
  - A. There are many different aircraft fire fighting situations
    1. There is no perfect, all purpose extinguishing agent for every situation
    2. There are many different extinguishing agents available to deal with aircraft fire situations
      - a) Each has advantages & limitations
      - b) Each requires specialized equipment, application skill & technique
    3. In this section of the course the following extinguishing agents will be discussed in great detail
      - a) Foams
      - b) Dry chemicals
      - c) Halons
      - d) Carbon dioxide
      - e) Dry powders
      - f) Water
    4. In order to successfully & safely perform their job, aircraft fire fighters must understand when & how to use extinguishing agents
      - a) They must be thoroughly trained & skilled in the use of fire fighting equipment
      - b) They must maintain their fire fighting equipment
  - B. No one will argue that the primary hazard in aircraft incidents is fuel fires

Slide 220 Lesson Title Plan "Extinguishing Agents"

Slide 221 FAA List Of Fire Situations & Recommended Agents

Slide 222 Using Foam

Slide 223 Aircraft On Fire

# INSTRUCTOR GUIDE

EXTINGUISHING AGENTS

PRESENTATION	APPLICATION
<ol style="list-style-type: none"><li>1. Most of our equipment is set up to extinguish aircraft fuel, Class B fires</li><li>2. Foam is the primary extinguishing agent</li><li>3. Let's look at how some other fire departments have handled flammable liquid incidents with foam<ol style="list-style-type: none"><li>a) Los Angeles (Van Nuys) Aircraft incident<ol style="list-style-type: none"><li>1) DC-6, low impact crash at a golf course in Van Nuys, 1970s</li><li>2) Crew of three (3) trapped in wreckage, fire department did not know if alive or dead. (Rumor had it that they were killed on impact)</li><li>3) Top notch, respected fire department, handling the incident according to recognized procedures at the time</li><li>4) There was a major, unignited Avgas spill which was covered with foam</li><li>5) A fire fighter was using a rescue saw to cut into the cockpit. A booster line was being used to cool the saw &amp; prevent sparks</li><li>6) The saw hit a rivet or oxygen line, sparked, &amp; ignited the fuel</li></ol></li><li>b) When you watch the video notice the following points<ol style="list-style-type: none"><li>1) Using water in a foam blanket</li><li>2) Lack of full turnouts on fire fighters (no turnout pants or rubber boots)</li></ol></li></ol></li></ol>	<p>Slide 224 Mass Foam Application</p> <p>Slide 225 Fire Fighter On Fire</p>

# INSTRUCTOR GUIDE

EXTINGUISHING AGENTS

PRESENTATION	APPLICATION
<p>3) Fire fighters did not know how long a foam blanket lasts, &amp; did not properly maintain the foam blanket</p> <p>4) Backup foam lines were manned &amp; charged, &amp; immediately utilized to extinguish burning fire fighters with foam, but they were still seriously burned</p> <p>c) Hawaii storage tank fire</p> <p>1) Firefighters were working in the spill &amp; did not need to be there</p> <p>2) Lack of full protective gear (full turnouts &amp; SCBA)</p> <p>3) Disrupted foam blanket with improper use of nozzle, improper foam application</p> <p>4) When the fire fighters ran, they disrupted the foam blanket even more, which made things worse</p> <p>5) After being disrupted, the foam blanket immediately came back together &amp; resealed itself</p> <p>6) The fire fighters used too much water, this flooded the incident area &amp; spread the burning gasoline</p> <p>7) It showed that airport fire apparatus does not work well at tank fires</p> <ul style="list-style-type: none"><li>- It is difficult for CFR equipment to maintain a sustained foam operation</li><li>- It is difficult for CFR apparatus to move in close to tanks. A lot of foam is wasted before it reaches the fire</li></ul>	<p>Slide 226 Fire Fighter In Flames</p>

# INSTRUCTOR GUIDE

## EXTINGUISHING AGENTS

PRESENTATION	APPLICATION
<p>4. Foam is the most important resource at a flammable or combustible liquid fire</p> <ul style="list-style-type: none"><li>a) Also very effective on ordinary, class A materials</li><li>b) Acts like a wetting agent</li></ul> <p>5. Foam is a complex subject</p> <ul style="list-style-type: none"><li>a) Most misunderstood resource</li><li>b) Many contradictions as to what it will or will not do</li></ul>	<p>Show video #5 <u>Van Nuys DC-6 Crash &amp; Hawaii Tank Fire</u></p> <p>What important points about foam &amp; flammable liquid fire fighting were brought out in the video?</p> <p>Answer: Wear full turnouts &amp; breathing apparatus when dealing with flammable liquids</p> <p>Enter spill only if you have to, otherwise stay out</p> <p>Maintain &amp; reapply foam gently &amp; try not to disturb the foam blanket</p> <p>Apply foam gently &amp; try not to disturb the foam blanket</p> <p>Use caution when using water around foam &amp; flammable liquids</p> <p>Slide 227 Large Flammable Liquid Fire</p> <p>Slide 228 Mad Scientist</p>



# INSTRUCTOR GUIDE

EXTINGUISHING AGENTS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>d) May see some 1% concentrate<ul style="list-style-type: none"><li>1) For premixing only (will discuss more later in lecture)</li><li>2) Not usually used with a proportioner because no room for error</li></ul></li><li>4. Next air is turbulently introduced into the foam solution<ul style="list-style-type: none"><li>a) Happens at nozzle</li><li>b) Called <u>aeriation</u> or expansion</li><li>c) This produces a watery suspension of air in liquid solution or in other words, foam bubbles</li></ul></li></ul>	<p>Slide 233 Foam Bubbles</p>
<ul style="list-style-type: none"><li>5. <u>Expansion ratio</u><ul style="list-style-type: none"><li>a) Ratio of amount of air to amount of foam solution (in finished foam)</li><li>b) Two of most common expansion ratios<ul style="list-style-type: none"><li>1) 4 to 1 - 4 parts (gallons) of air mixed with 1 part (gallon) of foam solution to make 11 parts (gallons) of finished foam</li><li>2) 10 to 1 - 10 parts (gallons) of air mixed with 1 part (gallon) of foam solution to make 11 parts (gallons) of finished foam</li><li>3) A standard fog nozzle expands foam solution 4 to 1</li><li>4) An air-aspirating foam nozzle expands foam solution 10 to 1</li></ul></li></ul></li></ul>	<p>Slide 234 Expansion Chart</p>
<ul style="list-style-type: none"><li>6. It is now finished foam or just foam<ul style="list-style-type: none"><li>a) This is how foam gets water to float on a flammable liquid, when pure water would sink</li></ul></li></ul>	<p>Slide 235 Finished Foam</p>

# INSTRUCTOR GUIDE

EXTINGUISHING AGENTS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>b) The water is suspended over the flammable liquid in the form of bubbles</li><li>c) The foam bubble functions as a vehicle to hold the water over the flammable liquid<ul style="list-style-type: none"><li>1) Does not last forever</li><li>2) The bubbles break down &amp; the water will drain out</li></ul></li><li>D. Two types of nozzles are used to add air to the foam solution or in other words make finished foam<ul style="list-style-type: none"><li>1. Air-aspirating foam nozzle &amp; non air-aspirating standard fog nozzle<ul style="list-style-type: none"><li>a) Each has advantages &amp; disadvantages</li></ul></li><li>2. Air-aspirating foam nozzle<ul style="list-style-type: none"><li>a) Aspirates, induces air into the foam solution as it passes through the nozzle<ul style="list-style-type: none"><li>1) By a venturi action through holes near the nozzle connection</li><li>2) The air is added in the nozzle</li></ul></li><li>b) Foam nozzles usually have screens or obstructions in the nozzle tube that further mix &amp; expand the foam solution</li><li>c) These nozzles are designated for, &amp; used only for making finished foam</li><li>d) Expansion ratio is 10 to 1<ul style="list-style-type: none"><li>1) For every 1 gallon of solution entering the foam nozzle, 11 gallons of finished foam comes out</li></ul></li></ul></li></ul></li></ul>	<p>Slide 236 Squirting Foam On A Fire</p> <p>Slide 237 Foam Nozzle Characteristics</p>

# INSTRUCTOR GUIDE

EXTINGUISHING AGENTS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>2) 10 gallons of air is added in the nozzle</li><li>e) Air-aspirating foam nozzles make thicker, longer lasting foam than with a fog nozzle<ul style="list-style-type: none"><li>1) Remember that the bubbles hold the foam solution</li><li>2) The more bubbles, the thicker the foam blanket/layer</li><li>3) Only the bottom of the foam blanket touches the flammable liquid &amp; this is where the foam breaks down</li><li>4) The thicker the blanket, the more bubbles of foam not touching the flammable liquid &amp; the longer the foam blanket will last</li></ul></li><li>f) An air-aspirating foam nozzle usually will not project a stream as far as a standard non air-aspirating fog nozzle</li><li>g) Some foam nozzles have a variable discharge pattern, others do not</li><li>3. Standard fog nozzle (non air-aspirating)<ul style="list-style-type: none"><li>a) Works differently than foam nozzle<ul style="list-style-type: none"><li>1) Air is not added in the nozzle</li><li>2) Air is added to the foam solution after the solution leaves the nozzle</li></ul></li><li>b) 4 to 1 expansion ratio<ul style="list-style-type: none"><li>1) For every one (1) gallon of foam solution that leaves fog nozzle, if properly applied, five (5) gallons of finished foam will flow onto the fire</li></ul></li></ul></li></ul>	<p>Slide 238 Standard Fog Nozzle Characteristics</p>

# INSTRUCTOR GUIDE

EXTINGUISHING AGENTS

PRESENTATION	APPLICATION
<p>2) Four gallons of air was added to the solution after it left the fog nozzle</p> <p>c) The foam solution picks up more air as it impacts an object in the spill and/or fire area</p> <p>1) Aircraft fuselage, wing, engines, building walls, etc.</p> <p>2) Ground in front of the spill</p> <p>d) After the solution impacts, it flows gently onto the spill</p> <p>1) Gently is the key word in foam application</p> <p>e) When using a fog nozzle &amp; unable to bank foam off an object</p> <p>1) Lob the foam over the spill/fire</p> <p>2) Let it gently fall</p> <p>3) Called raindrop technique</p> <p>f) By sailing the foam solution through the air &amp; impacting, bouncing it off objects the solution will be expanded or aeriated four (4) times</p> <p>1) Do not use wider than a 30° fog stream to make foam</p> <p>2) Except for protection from radiant heat</p> <p>g) A fog nozzle provides better protection for fire fighters than a foam nozzle</p> <p>1) A wide fog stream protects fire fighters from radiant heat while advancing or retreating from a fire</p>	<p>How does the foam solution pick up air after it leaves the fog nozzle?</p> <p>Answer: The foam solution picks up air as it sails, tumbles through the air</p> <p>Slide 239 Foam Sailing Through Air From Fog Nozzle</p> <p>Slide 240 Impacting Foam On Objects</p> <p>Slide 241 Foam Flowing Off Aircraft Fuselage</p> <p>Slide 242 Lobbing Foam Over A Spill Fire</p> <p>What fog nozzle pattern (setting) makes the best, most expanded foam? Straight stream or fog stream?</p> <p>Answer: Straight stream makes the best foam</p> <p>Slide 243 Fog &amp; Straight Stream</p> <p>Slide 244 Wide Fog Stream</p>

# INSTRUCTOR GUIDE

EXTINGUISHING AGENTS

PRESENTATION	APPLICATION
<p>h) Foam from a fog nozzle penetrates the fires thermal updraft (rising heat, flames, &amp; smoke) better than from a foam nozzle</p> <ol style="list-style-type: none"><li>1) A thermal updraft can be equivalent to a 60-70 mph wind</li><li>2) A fog nozzle makes a soupier, wetter, heavier foam because it is not expanded as much as foam from a foam nozzle (4 to 1)</li><li>3) This means a faster fire knockdown and extinguishment than with a foam nozzle</li><li>4) A air-aspirating foam nozzle makes lighter, more expanded, more aeriated foam which will last longer than foam made with a fog nozzle</li></ol> <p>i) Not all foams can be used with a fog nozzle</p> <ol style="list-style-type: none"><li>1) Regular protein &amp; fluoroprotein foams can only be used with an air-aspirating foam nozzle</li><li>2) Synthetic foams, like Aqueous Film Forming Foam (AFFF) can be used with either foam or fog nozzles because they require very little energy to make foam</li></ol>	<p>Slide 245 Fire Thermal Updraft</p>
<p>E. Fire burns when three elements are present</p> <ol style="list-style-type: none"><li>1. Heat, fuel, &amp; oxygen (air)<ol style="list-style-type: none"><li>a) Fire triangle</li></ol></li><li>2. Foam eliminates all three (3) sides of the fire triangle</li></ol>	<p>Slide 246 Fire Triangle</p> <p>What does foam do? How does it work?</p>

# INSTRUCTOR GUIDE

EXTINGUISHING AGENTS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>3. Smothers<ul style="list-style-type: none"><li>a) The foam blanket excludes air from mixing with flammable vapors</li><li>b) Foam separates the fuel from the oxidizing source</li></ul></li><li>4. Foam reduces &amp; suppresses vapor release from the flammable liquid surface<ul style="list-style-type: none"><li>a) Foam prevents the fuel from mixing with air</li><li>b) It eliminates the fuel side of the fire triangle</li></ul></li><li>5. Foam acts as a flame barrier<ul style="list-style-type: none"><li>a) It separates the heat &amp; flame from the flammable liquid (for a period of time, not indefinitely)</li><li>b) Foam prevents ignition &amp; reignition</li></ul></li><li>6. Because it contains water, it cools<ul style="list-style-type: none"><li>a) Absorbs heat from the flammable liquid &amp; any adjacent metal surfaces</li></ul></li><li>7. Foam concentrates reduce the surface tension of water<ul style="list-style-type: none"><li>a) Makes foam an excellent wetting agent on Class A, ordinary combustibles</li></ul></li><li>8. Foam does not inhibit the combustion chain reaction (fire tetrahedron)<ul style="list-style-type: none"><li>a) Only dry chemicals &amp; halons inhibit or break the combustion chain reaction</li></ul></li><li>9. Foam works primarily on flat, two dimensional (length X width) flammable liquid fires</li></ul>	<p>Slide 247 How Foam Works</p> <p>Slide 248 Class A Action</p> <p>Slide 249 Flame Chemical Reaction</p> <p>Slide 250 Foam On A Flat Liquid Fire</p>

# INSTRUCTOR GUIDE

EXTINGUISHING AGENTS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"> <li>a) Foam does not work on spraying, moving, flowing, pressure fed flammable liquid fires                             <ul style="list-style-type: none"> <li>1) This is a three dimensional fire (length X width X height)</li> <li>2) Need an agent that inhabits the combustion chain reaction to extinguish a three dimensional fire</li> <li>3) Halons &amp; dry chemicals inhibit or break the combustion chain reaction</li> </ul> </li> <li>F. Qualities of a good fire fighting foam                             <ul style="list-style-type: none"> <li>1. Flows freely                                     <ul style="list-style-type: none"> <li>a) Flows around objects &amp; gains access to areas hard to reach</li> </ul> </li> <li>2. Forms tough, cohesive blanket</li> <li>3. Light enough to float on surface of flammable liquids, yet dense enough to resist disruption by:                                     <ul style="list-style-type: none"> <li>a) Wind</li> <li>b) Heat &amp; flame</li> <li>c) Large thermal updraft</li> </ul> </li> <li>4. Resists fuel pickup or fuel attack</li> <li>5. Holds water</li> <li>6. Capable of resealing itself if disturbed</li> </ul> </li> <li>G. Methods to measure these qualities                             <ul style="list-style-type: none"> <li>1. Expansion ratio                                     <ul style="list-style-type: none"> <li>a) Ratio of volume of air to solution</li> </ul> </li> <li>2. Fire performance</li> </ul> </li> </ul>	<p>What qualities make up a good fire fighting foam?</p> <p>Slide 251 Flows Freely</p> <p>Slide 252 Tough Blanket</p> <p>Slide 253 Foam On A Fire</p> <p>Slide 254 Resist Fuel Pickup</p> <p>Slide 255 Holds Water</p> <p>Slide 256 Fire Fighters Entering A Foamed Spill</p> <p>Slide 257 Laboratory Test</p>

# INSTRUCTOR GUIDE

EXTINGUISHING AGENTS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>a) How long does it take to knockdown, extinguish a fire</li><li>3. Mobility<ul style="list-style-type: none"><li>a) Ability to flow over fuel surface</li></ul></li><li>4. Burnback resistance<ul style="list-style-type: none"><li>a) How long will it resist heat, flames before it breaks down</li></ul></li><li>5. Cohesion characteristics</li><li>6. Shelf life<ul style="list-style-type: none"><li>a) Length of time over which foam concentrate remains stable without significant changes in performance characteristics</li><li>b) In other words, how long will the stuff last</li><li>c) Big investment<ul style="list-style-type: none"><li>1) Foam concentrates cost from \$8.00 to \$25.00 per gallon depending on the type &amp; how much</li></ul></li><li>d) Synthetic foam concentrates last much longer than protein based concentrates<ul style="list-style-type: none"><li>1) AFFF will last 20 to 30 years, even longer under certain conditions</li></ul></li><li>e) Concentrates last the longest when left in their original containers</li><li>f) Shelf life is shortened by:<ul style="list-style-type: none"><li>1) Contamination</li><li>2) Heat, sunlight</li></ul></li></ul></li></ul>	<p>Slide 258 Foam Lot Number &amp; Manufacture Date</p>



# INSTRUCTOR GUIDE

EXTINGUISHING AGENTS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>g) At an incident, replenish the foam blanket every 5 to 10 minutes<ul style="list-style-type: none"><li>1) Constantly add fresh foam while fire fighters are working in a spill area</li><li>2) Fire fighters must always see a thick, unbroken blanket of white stuff</li><li>3) No open spaces or gaps</li></ul></li><li>h) Failure to maintain the foam blanket is the most common mistake fire fighters make</li></ul> <p>H. There are many types &amp; manufacturer of foam available</p> <ul style="list-style-type: none"><li>1. There is no perfect, all purpose foam<ul style="list-style-type: none"><li>a) Advertisements and articles about different foams in fire magazines</li><li>b) At a large mutual aid flammable liquid fire, you may see many different types &amp; brands of foam</li><li>c) Each has advantages &amp; disadvantages</li></ul></li><li>2. There are two types of foam concentrate most commonly used by airport fire fighters<ul style="list-style-type: none"><li>a) 3% &amp; 6% Aqueous film forming foam (AFFF)</li><li>b) Also called A triple F</li><li>c) Some fluoroprotein used</li></ul></li></ul> <p>I. Aqueous film forming foams</p>	<p>Slide 261 Family Of Fire Fighting Foams</p> <p>Slide 262 3% &amp; 6% AFFF Concentrate</p> <p>Slide 263 Developed In 1963</p>

# INSTRUCTOR GUIDE

EXTINGUISHING AGENTS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>1. Developed by the U.S. Navy &amp; 3M Company during the 1960s<ul style="list-style-type: none"><li>a) Also called "Light Water"<ul style="list-style-type: none"><li>1) Trade name developed by 3M Company</li></ul></li><li>b) Combination of:<ul style="list-style-type: none"><li>1) Fluorocarbon surfactants</li><li>2) Synthetic foaming agents</li><li>3) Stabilizers</li></ul></li></ul></li><li>2. Available in 1, 3, &amp; 6% concentrates<ul style="list-style-type: none"><li>a) Concentrates are mostly water</li><li>b) 3% is just more concentrated than 6%</li><li>c) Looks darker</li><li>d) 6% was first created<ul style="list-style-type: none"><li>1) The Navy &amp; Air Force used it so most commercial airport fire fighters started using it also</li></ul></li><li>e) Then 3% was developed<ul style="list-style-type: none"><li>1) Need only half as much 3% concentrate to make the same amount of finished foam as with 6%</li><li>2) One gallon of 3% will make twice as much finished foam as one gallon of 6%</li><li>3) Properly proportioned, 3% &amp; 6% finished foam is identical</li></ul></li><li>f) Using 6% allows more room for error</li></ul></li></ul>	<p>Slide 264 Two Bottles Of Concentrates</p>



# INSTRUCTOR GUIDE

EXTINGUISHING AGENTS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>e) Faster knockdown means lower application rates<ul style="list-style-type: none"><li>1) .1 GPM per square ft. for AFFF</li><li>2) .16 GPM per square ft. for protein foams</li></ul></li><li>f) Aqueous film acts both as a barrier to exclude air &amp; suppress the evolution flammable vapors<ul style="list-style-type: none"><li>1) In addition, it has a reforming, self healing action</li><li>2) AFFF foam fills in your steps when fire fighters walk or pull hose through it</li></ul></li><li>4. The low surface tension of AFFF solution provides rapid penetration on class A, ordinary combustibles<ul style="list-style-type: none"><li>a) Greatly increases the effectiveness of water</li><li>b) Much like a wetting agent</li><li>c) Aircraft interiors are mostly plastic, ordinary combustibles</li></ul></li><li>5. AFFF is a heavier, soupier, wetter foam<ul style="list-style-type: none"><li>a) Better penetrates the fires thermal updraft</li><li>b) Protein foams are lighter &amp; tend to be carried off by large fire updrafts as "snow" or "cornflakes"</li></ul></li><li>6. AFFF has a powerful detergent action &amp; is a strong penetrant<ul style="list-style-type: none"><li>a) Concentrates are stored in stainless steel or specially coated tanks</li></ul></li></ul>	<p>Slide 267 Fuel Fire</p>

# INSTRUCTOR GUIDE

## EXTINGUISHING AGENTS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>b) AFFF will lift rust &amp; corrosion in regular water tanks<ul style="list-style-type: none"><li>1) Will cause pump seals to leak</li></ul></li><li>c) Concentrate will remove apparatus paint to bare metal<ul style="list-style-type: none"><li>1) Always thoroughly wash all apparatus &amp; equipment used</li><li>2) Rinse for 5-10 minutes</li><li>3) Concentrate is tough to get off</li></ul></li><li>d) Continued contact will dry, irritate, &amp; crack skin<ul style="list-style-type: none"><li>1) Wash exposed areas with plain water &amp; apply hand cream</li></ul></li><li>7. AFFF can be pre-mixed &amp; will stay in solution form for long periods of time<ul style="list-style-type: none"><li>a) AFFF is suitable for use with &amp; dry chemical compatible</li><li>b) Pre-mixed AFFF is often used with Purple K dry chemical in "twin agent" systems</li></ul></li><li>8. AFFF requires relatively low energy to expand the solution into foam compared to protein concentrates</li><li>9. Because it is completely synthetic, it has a much longer shelf life compared to protein foams<ul style="list-style-type: none"><li>a) Expensive investment</li><li>b) Want it to last as long as possible</li><li>c) Do not want to wonder if your foam concentrate is still good</li></ul></li></ul>	<p>Slide 268 Washing ARFF Apparatus After Use</p> <p>Slide 269 Twin Agent System</p> <p>Slide 270 Stacked AFFF Concentrate Pails</p>



# INSTRUCTOR GUIDE

## EXTINGUISHING AGENTS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>a) Less than this, probably will not put the fire out<ul style="list-style-type: none"><li>1) The fire will keep burning up the foam as it is applied</li></ul></li><li>b) At this rate or above, you will put the fire out</li><li>c) If the application rate is increased the fire will go out faster, up to a point<ul style="list-style-type: none"><li>1) Called "mass application"</li></ul></li><li>2. First, the proper percentage must be proportioned for the type of concentrate using</li><li>3. There are different minimum application rates for different flammable liquid fire situations<ul style="list-style-type: none"><li>a) Gasoline tank truck fire<ul style="list-style-type: none"><li>1) One gallon of foam solution per minute for every 10 square ft. of spill surface area</li><li>2) Must be ready to supply this rate for ten minutes</li></ul></li><li>b) Storage tank fire<ul style="list-style-type: none"><li>1) One gallon of foam solution per minute for every 10 square ft. of fuel surface if using a fixed foam system which delivers all of the foam onto the burning fuel surface</li><li>2) Two gallons of foam solution per minute for every 10 square ft. of burning fuel surface when applied from ground monitors, where not all the foam reaches the fuel surface</li></ul></li></ul></li></ul>	<p>Slide 274 Setting Percentage</p> <p>Slide 275 Burning Tank Truck</p> <p>What is foam solution again?</p> <p>Answer: Foam concentrate properly proportioned with water</p> <p>Slide 276 Storage Tank Fire</p>





# INSTRUCTOR GUIDE

## EXTINGUISHING AGENTS

PRESENTATION	APPLICATION
4) This should extinguish the fire in one (1) minute	How many turrets do we need to apply this amount of foam?
e) We will need one 800 GPM turret or two 400 GPM turrets or some similar combination	Slide 282 Number of turrets needed/800 GPM
1) The Oshkosh P-4 has the capability to produce 1600 gallons of foam solution	
2) The standard top turret it came with has two barrels, 400 GPM each	
3) One P-4 using both barrels or two using single barrels could handle this fire	
f) $800 \text{ divided by } 100 = \text{eight (8) } 1 \frac{1}{2} \text{ hose lines}$	How many $1 \frac{1}{2}$ or $2 \frac{1}{2}$ hose lines would we need to apply this amount of foam?
g) $800 \text{ GPM divided by } 250 = \text{three } 2 \frac{1}{2} \text{ hose lines}$	Slide 283 Foam Hose Lines
1) Will need additional hose lines for backup & personnel protection	
h) $.03 \times 800 = 24 \text{ gallons of } 3\% \text{ foam concentrate}$	How many gallons of foam concentrate will we need to produce this amount of solution?
i) $.06 \times 800 \text{ GPM} = 48 \text{ gallons of } 6\% \text{ foam concentrate}$	Slide 284 How Much Foam Concentrate?
	How much finished foam will 800 gallons of foam solution produce?
j) $800 \text{ GPM} \times 4 = 3,200 \text{ gallons of finished foam using a non air-aspirating fog nozzle}$	Slide 285 Oshkosh P-4 Applying Finished Foam
1) A very small amount of foam concentrate will make alot of finished foam	



# INSTRUCTOR GUIDE

EXTINGUISHING AGENTS

PRESENTATION	APPLICATION
<ol style="list-style-type: none"><li>1. Absolutely do not mix different types of foam concentrate in the same storage tank or container<ol style="list-style-type: none"><li>a) Example - mixing AFFF with fluoroprotein concentrate</li><li>b) Concentrate could solidify or crust up<ol style="list-style-type: none"><li>1) Form globules that could clog up foam system</li></ol></li><li>c) Do not mix a 3% concentrate with a 6% concentrate of the same type foam<ol style="list-style-type: none"><li>1) Will not proportion properly</li><li>2) Finished foam will be too lean (thin) or too rich (thick)</li></ol></li><li>d) Military specifications (Mil spec) for AFFF requires that different brands (manufacturers) of the same percentage concentrate must be compatible &amp; able to mix together in storage<ol style="list-style-type: none"><li>1) Even this is not recommended</li></ol></li></ol></li></ol>	<p>Slide 288 Pouring Concentrate Into A Tank</p>
<ol style="list-style-type: none"><li>2. Different foam concentrates can be proportioned from different proportioners &amp; applied in succession or simultaneously on the same fire</li></ol>	<p>Slide 289 Multiple Foam Application</p>
<ol style="list-style-type: none"><li>3. Foams will not work on high vapor pressure flammable liquids like LPG<ol style="list-style-type: none"><li>a) Butane &amp; propane</li><li>b) Vapor will bubble through foam blanket</li><li>c) Water temperature in foam will cause liquid petroleum gas to vaporize even more</li></ol></li></ol>	<p>Slide 290 Burning LPG Tank</p>

# INSTRUCTOR GUIDE

EXTINGUISHING AGENTS

PRESENTATION	APPLICATION
<p>4. Never direct or plunge a straight stream of foam into the center of a flammable liquid spill</p> <ul style="list-style-type: none"><li>a) Causes fuel saturation of the foam</li><li>b) Will stir up the flammable liquid, making even more vapor</li><li>c) Reduces the effectiveness of the foam by over 60%</li><li>d) May splash, &amp; spread the burning flammable liquid</li><li>e) May disrupt an existing, functioning foam blanket</li></ul>	<p>Slide 291 Warning</p>
<p>5. If possible, approach &amp; begin foam application from upwind &amp; uphill</p> <ul style="list-style-type: none"><li>a) Operations conducted with the wind at your back provide:<ul style="list-style-type: none"><li>1) Improved visibility &amp; breathing</li><li>2) Decreased radiated heat &amp; smoke effects</li><li>3) Better application of foam, the wind will help carry the foam into the fire area</li><li>4) Reduced extinguishing time</li></ul></li><li>b) Start foam application at near edge of fire &amp; move up as fire recedes</li></ul>	<p>Slide 292 Effect Of Wind On Aircraft Fire</p>
<p>6. Caution should be observed when using water streams in conjunction with foam lines</p> <ul style="list-style-type: none"><li>a) Water streams should be used in such a way as to not physically disrupt the foam blanket</li></ul>	<p>Slide 293 Water Stream At A Fuel Fire</p>

# INSTRUCTOR GUIDE

EXTINGUISHING AGENTS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>b) Water will dilute &amp; wash away</li><li>7. All personnel involved in the foam operation should be in full turnouts<ul style="list-style-type: none"><li>a) Including turnout pants &amp; rubber boots</li><li>b) Wear SCBA breathing apparatus if necessary</li></ul></li><li>8. Foamed areas can be very slippery<ul style="list-style-type: none"><li>a) Walk in shuffling steps to maintain balance &amp; stability</li></ul></li><li>9. Never turn your back on a flammable liquid spill or fire<ul style="list-style-type: none"><li>a) Back out same as you approached until in a safe area</li><li>b) Always leave attack lines positioned &amp; charged to reapply foam if necessary</li><li>c) Back up lines should be charged with foam &amp; manned with attentive personnel</li><li>d) With flammable liquids, when things go bad, they do bad quickly</li></ul></li><li>10. Maintain the foam blanket<ul style="list-style-type: none"><li>a) Foamed areas should be constantly reexamined &amp; additional foam applied where the foam blanket has been interrupted or broken down</li><li>b) Use same techniques as initial foam application<ul style="list-style-type: none"><li>1) The fresh foam will reestablish the vapor sealing blanket</li></ul></li></ul></li><li>11. Obviously do not enter an unfoamed spill</li></ul>	<p>Slide 294 Full Turnouts</p> <p>Slide 295 Shuffling Steps</p> <p>Slide 296 Facing Fire</p> <p>Slide 297 Reapplying Foam</p> <p>Slide 298 Entering An Unfoamed Spill</p>

# INSTRUCTOR GUIDE

EXTINGUISHING AGENTS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>a) Also avoid entering a foamed spill<ul style="list-style-type: none"><li>1) Do so only if absolutely necessary</li><li>2) Have a good reason to be there</li></ul></li><li>b) Clear immediate operational area of all but necessary personnel involved in tasks at hand</li><li>c) This especially means news media &amp; non-fire personnel (police etc.)</li></ul> <p>12. Aircraft foam apparatus &amp; equipment should be subjected to proportioning &amp; flow tests quarterly (4 times per year)</p> <ul style="list-style-type: none"><li>a) Sample solutions are examined in a refractometer</li><li>b) Foam samples can be sent to the foam manufacturer in a one quart (unused paint can) for analysis</li></ul> <p>M. Explain premixed foam solution &amp; systems</p> <ul style="list-style-type: none"><li>1. Instead of using a proportioner, the foam solution is properly premixed in a storage container on the apparatus<ul style="list-style-type: none"><li>a) Example - 500 gallons of 3% premix<ul style="list-style-type: none"><li>1) Mix 15 gallons of 3% AFFF concentrate with 485 gallons of water</li><li>2) This is equivalent to 3 parts/3% of concentrate mixed with 97 parts/94% of water</li></ul></li><li>b) Can be stored premixed for years</li></ul></li><li>2. Pumped or pushed by gas to nozzle<ul style="list-style-type: none"><li>a) Compressed nitrogen or dry air</li></ul></li></ul>	<p>Slide 299 Refractometer &amp; Equipment</p> <p>Slide 300 Premix Foam Tank</p> <p>Slide 301 Dry Air Cylinders</p>

# INSTRUCTOR GUIDE

## EXTINGUISHING AGENTS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>3. Often used in conjunction with a secondary agent<ul style="list-style-type: none"><li>a) Usually purple K dry chemical</li><li>b) Called a "twin" or "dual agent" system</li></ul></li></ul>	Slide 302 Dry Chemical Tank & Twin Nozzle
<p>N. Other types of foam available</p> <ul style="list-style-type: none"><li>1. Two (2) major categories of foams<ul style="list-style-type: none"><li>a) Chemical foam</li><li>b) Mechanical foams</li></ul></li><li>2. The first fire fighting foam was chemical foam<ul style="list-style-type: none"><li>a) Introduced in the late 1800's to combat coal &amp; oil fires</li><li>b) The foam bubble resulted from a chemical reaction of sodium bicarbonate &amp; aluminum sulfate powders &amp; water<ul style="list-style-type: none"><li>1) The energy to make the foam came from the chemical reaction of the three materials</li><li>2) Formed CO<sub>2</sub> gas which was trapped in the foam bubble</li><li>3) This is why it is called chemical foam, it was formed by a chemical reaction</li><li>4) Stabilizers made from soybeans, blood meal or licorice were added to maintain the bubble</li></ul></li></ul></li></ul>	Slide 303 Family Of Foams  Slide 304 Chemical Foam
<ul style="list-style-type: none"><li>c) One &amp; two hopper proportioning generators were used to make chemical foam</li><li>d) Many problems associated with chemical foam</li></ul>	Slide 305 A&B Powder Hopper



# INSTRUCTOR GUIDE

EXTINGUISHING AGENTS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>1) Water</li><li>2) Concentrated foam liquid</li><li>3) Air</li><li>c) The energy to make the foam bubble comes from an outside force<ul style="list-style-type: none"><li>1) Usually at the nozzle (discharge device)</li><li>2) This is why it is called mechanical foam</li></ul></li><li>d) All mechanical foam making systems consist of four (4) parts<ul style="list-style-type: none"><li>1) Water supply</li><li>2) Foam concentrate</li><li>3) Proportioning device (inline eductor or CFR apparatus)</li><li>4) Discharge device (air-aspirating foam nozzle or nonair-aspirating standard fog nozzle)</li></ul></li><li>e) As we saw with AFFF, only small amounts of concentrate are necessary to produce large volumes of mechanical foam</li></ul>	<p>Slide 308 Making Mechanical Foam</p>
<ul style="list-style-type: none"><li>4. The first type of mechanical foam concentrate was protein<ul style="list-style-type: none"><li>a) Developed in the 1930's</li><li>b) Made from a chemical digestion, acid or alkaline hydrolysis of natural, organic, protein solids<ul style="list-style-type: none"><li>1) Such as animal horn, hoof, bone, feathers, fish scales, &amp; blood</li><li>2) Or vegetable proteins such as soybean or peanut meal</li></ul></li></ul></li></ul>	<p>Slide 309 3%-6% Protein Foam Concentrate</p>

# INSTRUCTOR GUIDE

EXTINGUISHING AGENTS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>3) It is rumored that it was edible, humans could survive on a diet of it</li><li>c) Metallic salts were added to strengthen the bubbles &amp; increase heat resistance</li><li>d) Organic solvents are added to improve concentrate uniformity &amp; control viscosity at low temperatures</li><li>e) Other stabilizers, inhibitors, &amp; preservatives are added to protect against freezing<ul style="list-style-type: none"><li>1) Prevent corrosion to containers &amp; equipment</li><li>2) Resist bacterial decomposition</li></ul></li><li>f) Advantages of protein foams<ul style="list-style-type: none"><li>1) Produced a dense, thick, viscous, very stable foam</li><li>2) Has high heat resistance</li><li>3) Slower drain out than AFFF</li><li>4) Good burnback resistance, twice that of AFFF</li><li>5) Good expansion qualities</li></ul></li><li>g) Only type of foam used for runway foaming, only foam that lasted long enough on runway<ul style="list-style-type: none"><li>1) Runway foaming is no longer done</li><li>2) Studies indicated no advantage gained by foaming runway</li><li>3) Aircraft usually missed or skidded off the foam blanket</li></ul></li></ul>	<p>Slide 310 Protein Foam Pails</p> <p>Slide 311 Runway Foaming</p>

# INSTRUCTOR GUIDE

EXTINGUISHING AGENTS

PRESENTATION	APPLICATION
<p>h) Disadvantages of protein foams</p> <ol style="list-style-type: none"><li>1) Slower fire knockdown/extinguishment than AFFF's</li><li>2) Lack of fuel tolerance, protein foams are easily contaminated by the fuel</li><li>3) Fuel will saturate, coat, &amp; burn on protein foam bubbles</li><li>4) Sedimentation, once a month had to turn protein foam pails over</li><li>5) Not compatible with dry chemicals</li><li>6) Can only be applied through air-aspirating foam nozzles</li><li>7) Requires a higher application rate than AFFF's to extinguish a fire</li><li>8) No aqueous film</li><li>9) Limited shelf life, does not last as long as AFFF, bacteria begins to decompose protein foam</li></ol> <p>5. Fluoroprotein foam concentrate</p> <ol style="list-style-type: none"><li>a) Developed in the 1960's<ol style="list-style-type: none"><li>1) Synthetic fluorocarbon surfactants are added to regular protein concentrate</li><li>2) Gave it a fuel reflecting, shedding quality (oleophobic)</li><li>3) Hence resistance to fuel contamination &amp; dry chemical compatible</li></ol></li><li>b) Except for above, same disadvantages &amp; disadvantages as regular protein foam</li></ol>	<p>Slide 312 3%-6% Fluoroprotein Pails</p>



# INSTRUCTOR GUIDE

EXTINGUISHING AGENTS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>1) Does not have alcohol in it</li><li>2) Name means it can be used on alcohol type polar solvents without being destroyed</li><li>3) Also works on nonpolar type hydrocarbons like aircraft fuels</li><li>4) Used by many fire departments because it can be used on any flammable or combustible liquid</li><li>5) Developed in the 1970's</li><li>g) Alcohol type concentrates, are regular foams, such as AFFF, with a special additive that forms a physical barrier between the foam bubbles &amp; the polar solvent liquid<ul style="list-style-type: none"><li>1) This polymer additive makes ATC look much thicker &amp; jelly like than regular AFFF concentrate</li><li>2) Looks like AFFF thats gone bad or spoiled</li></ul></li><li>h) As the polar solvent competes for the water in the foam blanket, it chemically reacts/combines with the polymer additive<ul style="list-style-type: none"><li>1) Forms a plastic like polymeric membrane</li><li>2) This thin, tough layer protects the foam &amp; its aqueous film from breakdown by the moisture seeking polar solvents</li></ul></li><li>i) If this protective layer should become disrupted, more polymeric layer is produced by a regenerative action<ul style="list-style-type: none"><li>1) Called self healing</li></ul></li></ul>	<p>Slide 315 Bottle Of ATC Concentrate</p> <p>Slide 316 ATC On Nonpolar &amp; Polar Hydrocarbons</p>

# INSTRUCTOR GUIDE

EXTINGUISHING AGENTS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>2) Unnecessary activity in the spill area should be avoided</li><li>3) Repair any disturbed areas with fresh ATC foam immediately</li><li>j) On a nonpolar hydrocarbon fuel (such as any aircraft fuel) ATC foam acts just like AFFF foam<ul style="list-style-type: none"><li>1) Does not form a polymeric layer</li><li>2) Polymeric layer only formed on polar solvents</li></ul></li><li>k) Therefore, alcohol type concentrates can be used on any flammable or combustible liquid<ul style="list-style-type: none"><li>1) Proportion at 3% when using on nonpolar flammable liquids (aircraft fuels)</li><li>2) Proportion at 6% when using on polar solvent type flammable liquids</li><li>3) Need a rich concentration, on polar solvents, to build up the polymeric layer</li></ul></li><li>l) ATC cannot be premixed</li><li>m) Like AFFF, ATC is a strong detergent &amp; can damage apparatus paint<ul style="list-style-type: none"><li>1) Thoroughly wash all apparatus &amp; equipment after use</li></ul></li><li>8. Film forming fluoroproteins<ul style="list-style-type: none"><li>a) Called triple F P (FFFP)</li><li>b) Developed in the 1980's</li></ul></li></ul>	<p>Slide 317 Petroseal</p>

# INSTRUCTOR GUIDE

EXTINGUISHING AGENTS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>c) An attempt to combine the longer burnback resistance &amp; drain time of fluoroprotein foam with the quicker extinguishment &amp; aqueous film of AFFF's<ul style="list-style-type: none"><li>1) Good idea</li><li>2) So far only a compromise between AFFF &amp; protein foams</li></ul></li><li>d) Available in 3% &amp; 6% concentrate</li><li>e) Also an alcohol type FFFP</li><li>f) Can be used with standard fog or foam nozzles</li></ul> <p>9. High &amp; medium expansion foams</p> <ul style="list-style-type: none"><li>a) Another type of mechanical foam in a category by itself</li><li>b) Blend of highly specialized synthetic surfactants &amp; foam stabilizers</li><li>c) Used in special high expansion air aspirating devices<ul style="list-style-type: none"><li>1) Air is passed through screen wetted by the foam solution</li><li>2) Produces large quantities of finished foam from relatively small amounts of water &amp; concentrate</li><li>3) Expansion ratios from 100 to 1, up to 1000 to 1</li><li>4) Typical proportioning percentages vary from 1 1/2 to 3%</li></ul></li><li>d) Primarily intended for use on class A, ordinary combustibles in confined areas</li></ul>	<p>Slide 318 National HIEX Foam Pail</p> <p>Slide 319 High Expansion Foam Generator</p> <p>Slide 320 High Expansion Foam In A Room</p>

# INSTRUCTOR GUIDE

## EXTINGUISHING AGENTS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>1) Basements, vaults</li><li>2) Cargo holds on ships</li><li>3) Other places inaccessible to fire fighters</li><li>4) Does not contain much water, has not been very successful</li><li>e) Although some success has occurred with medium expansion foams on flammable liquids, their use is very limited<ul style="list-style-type: none"><li>1) Most flammable liquid fires are outside &amp; high expansion foam is very adversely affected by wind</li><li>2) High expansion foams do not exhibit acceptable vapor sealing, burnback resistance, or fuel tolerance</li></ul></li><li>f) High expansion foams are difficult to work in<ul style="list-style-type: none"><li>1) Makes a mess</li><li>2) Restricts visibility, both of fire fighters &amp; area working in</li><li>3) Takes a long time to clear an area of HIEX foam after use (use smoke ejectors)</li></ul></li><li>g) High expansion foams have been effective in bomb or explosion suppression</li></ul> <p>10. Hazardous material foams</p> <ul style="list-style-type: none"><li>a) Not used for fire extinguishment<ul style="list-style-type: none"><li>1) Used for vapor suppression</li></ul></li></ul>	<p>Slide 321 Using Medium Expansion Foam</p> <p>Slide 322 Fire Fighter In HIEX Foam</p> <p>Slide 323 Applying Hazmat Foam</p>

# INSTRUCTOR GUIDE

EXTINGUISHING AGENTS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>b) Each manufacturers foam is proportioned, applied, &amp; performs differently</li><li>c) 3M company sells a liquid stabilizer which can be proportioned with their alcohol type concentrate (3%-6% ATC)<ul style="list-style-type: none"><li>1) Stabilizer cost \$45.00 per gallon</li><li>2) Requires a special proportioning device</li><li>3) Device cost from \$3000 for a small portable unit to \$25,000 for a trailer unit</li><li>4) Can be applied with a standard fog nozzle</li><li>5) When this foam sets up it forms a styrofoam like blanket, 1-2 inches thick, that can last several weeks</li></ul></li><li>d) National Foam makes two (2) types of hazmat foam concentrates<ul style="list-style-type: none"><li>1) One for acids, one for alkaline (basic) spills</li><li>2) These foams can be proportioned with an inline eductor, but require a special medium expansion nozzle to expand &amp; apply the resulting solution to the spill</li><li>3) They produce a temporary mechanical foam that must be periodically reapplied (similar to low expansion foams, such as AFFF's)</li></ul></li><li>e) Hazmat foams are still so new that it is unknown what chemicals they will work on</li></ul>	<p>Slide 324 ATC, Stabilizer, &amp; Proportioning Device</p> <p>Slide 325 Foam That Sets Up</p> <p>Slide 326 National Foam Advertising</p>

# INSTRUCTOR GUIDE

EXTINGUISHING AGENTS

PRESENTATION	APPLICATION
<p>1) Lots of research going on in this area</p> <p>11. Wildland fire fighting foams</p> <ul style="list-style-type: none"><li>a) Silv-ex forest fire control liquid concentrate</li><li>b) Premix in apparatus tank or use a proportioner</li><li>c) Can be dropped from aircraft</li><li>d) Some effectiveness on structure &amp; flammable liquid (Class B) fires</li><li>e) Will stick to vertical surfaces, a quality very different from other foams</li><li>f) Standard fog, medium expansion, or special Silv-ex nozzles can be used</li></ul> <p>0. Inline eductors</p> <ul style="list-style-type: none"><li>1. Most common type proportioner used</li><li>2. Uses venturi principle to pull/suction concentrate into water stream<ul style="list-style-type: none"><li>a) Flow of water past reduced orifice creates a vacuum (negative pressure)</li><li>b) Atmospheric pressure (14.7 psi) pushes the concentrate up the pickup tube</li><li>c) A ball check valve prevents water from flowing back into the concentrate container</li><li>d) Variable metering to change proportioning percentage</li></ul></li></ul>	<p>Slide 327 Silv-ex</p> <p>Slide 328 Sticking To Vertical Surfaces</p> <p>Slide 329 Silv-ex Nozzle</p> <p><u>Show Video #6 Table Top Demonstration Of Foam Properties &amp; Characteristics</u></p> <p>Slide 330 Inline Eductor</p> <p>Slide 331 Cut Away Of Inline Eductor</p>

# INSTRUCTOR GUIDE

EXTINGUISHING AGENTS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>1) Usually 1, 2, 3, &amp; 6% settings</li><li>3. Pickup tube should be clear, so operator can see if foam concentrate is flowing</li><li>4. Inline eductors have certain limitations &amp; <u>strict</u> procedures that must be followed<ul style="list-style-type: none"><li>a) Supply 200 psi to the inlet of the eductor (usually)<ul style="list-style-type: none"><li>1) May vary with different eductor manufacturers</li><li>2) Consult with manufacturer of your equipment</li></ul></li><li>b) Provides 100 psi nozzle pressure<ul style="list-style-type: none"><li>1) 35% pressure loss going through reduced orifice in eductor (approximately 70 psi)</li></ul></li><li>c) Nozzle bale must be fully open</li><li>d) No more than 150 ft. of 1 1/2 inch hose between eductor &amp; nozzle<ul style="list-style-type: none"><li>1) Can use less than 150 ft. (100 or just one 50 ft. length)</li><li>2) No kinks in hose</li></ul></li><li>e) Set meter on eductor for proper proportioning percentage for the type of foam concentrate using</li><li>f) Locate eductor at or near engine discharge outlet, if how lay is 150 or less</li><li>g) Locate &amp; stack an adequate amount of foam concentrate for the magnitude of the fire problem within reach of the pickup tube</li></ul></li></ul>	<p>Slide 332 Pickup Tube</p> <p>Slide 333 Possible eductor Problems</p> <p>Slide 334 Fog Nozzle Fully Open</p> <p>Slide 335 Disconnecting Hose</p> <p>Slide 336 Setting Percentage On Eductor</p> <p>Slide 337 Eductor On Pump Panel</p> <p>Slide 338 Stacking 5 Gallon Foam Pails</p>

# INSTRUCTOR GUIDE

EXTINGUISHING AGENTS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>h) Open all containers for quick suctioning &amp; movement from container to container</li><li>i) Write inline eductor procedures on outside of each container as a reminder or for quick reference</li><li>j) Set nozzle flow to match flow (GPM) of eductor<ul style="list-style-type: none"><li>1) GPM flow of eductor must match that of nozzle</li><li>2) 95 GPM eductor, set nozzle at 95</li><li>3) 60 GPM eductor, set nozzle at 60</li><li>4) Use a constant flow fog nozzle or a foam nozzle that matches eductor</li><li>5) Variable flow, spring type nozzles (Task Force Tips) are not recommended because flow will vary depending on the spring &amp; may not match eductor</li><li>6) Nozzle must be used at all times with the bale fully open</li></ul></li><li>k) Charge 200 psi to eductor<ul style="list-style-type: none"><li>1) Insert pick up tube in concentrate container<ul style="list-style-type: none"><li>1) Called stinging</li><li>2) As container empties, move to full one</li></ul></li></ul></li><li>5. If foam application is more than 150 ft. from the engine, use hose to expand the eductor within 150 ft. of the application</li><li>6. Thoroughly rinse all equipment used with plain water</li></ul>	<p>Slide 339 Opening Containers</p> <p>Slide 340 Instructions Written On Container</p> <p>Slide 341 Pump Panel Gauge</p> <p>Slide 342 Pickup Tube In Container</p> <p>Slide 343 Extending An Eductor With 2 1/2 Inch Hose</p>

# INSTRUCTOR GUIDE

EXTINGUISHING AGENTS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>a) Siphon fresh, clean water from a bucket or container through pickup tube</li><li>b) Take eductor apart &amp; rinse parts</li><li>c) Concentrate left in eductor will dry up and gum/stick check ball, plugging the pickup tube</li><li>d) Flush &amp; wash hose used</li><li>e) Thoroughly rinse concentrate off apparatus</li></ul>	<p>Slide 344 Siphoning Water Through Pickup Tube</p> <p>Slide 345 Rinsing Eductor Parts</p>
<p>P. Wetting agents</p>	<p>Slide 346 Detergent 40</p>
<ul style="list-style-type: none"><li>1. Often erroneously associated with Class B, flammable liquid fire fighting</li></ul>	
<ul style="list-style-type: none"><li>2. Decreases the surface tension of water</li></ul>	<p>Slide 347 Burned Aircraft</p>
<ul style="list-style-type: none"><li>a) Increases waters penetrating &amp; spreading abilities</li></ul>	
<ul style="list-style-type: none"><li>b) May want to use wetting agents on interior aircraft fires</li></ul>	
<ul style="list-style-type: none"><li>1) Fire has penetrated a mass of class A, ordinary combustibles, cargo</li></ul>	
<ul style="list-style-type: none"><li>3. May not be compatible with foam</li></ul>	
<ul style="list-style-type: none"><li>a) Wetting agents may adversely affect or damage a foam blanket</li></ul>	
<ul style="list-style-type: none"><li>b) Do not use water with wetting agents near a foam blanket</li></ul>	
<p>II. Extinguishing Agents - Dry Chemicals</p>	<p>Slide 348 "Dry Chemicals"</p>
<ul style="list-style-type: none"><li>A. Is specially prepared mixtures of finely divided salts</li></ul>	<p>Slide 349 NFPA #17</p>

# INSTRUCTOR GUIDE

EXTINGUISHING AGENTS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>1. Treated with:<ul style="list-style-type: none"><li>a) Tricalcium phosphate</li><li>b) Metallic (zinc) stearate</li><li>c) Silicon</li></ul></li><li>2. Treated to:<ul style="list-style-type: none"><li>a) Make water repellent</li><li>b) Prevent caking (caused by moisture)</li><li>c) Improve foam compatibility</li><li>d) Prevent packing (caused by vibration)</li><li>e) Allow storage at elevated temperatures</li><li>f) Improve flow capabilities</li><li>g) Limit abrasive action</li></ul></li><li>3. Particle size ranges from 5 to 75 microns<ul style="list-style-type: none"><li>a) Best is 20 to 25 microns</li></ul></li><li>4. Do not confuse with dry powders<ul style="list-style-type: none"><li>a) Dry powders are used on combustible metal (Class D) fires</li><li>b) Dry chemicals are called dry powder in England</li></ul></li><li>B. Recognized for unusual extinguishing efficiency &amp; rapid extinguishing action<ul style="list-style-type: none"><li>1. Used primarily on flammable &amp; combustible liquid (Class B) fires</li><li>2. One of most effective flame reduction or flame halting agents<ul style="list-style-type: none"><li>a) When applied in adequate rate</li></ul></li></ul></li></ul>	<p>What are dry powders used on?</p> <p>Slide 350 Using A Dry Chemical Extinguisher On A Fire</p>

# INSTRUCTOR GUIDE

EXTINGUISHING AGENTS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>b) In sufficient quantities</li><li>c) Provided agent reaches all areas of fire without interrupting application</li></ul> <p>3. Use of dry chemicals can require a high level of skill</p> <p>C. Dry chemicals work principally by chemically inhibiting the combustion chain reaction</p> <ul style="list-style-type: none"><li>1. The radicals of carbon (C), hydrogen (H), oxygen (O), &amp; OH are necessary for propagation of the chain reaction</li><li>2. Reaction of these free radicals with each other in the combustion chain reaction is necessary for continued burning</li><li>3. The chemical reaction increases as the fire grows in size &amp; intensity</li><li>4. Both dry chemicals &amp; halons act as chemical inhibitors or radical scavengers<ul style="list-style-type: none"><li>a) Both combine with the free radicals to terminate the flame chemical reaction</li><li>b) Both prevent radicals from coming together &amp; reacting with each other</li></ul></li></ul>	<p>Slide 351 Flame Matrix</p>
<p>D. Dry chemicals &amp; (halons) are very effective on three dimensional fuel fires</p> <ul style="list-style-type: none"><li>1. Examples of three dimensional fuel fires<ul style="list-style-type: none"><li>a) Running, dripping, spraying fuel fires</li><li>b) Pressure fires</li><li>c) Gravity, leak fed fires</li><li>d) Multidimensional, fire has length, width, &amp; height<ul style="list-style-type: none"><li>1) Not just flat, like a spill fire</li></ul></li></ul></li></ul>	<p>Slide 352 Spraying Gasoline Fire</p>

# INSTRUCTOR GUIDE

EXTINGUISHING AGENTS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>2. Foam is not effective on three dimensional fuel fires</li><li>E. Other properties of dry chemicals<ul style="list-style-type: none"><li>1. Nonconductive<ul style="list-style-type: none"><li>a) Class C rated</li><li>b) Electrical resistivity</li></ul></li><li>2. Minimal toxicity<ul style="list-style-type: none"><li>a) Finely divided material suspended in air<ul style="list-style-type: none"><li>1) Can interfere with visibility</li><li>2) Dust in eyes &amp; respiratory tract</li><li>3) Temporary breathing difficulty</li></ul></li><li>b) Wear self contained breathing apparatus</li></ul></li><li>3. Very slight smothering capability<ul style="list-style-type: none"><li>a) Absorbs some heat to become chemically active</li></ul></li><li>4. Very slight radiation shielding<ul style="list-style-type: none"><li>a) Cloud of powder shields fuel from radiated heat</li></ul></li><li>5. Easy to recharge extinguishers or systems</li><li>6. Good flooding characteristics<ul style="list-style-type: none"><li>a) Powder can penetrate inaccessible areas such as baggage compartments</li><li>b) Following discharge, dry chemical rapidly diminishes due to settling out</li></ul></li></ul></li></ul>	<p>Slide 353 Using Dry Chemical On A Fire</p>

# INSTRUCTOR GUIDE

## EXTINGUISHING AGENTS

PRESENTATION	APPLICATION
<p>1) Compared to gaseous diffusion of carbon dioxide &amp; halon, which will persist in atmosphere around fire</p> <p>7. Good on aircraft wheel fires</p> <ul style="list-style-type: none"><li>a) A heated wheel should be allowed to cool slowly to prevent crystallization of metal</li><li>b) Dry chemical is less likely to chill hot metal</li></ul> <p>8. Messy, clean up is a problem</p> <ul style="list-style-type: none"><li>a) Especially on delicate electrical relays, circuits</li><li>b) The insulating properties of dry chemicals may render electrical equipment inoperative</li><li>c) Some are slightly corrosive (acidic or alkaline)<ul style="list-style-type: none"><li>1) Most tend to be slightly alkaline</li></ul></li></ul> <p>9. No securing capabilities</p> <ul style="list-style-type: none"><li>a) Flashback or reignition is always possible</li><li>b) Never enter a spill area</li></ul> <p>10. Adversely affected by wind &amp; rain</p> <p>11. Training &amp; inexperience plays a big role in success using dry chemicals</p> <p>F. Do not mix different dry chemical agents</p> <ul style="list-style-type: none"><li>1. Some are alkaline, some are acidic</li><li>2. A chemical reaction could build up pressure &amp; explode extinguisher container</li><li>3. When recharge extinguishers, reuse of dry chemical agents is not recommended</li></ul>	<p>Slide 354 Dry Chemical &amp; Aircraft Wheel</p> <p>Slide 355 Dry Chemical On Motor</p> <p>Slide 356 Using Dry Chemical On A Large fire</p> <p>Slide 357 Dry Chemical In Wind</p> <p>Slide 358 Several Different Extinguishers</p>



# INSTRUCTOR GUIDE

## EXTINGUISHING AGENTS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>b) Followed by premixed AFFF to prevent reignition</li><li>2. A minimum rate of flow is critical<ul style="list-style-type: none"><li>a) May not extinguish fire if not enough is applied or it is applied too slowly</li></ul></li><li>3. Text extinguisher before approaching fire<ul style="list-style-type: none"><li>a) Make sure it is charged &amp; it works</li><li>b) Approach from up wind, wind at back</li><li>c) Range of extinguishers 18-20 ft.</li></ul></li><li>4. Direct stream at base of fire, six (6) inches in front of nearest edge<ul style="list-style-type: none"><li>a) Start at one side</li></ul></li><li>5. Sweep nozzle back &amp; forth until fire is extinguished<ul style="list-style-type: none"><li>a) Each sweep slightly wider than the fire</li><li>b) Slow side to side motion with arm, not wrist action</li></ul></li><li>6. Work fire to back of spill</li><li>7. Obstacles in the spill may require a multiple attack</li><li>8. Do not walk in spill<ul style="list-style-type: none"><li>a) Stay on perimeter of spill</li><li>b) Always danger of reignition, reflash unless spill is covered with foam</li></ul></li><li>I. Types of dry chemicals available</li></ul>	<p>Slide 361 Approaching Fire</p> <p>Slide 362 Nearest Edge</p> <p>Slide 363 Sweeping Nozzle</p> <p>Slide 364 Working Fire Back To Spill</p> <p>Slide 365 Multiple Attack</p> <p>Slide 366 Chart Of Dry Chemical Agents</p>

# INSTRUCTOR GUIDE

EXTINGUISHING AGENTS

PRESENTATION	APPLICATION
<ol style="list-style-type: none"><li>1. Sodium bicarbonate<ol style="list-style-type: none"><li>a) Baking soda</li><li>b) First used in Germany, 1912</li><li>c) BC agent<ol style="list-style-type: none"><li>1) Twice as effective as CO<sub>2</sub></li></ol></li><li>d) 1960's<ol style="list-style-type: none"><li>1) Silicon coated to render it compatible with protein foams</li><li>2) Reduction in particle size</li><li>3) Particle size has a definite effect on extinguishing ability</li></ol></li></ol></li><li>2. Potassium bicarbonate<ol style="list-style-type: none"><li>a) Purple K<ol style="list-style-type: none"><li>1) K - symbol for potassium</li><li>2) Purple - purple flame spectra it demonstrates when it encounters flame temperatures</li><li>3) Usually dyed purple, violet</li></ol></li><li>b) Developed by U.S. Navy, 1959</li><li>c) Most common dry chemical for aircraft applications, twin agent systems</li><li>d) Five (5) times more effective than CO<sub>2</sub><ol style="list-style-type: none"><li>1) Twice as effective as sodium bicarbonate</li></ol></li><li>e) Slightly alkaline</li></ol></li><li>3. Potassium chloride</li></ol>	

# INSTRUCTOR GUIDE

EXTINGUISHING AGENTS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>a) Super K</li><li>b) Developed in 1964</li><li>c) As efficient as Purple K</li><li>d) Corrosion problems with steel &amp; aluminum<ul style="list-style-type: none"><li>1) Will damage aircraft parts</li></ul></li></ul> <p>4. Monnex</p> <ul style="list-style-type: none"><li>a) Reaction product of urea &amp; potassium bicarbonate</li><li>b) Developed 1967</li><li>c) Most effective dry chemical<ul style="list-style-type: none"><li>1) Twice as effective as Purple K</li><li>2) Large particles, when subjected to heat, breaks down into smaller particles</li></ul></li></ul> <p>5. Monoammonium phosphate</p> <ul style="list-style-type: none"><li>a) Multipurpose (ABC) dry chemical</li><li>b) Developed in 1950's in Germany</li><li>c) Decomposes when heated &amp; forms a molten, sticky residue which adheres to heated surfaces<ul style="list-style-type: none"><li>1) Called metaphosphoric acid</li><li>2) Seals glowing material from oxygen</li><li>3) Becomes sticky, not recommended for use on fine machinery parts, such as found on aircraft</li></ul></li></ul>	

# INSTRUCTOR GUIDE

## EXTINGUISHING AGENTS

PRESENTATION	APPLICATION
<p>J. Other agents such as sand, dirt, graphite act as absorbents</p> <ol style="list-style-type: none"><li>1. Lower evaporation rate, vaporization of flammable liquids</li><li>2. Control spill surface area<ol style="list-style-type: none"><li>a) The less area involved, the less of a hazard</li></ol></li></ol>	<p>Slide 367 Absorbants</p>
<p>K. Types of extinguishers</p> <ol style="list-style-type: none"><li>1. Agent is stored in a pressure container, usually of welded steel construction</li><li>2. Either:<ol style="list-style-type: none"><li>a) Under atmospheric pressure until system is actuated</li><li>b) Or under pressure of an internally stored expellant gas</li></ol></li><li>3. Three types of extinguishers<ol style="list-style-type: none"><li>a) Difference is type of sealing method or means by which container is pressurized</li></ol></li><li>4. Stored pressure extinguishers<ol style="list-style-type: none"><li>a) Expellant gas &amp; agent are stored in a single chamber</li><li>b) Or under pressure of an internally stored expellant gas</li></ol></li><li>3. Three types of extinguishers<ol style="list-style-type: none"><li>a) Difference is type of sealing method or means by which container is pressurized</li></ol></li><li>4. Stored pressure extinguishers<ol style="list-style-type: none"><li>a) Expellant gas &amp; agent are stored in a single chamber</li></ol></li></ol>	<p>Slide 368 Different Extinguishers</p>
<ol style="list-style-type: none"><li>4. Stored pressure extinguishers<ol style="list-style-type: none"><li>a) Expellant gas &amp; agent are stored in a single chamber</li></ol></li></ol>	<p>Slide 369 Stored Pressure Extinguishers</p>

# INSTRUCTOR GUIDE

## EXTINGUISHING AGENTS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>b) Requires special recharging equipment</li><li>c) Found in areas where high use is not encountered, anticipated</li></ul> <p>5. Cartridge operated extinguishers</p> <ul style="list-style-type: none"><li>a) The expellant gas is stored in separate cartridge located within or adjacent to container or agent</li><li>b) Not under pressure until actuated</li><li>c) Constructed so gas flows into tank &amp; agitates the dry chemical</li><li>d) Control valve/nozzle usually at end of discharge hose</li><li>e) Easy to recharge</li><li>f) Large wheeled units of this type are usually found adjacent to fueling &amp; parking areas for large jet aircraft</li></ul> <p>6. Sealed pressure extinguishers</p> <ul style="list-style-type: none"><li>a) Dispensable</li><li>b) Nonrefillable</li><li>c) Usually small, less than 5 lbs.</li></ul> <p>L. Class B ratings</p> <ol style="list-style-type: none"><li>1. Number designating the rating represents the square ft. of fire area that a non-expert operator can expect to extinguish<ul style="list-style-type: none"><li>a) 40 BC equals 40 square ft.</li><li>b) An expert can extinguish 2 1/2 times what a non-expert can</li><li>c) Fire fighters are considered experts</li></ul></li></ol>	<p>Slide 370 Cartridge Operated Extinguishers</p> <p>Slide 371 Wheeled Unit</p> <p>Slide 372 Sealed Pressure Extinguishers</p> <p>Slide 373 Class B Ratings</p>

# INSTRUCTOR GUIDE

EXTINGUISHING AGENTS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>2. Rating test<ul style="list-style-type: none"><li>a) Square pan with 2 inches of gasoline</li><li>b) 1 minute preburn</li></ul></li> <li>III. Extinguishing Agents - Halons<ul style="list-style-type: none"><li>A. Halogenated hydrocarbons<ul style="list-style-type: none"><li>1. Also called:<ul style="list-style-type: none"><li>a) Halons</li><li>b) Halocarbons</li><li>c) Vaporizing liquids</li></ul></li><li>2. Liquid organic compounds with vapor forming properties</li></ul></li><li>B. Halons are hydrocarbons (methane or ethane) in which one or more atoms have been replaced by atoms from the halogen series<ul style="list-style-type: none"><li>1. Found on the right side of the periodic table of elements<ul style="list-style-type: none"><li>a) Fluorine</li><li>b) Chlorine</li><li>c) Bromine</li><li>d) Iodine</li></ul></li><li>2. All are highly oxidizing materials<ul style="list-style-type: none"><li>a) By adding a halogen, this adds nonflammability &amp; flame extinguishing properties</li><li>b) The first three (not iodine) are commonly found in halon extinguishing agents</li></ul></li></ul></li></ul></li></ul>	<p>Slide 374 "Halons"</p>



# INSTRUCTOR GUIDE

EXTINGUISHING AGENTS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>4) Therefore, Halon 1301 is less toxic &amp; turns into a vapor faster than 1211</li><li>b) The more chlorine in the molecule:<ul style="list-style-type: none"><li>1) Increases fire extinguishing ability, toxicity &amp; boiling point</li><li>2) Rescues thermal stability</li><li>3) Halon 1211 has one chlorine atom in each molecule compared to none in 1301</li><li>4) Therefore 1211 is more toxic &amp; stays liquid longer</li><li>5) This is why 1211 is used in portable extinguishers instead of 1301, because it will stay liquid long enough to be squirted on the fire</li></ul></li><li>c) Bromine atoms add the same qualities as chlorine atoms, only greater</li><li>5. British Fire Service use initials, capital alphabet system<ul style="list-style-type: none"><li>a) Will see this system on containers of halon used to refill extinguishers or systems</li><li>b) 1211 - BCF</li><li>c) 1301 - BTM</li><li>d) Carbon tetrachloride - CTC</li></ul></li><li>D. Characteristics of halogenated extinguishing agents<ul style="list-style-type: none"><li>1. Colorless</li><li>2. Odorless</li><li>3. Nonconductive, Class C rated</li></ul></li></ul>	<p>Slide 377 BCF Cylinder</p> <p>Slide 378 Bottle Of 1211 Liquid</p>

# INSTRUCTOR GUIDE

EXTINGUISHING AGENTS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>4. Limited corrosive residue<ul style="list-style-type: none"><li>a) Depends on heat of fire</li><li>b) Amount of moisture present</li></ul></li><li>5. High liquid densities<ul style="list-style-type: none"><li>a) Permits compact storage in containers</li></ul></li><li>6. Their vapors are heavier than air<ul style="list-style-type: none"><li>a) They will readily sink &amp; stay in the region of the base of the flames</li><li>b) Once mixed with air, will not settle out</li></ul></li><li>E. Mechanism of extinguishment<ul style="list-style-type: none"><li>1. Halons interrupt the combustion chemical chain reaction sequence<ul style="list-style-type: none"><li>a) How or why is not clearly understood</li><li>b) Very little is known about combustion kinetics</li><li>c) It is obvious that chemical reactions are involved because these agents are considerably more effective than processes of heat removal &amp; smothering can account for</li></ul></li><li>2. When a "halon" type agent contacts the heat &amp; burning gases of flames, a decomposition of the halon takes place<ul style="list-style-type: none"><li>a) Free activated atoms of halogens (F, Cl, Br) are evolved in the flame matrix</li><li>b) These atoms quickly react with the highly active fire radicals of O, OH, C, &amp; H</li></ul></li></ul></li></ul>	<p>Slide 379 Flame Chemicals</p>

# INSTRUCTOR GUIDE

## EXTINGUISHING AGENTS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>c) The halogens remove them from further heat producing reactions</li><li>d) A quenching takes place</li><li>e) Similar to dry chemical</li></ul> <p>3. Excellent on three (3) dimensional liquid fires</p> <ul style="list-style-type: none"><li>a) Spraying, flowing, pressure fires</li></ul> <p>4. Extinguishing concentrations of 4-6% by volume of air</p> <ul style="list-style-type: none"><li>a) 2 1/2 times more effective than CO<sub>2</sub></li></ul> <p>5. On class A, ordinary combustibles, may require a soaking time for the halon vapor to reach deep seated fire</p> <p>6. Halons lack sufficient cooling or vapor sealing affect</p> <ul style="list-style-type: none"><li>a) Reignition may occur (flashback)</li><li>b) Do not enter a fuel spill unless it is covered with a proper foam blanket</li></ul>	<p>Slide 380 Spraying Gasoline Fire</p>
<p>H. Types of halons used today</p> <p>1. Halon 1301</p> <ul style="list-style-type: none"><li>a) BTM</li><li>b) Both 1301 &amp; 1211 are used in aircraft onboard extinguishing systems<ul style="list-style-type: none"><li>1) Every commercial airliner built since DC-7 has a 1301 system in its engine nucleus</li><li>2) Lower cargo compartments on 747, DC-10, &amp; L1011 have 1301 systems</li></ul></li><li>c) 10% more effective than 1211</li></ul>	<p>Slide 381 Halon 1301 Cylinder</p>

# INSTRUCTOR GUIDE

## EXTINGUISHING AGENTS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>1) Requires 10% less agent to put out the same amount of fire as 1211</li><li>d) Lower boiling point ( -70° F)<ul style="list-style-type: none"><li>1) Vaporizes at atmospheric pressure &amp; room temperature</li><li>2) Therefore, not conducive to use in portable extinguishers</li><li>3) Vaporizes immediately at nozzle &amp; will not discharge a stream</li><li>4) Used only in total flooding systems</li></ul></li></ul>	
<ul style="list-style-type: none"><li>2. Halon 1211<ul style="list-style-type: none"><li>a) BCF</li><li>b) Higher boiling point than 1301<ul style="list-style-type: none"><li>1) Stays liquid longer</li><li>2) Will project in a liquid stream</li><li>3) Allows application from a safer operating distance</li></ul></li><li>c) Used in portable extinguishers on aircraft &amp; in systems on CFR vehicles</li></ul></li></ul>	Slide 382 Halon 1211 Extinguisher
<ul style="list-style-type: none"><li>3. Halon 2402<ul style="list-style-type: none"><li>a) Dibromotetrafluoroethane</li><li>b) Very toxic</li></ul></li></ul>	Slide 383 NFPA Standard On 2402
<ul style="list-style-type: none"><li>I. Halons can be corrosive to metals in the presence of moisture<ul style="list-style-type: none"><li>1. Forms acids with moisture</li><li>2. Depends on aircraft engine heat</li><li>3. If using halon on an aircraft engine fire:</li></ul></li></ul>	Slide 384 Jet Engine

# INSTRUCTOR GUIDE

EXTINGUISHING AGENTS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>a) Run engine within one (1) hour of incident</li><li>b) If not possible, apply dry, warm or compressed air to maintain between dew point &amp; ignition temperature</li><li>c) Or use maximum ventilation with smoke ejectors or fans</li></ul> <p>J. 1301 &amp; 1211 can be toxic</p> <ul style="list-style-type: none"><li>1. 1301 is least toxic of the two</li><li>2. Low concentrates (7-10%) lead to:<ul style="list-style-type: none"><li>a) Dizziness</li><li>b) Impaired coordination</li><li>c) Reduced mental acuity</li><li>d) Symptoms quickly disappear with fresh air</li></ul></li><li>3. Prolonged exposure at high concentrations could lead to unconsciousness &amp; death</li><li>4. Avoid:<ul style="list-style-type: none"><li>a) Over 10% volume in air of 1301</li><li>b) Over 4% volume in air of 1211</li></ul></li><li>5. Lethal concentrations for over 15 minutes<ul style="list-style-type: none"><li>a) 83% - 1301</li><li>b) 32% - 1211</li></ul></li></ul>	<p>Slide 385 Halon Toxicity Chart</p>
<p>K. Halon decomposition, combustion breakdown products are very toxic</p> <ul style="list-style-type: none"><li>1. Avoid breathing smoke after extinguishing a fire using halon extinguishing agents<ul style="list-style-type: none"><li>a) Always wear SCBA when using halons</li></ul></li></ul>	<p>Slide 386 Decomposition Products Of Halons</p>

# INSTRUCTOR GUIDE

EXTINGUISHING AGENTS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>b) Characteristic sharp, acrid odors</li><li>L. Ozone layer damage</li></ul> <p>IV. Extinguishing Agents - Carbon Dioxide</p> <ul style="list-style-type: none"><li>A. Normally used in aircraft fire fighting as a supplementary, secondary agent<ul style="list-style-type: none"><li>1. To control small fires in incipient stage</li><li>2. Control or extinguish fires in concealed or inaccessible locations</li><li>3. Portable extinguishers</li><li>4. Total flooding systems</li><li>5. Not used much any more in aircraft applications</li></ul></li><li>B. Colorless, nonflammable, almost odorless and tasteless<ul style="list-style-type: none"><li>1. Inexpensive<ul style="list-style-type: none"><li>a) Much cheaper than halon 1211 or 1301</li></ul></li><li>2. Readily &amp; easily available</li><li>3. Noncombustible, does not react with most substances</li><li>4. Provides its own pressure for discharge</li><li>5. Displaces oxygen</li><li>6. Excellent flooding characteristics<ul style="list-style-type: none"><li>a) CO<sub>2</sub> gas can penetrate &amp; spread to all parts of fire area</li><li>b) Distributes itself rapidly</li><li>c) Gaseous diffusion will persist around fire area for considerable time (if area is closed up or confined)</li></ul></li></ul></li></ul>	<p>Slide 387 "Carbon Dioxide"</p> <p>Slide 388 Old Air Force CO<sub>2</sub> ARFF Vehicle</p> <p>Slide 389 Discharging CO<sub>2</sub></p>

# INSTRUCTOR GUIDE

EXTINGUISHING AGENTS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>7. Nonconductive, will not conduct electricity</li><li>8. Leaves no residue, eliminates cleanup due to agent discharge</li><li>9. Noncorrosive, nondamaging to aircraft electrical &amp; machinery parts &amp; systems</li><li>10. Under normal conditions is naturally a gas<ul style="list-style-type: none"><li>a) Easily liquified by compressing &amp; cooling</li></ul></li><li>D. Two ways to store CO<sub>2</sub> for fire fighting applications<ul style="list-style-type: none"><li>1. High pressure cylinders at normal ambient temperatures<ul style="list-style-type: none"><li>a) 32 to 120° F ambient temperature</li><li>b) Limited to portable extinguishers or manifold systems</li><li>c) Stored at approximately 850 psi</li><li>d) Measured by weight<ul style="list-style-type: none"><li>1) A 15 lb. CO<sub>2</sub> extinguisher weighs approximately 45 lbs. but contains 15 lbs. of CO<sub>2</sub></li><li>2) Full &amp; empty weight stamped near neck of cylinder</li></ul></li><li>e) Cylinders<ul style="list-style-type: none"><li>1) Spun steels</li><li>2) Seamless, nonshatterable</li><li>3) Hydrostatic test required every five (5) years</li><li>4) Hydro date(s) stamped on cylinder</li></ul></li></ul></li></ul></li></ul>	<p>Slide 390 Standard CO<sub>2</sub> Cylinder</p>

# INSTRUCTOR GUIDE

## EXTINGUISHING AGENTS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>5) Safety disc on cylinder will relieve if cylinder is overpressurized</li><li>6) Multiple orifices at valve to prevent recoil if relieves</li></ul> <p>2. Low pressure, refrigerated &amp; insulated containers</p> <ul style="list-style-type: none"><li>a) Stored at 300 psig</li><li>b) 0° F storage temperature</li></ul> <p>E. Reduces oxygen content of atmosphere by dilution to a point where no longer will support combustion</p> <p>1. Ability to replace air, or displace oxygen above burning surface &amp; maintain a smothering atmosphere</p> <ul style="list-style-type: none"><li>a) 1 1/2 times the density (weight) of air</li></ul> <p>2. Application, extinguishing concentrations</p> <ul style="list-style-type: none"><li>a) Varies from 21 to 62% ratio to air depending on the material burning</li><li>b) 28% needed for aviation fuels</li><li>c) Higher concentration &amp; flooding time needed if fire penetrates below surface in ordinary combustibles that provide thermal insulation</li></ul> <p>3. When liquid carbon dioxide is released/discharged into atmosphere:</p> <ul style="list-style-type: none"><li>a) Rapidly reverts to a gaseous form</li><li>b) White cloudy appearance due to finely diverted dry ice particles &amp; condensation of water vapor from atmosphere</li></ul>	<p>Slide 391 Fixed Low Pressure System At Jet Engine Testing Building, Travis AFB</p> <p>Slide 392 Chart Of Extinguishing Concentrations</p> <p>Slide 393 Displaces Oxygen</p>

# INSTRUCTOR GUIDE

EXTINGUISHING AGENTS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>c) Can interfere with visibility</li><li>4. Some slight cooling effect<ul style="list-style-type: none"><li>a) Discharges at 110° F</li><li>b) Cooling capability<ul style="list-style-type: none"><li>1) 60 BTU/pound - high pressure CO<sub>2</sub></li><li>2) 110 BTU/pound - low pressure CO<sub>2</sub></li><li>3) 1/10th the cooling capacity of water</li><li>4) Can chill a warm can of beer</li><li>5) Can crack hot metal (aircraft hot brakes or wheel fire)</li></ul></li><li>c) Natural cooling takes place quickly flammable liquids<ul style="list-style-type: none"><li>1) Approximately 30 seconds with gasoline after extinguishment</li><li>2) Metal holds heat much longer</li></ul></li></ul></li><li>F. Drawbacks of using Carbon Dioxide<ul style="list-style-type: none"><li>1) Nonpermanent, temporary extinguishing agent<ul style="list-style-type: none"><li>a) Gas is rapidly dissipated in open outdoor, nonconfined areas</li><li>b) No vapor sealing property</li><li>c) Always the danger of flashback with CO<sub>2</sub></li><li>d) Fire fighting foam is only agent that will prevent reflash or reignition of aircraft fuels (for a period of time)</li></ul></li></ul></li></ul>	<p>Slide 394 CO<sub>2</sub> Snow</p> <p>Slide 395 CO<sub>2</sub> Characteristics Chart</p> <p>What is the only agent that will prevent reflash or reignition of aircraft fuels?</p>

# INSTRUCTOR GUIDE

EXTINGUISHING AGENTS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>2. Atmospheric conditions, particularly wind, may interfere with effectiveness of CO<sub>2</sub></li><li>3. Discharge of carbon dioxide generates static electricity<ul style="list-style-type: none"><li>a) Sufficient to create a spark capable of igniting flammable vapors</li></ul></li><li>4. Carbon dioxide can be toxic in sufficient concentrations<ul style="list-style-type: none"><li>a) Can produce unconsciousness &amp; death in fire extinguishing concentrations<ul style="list-style-type: none"><li>1) Over 9% by volume with air</li></ul></li><li>b) Affects &amp; influences vital body functions<ul style="list-style-type: none"><li>1) Control of respiration</li><li>2) Dilation &amp; constriction of crebrum blood vessels</li><li>3) PH of body fluids</li></ul></li></ul></li><li>G. Why isn't nitrogen used as an extinguishing agent?<ul style="list-style-type: none"><li>1. Nitrogen is an inert gas</li><li>2. Not easily compressible</li><li>3. Expensive</li><li>4. Must be stored at high pressures in a gaseous state</li><li>5. Slightly lighter than air<ul style="list-style-type: none"><li>a) Difficult to direct or maintain around seat of fire</li></ul></li></ul></li></ul>	

# INSTRUCTOR GUIDE

## EXTINGUISHING AGENTS

PRESENTATION	APPLICATION
<p>V. Extinguishing Agents - Dry Powders</p> <p>A. Class D, combustible/exotic metal extinguishing agents</p> <ol style="list-style-type: none"><li>1. Do not confuse with dry chemicals<ol style="list-style-type: none"><li>a) Used for flammable/combustible liquid, Class B fires</li><li>b) Yellow star symbol on extinguishers</li></ol></li></ol> <p>B. A variety of metals burn or support combustion</p> <ol style="list-style-type: none"><li>1. Especially in finely divided form</li><li>2. Metals usually require large inputs of heat before they reach ignition temperature<ol style="list-style-type: none"><li>a) Metals can be heated to high temperatures by friction or exposure to external heat</li></ol></li><li>3. Combustible metals tend to burn at much higher temperatures than Class A or B materials<ol style="list-style-type: none"><li>a) Flammable liquids - approximately 1500° F</li><li>b) Combustible metals - approximately 2500 to over 3000° F</li></ol></li><li>4. Combustible metals can burn in inert atmospheres of nitrogen &amp; carbon dioxide</li><li>5. Combustible metals produce an additional &amp; complicated problem in fire extinguishment when involved in an aircraft fire</li></ol> <p>C. Aircraft structural metals that can burn</p> <ol style="list-style-type: none"><li>1. Magnesium, titanium, aluminum, &amp; composite materials (Carbon/graphite or boron tungsten fibers)</li></ol>	<p>Slide 396 "Dry Powders"</p> <p>Slide 397 Class D, Yellow Star</p> <p>Slide 398 Metal Products Company</p> <p>Slide 399 Aircraft Construction/Manufacturing</p>

# INSTRUCTOR GUIDE

EXTINGUISHING AGENTS

PRESENTATION	APPLICATION
<p>2. Magnesium</p> <ul style="list-style-type: none"><li>a) Silvery, white metal</li><li>b) Lightest known structural metal that possesses the properties of:<ul style="list-style-type: none"><li>1) Performance</li><li>2) Stability</li><li>3) Light weight</li></ul></li><li>c) Not easily ignited as a solid<ul style="list-style-type: none"><li>1) Depends on thickness, size, &amp; shape</li></ul></li><li>d) Found in most large aircraft</li><li>e) Used in:<ul style="list-style-type: none"><li>1) Landing gear components</li><li>2) Engine mountings</li><li>3) Wheels</li><li>4) Power plant, engine parts</li></ul></li></ul> <p>3. Titanium</p> <ul style="list-style-type: none"><li>a) Silver, gray metal</li><li>b) As strong as steel, half as heavy</li><li>c) Three times stronger than aluminum alloys</li><li>d) Its ignition temperature is close to its melting point, (3, 140° F)</li></ul> <p>4. Aluminum</p> <ul style="list-style-type: none"><li>a) Durilium, aluminum alloy used on aircraft</li></ul>	<p><u>Instructor Note:</u> The following information covered under Section C was addressed under the previous Aircraft Familiarization Section (IV). It is optional, and can be omitted by the instructor or covered again to reinforce student learning</p>

# INSTRUCTOR GUIDE

EXTINGUISHING AGENTS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>b) Will burn &amp; support combustion under right circumstances</li><li>c) Melts at 1200° F<ul style="list-style-type: none"><li>1) Jet aircraft are extensively constructed of aluminum</li><li>2) A jet fuselage exposed to direct flame contact can begin to fail in 90-120 seconds</li></ul></li><li>d) Water or foam can usually handle aluminum, where magnesium &amp; titanium require special extinguishing agents</li></ul> <p>5. Composite materials</p> <ul style="list-style-type: none"><li>a) Carbon/graphite fibers (also called corker)<ul style="list-style-type: none"><li>1) Used on advanced military aircraft to provide:<ul style="list-style-type: none"><li>o Superior stiffness, lighter than aluminum, yet stronger than steel</li><li>o High strength to weight ratio</li><li>o Ease of fabrication</li><li>o To replace heavier metal components</li></ul></li><li>2) Carbon/graphite fibers can be released into air<ul style="list-style-type: none"><li>o When epoxy binder burns</li><li>o By mechanical agitation caused crash or explosion of the aircraft</li></ul></li><li>3) Fibers can be transported several miles by air currents</li></ul></li></ul>	<p>How many here have been to a mobile home fire?</p>

# INSTRUCTOR GUIDE

EXTINGUISHING AGENTS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>4) Because of their high electrical conductivity, these fibers can damage unprotected electronic equipment</li><li>5) Inhalation of composite fibers is harmful to personnel</li><li>6) Danger similar to asbestos fibers</li><li>b) Boron/tungsten fibers<ul style="list-style-type: none"><li>1) Less of a hazard to equipment<ul style="list-style-type: none"><li>o Heavier, less likely to become airborne</li><li>o Less electrically conductive</li></ul></li><li>2) Same health hazards as carbon/graphite fibers</li></ul></li><li>c) Composite materials found on F model fighter aircraft &amp; AV-8B<ul style="list-style-type: none"><li>1) Over 40% of F-18's surface area is composed of composite material</li></ul></li><li>d) Extinguish fires involving advanced military aircraft as quickly as possible</li><li>e) Provide maximum containment of aircraft debris</li><li>f) Treat incident &amp; conduct area cleanup as if it was a hazardous material spill incident</li><li>g) Work from up wind, wear SCBA &amp; full protective gear, &amp; decontaminate</li></ul>	
<p>D. Hazards of magnesium &amp; titanium</p> <ul style="list-style-type: none"><li>1. For all practical purposes, hazards the same for both materials</li></ul>	<p>Slide 400 Burning Magnesium &amp; Water</p>

# INSTRUCTOR GUIDE

## EXTINGUISHING AGENTS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>2. Burn at extremely high temperatures<ul style="list-style-type: none"><li>a) Constant threat/problem around flammable liquids and/or vapors</li></ul></li><li>3. Explosive reaction with certain extinguishing agents<ul style="list-style-type: none"><li>a) The flame zone in burning combustible metals is high temperature &amp; highly reactive area</li><li>b) Water &amp; water based agents increase intensity of burning metal fires<ul style="list-style-type: none"><li>1) Steam &amp; hydrogen explosions</li></ul></li></ul></li><li>4. Continue to burn even in inert atmospheres of:<ul style="list-style-type: none"><li>a) Nitrogen</li><li>b) Carbon dioxide</li></ul></li><li>5. Burning combustible metals give off toxic products of combustion<ul style="list-style-type: none"><li>a) Wear full turnouts &amp; SCBA</li></ul></li></ul> <p>E. Despite a large amount of investigation, no really successful material or agent has been developed to halt the vigorous, high temperature oxidation of burning combustible metals</p> <ul style="list-style-type: none"><li>1. Most agents work by:<ul style="list-style-type: none"><li>a) Withdrawing oxygen in some way<ul style="list-style-type: none"><li>1) Smothering</li><li>2) Inerting</li></ul></li><li>b) Cooling in some way<ul style="list-style-type: none"><li>1) Radiation or heat removal</li></ul></li></ul></li></ul>	<p>Slide 401 Burning Magnesium</p>

# INSTRUCTOR GUIDE

## EXTINGUISHING AGENTS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>2) Lower the temperature of the mass of burning metal below its ignition temperature</li><li>2. Most agents require copious amounts to control a metal fire</li><li>3. Successful control and/or extinguishment of metal fires depends on:<ul style="list-style-type: none"><li>a) Method of application</li><li>b) Training &amp; experience</li><li>c) Prior knowledge of capabilities &amp; limitations of agents &amp; associated equipment is vital in emergency situations</li></ul></li><li>F. Application/extinguishment techniques<ul style="list-style-type: none"><li>1. Dry powder extinguishers<ul style="list-style-type: none"><li>a) From a distance of several feet, cautiously feather a soft, heavy flow over burning metal mass</li><li>b) Avoid blowing burning metal into other areas</li><li>c) Extinguishers not designed to shoot a stream of powder like dry chemical extinguishers<ul style="list-style-type: none"><li>1) Only gently burps dry powder onto metal</li></ul></li><li>d) Most dry powders can also be applied with a shovel right from the shipping container (pail or box)</li><li>e) Dry powder agents are only useful on small fires</li></ul></li><li>2. Large burning metal pieces<ul style="list-style-type: none"><li>a) Use a high volume application of water in heavy, coarse streams</li></ul></li></ul></li></ul>	<p>How many of you have used a Class D type extinguisher or fought a metal fire?</p> <p>Slide 402 Extinguisher Instruction Panel</p>

# INSTRUCTOR GUIDE

EXTINGUISHING AGENTS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>1) Not using enough water can accelerate fire rather than cool</li><li>b) With heavy, high pressure stream, break loose burning molten metal from aircraft parts<ul style="list-style-type: none"><li>1) Prevent unburned metal from reaching ignition temperature</li><li>2) At first will intensify fire with considerable sparking, showering of burning metal</li></ul></li><li>3. Small pieces<ul style="list-style-type: none"><li>a) Using a shovel or tractor, segregate or remove from fire area</li><li>b) Separate fire control treatment<ul style="list-style-type: none"><li>1) Cover with dirt, sand, cement</li><li>2) Drop in a barrel of water</li><li>3) Remove it to another location &amp; let it burn out</li></ul></li></ul></li><li>4. If unable to extinguish burning metal, maintain foam blanket around it until it burns out</li><li>G. Met-L-X dry powder<ul style="list-style-type: none"><li>1. Most common dry powder used in aircraft applications</li><li>2. Sodium chloride base with additives<ul style="list-style-type: none"><li>a) Tricalcium chloride to improve flow</li><li>b) Metal sterates for water repellency</li><li>c) Thermoplastic material to bind sodium chloride particles into a solid mass under fire conditions</li></ul></li></ul></li></ul>	<p>Slide 403 Met-L-X Extinguisher</p>

# INSTRUCTOR GUIDE

EXTINGUISHING AGENTS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>3. Nontoxic<ul style="list-style-type: none"><li>a) No known health hazard from use</li></ul></li><li>4. Nonabrasive</li><li>5. Nonconductive</li><li>6. Indefinite shelf life</li><li>7. Found in bulk containers or portable extinguishers</li><li>8. Has ability to cling to vertical surfaces<ul style="list-style-type: none"><li>a) Good on solid chunks such as castings</li><li>b) Heat from fire causes powder to cake, forming a crust which excludes air</li></ul></li><li>F. Other commercially available dry powders or combustible metal agents<ul style="list-style-type: none"><li>1. GI powder<ul style="list-style-type: none"><li>a) Screened graphitized foundry coke<ul style="list-style-type: none"><li>1) Organic phosphate is added</li><li>2) Combination of carefully sized particles is used to provide good packing characteristics</li></ul></li><li>b) Acts as a heat conductor<ul style="list-style-type: none"><li>1) Absorbs heat &amp; lowers metal temperature below its ignition temperature</li><li>2) The closely packed particles also help smother</li></ul></li><li>c) The organic phosphate material in agent breaks down with heat to yield a slightly smoky gas that penetrates the spaces between the graphite particles, displacing air</li></ul></li></ul></li></ul>	<p>Slide 404 Chart Of Class D Agents</p>

# INSTRUCTOR GUIDE

EXTINGUISHING AGENTS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>d) Nontoxic &amp; indefinite shelf life</li><li>e) Applied with a shovel from a box or pail type container<ul style="list-style-type: none"><li>1) Packing characteristics prevent discharge or use in hand portable extinguishers</li></ul></li><li>f) Spread it evenly over the fire surface to a depth sufficient to smother fire<ul style="list-style-type: none"><li>1) Usually 1/2 inch for finely divided metal</li><li>2) Larger chunks require additional powder</li></ul></li></ul> <p>2. TMB - Trimethoxyboroxine</p> <ul style="list-style-type: none"><li>a) Liquid agent</li><li>b) Hand held extinguishers only</li><li>c) Contains methanol to make it free flowing</li><li>d) Was used by Air Force</li><li>e) Colorless</li><li>f) Hydrolizes to form a molten boric oxide coating to exclude air<ul style="list-style-type: none"><li>1) Water than gently applied to cool mass without disturbing coating</li><li>2) Produces loss of boric oxide smoke</li></ul></li></ul> <p>3. Inert gas blanketing</p> <ul style="list-style-type: none"><li>a) Only completely inert gases are:<ul style="list-style-type: none"><li>1) Argon</li><li>2) Helium</li></ul></li></ul>	

# INSTRUCTOR GUIDE

EXTINGUISHING AGENTS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>3) Neon</li><li>4. Lith-X powder<ul style="list-style-type: none"><li>a) Graphite based</li><li>b) Hand held extinguishers only</li><li>c) Excludes air &amp; conducts heat away</li><li>d) Does not cling to hot surfaces<ul style="list-style-type: none"><li>1) Must cover burning metal completely</li></ul></li><li>e) Designed for burning lithium, but works on magnesium</li></ul></li><li>5. Foundry flux</li><li>6. Pyromet powder<ul style="list-style-type: none"><li>a) Specially processed sodium chloride (table salt)</li><li>b) Plus diammonium phosphate &amp; protein</li></ul></li><li>7. Common cement<ul style="list-style-type: none"><li>a) What machine shops use</li><li>b) Controls burning metal piece(s) only until they burn out</li></ul></li></ul>	
<p>VI. Extinguishing Agents - Water</p> <ul style="list-style-type: none"><li>A. Do not forget plain water<ul style="list-style-type: none"><li>1. Tremendous potential for an ordinary Class A fire on large jet aircraft<ul style="list-style-type: none"><li>a) Aircraft interiors mainly plastics</li><li>b) Cargo</li><li>c) Baggage</li></ul></li></ul></li></ul>	<p>Slide 405 "Water"</p> <p>Slide 406 Water Hose Stream</p>

# INSTRUCTOR GUIDE

EXTINGUISHING AGENTS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>d) Tires</li><li>2. Ordinary combustibles require cooling &amp; quenching for extinguishment</li><li>3. Air Canada<ul style="list-style-type: none"><li>a) Large loss of life due to an interior fire</li><li>b) Easy for airport &amp; aircraft fire fighters to get tunnel vision<ul style="list-style-type: none"><li>1) Constantly training on flammable liquid fires with foam</li></ul></li><li>c) Aircraft interior fires often require techniques &amp; tactics similar to a structure fire<ul style="list-style-type: none"><li>1) Direct or indirect interior fire fighting</li><li>2) Ventilation</li><li>3) Confinement</li></ul></li></ul></li></ul>	<p>Slide 407 Air Canada, Cincinnati Fire</p>
<ul style="list-style-type: none"><li>B. Water, like foam or any other aqueous extinguishing agent conducts electricity<ul style="list-style-type: none"><li>1. Possible to conduct electrical charge along water stream to fire fighters</li><li>2. Disconnection of aircraft electrical power should always be one of the first priorities in all aircraft fires</li></ul></li></ul>	<p>Slide 408 Disconnecting Aircraft Battery</p>
<ul style="list-style-type: none"><li>C. Water fog may be used effectively in certain aircraft situations<ul style="list-style-type: none"><li>1. Best cooling agent<ul style="list-style-type: none"><li>a) Protect &amp; cool fuselage</li><li>b) Not recommended as only agent for aircraft fire fighting</li></ul></li></ul></li></ul>	<p>Slide 409 Cool Equipment</p>

# INSTRUCTOR GUIDE

## EXTINGUISHING AGENTS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>c) May initially be the only agent available at an off airport crash</li><li>2. Can be used to relocate, sweep burning fuel away from exposures<ul style="list-style-type: none"><li>a) Sweep unignited fuel spills away from hazardous areas to locations easier to deal with<ul style="list-style-type: none"><li>1) Be careful washing down fuel spills</li><li>2) Extensive environmental regulations &amp; penalties if done improperly</li></ul></li><li>b) Control vapor clouds</li></ul></li><li>3. Straight streams are not recommended when fighting fuel fires with water<ul style="list-style-type: none"><li>a) A modified, coarse fog stream is recommended</li><li>b) From a low angle, profile</li><li>c) Approximately 30° pattern is recommended</li></ul></li><li>4. Different technique with water than with foam<ul style="list-style-type: none"><li>a) Foam<ul style="list-style-type: none"><li>1) Gentle application</li><li>2) Straight stream makes best foam</li><li>3) Rainfall method</li></ul></li><li>b) Water<ul style="list-style-type: none"><li>1) High velocity</li><li>2) High pressure best</li></ul></li></ul></li></ul>	<p>Slide 410 Sweeping Fuel Away</p> <p>Slide 411 Water Stream From A ARFF Vehicle</p>

# INSTRUCTOR GUIDE

## EXTINGUISHING AGENTS

PRESENTATION	APPLICATION
5. Water can be used to furnish personnel with protection from extreme radiant heat	Slide 412 Fire Personnel Behind A Fog Stream
D. Water has limited extinguishing ability on large flammable liquid fires <ol style="list-style-type: none"><li>1. Large surface area, square footage involved<ol style="list-style-type: none"><li>a) The larger the fire, the more BTU's heat energy</li></ol></li><li>2. Fuel in depth</li><li>3. Low expansion foam is the first choice</li></ol>	Slide 413 Large Aircraft Fuel Fire
4. A thin film of jet fuel could be extinguished with water <ol style="list-style-type: none"><li>a) Jet A (JP-5) only</li><li>b) Flash point of 100 to 140° F</li><li>c) Possible to cool fuel below its ignition temperature<ol style="list-style-type: none"><li>1) Hydrant water is usually approximately 60° F</li></ol></li></ol>	Slide 414 Oil Fire Fighting School
E. Improper use of water can make fuel fire situations worse <ol style="list-style-type: none"><li>1. All aircraft fuels float on water</li><li>2. Misuse of water can spread &amp; increase area of burning fuel</li></ol>	Slide 415 Burning Fuel On Water
F. It is important to establish a water supply at large aircraft incidents <ol style="list-style-type: none"><li>1. To refill airport apparatus</li><li>2. Protect exposures &amp; extinguish exposure fires</li><li>3. Methods</li></ol>	Slide 416 Refilling A ARFF Vehicle With Water

# INSTRUCTOR GUIDE

EXTINGUISHING AGENTS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>a) Large diameter hose</li><li>b) Tankers</li><li>c) Underground &amp; above ground hydrants</li></ul> <p>G. Using water on wheel fires</p> <ul style="list-style-type: none"><li>1. Rapid cooling of hot wheels, especially if localized, may cause explosive failure of rim</li><li>2. Avoid (personnel &amp; equipment) lines of probable fragmentation directly out to the side of the heated wheel for at least 300 ft.</li><li>3. Solid streams of water should not be used except as a last resort</li><li>4. Dry chemical followed by cooling air from a smoke ejector or the aircraft propeller is the first choice</li></ul>	<p>Slide 417 Wheel Fire</p>
<p>H. Wetting agents may be used to increase the extinguishing efficiency of water</p> <ul style="list-style-type: none"><li>1. Wetting agents may not be compatible with certain foams</li><li>2. Wetting agents come in liquid &amp; powder form</li></ul>	<p>Slide 418 Wetting Agents</p> <p>Slide 419 Blank Slide</p>

# INSTRUCTOR GUIDE

EXTINGUISHING AGENTS

## SUMMARY

The student must understand the different characteristics, properties, and application equipment and techniques utilized for the various extinguishing agents used to combat aircraft fires. The ability to effectively extinguish fires involving aircraft determines the success or failure of most incidents.

## EVALUATION

The student will be evaluated by completing a written examination.

## ASSIGNMENT

To be determined by the Instructor(s).

# INSTRUCTOR GUIDE

PROTECTIVE CLOTHING AND  
BREATHING APPARATUS

## AIRCRAFT CRASH FIRE RESCUE

### LESSON PLAN 7

TOPIC: Protective Clothing And Breathing Apparatus

LEVEL: I

TIME: 30 Minutes

#### BEHAVIORAL OBJECTIVES:

Given: A written examination

Performance: The student will be able to identify:

1. The reasons for using protective clothing and breathing apparatus
2. The types, construction and care of protective clothing and breathing apparatus
3. The proper donning methods for protective clothing and breathing apparatus

Standard: With 70% accuracy

REFERENCES: IFSTA 206, Aircraft Fire Protection & Rescue Procedures, 2nd Edition, International Fire Service Training Association  
NFPA 1003 - Airport Fire Fighter Qualifications, National Fire Protection Association, 1987

MATERIALS NEEDED: A/V, slide projector, screen, samples of standard structural protective clothing & aircraft proximity fire fighting protective clothing, self contained breathing apparatus and face piece

PREPARATION: Fire fighter safety is paramount when working around aircraft incidents. Proper utilization of protective clothing and breathing apparatus is essential for maximum protection of personnel.

# INSTRUCTOR GUIDE

PROTECTIVE CLOTHING AND  
BREATHING APPARATUS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>I. Standards For Aircraft Fire Fighting Protective Clothing<ul style="list-style-type: none"><li>A. National Fire Protection Association (NFPA) currently developing a standard for aircraft fire fighting protective clothing<ul style="list-style-type: none"><li>1. NFPA Standard 1971 - Standard for structural fire fighting protective clothing<ul style="list-style-type: none"><li>a) Revised in 1981</li><li>b) Much of this standard also applies to aircraft protective clothing</li></ul></li></ul></li><li>B. Occupational Safety &amp; Health Administration (OSHA) Standards<ul style="list-style-type: none"><li>1. Meets or adopts NFPA standards</li></ul></li><li>C. Federal Aviation Administration (FAA) regulations/requirements<ul style="list-style-type: none"><li>1. Very vague</li><li>2. Fire fighters at certified airports must have proper protective clothing for aircraft fire fighting situations</li></ul></li></ul></li></ul>	<p>Slide 420 Lesson Plan Title "Protective Clothing &amp; Breathing Apparatus"</p> <p>Slide 421 Fire Fighters Wearing Aircraft Fire Fighting Protective Clothing</p>
<ul style="list-style-type: none"><li>II. Fire Fighting Protective Clothing<ul style="list-style-type: none"><li>A. Called turnout or bunker gear<ul style="list-style-type: none"><li>1. Use proper/right equipment</li><li>2. Make sure it fits</li><li>3. Wear it properly</li><li>4. Maintain &amp; take care of it</li><li>5. This is a dangerous occupation, give yourself every advantage</li></ul></li></ul></li></ul>	<p>Slide 422 Standard Structural Full Protective Gear</p>

# INSTRUCTOR GUIDE

PROTECTIVE CLOTHING AND  
BREATHING APPARATUS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>B. Three (3) types of fire fighting protective clothing<ul style="list-style-type: none"><li>1. Regular/standard structural protective clothing</li><li>2. Approach &amp; proximity suits</li><li>3. Entry suits</li></ul></li><li>C. Also wildland fire fighting protective clothing<ul style="list-style-type: none"><li>1. Not applicable to aircraft fire situations</li></ul></li></ul> <p>III. Regular/Standard Structural Type Protective Clothing</p> <ul style="list-style-type: none"><li>A. Designed for structural fire fighting</li><li>B. Can be used for aircraft or flammable liquid fire fighting</li><li>C. Provides protection from cold, heat, &amp; water (moisture)</li><li>D. Insulates the fire fighter from heat only<ul style="list-style-type: none"><li>1. No heat reflective capabilities</li></ul></li><li>E. Wear protective clothing properly<ul style="list-style-type: none"><li>1. Coat buttoned/zipped all the way up</li><li>2. Collar up &amp; secured</li><li>3. Fire resistant hood, optional but recommended</li><li>4. Helmet ear flaps down</li><li>5. Gloves</li></ul></li><li>F. Many fire departments do not wear turnout pants during day hours on fire calls</li></ul>	<p>Slide 423 Fire Fighter Wearing Regular Structural Clothing</p> <p><u>Instructor Note:</u> Use sample protective clothing to illustrate/demonstrate the following information in lesson plan and/or let students examine clothing</p> <p>How many departments represented here wear full turnouts on all fire calls?</p>

# INSTRUCTOR GUIDE

PROTECTIVE CLOTHING AND  
BREATHING APPARATUS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>1. Wear a uniform pant during day</li><li>2. Wear full turnouts at night only</li><li>3. Usually larger municipal fire departments</li></ul> <p>IV. Approach And Proximity Suits</p> <ul style="list-style-type: none"><li>A. Allows fire fighter to get closer to fire</li><li>B. Protects fire fighter against radiated, convected, &amp; conducted heat<ul style="list-style-type: none"><li>1. Proximity gear will not protect against direct flame contact</li><li>2. Proximity gear will burn</li><li>3. Reflects 90% of radiated heat</li></ul></li><li>C. Designed for outside use, not for inside of aircraft<ul style="list-style-type: none"><li>1. As name implies, proximity gear is intended to protect crash crews in close proximity to flames &amp; heat given off by aircraft fuel fires</li></ul></li><li>D. Designed to be worn over other clothing<ul style="list-style-type: none"><li>1. Long sleeve shirts</li><li>2. Cotton, nonmelting type underwear</li><li>3. Proximity clothing can give fire fighters a false sense of security</li></ul></li></ul>	<p>Slide 424 Fire Fighter Wearing A Proximity Suit</p>
<p>V. Entry suits</p> <ul style="list-style-type: none"><li>A. Suit can withstand direct flame contact &amp; 2000° F for a limited time</li><li>B. Not appropriate or practical for CFR</li></ul>	<p>Slide 425 Entry Suit</p>

# INSTRUCTOR GUIDE

PROTECTIVE CLOTHING AND  
BREATHING APPARATUS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>1. Most models too bulky for aircraft fire situations</li><li>2. Donning takes too long</li><li>3. Cannot rescue people into a fire atmosphere unless they are in the same suit</li><li>C. Used to shut off valves under fire conditions at oil refineries &amp; drilling rigs</li></ul>	
<p>VI. Fire Fighting Protective Clothing Is Made Up Of Three (3) Layers</p>	<p>Slide 426 Three Layers In A Turnout Coat</p>
<ul style="list-style-type: none"><li>A. Combination protection of heat reflection &amp; heat insulation<ul style="list-style-type: none"><li>1. Outer shell</li><li>2. Vapor barrier</li><li>3. Inner lining</li></ul></li></ul>	
<ul style="list-style-type: none"><li>B. Outer shell<ul style="list-style-type: none"><li>1. Tough, durable</li><li>2. Resist abrasion, high temperature exposure, mildew, chemical attack</li><li>3. Low moisture pickup</li><li>4. Flexible</li></ul></li></ul>	<p>Slide 427 Outer Shell</p>
<ul style="list-style-type: none"><li>C. Vacuum deposited aluminum reflective material<ul style="list-style-type: none"><li>1. Materials usually aluminized<ul style="list-style-type: none"><li>a) Nomex (Dupont)</li><li>b) Cotton duck</li><li>c) PBI, Rayon, Kevlar</li></ul></li></ul></li></ul>	<p>Slide 428 Closeup Of Reflective Outer Shell Material</p>



# INSTRUCTOR GUIDE

PROTECTIVE CLOTHING AND  
BREATHING APPARATUS

PRESENTATION	APPLICATION
<p>2. NFPA recommends nonremovable liner so fire fighters will not be tempted to use lighter, cooler coat without liner</p> <p>3. Protective clothing is a system, never use without all its components</p> <p>4. Several materials available</p> <ul style="list-style-type: none"> <li>a) Flannel</li> <li>b) Tricot polyester</li> <li>c) Nomex</li> <li>d) Fiberglass</li> </ul> <p>VII. Care Of Protective Clothing</p> <p>A. After each use, whether drill or actual service, observe instructions for correctly removing:</p> <ul style="list-style-type: none"> <li>1. Dirt</li> <li>2. Grease stains &amp; fuel</li> <li>3. Foam &amp; other extinguishing agents</li> </ul> <p>B. Aircraft protective clothing is expensive, up to \$900.00 per suit</p> <p>C. Proper storage should be on hangers or neatly folded</p> <ul style="list-style-type: none"> <li>1. When thoroughly cleaned, hang up in well ventilated, room temperature area</li> <li>2. Do not fold or store garments wet</li> <li>3. Do not sit on folded protective clothing</li> </ul> <p>D. Suits should be replaced when protective reflective material wears off or fabric cracks or tears</p>	<p>Why should long sleeve clothing be worn under protective clothing?</p> <p>Answer: To avoid steam burns</p> <p>Slide 431 Storage Area For Protective Clothing</p> <p>When should protective clothing be inspected?</p> <p>Answer: Daily &amp; after use</p> <p>Slide 432 Worn Out Coat</p>



# INSTRUCTOR GUIDE

PROTECTIVE CLOTHING AND  
BREATHING APPARATUS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"> <li>2. Lift front hood</li> <li>C. Use/wear a standard structural helmet when entering an aircraft for interior fire fighting               <ul style="list-style-type: none"> <li>1. OK to use remainder of reflective clothing inside aircraft</li> <li>2. Aluminized helmet covers are available for standard structural fire fighting helmets</li> </ul> </li> <li>D. Boots               <ul style="list-style-type: none"> <li>1. Can receive burned toes with regular black turnout boots from radiated heat                   <ul style="list-style-type: none"> <li>a) Spray paint boot silver</li> <li>b) Aluminized reflective booties available to go over turnout boots</li> </ul> </li> <li>2. Steel safety toe, insole required</li> <li>3. Nonslip soles</li> <li>4. Insulated &amp; noninsulated boots available</li> </ul> </li> <li>E. Gloves               <ul style="list-style-type: none"> <li>1. Gauntlet type</li> <li>2. Lightweight inner glove attached to sleeve of coat</li> <li>3. Wristlet</li> <li>4. Mitten type gloves</li> </ul> </li> <li>F. Touch up kit of vaporized aluminum in pressurized cans available for surface renewal of worn spots</li> </ul>	<p>Slide 436 Lift Front Hood</p> <p>Slide 437 Structural Helmet &amp; SCBA Mask</p> <p>Slide 438 Turnout Boots Painted Silver</p> <p>Slide 439 Aircraft Fire Fighting Gloves</p> <p>Slide 440 Can Of Touch Up Silver Spray Paint</p>

# INSTRUCTOR GUIDE

## PROTECTIVE CLOTHING AND BREATHING APPARATUS

PRESENTATION	APPLICATION
<p>IX. Self Contained Breathing Apparatus</p> <p>A. Standards</p> <ol style="list-style-type: none"><li>1. Must be approved by U.S. Bureau of Mines</li><li>2. Must meet requirements of NFPA standard 19B, "Standard on Respiratory Protective Equipment for Fire Fighters"</li></ol> <p>B. Many toxic gases are produced when aircraft burn</p> <ol style="list-style-type: none"><li>1. When aircraft cabin interiors burn, it gives off:<ol style="list-style-type: none"><li>a) Carbon monoxide</li><li>b) Hydrogen Chloride</li><li>c) Chlorine</li><li>d) Hydrogen cyanide</li><li>e) Phosgene gas</li><li>f) Superheated air</li><li>g) Oxygen deficient atmospheres</li></ol></li><li>2. Aircraft interiors made up mostly of plastics &amp; other synthetic materials</li><li>3. Also toxic &amp; hazardous cargos</li><li>4. Aircraft hydraulic fluids</li></ol>	<p>Slide 441 Breathing Apparatus</p> <p><u>Instructor Note:</u> Use sample self contained breathing apparatus &amp; face piece to demonstrate/illustrate this section of the lesson plan and/or let students examine breathing equipment</p> <p>Slide 442 List Of Some Of The Toxic Gases Produced</p> <p>Slide 443 Example Of Sulfuric Acid Packaged For Transportation By Aircraft</p> <p>Slide 444 Hydraulic Landing Gear</p>

# INSTRUCTOR GUIDE

## PROTECTIVE CLOTHING AND BREATHING APPARATUS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>a) Skydrol hydraulic fluid used on large jet aircraft<ul style="list-style-type: none"><li>1) Toxic, acrid white smoke</li><li>2) Yellowish flame</li><li>3) Will destroy all but butyl rubber</li></ul></li><li>5. Toxic extinguishing agents<ul style="list-style-type: none"><li>a) Halons</li><li>b) Carbon dioxide, CO<sub>2</sub></li><li>c) Toxic products of combustion when extinguishing agents, such as halon, react &amp; break down on contact with the burning material or heat</li></ul></li><li>6. Aircraft combustibile metals<ul style="list-style-type: none"><li>a) Some toxic &amp; water reactive</li><li>b) Aluminum</li><li>c) Magnesium</li><li>d) Titanium</li><li>e) Carbon &amp; graphite construction materials on military aircraft create a fiber hazard similar to asbestos</li></ul></li></ul>	<p>Slide 445 Toxic Concentrates Of Three Halon Extinguishing Agents</p> <p>Slide 446 Burning Magnesium</p> <p>Because aircraft wheel fires involve combustibile metals, fire fighters should always wear what type of protective equipment?</p> <p>Answer: Breathing apparatus</p> <p>Aircraft parts made of magnesium and alloys when burning will react violently with what extinguishing agent(s)?</p>

# INSTRUCTOR GUIDE

PROTECTIVE CLOTHING AND  
BREATHING APPARATUS

PRESENTATION	APPLICATION
<p>C. Helmets &amp; hoods should be designed to accommodate SCBA face piece mask</p> <p>D. Check at the beginning of each work shift</p> <ol style="list-style-type: none"><li>1. Safe working conditions</li><li>2. Ready for immediate use</li><li>3. Working properly</li><li>4. Full cylinder</li></ol> <p>E. Three (3) methods to don SCBA</p> <ol style="list-style-type: none"><li>1. Over the head method</li><li>2. Backing in method</li><li>3. Coat method</li></ol> <p>F. Most SCBA units are worn outside the proximity suit</p> <ol style="list-style-type: none"><li>1. Most proximity suits are not designed to accommodate an SCBA inside</li><li>2. Inside best to protect unit from radiated heat</li></ol> <p>G. 30 to 60 minute air cylinders available</p> <ol style="list-style-type: none"><li>1. D type cylinder</li><li>2. 45 cubic ft.</li></ol>	<p>Answer: Water &amp; foam</p> <p>When fighting aircraft fires, when should self contained breathing apparatus be donned?</p> <p>Answer: Any time toxic atmospheres exist</p> <p>Slide 447 Mask On Inside Of Hood</p> <p>Slide 448 Fire Fighter Checking SCBA</p> <p>Slide 449 Over The Head Donning Method</p> <p>Slide 450 Backing Into Mounted SCBA Unit</p> <p>Slide 451 Fire Fighter Putting On SCBA Like A Coat</p> <p>Slide 452 SCBA Unit Outside Proximity Suit</p> <p>Slide 453 Air Cylinder</p>

# INSTRUCTOR GUIDE

PROTECTIVE CLOTHING AND  
BREATHING APPARATUS

PRESENTATION	APPLICATION
<p>3. Two different cylinder types</p> <ul style="list-style-type: none"><li>a) Steel, approximately 23 lbs.</li><li>b) Composite (aluminum &amp; fiberglass) 13 lbs.</li></ul>	<p>Slide 454 Blank Slide</p>

# INSTRUCTOR GUIDE

PROTECTIVE CLOTHING AND  
BREATHING APPARATUS

## SUMMARY

There are several different types of fire fighting protective clothing and some are better than others for aircraft fire fighting situations. Fire fighting protective clothing and equipment is a system and must be properly utilized and cared for.

## EVALUATION

The student will be evaluated by completing a written examination.

## ASSIGNMENT

To be determined by the Instructor(s).

# INSTRUCTOR GUIDE

SPECIAL HAZARDS/  
HAZARDOUS MATERIALS

## AIRCRAFT CRASH FIRE RESCUE

### LESSON PLAN 8

TOPIC: Special Hazards/Hazardous Materials

LEVEL: I

TIME: 60 Minutes

#### BEHAVIORAL OBJECTIVES:

Given: A written examination

Performance:

1. The student will be able to identify hazards associated with aircraft canopy opening and jettison systems
2. The student will be able to identify hazards associated with aircraft catapult ejection seat systems
3. The student will be able to recognize armament carried aboard military aircraft and it's associated hazards
4. The student will be able to identify hazardous cargo shipped on military and civilian aircraft

Standard: With 70% accuracy

REFERENCES: IFSTA 206, Aircraft Fire Protection & Rescue Procedures, 2nd Edition, International Fire Service Training Association  
NFPA 1003 - Airport Fire Fighter Qualifications, National Fire Protection Association, 1987

MATERIALS NEEDED: A/V, slide projector, screen

PREPARATION: In order for fire fighters to safely perform aircraft fire fighting operations they must understand how to work around aircraft emergency egress systems, aircraft armament and have an understanding of the types of hazardous cargo carried aboard aircraft.

# INSTRUCTOR GUIDE

SPECIAL HAZARDS/  
HAZARDOUS MATERIALS

PRESENTATION	APPLICATION
<p>I. Special Hazards</p> <p>A. Canopy actuation: The canopy is a metal framework with a transparent covering. It is provided to enclose the cockpit and afford protection and visibility to the pilot or crewmen. The clamshell and sliding type are commonly used. The sliding type canopy is more easily used in rescue of personnel since it does not present as many restrictions as does the clamshell type canopy</p> <p>1. Aircraft manufacturers use various methods of actuating the canopy</p> <ul style="list-style-type: none"><li>a) Normal opening (sliding type)</li><li>b) Electrical (clamshell type)</li><li>c) Pneumatic</li><li>d) Hydraulic</li></ul> <ul style="list-style-type: none"><li>1) In the event of malfunction or mechanical damage to the opening system, the canopy may be opened manually</li><li>2) Normally, when the clamshell canopy is opened manually, it must be physically held or propped open. The clamshell canopy on some aircraft can be locked open with a canopy lock, to prevent closing by accidental actuation of the canopy closing control</li></ul> <p>B. Canopy jettisoning: Should be done only when the canopy cannot be opened by primary (normal opening procedures) or by secondary (manual) procedures. The word "jettison" used in aircraft rescue terminology, means to blow away by mechanical or explosive action. On modern aircraft (especially military) designed for extremely high speeds, explosive cartridge and/or rocket-powered devices are installed to "blow" away hatches and canopies.</p>	<p>Slide 455 Lesson Plan Title "Special Hazards/ Hazardous Materials"</p> <p>Slide 456 Types Of Canopies</p> <p>Slide 457 Instructions On The Side Of The Aircraft</p>

# INSTRUCTOR GUIDE

SPECIAL HAZARDS/  
HAZARDOUS MATERIALS

PRESENTATION	APPLICATION
<p>B. Some types are designed to travel (cont) (cont.) straight up and may travel straight up and fall back upon the plane. Canopies or hatches should not be jettisoned unless absolutely necessary. Caution: jettisoning the canopy may ignite spilled fuel vapors. Jettisoning a canopy should be attempted in a fire situation</p> <ol style="list-style-type: none"><li>1. Canopy jettisoning procedures<ol style="list-style-type: none"><li>a) Read and follow the instructions on the side of the aircraft</li></ol></li><li>2. Common instructions for jettison<ol style="list-style-type: none"><li>a) Open control door</li><li>b) Pull out handle and lanyard (usually six feet long)</li><li>c) Give a sharp pull to the handle</li><li>d) Quickly exit the area</li></ol></li><li>3. Canopy removers: Generally, canopy removers are gas pressure telescoping devices which forcibly jettison the canopy in an emergency. When the cartridge is fired, the rapidly expanding gases force the telescoping tubes to expand and jettison the canopy from the aircraft</li></ol> <p>C. Seat ejection: As the canopy is jettisoned it may automatically "prime" or "cock" the seat ejection mechanism in preparation for the crew member to eject. In this position the seat is similar to the bullet in the chamber of a loaded gun. Ejection seats are fired from the aircraft by pulling down a face curtain or actuating a handle, located on the seat between the legs of the occupant, elsewhere on the seat, or on the armrest. "A rule-of-thumb" to be observed is, "If the seat does not have a face curtain, beware of armrests".</p>	<p>Slide 458 Jettisoning Procedures</p> <p>Slide 459 Rescuer With The Jettison Lanyard And Handle</p> <p>Slide 460 Ejection Seats (Types)</p>



# INSTRUCTOR GUIDE

SPECIAL HAZARDS/  
HAZARDOUS MATERIALS

PRESENTATION	APPLICATION
<p>II. Armament And Explosive Cargo</p> <p>A. The recognition of associated hazards in an aircraft incident where armament is involved will afford greater safety and effectiveness in fire fighting and rescue operations</p> <p>B. The type of aircraft involved will be important in determining if armament or explosives are involved i.e. military cargo</p> <p>C. Storage locations on aircraft: In general, munitions are carried in the following types of aircraft:</p> <ol style="list-style-type: none"><li>1. Fighter aircraft<ol style="list-style-type: none"><li>a) Wings and fuselage</li></ol></li><li>2. Cargo aircraft<ol style="list-style-type: none"><li>a) Forward or aft fuselage</li></ol></li><li>3. Bomber aircraft<ol style="list-style-type: none"><li>a) Under wings and in bomb bay</li></ol></li></ol> <p>D. Classes of explosive cargo</p> <ol style="list-style-type: none"><li>1. Hazardous cargo of, armament, or munition types are classified according to their reaction characteristics<ol style="list-style-type: none"><li>a) Class A explosives</li></ol></li></ol>	<p>Slide 464 Fighter Aircraft</p> <p>Slide 465 Cargo Aircraft</p> <p>Slide 466 Bomber Aircraft</p>

# INSTRUCTOR GUIDE

SPECIAL HAZARDS/  
HAZARDOUS MATERIALS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>a) Class A explosives<ul style="list-style-type: none"><li>1) Explosives designated as "Class A" are detonating or otherwise maximum hazard, i.e. dynamite, blasting caps and bombs</li><li>2) Withdrawal distance is 2,000 ft.</li></ul></li><li>b) Class B explosives<ul style="list-style-type: none"><li>1) Explosives designated as "Class B" are flammable hazards, i.e. photograph flash powder, pyrotechnic signal devices, liquid or solid propellant</li><li>2) Withdrawal distance is 2,000 ft.</li></ul></li><li>c) Class C explosives<ul style="list-style-type: none"><li>1) Explosives designated as "Class C" are composed of both Class A and Class B explosives in restricted quantities</li><li>2) Class C explosives can be expected to burn with minor explosion and poisonous fumes may be encountered</li><li>3) Withdrawal distance is at least 500 ft.</li></ul></li></ul>	
<p>E. Bombs: A great variety of types and sizes of bombs are transported on aircraft. It would not be possible for fire fighters to learn to identify all types by their size and physical appearance. In general, bombs are classified according to the ratio of their high-explosive charge to their weight; that is, large bombs carry more high explosives than small bombs</p>	<p>Slide 467 Picture Of Bombs</p>
<p>F. Rockets: Rockets may consist of either an explosive or inert head, a motor, and a means of stabilization during flight</p>	<p>Slide 468 Picture Of Rockets</p>

# INSTRUCTOR GUIDE

SPECIAL HAZARDS/  
HAZARDOUS MATERIALS

PRESENTATION	APPLICATION
<ol style="list-style-type: none"><li>1. The head is designed to produce the desired effect at the target and usually contains a fuse and explosive filler</li><li>2. The motor consists of elements necessary to propel the rocket. Such propellant charges may be either solid or liquid fuels. Like bombs, rockets would be impossible for fire fighters to learn to identify all types</li></ol> <p>III. Munitions Fire Fighting Procedures</p> <p>A. When fighting an aircraft fire that involves conventional weapons, speed is essential for fast knockdown and control of the fire so rescue can be performed in the shortest time possible</p> <ol style="list-style-type: none"><li>1. When the aircraft involved has either guns or rockets, crash vehicles should not be positioned directly in front or behind the aircraft</li><li>2. The vehicles should be positioned approximately at 45° angles to the fuselage so that in the event of discharge of any guns or rockets, they will not strike fire fighting vehicles</li><li>3. These same precautions hold true for fire fighters not walking in front or behind such weapons</li><li>4. Time factors start when explosives are enveloped in fire. Efforts to keep munitions cool should be simultaneous with rescue and fire control</li></ol> <p>B. Emergency procedures for non-fire fighting personnel</p> <ol style="list-style-type: none"><li>1. In case an emergency occurs in which the fire department is not immediately available, personnel at the fire scene involving conventional munitions should attempt to accomplish the following when possible</li></ol>	<p>Slide 469 Positioning On Aircraft With Munitions</p>

# INSTRUCTOR GUIDE

SPECIAL HAZARDS/  
HAZARDOUS MATERIALS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>a) Extinguish the fire</li><li>b) Call the fire department</li><li>c) Move all nonessential personnel to at least the minimum withdrawal distance for the public</li><li>d) Note exact time munitions became enveloped in flames</li><li>e) Withdraw all remaining personnel to "public distance" when the time factor for the munitions involved is up.</li><li>f) Advise the fire department when they arrive of any munitions involved in fire</li></ul>	
<p>IV. Nuclear Weapons</p> <ul style="list-style-type: none"><li>A. The possibility of a nuclear weapon contributing (atomic explosion) in a fire is practically nonexistent. The presence of a nuclear weapon in an aircraft fire presents no greater hazard than the presence of high explosives. In fact, the amount of high explosives may be less than found in conventional bombs of the same size<ul style="list-style-type: none"><li>1. Nuclear weapons, however, may present minor chemical and/or radiological hazards during and after an accident or fire</li><li>2. Basically, the same techniques that are used for conventional high explosives apply to nuclear weapons</li></ul></li><li>B. Nuclear weapon characteristics<ul style="list-style-type: none"><li>1. In general, nuclear weapons resemble conventional bombs<ul style="list-style-type: none"><li>a) Most contain conventional types of explosives which may detonate on impact or when subject to fire</li></ul></li></ul></li></ul>	<p>Slide 470 Fighting Nuclear Weapon Fires</p>

# INSTRUCTOR GUIDE

SPECIAL HAZARDS/  
HAZARDOUS MATERIALS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>b) If the casing ruptures on impact, the pieces of explosive can ignite and burn</li><li>c) Some minor radiological hazards may exist, regardless of the particular type of nuclear weapon, when it burns or is detonated</li></ul> <p>2. Time factors</p> <ul style="list-style-type: none"><li>a) The length of time available to fight a fire involving nuclear or conventional weapons depends largely upon the physical characteristics of the weapon or warhead used</li><li>b) Since the weapons and warheads vary in thickness, the "time factor" may range from zero to indefinite</li><li>c) If the time factor is unknown, the area must be immediately evacuated a distance of 2,000 ft.</li></ul> <p>3. Precautionary measures</p> <ul style="list-style-type: none"><li>a) Under no circumstances should any high explosive material from ruptured weapons that have been exposed to fire be handled, stepped on, driven over, or disturbed in any manner</li><li>b) This material is extremely sensitive to shock or impact and may detonate and cause injury</li><li>c) If a nuclear weapon is involved, all equipment, clothing, etc. used during the fire should be monitored for possible radiation by specialized personnel</li></ul> <ul style="list-style-type: none"><li>1) Don't eat, drink, or smoke around the area. Set up re-hab areas remote from the scene</li></ul>	<p>Slide 471 Precautions When Working Around A Nuclear Accident</p>

# INSTRUCTOR GUIDE

SPECIAL HAZARDS/  
HAZARDOUS MATERIALS

PRESENTATION	APPLICATION
<p>4. The only radiation hazard the fire fighter need be concerned with is alpha contamination</p> <ul style="list-style-type: none"><li>a) Alpha particles are so fine that they are carried as smoke or dust</li><li>b) Some alpha contamination may be expected in the immediate area down wind</li></ul> <p>V. Hazardous Materials Associated With Aircraft</p> <p>A. In 1973, a Pan American Boeing 707 cargo freighter took off from Boston's Logan Airport for Europe with a full load of cargo &amp; crew of three</p> <ul style="list-style-type: none"><li>1. Shortly after takeoff, over the Atlantic Ocean, the crew smelled &amp; noticed smoke issuing from the cargo area. They reported an inflight emergency &amp; headed back to Boston</li><li>2. They never made it. The plane crashed on the airport approach with a total loss of life, cargo &amp; the aircraft</li><li>3. A shipper had improperly packaged nitric acid bottles in sawdust, an organic material</li><li>4. The acid leaked, caused a chemical reaction with the sawdust, which generated heat &amp; smoke. The smoke obscured the vision of the flight crew to the point they could not see the controls or operate the plane</li></ul> <ul style="list-style-type: none"><li>a) The nitric acid should have been double packaged in noncombustible, inert, absorbent material such as vermiculite &amp; in an approved container</li></ul>	<p>Slide 472 "Hazardous Materials Carried On Aircraft"</p> <p>Slide 473 Wreckage At Boston Airport</p> <p>What happened?</p> <p>What happens when a strong acid comes in contact with a organic material like sawdust?</p>

# INSTRUCTOR GUIDE

SPECIAL HAZARDS/  
HAZARDOUS MATERIALS

PRESENTATION	APPLICATION
<p>b) This aircraft incident generated many regulations controlling hazardous materials shipped by aircraft</p> <p>B. Almost everything can &amp; is transported by aircraft</p> <ol style="list-style-type: none"><li>1. From elephants to hazardous materials</li><li>2. Flying Tiger transports poisons only on Fridays</li><li>3. The shipper is responsible for properly packaging &amp; labeling hazardous materials for air shipment</li><li>4. Unless the package arouses suspicion of an air cargo employee, is leaking, or obviously improperly packaged, it is shipped as received by the airline</li><li>5. Air cargo people take their jobs very seriously<ol style="list-style-type: none"><li>a) They do not want to lose aircraft</li><li>b) Their business is based on getting the shipment to its destination quickly and safely</li><li>c) This is why people pay the prices to ship by air</li><li>d) An incident involving a leaking package or container can hold up a flight for hours, even days</li><li>e) Regular inspections &amp; tough regulations are imposed by FAA on airlines</li></ol></li></ol> <p>C. It is very expensive to ship hazardous materials by air</p> <ol style="list-style-type: none"><li>1. There is a real incentive to hide hazardous materials in unregulated packaging</li></ol>	<p>Slide 474 Hazardous Material Placards</p> <p>Does it make you feel secure that the Mom &amp; Pop, fly-by-night chemical company that we see so often on hazardous material incidents &amp; building inspections package their own shipments?</p> <p>Slide 475 Types Of Hazard Classes</p>

# INSTRUCTOR GUIDE

SPECIAL HAZARDS/  
HAZARDOUS MATERIALS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>a) Or to even sneak hazardous materials through in personal luggage</li><li>2. It is even more expensive if a person gets caught<ul style="list-style-type: none"><li>a) FAA fines</li><li>b) Must be repackaged properly by a special contractor at shipper's expense</li></ul></li><li>3. Many interior passenger aircraft fires have originated in baggage areas<ul style="list-style-type: none"><li>a) Matches are the most common cause</li><li>b) A major interior aircraft inflight fire occurred several years ago on a charter jumbo jet carrying pilgrims to Mecca<ul style="list-style-type: none"><li>1) The pilot was able to land the aircraft with heavy smoke inside, at a Saudi Arabian airport</li><li>2) The airport fire department had difficulty getting into the aircraft because of bodies stacked against the doors</li><li>3) The entire flight crew &amp; several hundred passengers lost their lives</li><li>4) The fire originated in the lower cargo hold, baggage area</li></ul></li></ul></li><li>D. Hazardous materials can be found on passenger aircraft<ul style="list-style-type: none"><li>1. Maximum of 100 lbs. of hazardous cargo allowed per cargo/baggage area</li><li>2. Only certain materials can be transported on passenger aircraft</li></ul></li></ul>	<p>Slide 476 Passenger Aircraft</p>



# INSTRUCTOR GUIDE

SPECIAL HAZARDS/  
HAZARDOUS MATERIALS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>2) Regulations are applied based on the most similar chemical like it listed on the table</li><li>3) A permit must be applied for in order to ship a material not listed on the table</li><li>4) If there is an "A" in the first column of the table, the material is regulated only on aircraft</li><li>5) If the column is blank it is regulated in all modes</li></ul> <p>3. CFR 49 regulates hazardous materials in all modes of transportation</p> <ul style="list-style-type: none"><li>a) Air</li><li>b) Truck</li><li>c) Railroad</li><li>d) Vessel</li><li>e) Pipeline</li></ul> <p>4. It has "Reportable Quantities" (RQ)</p> <ul style="list-style-type: none"><li>a) Under these amounts, regulations are less stringent or nonexistent</li></ul> <p>5. CFR 49 is applicable only over the continental United States</p> <p>6. Difficult &amp; detailed regulations</p> <ul style="list-style-type: none"><li>a) Hard to use</li></ul> <p>7. May see UN &amp; NA (North America) chemical identification numbers</p> <p>8. Very few airlines use CFR 49</p>	<p>Slide 479 Modes Of Transportation</p>
<p>G. Most airlines use "IATA Dangerous Goods Regulations"</p>	<p>Slide 480 IATA Book</p>

# INSTRUCTOR GUIDE

SPECIAL HAZARDS/  
HAZARDOUS MATERIALS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>1. Published by the International Air Transport Association</li><li>2. Apply only to transportation of hazardous materials by air</li><li>3. All quantities of hazardous cargo are regulated, no matter how small</li><li>4. Much easier to understand &amp; use</li><li>5. Does not recognize all ORMs (other regulated material)</li><li>H. Not important for aircraft fire fighters to know shipping regulations<ul style="list-style-type: none"><li>1. Important to be able to:<ul style="list-style-type: none"><li>a) Recognize hazardous cargo packaging &amp; labeling</li><li>b) Recognize when you have a hazardous material problem or incident</li><li>c) Protect yourself &amp; the public</li><li>d) Know who to call for help</li><li>e) Perform first responder steps</li></ul></li></ul></li><li>I. Many large carriers of hazardous cargo<ul style="list-style-type: none"><li>1. Federal Express</li><li>2. Emery Air Freight</li><li>3. United Parcel Service</li><li>4. Flying Tigers</li><li>5. Many foreign airlines</li></ul></li><li>J. Smaller hazardous shipments</li></ul>	<p>Slide 481 UPS Truck &amp; General Aviation Aircraft</p>

# INSTRUCTOR GUIDE

SPECIAL HAZARDS/  
HAZARDOUS MATERIALS

PRESENTATION	APPLICATION
<ol style="list-style-type: none"> <li>1. May see some small shipments by United Parcel Service on chartered aircraft</li> <li>2. Or Flying Tigers</li> <li>3. Most cargo operations are at the larger airports               <ol style="list-style-type: none"> <li>a) These aircraft could be diverted to or crash at your airport/jurisdiction</li> </ol> </li> </ol>	<p>Slide 482 Flying Tigers &amp; Chartered Aircraft</p>
<p>K. Aircraft that carry only cargo are called freighters</p>	<p>Slide 483 UPS Boeing 747 Freighter</p>
<ol style="list-style-type: none"> <li>1. Cargo may be shipped in "unit load devices"</li> </ol>	<p>Slide 484 Unit Load Device</p>
<ol style="list-style-type: none"> <li>2. Or on palletized overpacks         <ol style="list-style-type: none"> <li>a) Covered with netting or shrink wrapping</li> </ol> </li> </ol>	<p>Slide 485 Palletized Cargo</p>
<ol style="list-style-type: none"> <li>3. Each freighter has designated pallet locations         <ol style="list-style-type: none"> <li>a) Regulations call for an 18 inch pathway between the interior bulkhead &amp; the cargo</li> <li>b) Allows flight crew to check the cargo, investigate &amp; deal with cargo problems</li> </ol> </li> </ol>	<p>Slide 486 Stowage Plan</p>
<ol style="list-style-type: none"> <li>4. Usually hazardous cargo is the last loaded &amp; the first unloaded</li> </ol>	<p>Slide 487 Cargo Door</p>
<ol style="list-style-type: none"> <li>a) Hazardous materials will usually be stowed near or just inside the cargo doors</li> </ol>	<p>Slide 488 Red Bordered Container</p>
<ol style="list-style-type: none"> <li>b) The pilot &amp; airline office at airport of departure will have a stowage plan showing the location of cargo on the aircraft</li> </ol>	<p>Slide 489 Halon Cylinder &amp; Hose</p>
<ol style="list-style-type: none"> <li>5. There are two (2) cargo compartments</li> </ol>	<p>Slide 490 Lower Cargo Door</p>



# INSTRUCTOR GUIDE

SPECIAL HAZARDS/  
HAZARDOUS MATERIALS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>a) Name of shipper<ul style="list-style-type: none"><li>1) May or may not be the manufacturer</li></ul></li><li>b) Consignee<ul style="list-style-type: none"><li>1) Who the material is being shipped to</li><li>2) Both shipper, consignee, &amp; manufacturer are valuable sources of information about &amp; how to handle the materials</li><li>3) Many, such as Dow Chemical, Monsanto, Chevron have their own response teams to assist us</li></ul></li><li>c) Transporting airline</li><li>d) Airports of departure &amp; destination<ul style="list-style-type: none"><li>1) Airline office at airport of departure will have copies of airbills &amp; stowage plan</li></ul></li><li>e) Whether material can be transported on passenger or just cargo aircraft</li><li>f) Radioactive or nonradioactive</li><li>g) Proper shipping name, hazard class, &amp; hazard class number</li><li>h) UN or NA (Regulated only in North America) numbers</li><li>i) Subsidiary risk</li></ul>	

# INSTRUCTOR GUIDE

SPECIAL HAZARDS/  
HAZARDOUS MATERIALS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>1) Example: a poison (primary hazard) that is also a flammable liquid</li><li>j) Quantity &amp; type of packaging</li><li>k) DOT or IATA approved container or package</li><li>l) Additional handling information</li><li>5. Airbills are kept in the flight deck area (cockpit)<ul style="list-style-type: none"><li>a) In the possession of the pilot or other officer</li><li>b) Do not expect the flight crew to remember to bring the airbills when they evacuate an aircraft during an emergency</li><li>c) The airline office of departure will also have copies of the airbills</li></ul></li><li>M. Often the only separation between the flight crew &amp; the cargo is a net<ul style="list-style-type: none"><li>1. Easy for smoke &amp; vapors to overcome crew</li><li>2. If there is a problem on board with hazardous materials<ul style="list-style-type: none"><li>a) Crew carries a copy of the DOT orange Emergency Response Guidebook</li><li>b) It is designed primarily for surface transportation (trucks &amp; trains)</li><li>c) It may instruct the flight crew to "avoid fumes &amp; evacuate 2000 ft. up wind"<ul style="list-style-type: none"><li>1) Tough to do in an aircraft at 10,000 ft.</li></ul></li><li>d) Cargo aircraft do not carry SCBA's</li></ul></li></ul></li></ul>	<p>Slide 493 Flight Crew With Airbill</p> <p>Slide 494 Net Between Cargo &amp; Cockpit</p>

# INSTRUCTOR GUIDE

SPECIAL HAZARDS/  
HAZARDOUS MATERIALS

PRESENTATION	APPLICATION
<p>N. Some unique package labels may be encountered</p> <ol style="list-style-type: none"><li>1. Magnetized material<ol style="list-style-type: none"><li>a) For shipments that may affect aircrafts navigational &amp; other sensitive electronic equipment</li></ol></li><li>2. "Do Not Load On Passenger Aircraft" label<ol style="list-style-type: none"><li>a) Material is not allowed to be transported on passenger aircraft</li><li>b) Too dangerous a material</li></ol></li></ol> <p>0. Examples of packaging of hazardous shipments by air</p> <ol style="list-style-type: none"><li>1. Ethyl Chloroformate shipment<ol style="list-style-type: none"><li>a) Note that the shipper &amp; consignee are listed on the package</li><li>b) Name of material &amp; four digit UN number<ol style="list-style-type: none"><li>1) Each material has its own unique UN or NA number</li><li>2) Numbers &amp; emergency guidelines are listed in the DOT orange Emergency Response Guidebook</li></ol></li><li>c) A label must be affixed to the container for each separate hazard<ol style="list-style-type: none"><li>1) Contrary to this, trucks &amp; railcars are only placarded for the principle hazard &amp; sometimes only if load is over 2000 lbs.</li></ol></li><li>d) This side up label</li><li>e) Approved box (IATA TSA30)<ol style="list-style-type: none"><li>1) There are DOT &amp; IATA approved shipping containers</li></ol></li></ol></li></ol>	<p>Slide 495 Magnitized Material</p> <p>Slide 496 "Do Not Load On Passenger Aircraft" Label</p> <p>Slide 497 Ethyl Chloroformate Shipment</p>

# INSTRUCTOR GUIDE

SPECIAL HAZARDS/  
HAZARDOUS MATERIALS

PRESENTATION	APPLICATION
f) Do not load on passenger aircraft label	Slide 498 Airbill For Ethyl Chloroformate
2. Corresponding airbill for ethyl chloroformate	
a) Cargo aircraft only, must be bad stuff	
b) Lists what number this airbill is in the total stack (1 of 1)	
c) Describes the container, weight	Slide 499 55 Gallon Drum
3. May encounter metal & plastic drums	
a) 5 & 55 gallon drums most common	
b) May see some 20 & 30 gallon drums	
c) Glass carboys	
d) Diethylacetal	
1) Poison	
2) Flammable liquid	
4. Wooden crates	Slide 500 Wooden Crate Of Ammonium Nitrate
5. Flammable solid liquid	Slide 501 Flammable Solid Shipment
a) Maneb	
b) Flammable solid & dangerous when wet labels	
6. Radioactives	Slide 502 Radioactive I Shipment
a) Radioactive III most hazardous	
b) Radioactive I least hazardous	
c) Airbill has additional handling information	Slide 503 Airbill For Above Shipment

# INSTRUCTOR GUIDE

SPECIAL HAZARDS/  
HAZARDOUS MATERIALS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>d) Special certificate required for radioactives</li><li>7. Infectious substances<ul style="list-style-type: none"><li>a) Etiologic agents</li><li>b) Both radioactives &amp; materials used in medical research or treatment are common cargoes on passenger aircraft<ul style="list-style-type: none"><li>1) Usually small packages</li><li>2) Well packaged, rarely have problems with these types of shipments</li></ul></li></ul></li><li>P. Learn to recognize a hazardous material situation on aircraft &amp; various buildings on or about the airport<ul style="list-style-type: none"><li>1. National Fire Protection Association (NFPA) 704 M Placard System<ul style="list-style-type: none"><li>a) Blue - health hazard</li><li>b) Red - flammability hazard</li><li>c) Yellow - Reactivity hazard</li><li>d) 0 - no hazard in that category</li><li>e) 4 - highest hazard in that category</li></ul></li><li>2. When dealing with hazardous materials follow recommended procedures<ul style="list-style-type: none"><li>a) Always wear SCBA &amp; proper protective clothing</li><li>b) Stay upwind &amp; uphill</li><li>c) Isolate the area of nonessential personnel<ul style="list-style-type: none"><li>1) Consider the need to evacuate downwind</li></ul></li></ul></li></ul></li></ul>	<p>Slide 504 Infectious Substance Shipment</p> <p>Slide 505 NFPA 704 M Placard System</p> <p>Slide 506 Fire Fighters Working With Materials</p>



# INSTRUCTOR GUIDE

SPECIAL HAZARDS/  
HAZARDOUS MATERIALS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>c) Lists possible reactions when certain materials are mixed</li><li>3. Many other reference books available</li><li>4. Make use of Hazardous Materials Response Teams<ul style="list-style-type: none"><li>a) Chemical expertise &amp; knowledge</li><li>b) Specialized detection &amp; protective equipment</li><li>c) Communication capabilities at incidents</li><li>d) Technical advice for incident commander</li></ul></li><li>5. Chemical clean up contractors<ul style="list-style-type: none"><li>a) Experience &amp; expertise</li><li>b) Equipment</li></ul></li><li>R. Military transports large quantities of hazardous materials by air<ul style="list-style-type: none"><li>1. Shipments will be labeled similar to commercial shipments identifying all the hazards</li><li>2. Shipping papers &amp; stowage plan will be available on the aircraft<ul style="list-style-type: none"><li>a) Crew loadmaster is best source of information</li></ul></li><li>3. Hazardous materials will usually be stowed near cargo doors</li><li>4. Large military transports like the C-5 may also be carrying passengers</li><li>5. Military will usually respond to incidents involving their aircraft</li></ul></li></ul>	<p>Slide 509 Fire Department HIT Unit</p> <p>Slide 510 Clean Up Contractor At Work</p> <p>Slide 511 Air Force C-5 Transport</p> <p>Slide 512 C-141</p> <p>Slide 513 C-130</p>

# INSTRUCTOR GUIDE

SPECIAL HAZARDS/  
HAZARDOUS MATERIALS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"> <li>a) Extinguish any fire, rescue if possible, isolate the area</li> <li>b) Then wait for military teams to arrive</li> </ul>	
<p>S. Tremendous potential for an aircraft incident involving an agricultural spraying or crop dusting operation</p> <ul style="list-style-type: none"> <li>1. Both on &amp; off the airport</li> <li>2. In 1977, 250 million lbs. of pesticides were used in California               <ul style="list-style-type: none"> <li>a) More than any other state</li> <li>b) 2/3 applied by aircraft</li> </ul> </li> </ul>	<p>Slide 514 Crop Dusting Operation</p>
<ul style="list-style-type: none"> <li>3. Pesticide - any chemical or mix of chemicals used to destroy, prevent, or control any living thing considered a pest           <ul style="list-style-type: none"> <li>a) Types sprayed by aircraft               <ul style="list-style-type: none"> <li>1) Insecticides</li> <li>2) Fungicides</li> <li>3) Herbicides</li> </ul> </li> <li>b) Over 1000 basic chemicals are mixed with other materials to produce over 35,000 pesticide products</li> </ul> </li> </ul>	<p>Slide 515 Pests</p> <p>Slide 516 Soilserv Sign</p>
<p>T. Crop dusting operation</p> <ul style="list-style-type: none"> <li>1. Conducted by fixed or rotary wing aircraft (helicopters)</li> <li>2. Fixed wing aircraft           <ul style="list-style-type: none"> <li>a) Either single wing</li> <li>b) Or biplanes</li> </ul> </li> </ul>	<p>Slide 517 Fixed &amp; Rotary Dusting Aircraft</p> <p>Slide 518 Single Wing Aircraft</p> <p>Slide 519 Biplane Duster</p>

# INSTRUCTOR GUIDE

SPECIAL HAZARDS/  
HAZARDOUS MATERIALS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>1) Fuel usually in upper wing</li><li>2) Gravity flow</li><li>c) Pesticide tank usually just in front of cockpit<ul style="list-style-type: none"><li>1) Approximately 200-300 gallon capacity</li><li>2) Often covers pilot with product after crash impact</li></ul></li><li>d) Filling connection</li><li>e) Spray nozzles on trailing edge of wing</li><li>f) Equipment on underside of aircraft to create proper airflow to distribute pesticides</li><li>g) Material mixed &amp; loaded at airport</li></ul>	<p>Slide 520 Pesticide Tank Area</p> <p>Slide 521 Inside Of Tank</p> <p>Slide 522 Filling Connection On Port Side</p> <p>Slide 523 Spray Nozzle On Wing</p> <p>Slide 524 Equipment</p> <p>Slide 525 Mixing/Loading Equipment At Airport</p>
<p>3. Rotary wing aircraft (helicopters)</p> <ul style="list-style-type: none"><li>a) Approximately 100 to 300 gallon capacity</li><li>b) Material mixed &amp; loaded at job site</li></ul>	<p>Slide 526 Helicopter Duster</p> <p>Slide 527 Product Tank</p>
<p>4. Support trucks</p> <ul style="list-style-type: none"><li>a) Water tank</li><li>b) Concentrated pesticide in manufactures container loaded on flatbed part of truck<ul style="list-style-type: none"><li>1) Bag, box, bottles, or drums</li><li>2) Liquid or powder</li></ul></li></ul>	<p>Slide 528 Helicopter Support Truck</p> <p>Slide 529 Support Tank Truck</p>

# INSTRUCTOR GUIDE

SPECIAL HAZARDS/  
HAZARDOUS MATERIALS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>c) Batch mixed in a separate tank<ul style="list-style-type: none"><li>1) Closed system</li><li>2) Boom loads onto aircraft</li></ul></li><li>5. Extensive regulations on:<ul style="list-style-type: none"><li>a) Loading</li><li>b) Cleaning equipment</li><li>c) Protective clothing</li><li>d) Spraying procedures</li><li>e) Regulated by county &amp; state Agriculture Departments</li></ul></li><li>6. Many different types of materials used<ul style="list-style-type: none"><li>a) Depends on time of year<ul style="list-style-type: none"><li>1) Spring - herbicides</li><li>2) Plants too tall for vehicles to spray</li><li>3) Ground too soft or wet for vehicle to spray</li><li>4) Farmer needs to have it done quickly to get jump on competition or get market advantage</li></ul></li><li>b) Type of crop</li><li>c) Type of infestation</li><li>d) Usually 3 to 20 gallons per acre used</li></ul></li><li>7. Farmer contracts with pesticide supplier<ul style="list-style-type: none"><li>a) Field rep visits job site</li></ul></li></ul>	<p>Slide 530 Support Trucks</p> <p>Slide 531 Spill Near Aircraft</p> <p>Slide 532 Aircraft Spraying</p> <p>Slide 533 Wet Field</p> <p>Slide 534 Pesty Worm</p> <p>Slide 535 Western Farm Service</p>

# INSTRUCTOR GUIDE

SPECIAL HAZARDS/  
HAZARDOUS MATERIALS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"> <li>1) Determine what material needed &amp; how much</li> <li>2) Supplier contracts crop duster</li> <li>3) Crop duster does not store pesticides (Prohibited by law)</li> <li>4) Crop duster obtains materials from supplier just prior to job</li> </ul> <p>8. Most accidents occur at or near job site</p> <ul style="list-style-type: none"> <li>a) Aircraft hits an obstruction               <ul style="list-style-type: none"> <li>1) Pole, electrical wires</li> <li>2) Clips a tree</li> <li>3) Dips a wing into ground on a turn</li> </ul> </li> <li>b) Pilot usually does a fly by to check out hazards</li> </ul> <p>9. Usually no information on material being sprayed carried on aircraft</p> <ul style="list-style-type: none"> <li>a) Contact crop dusting business office or owner</li> <li>b) Supplier that sold pesticide</li> <li>c) Have a list of contact persons &amp; phone numbers of crop dusters &amp; suppliers operating in your area</li> <li>d) Obtain information on the various materials they are using</li> </ul> <p>U. Materials being sprayed are concentrates mixed or diluted with water for specific applications</p> <p>1. Materials being used are:</p> <ul style="list-style-type: none"> <li>a) Organophosphates</li> </ul>	<p>Slide 536 Duster Flying Near Wires</p> <p>Slide 537 Plane Making A Dust Run</p> <p>Slide 538 Organophosphates</p>

# INSTRUCTOR GUIDE

SPECIAL HAZARDS/  
HAZARDOUS MATERIALS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"> <li>b) Carbamates</li> </ul>	<p>Slide 539 Carbamate Insecticides &amp; Herbicides</p>
<ul style="list-style-type: none"> <li>c) Organochlorines</li> </ul>	<p>Slide 540 Organochlorines</p>
<ul style="list-style-type: none"> <li>d) Nitro &amp; Chlorophenols                             <ul style="list-style-type: none"> <li>1) Herbicides &amp; fungicides</li> </ul> </li> </ul>	<p>Slide 541 Chlorophenoxy Herbicides</p>
<ul style="list-style-type: none"> <li>e) Some dusting sulphur</li> </ul>	<p>Slide 542 Dusting Sulphur</p>
<ul style="list-style-type: none"> <li>2. Some common materials used in California</li> </ul>	
<ul style="list-style-type: none"> <li>a) Orthene</li> </ul>	<p>Slide 543 Orthene</p>
<ul style="list-style-type: none"> <li>b) Phosdrin</li> </ul>	<p>Slide 544 Phosdrin 4E</p>
<ul style="list-style-type: none"> <li>c) Metasystox-R</li> </ul>	<p>Slide 545 Metasystox-R</p>
<ul style="list-style-type: none"> <li>d) Lannate</li> </ul>	<p>Slide 546 Dupont Lannate Methomyl Insecticide</p>
<ul style="list-style-type: none"> <li>e) Maneb (Fungicide)</li> </ul>	<p>Slide 547 Maneb</p>
<ul style="list-style-type: none"> <li>f) Paraquate (Herbicide)</li> </ul>	<p>Slide 548 Ortho (Chevron) Paraquate CL</p>
<ul style="list-style-type: none"> <li>g) 2, 4-D</li> </ul>	<p>Slide 549 92 2, 4-D</p>
<ul style="list-style-type: none"> <li>V. Emergency response personnel must be able to recognize an aircraft hazardous materials incident</li> </ul>	<p>Slide 550 Pesticides On Ground</p>
<ul style="list-style-type: none"> <li>1. Law enforcement officers may usually be the first on the scene</li> </ul>	
<ul style="list-style-type: none"> <li>a) Equipment, type of aircraft &amp; support trucks</li> </ul>	
<ul style="list-style-type: none"> <li>b) Labels &amp; Placards</li> </ul>	<p>Slide 551 Danger Sign</p>
<ul style="list-style-type: none"> <li>2. Three (3) toxicity categories</li> </ul>	

# INSTRUCTOR GUIDE

SPECIAL HAZARDS/  
HAZARDOUS MATERIALS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>a) Signal words on labels</li><li>b) Danger<ul style="list-style-type: none"><li>1) High hazard</li><li>2) Skull &amp; crossbones</li><li>3) Poison in red letters</li></ul></li><li>c) Warning - moderate hazard</li><li>d) Caution - lowest, least hazard</li></ul> <p>3. Enters body through:</p> <ul style="list-style-type: none"><li>a) Eyes, mucous membranes</li><li>b) Skin</li><li>c) Nose, inhalation</li><li>d) Mouth, ingestion</li></ul> <p>4. Learn to recognize signs &amp; symptoms of pesticide exposure in victims &amp; emergency response personnel</p> <ul style="list-style-type: none"><li>a) Any unusual appearance or behavior<ul style="list-style-type: none"><li>1) Disorientation, dizziness</li><li>2) Weakness, muscle cramps, convulsions, coma</li><li>3) Slurred speech, high temperature, high blood pressure, rapid pulse</li><li>4) Pinpoint pupils, profuse sweating</li><li>5) Headache, pain, difficulty breathing</li></ul></li></ul>	<p>Slide 552 Danger Parathion</p> <p>Slide 553 Warning Nematicide</p> <p>Slide 554 Caution, Keep Out Of Reach Of Children</p> <p>Slide 555 Points Of Entry</p> <p>Slide 556 Signs &amp; Symptoms</p>

# INSTRUCTOR GUIDE

SPECIAL HAZARDS/  
HAZARDOUS MATERIALS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>b) Signs &amp; symptoms can be delayed up to 12 hours</li><li>c) Can effect kidneys, liver, central nervous system</li><li>d) More severe if victim is exposed to heat at same time as pesticide exposure occurs</li><li>e) Suspect or any doubt, treat as an exposure</li></ul> <p>5. Pesticide container label</p> <ul style="list-style-type: none"><li>a) Contains a lot of information we can use</li><li>b) Lists physical &amp; chemical hazards<ul style="list-style-type: none"><li>1) Some can be corrosive or flammable</li></ul></li><li>c) Important to get spelling correct<ul style="list-style-type: none"><li>1) Many have similar names, soundings &amp; spellings</li><li>2) But require different response procedures or treatment</li></ul></li><li>d) Must get EPA (Environmental Protection Agency) registration number<ul style="list-style-type: none"><li>1) Product name</li><li>2) Chemical name(s) ingredients</li></ul></li><li>e) Try to get an uncontaminated label to send to hospital in a plastic bag</li><li>f) Label also provides information on:<ul style="list-style-type: none"><li>1) Storage &amp; disposal</li><li>2) Environmental hazards</li></ul></li></ul>	<p>Slide 557 Ortho Paraquat Label</p>

# INSTRUCTOR GUIDE

SPECIAL HAZARDS/  
HAZARDOUS MATERIALS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>6. Avoid contact with:<ul style="list-style-type: none"><li>a) Chemicals themselves</li><li>b) Smoke and/or fumes</li><li>c) Contaminated run off</li><li>d) Stay upwind, upgrade</li></ul></li><li>7. Wear full protective clothing<ul style="list-style-type: none"><li>a) Positive pressure SCBA</li><li>b) Rubber or plastic gloves</li><li>c) All exposed skin must be protected</li></ul></li><li>8. Treatment of exposed victims/personnel<ul style="list-style-type: none"><li>a) Remove from contact, to safe area</li><li>b) Open airway, administer oxygen</li><li>c) Decontaminate with lots of water &amp; mild detergent</li><li>d) Look for material label for additional instructions<ul style="list-style-type: none"><li>1) Try not to send to hospital still contaminated</li></ul></li><li>e) Continually observe victim &amp; monitor vital signs</li><li>f) Avoid excessive sensory stimulation (lights &amp; sirens)</li></ul></li></ul>	<p>Slide 558 Fire Fighting Tactics</p> <p>Slide 559 First Aid</p>
<ul style="list-style-type: none"><li>W. Sources of information and/or help<ul style="list-style-type: none"><li>1. Chemtrec (Chemical Transportation Emergency Center)<ul style="list-style-type: none"><li>a) 800-424-9300</li><li>b) Can contact chemical manufacturer</li></ul></li></ul></li></ul>	<p>Slide 560 Chemtrec</p>



# INSTRUCTOR GUIDE

SPECIAL HAZARDS/  
HAZARDOUS MATERIALS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>2) Minimum restrictions on emergency response personnel in regards to movement &amp; activities</li><li>3) Command post location</li><li>4) Law enforcement, scene security &amp; traffic control</li></ul> <p>b) Warm zone</p> <ul style="list-style-type: none"><li>1) Minimum of 500 ft. from center of incident</li><li>2) Zone of restricted activity</li><li>3) May contain some hazards, especially if incident suddenly escalates, worsens, wind changes, etc.</li><li>4) No unnecessary personnel allowed here, must have a reason to be there</li><li>5) No public, police can enter to assist</li></ul> <p>c) Hot zone</p> <ul style="list-style-type: none"><li>1) Highest hazard area</li><li>2) Known or suspected spill</li><li>3) Need proper protective equipment to enter this area</li><li>4) Area where release occurred, area immediately exposed to material</li></ul> <p>2. Keep a detailed log of incident events</p> <ul style="list-style-type: none"><li>a) May often end up in court to make someone pay for cleanup</li></ul> <p>3. Have safety officer(s)</p>	



# INSTRUCTOR GUIDE

SPECIAL HAZARDS/  
HAZARDOUS MATERIALS

PRESENTATION	APPLICATION
<p>c) Shovel material into a recovery drum</p> <p>1) Also contaminated soil</p>	<p>Slide 571 Blank Slide</p>

# INSTRUCTOR GUIDE

SPECIAL HAZARDS/  
HAZARDOUS MATERIALS

## SUMMARY

A thorough understanding of aircraft egress systems, armament and hazardous materials typically carried, is essential to properly carry out fire fighting and rescue operations.

## EVALUATION

The student will be evaluated by completing a written examination.

## ASSIGNMENT

To be determined by the Instructor(s).

# INSTRUCTOR GUIDE

AIRCRAFT FIRE FIGHTING  
APPARATUS AND EQUIPMENT

## AIRCRAFT CRASH FIRE RESCUE

### LESSON PLAN 9

TOPIC: Aircraft Fire Fighting Apparatus And Equipment

LEVEL: I

TIME: 60 Minutes

#### BEHAVIORAL OBJECTIVES:

Given: A written examination

Performance: The student will be able to identify the types, capabilities, and operation of specialized and conventional apparatus available for aircraft fire fighting and rescue operations. The student will be familiar with the applicable Federal Aviation Administration (FAA) regulations and National Fire Protection Association (NFPA) recommendations for aircraft fire fighting apparatus

Standard: With 70% accuracy

REFERENCES: IFSTA 206, Aircraft Fire Protection & Rescue Procedures, 2nd Edition, International Fire Service Training Association  
NFPA 1003 - Airport Fire Fighter Qualifications, National Fire Protection Association, 1987  
NFPA 403, Aircraft Rescue & Fire Fighting Services, National Fire Protection Association, 1987  
NFPA 412, Evaluating Foam Fire Fighting Equipment On Aircraft Rescue & Fire Fighting Vehicles, National Fire Protection Association, 1987  
NFPA 414, Aircraft Rescue & Fire Fighting Vehicles, National Fire Protection Association, 1987

MATERIALS NEEDED: A/V, slide projector and screen

# INSTRUCTOR GUIDE

AIRCRAFT FIRE FIGHTING  
APPARATUS AND EQUIPMENT

PREPARATION:

Successful aircraft fire fighting and rescue operations depend on quick response and effective use of apparatus and equipment. Emphasize to the student the importance of maintaining, knowing how to operate, and understanding the capabilities of aircraft fire fighting and rescue apparatus and equipment.

# INSTRUCTOR GUIDE

AIRCRAFT FIRE FIGHTING  
APPARATUS AND EQUIPMENT

PRESENTATION	APPLICATION
<p>I. Types Of Aircraft Crashes</p> <p>A. High speed and/or high angle impact</p> <ol style="list-style-type: none"><li>1. Usually results in such structural breakup that survival of the occupants is unlikely</li><li>2. Usually occurs off airport</li><li>3. Not much fire fighters can do except to save people &amp; property on ground</li></ol> <p>B. Relatively low speed and/or shallow impact angle</p> <ol style="list-style-type: none"><li>1. Occupant survival rate can be very high<ol style="list-style-type: none"><li>a) If there is some degree of pilot control prior to impact</li><li>b) If there is no post crash fire</li><li>c) If any post crash fire is controlled quickly (i.e. by fire fighters)</li></ol></li><li>2. This type of crash scenario presents a tremendous opportunity for fire fighters to save lives if they are properly equipped and trained</li></ol> <p>II. Studies By The International Federation Of Airline Pilots &amp; The Airline Pilots Association</p> <p>A. Largest percentage of survival accidents occur within a certain relationship</p> <ol style="list-style-type: none"><li>1. To runway centerline</li><li>2. To threshold lights</li><li>3. This is called the "Critical Rescue &amp; Fire Fighting Access Area"</li><li>4. Defined in NFPA Standard #403</li></ol>	<p>Slide 572 Lesson Plan Title "Aircraft Fire Fighting Apparatus &amp; Equipment"</p> <p>Slide 573 High Impact Crash</p> <p>Slide 574 Low Impact Crash</p> <p>Slide 575 Crash Locations Marked On Runway Diagram</p>

# INSTRUCTOR GUIDE

AIRCRAFT FIRE FIGHTING  
APPARATUS AND EQUIPMENT

PRESENTATION	APPLICATION
<p>III. Post Crash Fire Is Common After Impact</p> <ul style="list-style-type: none"><li>A. Fire quickly reaches a high intensity</li><li>B. Direct flame impingement on aircraft fuselage can burn through in 90 to 120 seconds</li><li>C. Presents a challenge to fire fighters to be able to quickly &amp; efficiently perform their job</li></ul>	<p>Slide 576 Aircraft Fuel Fire &amp; Smoke Column</p>
<p>IV. After 1973, Could Not Operate An Airport Serving Any Civil Aeronautics Board Certified Air Carrier With An "Airport Operating Certificate"</p> <ul style="list-style-type: none"><li>A. Part 139, Title 14, Code of Federal Regulations is law that requires this<ul style="list-style-type: none"><li>1. Levels of required fire fighting &amp; rescue capability determined by an index based on frequency &amp; length of aircraft using airport<ul style="list-style-type: none"><li>a) Determined by National Fire Protection Association (NFPA) &amp; a private consultant</li><li>b) Based on average daily departures of large, air carrier (transport) aircraft</li></ul></li><li>2. Five indexes, designated A through E<ul style="list-style-type: none"><li>a) Five (5) or more departures of largest (longest length) transport aircraft<ul style="list-style-type: none"><li>1) Index A - less than 90 ft. long</li><li>2) Index B - 90 to 126 ft.</li><li>3) Index C - 126 to 160 ft.</li><li>4) Index D - 160 to 200 ft.</li><li>5) Index E - Over 200 ft. long</li></ul></li></ul></li></ul></li></ul>	<p>Slide 577 Airport Certification</p> <p>Slide 578 Part 139</p> <p>Slide 579 Commercial Jet Aircraft On Taxiway</p>
	<p>Slide 580 Indexes</p>

# INSTRUCTOR GUIDE

AIRCRAFT FIRE FIGHTING  
APPARATUS AND EQUIPMENT

PRESENTATION	APPLICATION
<ul style="list-style-type: none"> <li>b) Specifies number of apparatus &amp; amounts of extinguishing agents required for each index</li> </ul>	
<ul style="list-style-type: none"> <li>3. Federal financial assistance was provided to help airports purchase fire fighting apparatus</li> </ul>	
<ul style="list-style-type: none"> <li>V. FAA Also Issued Advisory Circular 150/5210-6B</li> </ul>	<p>Slide 581 Advisory Circular 150/5210-6B</p>
<ul style="list-style-type: none"> <li>A. Recommended higher levels than FAR part 139               <ul style="list-style-type: none"> <li>1. Vague, broad requirements stating what airports must do, not how to do it</li> <li>2. National Fire Protection Association (NFPA) standards explain how to fulfill index requirements</li> </ul> </li> </ul>	
<ul style="list-style-type: none"> <li>B. NFPA #403               <ul style="list-style-type: none"> <li>1. Aircraft rescue &amp; fire fighting services at airports</li> <li>2. Discusses apparatus, equipment, manning, extinguishing agents, &amp; training</li> </ul> </li> </ul>	<p>Slide 582 NFPA #403</p>
<ul style="list-style-type: none"> <li>C. NFPA #414               <ul style="list-style-type: none"> <li>1. Aircraft rescue, fire fighting vehicles</li> </ul> </li> </ul>	<p>Slide 583 NFPA #414</p>
<ul style="list-style-type: none"> <li>D. NFPA #412               <ul style="list-style-type: none"> <li>1. Evaluating foam fire equipment on aircraft rescue &amp; fire fighting vehicles</li> </ul> </li> </ul>	<p>Slide 584 NFPA #412</p>
<ul style="list-style-type: none"> <li>VI. Guidelines For Aircraft Fire Fighting Found In FAA Regulations &amp; NFPA Standards</li> </ul>	
<ul style="list-style-type: none"> <li>A. First fire fighting vehicle must arrive &amp; discharge agent at the midpoint of the farthest runway within three (3) minutes</li> </ul>	<p>Slide 585 Apparatus Arriving On Scene</p>

# INSTRUCTOR GUIDE

AIRCRAFT FIRE FIGHTING  
APPARATUS AND EQUIPMENT

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>1. Timed from alarm notification to initial agent application</li><li>2. Next required units must arrive on scene within four (4) minutes</li><li>3. FAA conducts periodic tests of airport response capabilities</li><li>B. Response vehicles must be able to control fire within one (1) minute after arrival</li><li>C. Indexes require a lightweight, quick response vehicle with a minimum of:<ul style="list-style-type: none"><li>1. 450 lbs. of dry chemical</li><li>2. 50 gallons of premixed AFFF</li></ul></li><li>D. Enough personnel;<ul style="list-style-type: none"><li>1. To apply 83% of agent carried on apparatus</li><li>2. Properly clothed and trained</li></ul></li><li>E. Vehicles must be self contained units<ul style="list-style-type: none"><li>1. Carry sufficient quantities of agent(s) for the magnitude of the fire anticipated</li><li>2. Present day transport aircraft<ul style="list-style-type: none"><li>a) Numerous passengers, up to 400</li><li>b) Large volumes of fuel, to 40,000 gallons</li></ul></li></ul></li><li>F. Vehicle must be able to discharge large quantities of extinguishing agents within a short period of time<ul style="list-style-type: none"><li>1. Overwhelm the fire</li><li>2. Called mass application</li></ul></li></ul>	<p>Slide 586 Apparatus Next To Controlled Fuel Fire</p> <p>Slide 587 Quick Response Vehicle</p> <p>Slide 588 ARFF Station &amp; Personnel</p> <p>Slide 589 Top Turret Discharging</p> <p>Slide 590 Top Turret Discharging</p>

# INSTRUCTOR GUIDE

AIRCRAFT FIRE FIGHTING  
APPARATUS AND EQUIPMENT

PRESENTATION	APPLICATION
G. Minimum application rates recommended	
1. FAA	
a) .13 gpm per sq. ft. - AFFF	
2. NFPA	
a) .2 gpm per sq. ft. - any foam	
b) Almost all airports use AFFF	
H. Index C requires two (2) or more vehicles	
1. To protect both sides of fuselage	
2. To minimize seriousness of a breakdown or out of service for repair	Slide 591 ARFF Station & Apparatus
I. Vehicles must be able to discharge agent while moving	
1. Uninterrupted even while maneuvering	
2. Accomplished by independent pumping engine or power take off (PTO)	Slide 592 Apparatus Discharging While Moving
J. Strategically located hydrants required on airport and/or tank vehicle(s) to refill CFR apparatus	
1. Nurse tanker must have own pump to refill CFR apparatus or extinguish fire	Slide 593 Tanker Refilling A ARFF Vehicle
K. ARFF vehicles must be capable of performing on & off pavement	
1. Regular practice/driver training is essential	
2. Train during various weather & terrain conditions experienced at airport	Slide 594 ARFF Vehicle In Mud

# INSTRUCTOR GUIDE

AIRCRAFT FIRE FIGHTING  
APPARATUS AND EQUIPMENT

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>3. Training prior to actual emergency may disclose areas impossible to reach<ul style="list-style-type: none"><li>a) May be necessary to fund &amp; build more &amp; better access roads</li></ul></li><li>4. Train under day &amp; night conditions, different aircraft landing situations</li><li>5. Skill levels of drivers is critical</li><li>L. Recommended minimum acceleration rates<ul style="list-style-type: none"><li>1. Depends on type, load, &amp; size of vehicle</li><li>2. Specified in NFPA Standard #414</li></ul></li><li>M. Two way radio for communication with tower<ul style="list-style-type: none"><li>1. Standard ground control frequency is 121.7</li><li>2. Other radio channels for communication with mutual air fire companies, law enforcement, airport operations</li></ul></li><li>N. Flashing beacon &amp; marked for rapid &amp; positive identification</li><li>O. Cover for vehicles must be provided if prolonged temperatures below 33° F</li><li>P. One or more turrets<ul style="list-style-type: none"><li>1. For mass application of agent</li><li>2. May be manually operated, remote controlled, or both</li><li>3. Should have a variable discharge pattern</li></ul></li></ul>	<p>Slide 595 ARFF Vehicle Accelerating Down Runway</p> <p>Slide 596 Radio In ARFF Apparatus</p> <p>Slide 597 Beacon On Top Of ARFF Vehicle</p> <p>Slide 598 ARFF Station</p> <p>Slide 599 Top Turret</p>



# INSTRUCTOR GUIDE

AIRCRAFT FIRE FIGHTING  
APPARATUS AND EQUIPMENT

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>g) Briefed before test, in real life passengers may not listen to precrash talkdown, if there is time for one</li><li>h) Victim(s) know exit locations</li><li>i) No obstructions in plane, such as luggage, dislodged seats, or bodies as in a real crash situation</li><li>j) Evacuation test determines how many seats or passengers aircraft can carry</li></ul> <p>R. Optional ground sweep or under apparatus nozzles</p> <ul style="list-style-type: none"><li>1. Utilized to lay a blanket or path of foam in front of vehicle so it can move into position without endangering self</li><li>2. Used to prevent fuel or flames from floating back or igniting under vehicle</li><li>3. Controlled from inside cab of vehicle</li></ul>	<p>Slide 602 Ground Sweep Nozzles</p>
<p>VII. Extinguishing agents</p> <p>A. Foam is primary agent</p> <ul style="list-style-type: none"><li>1. Can carry 1/3 less if use AFFF instead of protein based foam<ul style="list-style-type: none"><li>a) AFFF has a faster fire knockdown ability</li></ul></li><li>2. Must carry twice the foam concentrate needed for amount of water carried<ul style="list-style-type: none"><li>a) Example: Vehicle can refill water tank twice without having to refill concentrate foam tank</li><li>b) Based on 6% foam concentrate, can adjust if use 3% concentrate</li></ul></li></ul>	<p>Slide 603 Loading Foam Concentrate On ARFF Vehicle</p> <p>Slide 604 ARFF Vehicle Refilling Water Tank</p>

# INSTRUCTOR GUIDE

AIRCRAFT FIRE FIGHTING  
APPARATUS AND EQUIPMENT

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>c) Establishing a water supply for CFR vehicles is important at major aircraft incidents</li><li>B. Reserve supply of extinguishing agents(s) stored at firestation<ul style="list-style-type: none"><li>1. Should have quantity equal to twice amounts carried on apparatus</li><li>2. Plus an additional amount for training</li><li>3. Some method to pump or quick load agent onto vehicles is recommended to minimize out of service time</li></ul></li><li>C. Secondary agent may be:<ul style="list-style-type: none"><li>1. Dry chemical (Purple K)</li><li>2. Halon 1211</li><li>3. Carbon dioxide (CO<sub>2</sub>), (rarely used)</li></ul></li></ul>	<p>Slide 605 Agent Storage Area</p> <p>Slide 606 Dry Chemical Tank On Twin Agent Unit</p>
<p>VIII. Types Of Aircraft Fire Fighting Vehicles</p> <ul style="list-style-type: none"><li>A. Rescue vehicle<ul style="list-style-type: none"><li>1. Often called a "Rapid Intervention Vehicle" (RIV)<ul style="list-style-type: none"><li>a) Complimentary vehicle to other major fire fighting vehicles</li><li>b) Designed to bring extinguishing agent to crash scene faster than other fire fighting vehicles</li><li>c) First unit to reach crash location</li></ul></li><li>2. Able to be operated by one person</li></ul></li></ul>	<p>Slide 607 Oshkosh P-19</p> <p>Slide 608 Extinguishing System Activation Controls</p>

# INSTRUCTOR GUIDE

AIRCRAFT FIRE FIGHTING  
APPARATUS AND EQUIPMENT

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>a) Charge extinguishing system enroute</li><li>b) Attack fire in incipient stage</li><li>c) Hold fire from enlarging</li><li>d) Maintain one clear rescue path</li></ul> <p>3. Dry chemical (DC) truck</p> <ul style="list-style-type: none"><li>a) Twin (dual) agent<ul style="list-style-type: none"><li>1) 250 to 1500 lbs. of Purple K dry chemical</li><li>2) 50 to 500 gallons of premixed AFFF</li></ul></li><li>b) Agent is expelled by cylinders of nitrogen or dry air<ul style="list-style-type: none"><li>1) Usually 400 cu. ft. cylinders</li><li>2) Cylinders pressurized at 2500 psi, regulated to a working pressure of 210-230 psi</li></ul></li><li>c) Can operate each agent separately or simultaneously<ul style="list-style-type: none"><li>1) Dry chemical/purple K knocks flames down</li><li>2) Foam blankets spill, secures it from reignition, and cools hot metal</li></ul></li><li>d) Hard rubber, noncollapsible rubber hose<ul style="list-style-type: none"><li>1) One inch for foam</li><li>2) 3/4 inch for dry chemical</li><li>3) Fully extended hose before charging or dry powder may clog in hose</li></ul></li></ul>	<p>Slide 609 Ansul Twin Agent Unit</p> <p>Slide 610 Twin Agent Cylinders</p> <p>Slide 611 Fire Fighter Operating A Twin Agent Nozzle</p> <p>Slide 612 Twin Agent Hoses &amp; Nozzles</p>

# INSTRUCTOR GUIDE

AIRCRAFT FIRE FIGHTING  
APPARATUS AND EQUIPMENT

PRESENTATION	APPLICATION
<ul style="list-style-type: none"> <li>4) Usually 100 ft. twinned hose per reel</li> <li>5) Dual nozzles with dual bales or triggers</li> <li>e) Do not overload vehicles</li> <li>1) Detracts from acceleration, speed, safety, maneuverability, &amp; traction capabilities</li> </ul>	<p>Slide 613 Overloaded Vehicle</p>
<p>D. Major rescue &amp; fire fighting apparatus</p>	<p>Slide 614 Oshkosh P-15</p>
<p>E. Many CFR apparatus have structural fire fighting capabilities</p>	<p>Slide 615 Oshkosh P-4 Pumping Handline Off Hydrant</p>
<p>F. Municipal structure type fire fighting apparatus can be set up for or utilized on aircraft incidents</p>	<p>Slide 616 Triple Combination Pumper At Aircraft Incident</p>
<ul style="list-style-type: none"> <li>1. Preplumbed foam tanks with preconnected hose lines</li> </ul>	<p>Slide 617 Preplumbed Foam System On Engine</p>
<ul style="list-style-type: none"> <li>2. Specialized extinguishing agent systems added to or specified when apparatus is ordered from manufacturer</li> </ul>	<p>Slide 618 Twin Agent System On Structure Engine</p>
<ul style="list-style-type: none"> <li>a) Twin agent systems</li> </ul>	
<ul style="list-style-type: none"> <li>b) Halon 1211 systems</li> </ul>	<p>Slide 619 Halon System On Structure Pumper</p>
<ul style="list-style-type: none"> <li>c) Skid mounted systems</li> </ul>	<p>Slide 620 Skid System On Apparatus</p>
<ul style="list-style-type: none"> <li>d) Large extinguishers carried on apparatus</li> </ul>	<p>Slide 621 Large Dry Chemical Extinguisher On Rig</p>
<ul style="list-style-type: none"> <li>e) Turrets mounted on structural apparatus</li> </ul>	<p>Slide 622 Turrets On Structure Pumper</p>
<ul style="list-style-type: none"> <li>3. Other modifications applicable to aircraft incidents</li> </ul>	

# INSTRUCTOR GUIDE

AIRCRAFT FIRE FIGHTING  
APPARATUS AND EQUIPMENT

PRESENTATION	APPLICATION
a) Apparatus modified to access difficult areas to reach on airport	Slide 623 San Francisco Airport Pumper
b) All wheel drive capability	Slide 624 Four Wheel Drive Structure Engine
4. Other apparatus	
a) Elevating platforms	Slide 625 San Francisco Airport Ladder Tower
1) To reach #2 engine on DC9, DC10, & L1011	
2) To take elevated photographs	
b) Rescue apparatus	
1) Light rescue unit	Slide 626 Small Utility Type Truck
2) Medium sized rescue unit	Slide 627 Chico Fire Dept. Rescue Unit
3) Heavy rescue unit	Slide 628 Sunnyvale Heavy Rescue/Haz Mat Vehicle
c) Lighting units	Slide 629 San Jose Light Unit
d) Specialized foam units	Slide 630 San Jose Foam Unit 3
1) Often found at oil refineries	
2) Trailer mounted units	Slide 631 Trailer Foam Unit
3) Carry large quantities of foam concentrate	
4) May also have capability to pump water, carry hose, foam nozzles	Slide 632 Chevron Refinery Pumper
5) Include these apparatus in mutual aid response	

# INSTRUCTOR GUIDE

AIRCRAFT FIRE FIGHTING  
APPARATUS AND EQUIPMENT

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>e) Five (5) gallon pails of foam concentrate &amp; inline eductor on all engines who respond to airport<ul style="list-style-type: none"><li>1) Modifications made to apparatus to make it more useful at aircraft incidents is only limited by the creativity &amp; ingenuity of fire personnel</li></ul></li><li>f) Ambulances</li><li>g) Hazardous Incident Response Teams</li><li>h) Command or communication vehicles</li><li>i) Search &amp; rescue vehicles</li><li>j) Fuel rigs</li><li>k) Quick attack pumpers or wildland trucks</li><li>l) Trailers with pre-established medical supplies</li><li>m) Hose wagons/trucks</li><li>n) Tankers, water tender</li></ul>	<p>Slide 633 Foam Pails &amp; Eductor On Engine</p> <p>Slide 634 Ambulances</p> <p>Slide 635 San Jose HIT Unit</p> <p>Slide 636 Command Vehicle</p> <p>Slide 637 Search &amp; Rescue Vehicle</p> <p>Slide 638 San Jose Fuel Rig</p> <p>Slide 639 San Jose Patrol Unit</p> <p>Slide 640 Sacramento Mass Casualty Trailer</p> <p>Slide 641 Sacramento 5 Inch Hose Tender</p> <p>Slide 642 Tanker</p> <p>Can you name any other fire apparatus which could be used at an aircraft incident?</p>
<p>5. Other specialized (nonfire) apparatus which could be useful at an aircraft incident</p> <ul style="list-style-type: none"><li>a) Cranes</li><li>b) Cherry picker</li></ul>	<p>Slide 643 Crane</p> <p>Slide 644 Cherry Picker</p>

# INSTRUCTOR GUIDE

AIRCRAFT FIRE FIGHTING  
APPARATUS AND EQUIPMENT

PRESENTATION	APPLICATION
c) Tow trucks	Slide 645 Tow Trucks
d) Tractors	Slide 646 Tractor At Crash Scene
e) Flatbed truck, pickup trucks	Slide 647 Flatbed Truck
f) Dump trucks	Slide 648 Dumptruck
1) Bring sand to scene	
2) Remove debris from scene	
g) Office (construction) trailers	Slide 649 Office Trailer
h) Outhouses, tents	Slide 650 Outhouses
i) Military vehicles	Slide 651 Military Vehicles
j) Vacuum trucks	Slide 652 Vacuum Truck
k) Airport food service trucks with elevating platform	Slide 653 Airport Food Service Truck
l) Buses to transport victims, passengers from incident scene	Slide 654 Buses
m) Lighting equipment	Slide 655 Lighting Trailer At Airport
n) Portable generators	Slide 656 Generator Trailer
o) Aircraft mobile stairs	Slide 657 Aircraft Stairs
p) Refrigerated trucks, trailers	Slide 658 Refrigerated Trailer
1) Temporary morgue	
q) House moving equipment	Slide 659 House Moving Equipment
r) Mobile kitchens & food vehicles	Slide 660 Food Truck

# INSTRUCTOR GUIDE

AIRCRAFT FIRE FIGHTING  
APPARATUS AND EQUIPMENT

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>s) Snow plows</li><li>t) Boats</li></ul>	
<p>IX. Access For Vehicles &amp; Apparatus To &amp; From Airport During An Aircraft Incident</p> <ul style="list-style-type: none"><li>A. Suitable quick exits or gates<ul style="list-style-type: none"><li>1. All responders have keys or combinations</li><li>2. Maps identifying access/exit locations hydrant locations</li></ul></li><li>B. Breakaway fences<ul style="list-style-type: none"><li>1. Cut &amp; wired back together</li><li>2. Identified with paint</li></ul></li></ul>	<p>Can you name any other apparatus, vehicle, or equipment that might be useful at an aircraft incident?</p> <p>Slide 661 Snow Plows</p> <p>Slide 662 Boat</p> <p>Slide 663 Airport Gate</p>
	<p>Slide 664 Blank Slide</p>

# INSTRUCTOR GUIDE

AIRCRAFT FIRE FIGHTING  
APPARATUS AND EQUIPMENT

## SUMMARY

Airport index ratings are based on the length of aircraft that use the airport and specify number of fire fighting vehicles and amount of extinguishing agents required. Specific guidelines for airport rescue & fire fighting apparatus are found in FAA regulations and NFPA standards. Many types of emergency and non-emergency apparatus, vehicles, and equipment can be utilized at aircraft incidents. Often existing fire apparatus can be modified to make them more conducive at aircraft incidents.

## EVALUATION

The student will be evaluated by completing a written examination.

## ASSIGNMENT

To be determined by the Instructor(s).

# INSTRUCTOR GUIDE

AIRCRAFT FIRE FIGHTING  
AND RESCUE PROCEDURES

## AIRCRAFT CRASH FIRE RESCUE

### LESSON PLAN 10

TOPIC: Aircraft Fire Fighting And Rescue Procedures

LEVEL: I

TIME: 180 Minutes

#### BEHAVIORAL OBJECTIVES:

Given: A written examination

Performance: The student will be able to:

1. Define size-up as it applies to aircraft problems
2. List the appropriate hand signals used in aircraft fire fighting
3. Indicate approved methods of aircraft fire fighting and rescue procedures
4. Identify correct vehicle positioning for inflight emergencies and crashes

Standard: With 70% accuracy

REFERENCES: IFSTA 206, Aircraft Fire Protection & Rescue Procedures, 2nd Edition, International Fire Service Training Association  
NFPA 1003 - Airport Fire Fighter Qualifications, National Fire Protection Association, 1987

MATERIALS NEEDED: A/V slide projector, screen, video tape player, color monitor, handouts, video tapes - Aircraft Fire Fighting Procedures, Air Canada, Orange County Flashover (Optional)

# INSTRUCTOR GUIDE

AIRCRAFT FIRE FIGHTING  
AND RESCUE PROCEDURES

PREPARATION:

Aircraft fire fighting is a unique field and calls for split recall and decision making ability. There is no second chance and lack of knowledge breeds fear and lack of self confidence. Aircraft fire fighting teams must be prepared, know the subject and be ready. In order to be prepared you must have a sound workable knowledge of all facets of aircraft fire fighting and rescue procedures.

# INSTRUCTOR GUIDE

AIRCRAFT FIRE FIGHTING  
AND RESCUE PROCEDURES

PRESENTATION	APPLICATION
<p>I. Aircraft Fire Fighting And Rescue Procedures</p> <p>A. Types of aircraft incidents: Aircraft frequently develop minor difficulties while in flight that may or may not be cause for alarm</p> <ol style="list-style-type: none"><li>1. The vast majority of inflight emergencies go unnoticed by passengers since they are not serious enough to cause the aircraft to behave abnormally</li><li>2. Typical of this type incident is the electrical malfunction which causes the instrument panel to show a fire warning light when there is no fire</li><li>3. Other incidents, however, may seriously jeopardize the security of the aircraft and its passengers</li></ol> <p>B. Inflight emergencies</p> <ol style="list-style-type: none"><li>1. The following information should be obtained as soon as possible from the information center upon notification of an inflight emergency (i.e. fire in flight, loss of gear, hydraulic failure, or other malfunction)<ol style="list-style-type: none"><li>a) Type of aircraft</li><li>b) Nature and severity of emergency</li><li>c) Amount of fuel on board</li><li>d) Number and location of passengers and crew</li><li>e) Runway to be used</li><li>f) Nature and location of any cargo of critical significance</li></ol></li><li>2. Vehicle positioning for inflight emergencies: The positioning of both airport fire fighting and assisting equipment is important and consideration should be given to the following factors:</li></ol>	<p>Slide 665 Lesson Plan Title Title-"Aircraft Fire Fighting &amp; Rescue Procedures"</p> <p>Slide 666 In Flight Emergency - Aircraft</p> <p>Slide 667 Inflight Emergency Information</p> <p>Slide 668 Vehicle Positioning For Standby</p>

# INSTRUCTOR GUIDE

AIRCRAFT FIRE FIGHTING  
AND RESCUE PROCEDURES

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>a) The equipment must be in a position to view the fireground</li><li>b) It must not be placed in a position hazardous because of spillage of fuel</li><li>c) Slope of the ground or wind direction must be noted</li><li>d) No unit should be positioned so that it will deny approach to the scene for other emergency vehicles</li><li>e) Vehicles must be positioned so that they can operate effectively on the fire and perform rescue operations without getting trapped by fire</li></ul> <ol style="list-style-type: none"><li>1) Major approach equipment should be located at the center intersection 600 ft. from runway. If there are three pieces then one should be at the approach, center and roll off intersection 600 ft. from runway</li><li>2) Major units equipped with turrets for mass application of extinguishing agent should be positioned to facilitate the most effective use of the turret streams</li><li>3) It is vitally important to avoid wasting the limited quantities of agents available, therefore, turrets should be used only when they are being effective, and repositioning or drive around may be needed to effectively extinguish fire</li><li>4) Since handlines normally control the rescue paths, it is equally important to locate equipment to permit the effective employment of these lines</li></ol>	

# INSTRUCTOR GUIDE

AIRCRAFT FIRE FIGHTING  
AND RESCUE PROCEDURES

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>5) Positioning apparatus properly is, in fact, often the key to successful operations</li><li>6) The initial discharge of foam should then be directed to drive the fire outward</li><li>7) When selecting the best position to accomplish this purpose, remember the wind has considerable influence upon the heat travel and rate of fire</li><li>8) The apparatus positioning and the escape route should be chosen with this in mind, thus utilizing the wind whenever possible, to assist in the main objective</li><li>9) Prefire plans should include a variety of types of emergency landings, showing apparatus positioning for each type</li></ul>	<p>Slide 669 Single Truck Attack Nose</p>
<p>C. Types of crashes</p> <ul style="list-style-type: none"><li>1. The wheels-up or belly landing is probably the most common example of the less serious type of accident<ul style="list-style-type: none"><li>a) It may result from a failure of the hydraulic power supply or from several other causes</li><li>b) Although belly landings most commonly occur on the airport, there are some instances in which an aircraft attempting take off is unable to gain height or remain airborne and has to be brought down either on or off the airport landing strip</li><li>c) An outbreak of fire is extremely likely although not inevitable in these cases</li></ul></li></ul>	<p>Slide 670 Belly Crash</p>

# INSTRUCTOR GUIDE

AIRCRAFT FIRE FIGHTING  
AND RESCUE PROCEDURES

PRESENTATION	APPLICATION
<ol style="list-style-type: none"><li>1) Fuel lines and tanks may be ruptured by the scraping of the lower part of the aircraft on the ground and tremendous heat and sparks are generated</li><li>2) This effect is more likely on the runways of an airport than on soft ground</li><li>3) Fire fighting or the prevention of ignition is extremely urgent following a belly landing since fatalities among the occupants are not likely unless there is a subsequent fire</li><li>4) Anytime an aircraft belly lands, the standing fuel, even though not on fire, should be covered with foam, or AFFF</li><li>5) After a belly landing, a large aircraft is likely to be substantially intact and there is a prospect of the majority of the occupants being able to make their own way out</li><li>6) If fire breaks out, the fire department should make an immediate attack to keep fire clear of the fuselage, especially the escape points</li><li>7) A small aircraft is more likely to suffer damage in a belly landing and immediate rescue of the occupants is extremely necessary</li><li>8) This is particularly true in view of the possibility that their feet and legs may be trapped</li></ol>	<p>Slide 671 DC-10 Runway Skid</p>
<ol style="list-style-type: none"><li>2. Hillside crashes: Aircraft fires on hillsides are usually so difficult to reach that fire fighting may only amount to the prevention of fire spread</li></ol>	<p>Slide 672 Hillside Crash</p>

# INSTRUCTOR GUIDE

AIRCRAFT FIRE FIGHTING  
AND RESCUE PROCEDURES

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>a) The fuel usually scatters over a wide area and burns out, leaving only burning pieces of wreckage and vegetation</li><li>b) Usually the aircraft will disintegrate upon impact with the ground or trees</li><li>c) Sometimes, because of obstructions in its path, it may cartwheel<ul style="list-style-type: none"><li>1) In the event, the main structural features such as the wings and undercarriage may be torn off and scattered over a wide area in the line of approach</li><li>2) Likewise, crew members of passengers may be thrown from the aircraft before it comes to rest</li></ul></li><li>d) A thorough search should be carried out for casualties under these conditions<ul style="list-style-type: none"><li>1) Watch for injured people laying on the ground on your approach</li><li>2) Never position downhill from the crashed aircraft, a tank may rupture and the fuel flow down hill</li></ul></li><li>3. Water crashes: In this type of crash, the surface of the water may be covered with fuel which may or may not be burning<ul style="list-style-type: none"><li>a) If practical, a blanket of foam or light water should be put over the entire area</li><li>b) If the aircraft is half in and half out of the water and has not ignited, great care should be taken when carrying out rescue operations</li></ul></li></ul>	

# INSTRUCTOR GUIDE

AIRCRAFT FIRE FIGHTING  
AND RESCUE PROCEDURES

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>c) Fuel rising to the surface may come in contact with heated parts of the engine and ignite</li><li>d) Rescue personnel should be aware that an aircraft wreckage may be floating only as a result of trapped air pockets in the top of the compartments</li><li>e) Any attempt at forcing an opening at a point above the water level may allow the air to escape and thus become submerged before the victims can be removed</li><li>f) Entry into a floating partly submerged aircraft should only be accomplished below water level</li></ul> <p>4. Nose dive crashes: On soft ground a nose dive high speed crash usually results in a large crater, which contains the wreckage of the fuselage and engines, a quantity of fuel, and possibly the bodies of occupants</p> <ul style="list-style-type: none"><li>a) Under such conditions, there is little hope of rescue being carried out</li><li>b) Engines may penetrate as deep as 20 ft. into the ground and throw up a large mass of earth</li><li>c) In some cases, an explosion takes place which scatters the wreckage</li><li>d) The wreckage in the crater burns fiercely, often with small underground explosions</li><li>e) A foam or light water seal should be applied where possible</li><li>f) It may be advantageous to flood the hole with water and apply a foam or light water blanket on the water</li></ul>	<p>Slide 673 Nose Dive Crash</p>

# INSTRUCTOR GUIDE

AIRCRAFT FIRE FIGHTING  
AND RESCUE PROCEDURES

PRESENTATION	APPLICATION
<p>5. Crashes into buildings: This type of accident presents a far more complex problem than an accident involving only an aircraft</p> <ul style="list-style-type: none"><li>a) The fire officer and his crew should make a rapid and accurate assessment of the situation</li><li>b) The aircraft will normally have broken open upon impact and the wreckage may cause wide spread damage to surrounding properties</li><li>c) Fires can be widely separated and they may spread with rapidity due to scattered fuel, severed gas lines, electrical short circuits, and other causes</li><li>d) Roofs and upper stories of buildings may suffer considerable damage resulting in the collapse of floors and walls</li><li>e) The situation may well cause injuries to many people within and outside the buildings</li><li>f) Search of threatened properties should be undertaken and the entire area should be evacuated</li><li>g) Smoking should be prohibited and other steps taken to guard against sources of ignition</li><li>h) It is almost certain that fuel tanks will be severely damaged and the contents distributed over a wide area</li><li>i) No fire has occurred, all fuel and aircraft engines should be covered with a foam or light water blanket and the surrounding property should be protected with fog lines</li></ul>	<p>Slide 674 Crash Into A Building, Bellevue-Cessna 21</p>



# INSTRUCTOR GUIDE

AIRCRAFT FIRE FIGHTING  
AND RESCUE PROCEDURES

PRESENTATION	APPLICATION
<ol style="list-style-type: none"><li>1) If the engine cut off, the rotor may continue to turn for some time with the tips of the rotor blades sagging lower and lower as they lose speed</li><li>2) It must be assumed that they will sag well below head level and could cause a serious accident to the rescuer</li><li>3) It is advisable, therefore, to watch the rotor blades and, if necessary, approach the aircraft in a crouching position</li></ol> <p>7. No fire crashes: Even though fire may not have broken out by the time the fire fighters arrive at the scene of the crash, the assumption must be made that there is severe and continuous danger of this occurring at any instant</p> <ol style="list-style-type: none"><li>a) The fuel system of the aircraft extends far beyond the actual fuel tank bays and the crash has likely fractured some part of the fuel system or the tanks, thereby releasing fuel vapor in the vicinity of the aircraft</li><li>b) Hazard: Extreme with piston aircraft because of aviation gasoline low flash point</li><li>c) Particular attention should be given to the following points, any or all of which may be important in the prevention of an outbreak of fire<ol style="list-style-type: none"><li>1) All vehicle engines not in use should be switched off</li><li>2) All exposed fuel surfaces should be blanketed with foam or light water</li></ol></li></ol>	<p>Slide 677 No Fire Crash 707</p>

# INSTRUCTOR GUIDE

AIRCRAFT FIRE FIGHTING  
AND RESCUE PROCEDURES

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>3) Other foam lines should be laid out to vantage points in readiness to cover rescue operations if fire should break out</li><li>4) Fuel should be prevented from entering sewers, buildings, and basements</li><li>5) Every attempt should be made stop leaking fuel by closing fuel valves or flattening or plugging the ends of broken fuel lines</li><li>6) Care should be taken around hard surface areas to avoid creating friction sparks</li><li>7) It is important to not unnecessarily interfere with anything associated with the aircraft, including detached pieces of the wreckage</li><li>8) Apart from increasing the risk of fire, such action may easily have the effect of destroying vital evidence, thus hampering subsequent investigations</li><li>9) All forms of naked lights must be banned throughout the area where fuel has been spilled</li><li>10) The aircraft electrical system should be disconnected, since the danger of sparking is present where such systems are energized</li><li>11) Knowledge of the aircraft is an important factor in these cases</li></ul>	
<p>D. Wheel, brake, and tire fires</p> <ul style="list-style-type: none"><li>1. The landing gear is an item of considerable concern during both normal and emergency landings.</li></ul>	<p>Slide 678 Hot Brakes</p>

# INSTRUCTOR GUIDE

PRESENTATION	APPLICATION
<p>With the added weight &amp; landing speeds of modern aircraft, touchdown speed, &amp; extreme braking required on shorter runways, overheated brakes &amp; wheels are becoming a common occurrence</p> <ul style="list-style-type: none"><li>a) The heating of aircraft wheels and tires presents a potential explosion hazard which is greatly increased when fire is present</li><li>b) In order not to endanger the crews needlessly, it is important not to mistake hot brakes for brake fires<ul style="list-style-type: none"><li>1) Hot brakes will normally cool by themselves without the use of an extinguishing agent</li><li>2) Most aircraft operating manuals for propeller driven aircraft recommend that flight crews keep the propeller forward of the fire, turning fast enough to provide an ample cooling air flow</li><li>3) One emergency measure that can be used by the responding fire forces, in the event of hot brakes, is the use of the smoke ejector</li><li>4) In most cases, the smoke ejector, properly placed, will serve the purpose of providing an ample air flow to the area involved</li><li>5) Most jet aircraft have fusible plugs which will melt at extreme heat and deflate the tire before dangerous pressures are reached</li><li>6) When responding to a wheel fire, emergency crews should approach the wheels with extreme caution in a fore or aft direction, never from the side in line with the axle.</li></ul></li></ul>	<p>Slide 679 Fire Fighters Approaching Wheel &amp; Brake Fires</p>

# INSTRUCTOR GUIDE

AIRCRAFT FIRE FIGHTING  
AND RESCUE PROCEDURES

PRESENTATION	APPLICATION
<p>Peak temperatures may not be reached until 15-20 minutes after the aircraft has come to a complete stop</p> <p>2. Braking problems in jetliners</p> <p>a) Brakes on jetliners operate under more severe conditions than do the brakes on present day piston powered aircraft. In addition to their greater gross weight, the jetliners normally fly at higher takeoff and landing speeds. Along with the reduced effectiveness of thrust reverses, when compared to reversible propellers, the brakes are not cooled by the air blast from the propellers while moving slowly or when standing still. Heat is the major factor affecting brake operations</p> <ol style="list-style-type: none"><li>1) If the fire is in the brakes, the fire officer in charge should pull his unit to within effective fire fighting range, into a position that will enable him to attack from the front or rear of the wheel, and then begin the attack</li><li>2) Hot or overheated brakes are regarded as normal characteristics of operating aircraft</li><li>3) If a plane comes to rest with an overheated brake, or the wheel is smoking around the drums and tires, the whole assembly should be allowed to cool by natural processes - that is, without the application of any cooling agent other than air</li><li>4) However, certain potential hazards may exist</li></ol>	<p>Slide 680 747 Wheel And Tire Failure</p>

# INSTRUCTOR GUIDE

AIRCRAFT FIRE FIGHTING  
AND RESCUE PROCEDURES

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>5) The wheels are highly stressed because they support the weight of the airplane and are also under pressure from the tremendous forces imposed by the inflated tires</li><li>6) The inflation pressure is increased by the heat</li></ul>	
<p>3. Fusible tire plugs</p>	
<ul style="list-style-type: none"><li>a) Major jet aircraft and several propeller driven and turboprop aircraft now have fusible plugs incorporated in the wheel rims</li></ul>	
<ul style="list-style-type: none"><li>1) These fusible plugs will automatically deflate the tires when a temperature of approximately 400° F is reached</li></ul>	
<ul style="list-style-type: none"><li>2) The release of the tire pressure will reduce the pressure on the wheel and thus eliminate the possibility of explosion</li></ul>	<p>Slide 681 Tire Plugs</p> <p>Slide 682 Fusible Tire Plug</p>
<ul style="list-style-type: none"><li>3) An overheated brake can cause a landing gear fire by igniting hydraulic oil or grease on the assembly</li></ul>	<p>Slide 683 Fire Fighter Fighting A Magnesium Fire</p>
<ul style="list-style-type: none"><li>4) An actual flame not only threatens the aircraft but could ignite the magnesium wheels with which many aircraft are equipped</li></ul>	
<ul style="list-style-type: none"><li>5) Although magnesium does not easily ignite, once ignited, it burns fiercely and is difficult to extinguish</li></ul>	
<p>4. Brake or wheel fires</p>	
<ul style="list-style-type: none"><li>a) Following extreme brake usage during an aborted takeoff or consecutive landings without cooling between, high temperature may start a brake or wheel fire</li></ul>	<p>Slide 684 Wheel Fire</p>

# INSTRUCTOR GUIDE

AIRCRAFT FIRE FIGHTING  
AND RESCUE PROCEDURES

PRESENTATION	APPLICATION
<ol style="list-style-type: none"><li>1) Because of the time lag between the absorption of high energies and peak temperatures of wheel parts, a fire may occur after completion of taxi while the aircraft is sitting still</li><li>2) The fusible plugs will probably melt out, allowing tires to deflate if temperatures are high enough to cause a fire</li><li>3) For propeller driven aircraft it is recommended that no one approach a wheel to cool it by any means if the wheel is simply overheated and no flame is present</li><li>4) Air blown by the propeller can be used to safely reduce the excess heat</li><li>5) The propeller blast is also the first defense for flames, since the blast can be used to drive the flames aft, away from the nacelle area, and a fire can frequently be blown out</li></ol> <p>5. Extinguishing or cooling</p> <ol style="list-style-type: none"><li>a) Rapid cooling of hot wheels, especially if localized, may cause explosive failure of the wheel<ol style="list-style-type: none"><li>1) Personnel and equipment should avoid the lines of probable fragmentation directly out to the side of the heated wheel for at least 300 ft.</li><li>2) Solid streams of water should not be used except as a last resort</li></ol></li></ol>	

# INSTRUCTOR GUIDE

AIRCRAFT FIRE FIGHTING  
AND RESCUE PROCEDURES

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>3) Water fog can be used but intermittent application of short bursts of 5-10 seconds is recommended</li><li>4) Dry chemical and CO<sub>2</sub> have limited cooling capacities but are effective extinguishing agents</li><li>5) Once the tires are deflated, any extinguishing agent may be safely used as there is no further danger of explosion</li></ul> <p>6. Use of dry chemical on wheel fires</p> <ul style="list-style-type: none"><li>a) The dry chemical powder fire extinguisher is recommended for controlling wheel fires on all types of aircraft because it is less likely to chill the metal in wheel parts</li><li>1) Serious accidents have resulted when either CO<sub>2</sub> or a stream of water has been used on a wheel fire</li></ul>	
<p>E. "Class A" fires in aircraft</p> <ul style="list-style-type: none"><li>1. "Class A" fires in aircraft may involve cargo, upholstery, and similar solid combustibles which require cooling and quenching for extinguishment</li><li>2. If flammable liquids are not involved, the officer in charge may find it advantageous to use water on fires of this type</li><li>3. Experience, planning, and a knowledge of how to use available equipment to the best advantage will be the guides in making a decision</li><li>4. "Class A" fire extinguishers are available in aircraft for use in minor fires</li></ul>	<p>Slide 685 Cabin Fire</p> <p>Slide 686 Combustible Materials Used In Aircraft Interiors</p> <p>Slide 687 Fire Fighter Wearing Breathing Apparatus</p> <p><u>Instructor Note:</u> Aircraft fire fighting is extremely hazardous due to the toxic gases produced by the aircraft interior contents, flammable metals, and flammable liquids</p>

# INSTRUCTOR GUIDE

AIRCRAFT FIRE FIGHTING  
AND RESCUE PROCEDURES

PRESENTATION	APPLICATION
<p>F. Hand signals for fighting aircraft fires</p> <ol style="list-style-type: none"><li>1. There is a definite need for a set of hand signals to enable an officer who is directing fire fighting operations to communicate his intentions to his personnel in situations where noise at the scene of the emergency would hamper voice or radio communications</li><li>2) Each department should develop a series of operation and maneuvers of personnel, apparatus and equipment during fire fighting operations</li><li>3) Some recommended signals are shown for the various operations<ol style="list-style-type: none"><li>a) Five basic hand signals:<ol style="list-style-type: none"><li>1) The hand signal for ready for operations: water flow, rescue etc. is:  ONE HAND EXTENDED HIGH WITH A THUMB UP SHOWING</li><li>2) The hand signal for straight stream from the top turret is:  ONE HAND POINTING TO THE ROOF TURRET; THE OTHER POINTING TO WHERE THE STREAM IS TO BE DIRECTED</li></ol></li></ol></li></ol>	<p>BREATHING APPARATUS IS MANDATORY WHEN INVOLVED IN FIGHTING AIRCRAFT FIRES</p> <p><u>Instructor Note:</u> Hand out aircraft materials - IFSTA</p> <p><u>Instructor Note:</u> The hand signals that will be presented are not in reference with IFSTA 206. Rather, they are a condensed version from United States Air force Aircraft Fire Fighting School</p> <p>Hand out hand signals for aircraft fire fighting</p> <p>Slide 688 Diagram (1)</p>  <p>Ready for Operations/ Everything OK</p> <p>Slide 689 Diagram (2)</p>  <p>Straight Stream Top Turret (Lower hand directs stream)</p>

# INSTRUCTOR GUIDE

AIRCRAFT FIRE FIGHTING  
AND RESCUE PROCEDURES

PRESENTATION	APPLICATION
<p>3) The hand signal for bumper turret operations is:</p> <p>ONE ARM FOLDED ACROSS THE CHEST</p>	<p>Slide 690 Diagram (3)</p>  <p>Bumper Turret Operation</p>
<p>4) The hand signal for dispersed (FOG) pattern is:</p> <p>BOTH HANDS OVER THE HEAD IN AN INVERTED "V"</p>	<p>Slide 691 Diagram (4)</p>  <p>Dispersed Pattern Turret (full fog)</p>
<p>5) The hand signal for cease (STOP) operations is:</p> <p>ONE HAND EXTENDED HIGH WITH A THUMB DOWN SHOWING</p>	<p>Slide 692 Diagram (5)</p>  <p>STOP Operations/ Malfunction</p>

# INSTRUCTOR GUIDE

AIRCRAFT FIRE FIGHTING  
AND RESCUE PROCEDURES

PRESENTATION	APPLICATION
<p>G. Fighting aircraft fires</p> <ol style="list-style-type: none"><li>1. Fire extinguishment at an aircraft fire is not the primary objective, it is only incidental to rescue. The fire officer in charge of an operation should plan all actions with this principle in mind. Fire fighting solely for extinguishment will be the last action taken on the fire incident. The objective at all times must be to move the fire away from accommodation spaces and the area in which rescue or evacuation operations are in progress. If fire is in the engine nacelles or wings only, a stop should be attempted at the wing root. If fuel is leaking from the tanks and spreading on the ground, the objective should be to keep this entire area free of fire long enough for the rescue to be accomplished. With the wind blowing, it may be possible to keep one side of the aircraft relatively free of smoke and heat, and fire fighting efforts should be concentrated on maintaining this condition so that occupants may be brought out of the aircraft into a bearable atmosphere. Control is, therefore, more important than extinguishment</li></ol> <ol style="list-style-type: none"><li>a) There are eight basic aircraft fire fighting procedures:<ol style="list-style-type: none"><li>1) Response</li><li>2) Size-up/approach</li><li>3) Positioning</li><li>4) Attack</li><li>5) Control</li><li>6) Rescue</li><li>7) Extinguishment</li><li>8) Overhaul</li></ol></li></ol>	<p>Slide 693 Eight Aircraft Fire Fighting Procedures</p>

# INSTRUCTOR GUIDE

## AIRCRAFT FIRE FIGHTING AND RESCUE PROCEDURES

PRESENTATION	APPLICATION
<p>2. Response procedures: This phase refers to the response, of fire fighting vehicles from the fire department to predetermined positions on the runway to stand by for an anticipated emergency landing or accident, or directly to the scene of an unexpected aircraft crash, fire, or other incident. Responding fire fighting crews, should, if possible, know the following information concerning the accident:</p> <ul style="list-style-type: none"><li>a) Type of aircraft involved</li><li>b) Nature of emergency<ul style="list-style-type: none"><li>1) In flight, what emergency exists .</li><li>2) Crash, condition of aircraft</li></ul></li><li>c) Amount of fuel on board</li><li>d) Number of passengers and crew<ul style="list-style-type: none"><li>1) Their locations, if possible</li><li>2) Infants on board. Common practice used by airlines is to wrap infants in blankets</li><li>3) Injuries, if known</li></ul></li><li>e) Location</li><li>f) Runway to be used, if landing</li></ul>	<p><u>Video #7 Aircraft Fire Fighting Procedures</u></p> <p>Explain the FAA Part 139 Response Drill At Airports, With Full Time Fire Fighters</p> <p>First response vehicle: To the center of the most distant runway discharging agent within four minutes</p> <p>Second response vehicle: To the center of the most distant runway discharging agent within 4 minutes</p> <p>Third response vehicle: To the center of the most distant runway discharging agent within four and one half minutes</p> <p>Slide 694 Information Needed By Responding Fire Fighters</p>

# INSTRUCTOR GUIDE

AIRCRAFT FIRE FIGHTING  
AND RESCUE PROCEDURES

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>1) Specific site, if crashed</li><li>g) Cargo of critical significance<ul style="list-style-type: none"><li>1) Nature</li><li>2) Location</li></ul></li><li>h) Wind direction and speed</li><li>i) While speed is essential to any emergency procedure, response of fire fighting vehicles must be tempered with discretion<ul style="list-style-type: none"><li>1) Control must be maintained with consideration given to conditions such as weather, visibility, terrain, traffic, and other existing situations</li><li>2) Promptness and safety are both objectives of response</li><li>3) When responding to an accident site some distance from the fire department, it may become necessary to travel in convoy</li><li>4) Specific procedures should be established for the formation and control of a convoy, with special emphasis on notification, formation point, convoy leadership, police escort, and types of vehicles required</li><li>5) Response routes should be predetermined to the maximum extent possible and reflected in the fire department pre-incident plan</li><li>6) The selection of the various routes must take into consideration the following factors:</li></ul></li></ul>	

# INSTRUCTOR GUIDE

AIRCRAFT FIRE FIGHTING  
AND RESCUE PROCEDURES

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>o Probable accident sites</li><li>o Presently available routes</li><li>o Possible future routes</li><li>o Design of fire fighting vehicles (weight, height, width, etc.)</li><li>o Load capacity of bridges, ramps, etc.</li><li>o Terrain (rough, even, paved, unpaved, flat, hilly, etc.)</li><li>o Weather (effect on roads, restriction of travel, etc.)</li><li>o Other obstacles</li></ul> <p>3. Undeclared emergency response procedures: The undeclared emergency is one that occurs without warning. Normally, with the inflight emergency fire, crews are in possession of certain preapproach information several minutes before the aircraft actually attempts landing. With the undeclared emergency, they may only give a brief message, such as "aircraft on fire on the south end of the runway". The aircraft fire fighting team must be prepared for any eventuality. They are dispatched direct route to the scene of the incident. The control tower normally relays additional information to responding apparatus while enroute. This type of incident may include aborted take-off, overheated brakes, or even a "Class A" fire in the passenger or cargo compartment</p> <p>a) Size-up and approach: Upon arrival at the actual accident site several important decisions must be made</p>	<p>Slide 695 Size-Up &amp; Approach</p>

# INSTRUCTOR GUIDE

## AIRCRAFT FIRE FIGHTING AND RESCUE PROCEDURES

PRESENTATION	APPLICATION
<ol style="list-style-type: none"><li>1) The overall size-up of all factors of the situation must be made to determine the specific actions required, any additional support which may be necessary, and the best location of vehicle positions for fire fighting and rescue</li><li>2) If at all possible, the arrival at the accident site by the first fire vehicle should be made by a route which takes advantage of existing wind, terrains, and aircraft wreckage features</li><li>3) This approach is desirable because the first fire vehicle usually establishes the route for other approaching vehicles and will normally provide a natural approach into correct fire fighting positions</li><li>4) Extreme caution must be exercised in the approach of all vehicles to avoid inflicting further injuries upon persons who may have been thrown clear or escaped from the crashed aircraft</li><li>5) This is especially true when visibility is restricted due to ground cover, weather, smoke, or darkness</li><li>6) In addition, an attempt should be made to avoid further damage of aircraft parts and components scattered throughout the accident area</li><li>7) This will aid in preserving the accident scene for investigators, safeguarding evidence as to the possible cause of the accident, and preventing possible damage to responding fire fighting vehicles and equipment</li></ol>	

# INSTRUCTOR GUIDE

AIRCRAFT FIRE FIGHTING  
AND RESCUE PROCEDURES

PRESENTATION	APPLICATION
<p>8) In the event vision is obscured, an acceptable practice is to have a crew member precede the vehicle on foot to insure that the way is clear</p> <p>9) This is especially applicable if the vehicle approach is in or near the path which the aircraft took after first hitting the ground</p> <p>b) Positioning: The efficiency of the overall fire fighting and rescue operation may well be determined by the factors considered and the resultant decisions made in the positioning of fire apparatus at the aircraft site</p> <p>1) Due to the variables involved in an aircraft accident, the desired positions of the fire apparatus will be a judgment decision made by the senior fire officer at the scene</p> <p>2) This judgment requires a rapid evaluation of all factors concerned in placing vehicles in the most effective operating position</p> <p>3) To make his decision, the senior fire officer must consider the incident conditions and their effect on positioning and the overall operation</p> <p>4) These attack plans are highly simplified</p> <p>5) Each aircraft fire is unique and must be individually evaluated</p> <p>6) The principles illustrated in these figures are as follows:</p>	<p>Slide 696 Single Truck Attack Nose</p> <p>Slide 697 Two Truck Attack Nose</p> <p><u>Instructor Note:</u> Stress that handlines should only be brought into play after the bulk of the fire has been knocked down by the turrets</p>



# INSTRUCTOR GUIDE

AIRCRAFT FIRE FIGHTING  
AND RESCUE PROCEDURES

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>4) At least two rescuers work together</li><li>5) Remove occupants into a bearable atmosphere<ul style="list-style-type: none"><li>o Wind<ul style="list-style-type: none"><li>- While effective operations conducted against the wind are conceivable, those conducted with the wind will provide improved visibility and breathing, decreased heat and smoke effects, better application of extinguishing agents, and reduced extinguishing and rescue time factors</li></ul></li><li>o Terrain<ul style="list-style-type: none"><li>- The influence of ground features are readily apparent, since soft or muddy areas may mire heavy vehicles and equipment, slopes may be difficult to traverse or climb, low or downhill areas may become flooded with fuel, and rough or rocky terrain may be impassable. Fire equipment should avoid gulleys and downhill areas near the crashed aircraft into which fuel may have drained</li></ul></li><li>o Type of aircraft<ul style="list-style-type: none"><li>- The specific aircraft involved may alter positioning and attack large aircraft may require a sustained rescue effort at several points, while military fighter types call for a quick and concentrated single point effort</li></ul></li></ul></li></ul>	<p>Slide 700 Wind Velocity Chart</p>

# INSTRUCTOR GUIDE

AIRCRAFT FIRE FIGHTING  
AND RESCUE PROCEDURES

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>- The type of aircraft determines occupant locations, fuel capabilities, and specific hazards</li><li>o Wreckage<ul style="list-style-type: none"><li>- Consideration must be given to the condition and location of the wreckage and the hazards which it creates. A different attack position is required if the aircraft has broken open or is upside down, fragmented, or intact. More than one apparatus setup may be required if the occupied portion of the aircraft is broken and separated into different specific pieces of wreckage</li></ul></li><li>o Occupants and rescue areas<ul style="list-style-type: none"><li>- The number and location of occupants usually establishes the first point of rescue effort and therefore would be a primary factor in positioning the apparatus. If the occupants have not attempted to evacuate the crashed aircraft and it is intact, then the proposed rescue entrance (normal loading doors, emergency exits, or emergency cut-in positioning. If the evacuation has begun from the interior, the exit(s) being used by the occupants must be protected</li><li>- Exits may be blocked by victims and other exits should be used</li></ul></li></ul>	<p><u>Instructor Note:</u> If there is a hole in the fuselage, do not shoot water into it</p> <p>Slide 701 707 With Normal Exits Operational</p> <p>Slide 702 Evacuation Lighting In Floor Of Aircraft: Mandatory 1987</p>

# INSTRUCTOR GUIDE

AIRCRAFT FIRE FIGHTING  
AND RESCUE PROCEDURES

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>o Ventilation: The planned and systematic release and removal of heated air, smoke and gases from an aircraft and the replacement of these products with a supply of cooler air<ul style="list-style-type: none"><li>- Negative panic, passengers shut down remain seated, will not take direction</li><li>- Sink when cooled</li><li>- Senses cannot detect</li><li>- Sink when cooled</li><li>- Carbon monoxide poisoning impairs judgement</li></ul></li><li>o Phases of fire<ul style="list-style-type: none"><li>- Incipient (early stages small)</li><li>- Free burning</li><li>- Smoldering (normally found in closed aircraft)</li><li>- Pressurized aircraft are air tight &amp; difficult to open because of construction. Use doors &amp; hatches as first choice</li><li>- Back draft: An explosion of rapid burning gases resulting from the introduction of oxygen when air is admitted to a fire which has depleted its oxygen source</li><li>- Back draft situations are inherent in aircraft cabin fires due to the air tight cabin.</li></ul></li></ul>	<p>Video Tape #8 <u>Air Canada</u></p> <p><u>Instructor Note:</u> All airlines are required to have smoke detectors in bathrooms, mandatory 1987</p> <p>Slide 703 Halon 1211 Fixed Systems In Bathrooms Mandatory 1987</p>

# INSTRUCTOR GUIDE

AIRCRAFT FIRE FIGHTING  
AND RESCUE PROCEDURES

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>- Extreme caution must be exercised when opening aircraft doors &amp; working off ladders &amp; wings</li><li>o Types of ventilation<ul style="list-style-type: none"><li>- Effective ventilation prevents the possibility of a back draft situation</li><li>- Horizontal (cross ventilation)</li><li>- Opening doors</li><li>- Opening emergency windows</li></ul></li><li>o Vertical ventilation<ul style="list-style-type: none"><li>- Fire may open up the roof and vent itself</li><li>- Open the top of fuselage, hatches, panels</li><li>- Do not direct water through openings of vertical ventilation</li></ul></li><li>f) Hazardous areas: While the entire area of a crash accident site may be considered hazardous, there are specific areas to be avoided whenever possible. Propeller areas of conventional aircraft are always a hazard, even when the engine is not running, since autoignition or uncontrolled engine ignition may cause the propeller or rotor to turn.</li></ul>	<p><u>Instructor Note:</u> Opening windows on pressurized aircraft very difficult (consider as a last resort)</p> <p>Example: Air Canada</p> <p><u>Instructor Note:</u> Once the aircraft has been ventilated, do not attempt to restrict ventilation</p>



# INSTRUCTOR GUIDE

AIRCRAFT FIRE FIGHTING  
AND RESCUE PROCEDURES

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>o One aspect of aircraft fire fighting equipment often overlooked is additional breathing apparatus. Since rescue and interior fire fighting may be extended for hours, enough spare air bottles or means of refilling them must be at the scene or close by</li><li>o Aircraft fire fighting operations drain manpower above all resources. It is extremely important that addition manning be mobilized and staged in order to lessen the impact on overexersion to personnel</li><li>o Most of the total extinguishment phase will be done with handlines. However, if personnel are not in the fire area the use of apparatus turrets for this operation is very effective and preserves manpower</li></ul> <p>h) Overhaul: After every aircraft incident, personnel must conduct a complete overhaul whether a fire has occurred or not</p> <p>1) Overhaul operations</p> <ul style="list-style-type: none"><li>o Involves a thorough inspection of the entire aircraft</li><li>o Heavy equipment may have to lift parts of the aircraft to complete overhaul</li><li>o Batteries must be disconnected and other ignition sources be eliminated</li><li>o Fuel lines must be crimped or plugged</li></ul>	<p>Slide 707 Breathing Apparatus-Reservicing Equipment</p> <p>Slide 708 Fire Fighter Resource Area</p> <p>Slide 709 Aircraft Being Lifted By A Crane</p>

# INSTRUCTOR GUIDE

## AIRCRAFT FIRE FIGHTING AND RESCUE PROCEDURES

PRESENTATION	APPLICATION
<ul style="list-style-type: none"> <li>o All hot spots should be cooled down, use back of hand to feel for hot spots on the fuselage wings and engines</li> <li>o Exercise extreme care while working overhaul due to jagged metal edges</li> <li>o Avoid disturbing all evidence that may aid in the investigation of the accident</li> <li>o Remove only those parts of the aircraft which hamper the fire fighting effort</li> <li>o If aircraft parts or controls must be moved for fire fighting or victim removal efforts must be made to record the original location of the parts</li> <li>o Body removal during overhaul for fire fighting purposes should be done under medical supervision only</li> <li>o Stakes should be placed in the spot where the body was removed. Also photographs should be taken of the area where the body was located</li> </ul>	<p>Slide 710 Overhaul Operations Handline</p> <p><u>Instructor Note:</u> More fire fighters are injured during overhaul than any other phase of fire fighting</p> <p><u>Instructor Note:</u> All protective clothing must be worn during overhaul is mandatory <u>Videotape #9 Orange County Flashback (Optional)</u></p> <p><u>Instructor Note:</u> Additional information on protecting evidence at an accident scene can be found in the Federal Aviation Administration Bulletin AC 150/5200-12 "Fire Department Responsibility Of Protecting Evidence At The Scene Of An Accident"</p> <p>The coroner or the investigational authority should supervise the removal</p>
<p>II. Forcible Entry And Equipment</p> <p>A. Portland United Airlines crash</p> <ol style="list-style-type: none"> <li>1. Pilot was in the process of dumping fuel because of an inflight emergency</li> </ol>	<p>Slide 711 "Forcible Entry"</p>

# INSTRUCTOR GUIDE

AIRCRAFT FIRE FIGHTING  
AND RESCUE PROCEDURES

PRESENTATION	APPLICATION
<ul style="list-style-type: none"> <li>a) Made the mistake of dumping all the fuel on board</li> <li>b) Ran out of fuel and engines quit</li> <li>c) Crashed, no fire on impact</li> </ul> <p>2. Good example of the destruction &amp; aircraft wreckage first responders may encounter at aircraft incidents</p> <p>B. The primary objective in any aircraft incident is rescue of occupants</p> <ul style="list-style-type: none"> <li>1. There are instances where very little can be accomplished to save people               <ul style="list-style-type: none"> <li>a) Remoteness of accident site</li> <li>b) Severity of impact forces</li> </ul> </li> <li>2. Low impact crash, or near an airport               <ul style="list-style-type: none"> <li>a) Lives of many victims can be saved</li> <li>b) Takes:                   <ul style="list-style-type: none"> <li>1) Preplanning</li> <li>2) Training</li> </ul> </li> </ul> </li> <li>3. Crash, may come to rest in any position               <ul style="list-style-type: none"> <li>a) Any abnormal landing force can jam access &amp; escape openings</li> </ul> </li> <li>4. Fuselage may be broken open or compacted by impact</li> <li>5. Each accident presents different problems               <ul style="list-style-type: none"> <li>a) High speed, high angle impact</li> <li>b) Versus low speed, shallow impact angle</li> <li>c) Difficult to anticipate</li> </ul> </li> </ul>	<p>Slide 712 High Impact Crash</p> <p>Slide 713 Low Impact Crash</p> <p>Slide 714 Lear Jet Upside Down</p> <p>Slide 715 Compacted Forward Section</p>



# INSTRUCTOR GUIDE

AIRCRAFT FIRE FIGHTING  
AND RESCUE PROCEDURES

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>c) At crash scene is not the time to try and learn</li><li>2. Practice using forcible entry tools<ul style="list-style-type: none"><li>a) Rip up cars and buses</li></ul></li><li>3. Know how to operate:<ul style="list-style-type: none"><li>a) Normal doors and hatches</li><li>b) Emergency doors, hatches, windows</li><li>c) Wide variety of escape systems</li></ul></li><li>4. Review crash charts<ul style="list-style-type: none"><li>a) Available from most airframe manufacturers</li><li>b) Often indicate emergency cut in areas<ul style="list-style-type: none"><li>1) Exit locations</li><li>2) Exit operation</li><li>3) Location of aircraft system</li></ul></li></ul></li><li>5. Become familiar with the aircraft that frequent your airport/area<ul style="list-style-type: none"><li>a) Construction</li><li>b) Interior arrangement</li><li>c) Special features</li><li>d) Systems (fuel, hydraulic, electrical, oxygen etc.)</li></ul></li><li>6. Many aircraft operators encourage familiarization tours</li><li>7. Arrange to attend airline flight crew emergency training schools<ul style="list-style-type: none"><li>a) Training mockups of all exit doors on aircraft used by that airline</li></ul></li></ul>	<p>Slide 719 Opening Over The Wing Door</p> <p>Slide 720 Reviewing Crash Charts</p> <p>Slide 721 Aircraft Familiarization Tour</p> <p>Slide 722 Touring Inside Of Boeing 747</p> <p>Slide 723 United Airlines School In San Francisco</p>

# INSTRUCTOR GUIDE

AIRCRAFT FIRE FIGHTING  
AND RESCUE PROCEDURES

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>b) May also have an aircraft cabin simulator<ul style="list-style-type: none"><li>1) Simulate an actual crash</li><li>2) Lights, sound effects, vibration</li></ul></li><li>c) Permits hands on operation for aircraft fire fighters</li><li>8. Become familiar with aircraft construction materials<ul style="list-style-type: none"><li>a) Know, recognize, &amp; understand materials forming major parts of aircraft</li><li>b) Manner in which materials are put together</li><li>c) Where different materials are found on aircraft</li><li>d) How certain materials affect fire fighting operations<ul style="list-style-type: none"><li>1) Especially forcible entry</li><li>2) Most have low resistance to flame exposure</li></ul></li></ul></li><li>D. Aircraft construction materials in regards to forcible entry<ul style="list-style-type: none"><li>1. Duraluminum<ul style="list-style-type: none"><li>a) Aluminum alloy</li><li>b) Most commonly used aircraft construction material</li><li>c) Makes up much of modern aircraft structure &amp; sheets for skin sections</li><li>d) Channels for framework<ul style="list-style-type: none"><li>1) Spars</li></ul></li></ul></li></ul></li></ul>	<p>Slide 724 Chart Of Aircraft Construction Materials</p> <p>Slide 725 Aircraft Manufacturing</p> <p><u>Instructor Note:</u> This section is optional for the instructor to use. Aircraft construction &amp; materials were covered partly under aircraft familiarization section (IV)</p>

# INSTRUCTOR GUIDE

AIRCRAFT FIRE FIGHTING  
AND RESCUE PROCEDURES

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>2) Pressed sections</li><li>3) Plates &amp; castings for bulkheads &amp; fittings</li><li>e) Thin sheets of duraluminum are easily pierced</li><li>f) Heavy sections can present difficult to impossible forcible entry problem</li><li>g) Melts at 1200 ° F<ul style="list-style-type: none"><li>1) 90-120 seconds after direct flame contact</li><li>2) Does not spark</li></ul></li></ul>	
<p>2. Magnesium &amp; alloys</p> <ul style="list-style-type: none"><li>a) Not generally used in forcible entry areas</li><li>b) In most large aircraft used in framework &amp; flooring<ul style="list-style-type: none"><li>1) Landing gear</li><li>2) Some helicopters use in fuselage skin</li><li>3) Commonly used in engine parts, crankcase, brackets</li></ul></li><li>c) Can spark &amp; cable of burning</li></ul>	<p>Slide 726 Landing Gear</p>
<p>3. Titanium</p> <ul style="list-style-type: none"><li>a) Used to reinforce skin surfaces to guard against exhaust heat</li><li>b) Capable of sparking &amp; burning</li><li>c) Both magnesium &amp; titanium are very difficult to penetrate, cut, or bend even with power tools</li></ul>	<p>Slide 727 Aircraft Engine</p>

# INSTRUCTOR GUIDE

AIRCRAFT FIRE FIGHTING  
AND RESCUE PROCEDURES

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>4. Steel<ul style="list-style-type: none"><li>a) Structural framing</li><li>b) Stainless steel skin surfaces</li><li>c) Rivets, fasteners, &amp; brackets</li><li>d) Engine parts</li><li>e) Capable of sparking</li></ul></li><li>5. Wood<ul style="list-style-type: none"><li>a) Older aircraft</li><li>b) Usually not much of a forcible entry problem</li></ul></li><li>E. Forcible entry through skin should be attempted only after all other means of entry have failed<ul style="list-style-type: none"><li>1. Last resort<ul style="list-style-type: none"><li>a) Usually difficult &amp; time consuming</li></ul></li><li>2. First try to force normal or emergency doors &amp; windows</li><li>3. If cutting fuselage is only means:<ul style="list-style-type: none"><li>a) Each aircraft is different</li><li>b) There are some general rules of thumb</li></ul></li><li>4. Stabilize aircraft prior to forcible entry<ul style="list-style-type: none"><li>a) Movement &amp; strains on fuselage may<ul style="list-style-type: none"><li>1) Liberate fuel from damaged tanks</li><li>2) Cause collapse or rollover of fuselage</li><li>3) Cause greater injury to trapped persons</li></ul></li></ul></li></ul></li></ul>	<p>Slide 728 Stainless Steel, Riveted Aircraft Skin</p> <p>Slide 729 Biplane</p> <p>Slide 730 Try Normal Access First</p> <p>Slide 731 Forcible Entry Is The Last Resort</p> <p>Slide 732 Los Angeles DC-10 Crash</p>

# INSTRUCTOR GUIDE

AIRCRAFT FIRE FIGHTING  
AND RESCUE PROCEDURES

PRESENTATION	APPLICATION
<p>5. Create a mental picture of interior arrangement</p> <ul style="list-style-type: none"><li>a) Bulkheads</li><li>b) Partitions</li><li>c) Decks</li><li>d) Fixed equipment</li></ul>	<p>Slide 733 Aircraft Interior</p>
<p>6. Visualize location of trapped crew &amp; passengers</p> <ul style="list-style-type: none"><li>a) Density of seating varies<ul style="list-style-type: none"><li>1) Between cabin sections (First Class vs. Coach)</li><li>2) Between carriers</li></ul></li><li>b) There may also be dislodged seats, galley, baggage, bodies, etc.</li></ul>	<p>Slide 734 Aircraft Seating</p>
<p>7. Military aircraft, location of crew</p> <ul style="list-style-type: none"><li>a) Depends on type of aircraft</li><li>b) Can sometimes be determined by exterior design<ul style="list-style-type: none"><li>1) Location of canopies</li><li>2) Gun positions</li></ul></li><li>c) This is why regular familiarization on the types of aircraft that frequent your airport is so important</li></ul>	<p>Slide 735 Air Force Fueler</p>
<p>8. Try to avoid aircraft systems underneath outer skin</p> <ul style="list-style-type: none"><li>a) Could complicate forcible entry<ul style="list-style-type: none"><li>1) Wires, cables, electrical</li><li>2) Oxygen &amp; high pressure hydraulic lines</li></ul></li></ul>	<p>Slide 736 Cutaway Of Aircraft</p>

# INSTRUCTOR GUIDE

AIRCRAFT FIRE FIGHTING  
AND RESCUE PROCEDURES

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>3) Fuel lines<ul style="list-style-type: none"><li>o Rear engine jest especially</li></ul></li><li>9. Avoid nearby structural members<ul style="list-style-type: none"><li>a) Try to involve least number of:<ul style="list-style-type: none"><li>1) Reinforcing channels</li><li>2) Stiffeners</li><li>3) Horizontal stringers</li><li>4) Longerons</li></ul></li><li>b) Skin structural reinforcements are almost always parallel or perpendicular to length of fuselage<ul style="list-style-type: none"><li>1) Creates rectangular sections</li></ul></li><li>c) Cut two (2) inches from structural members</li></ul></li></ul>	<p>Slide 737 Aircraft Structural Framework</p>
<ul style="list-style-type: none"><li>10. Military cargo &amp; passenger type aircraft have distinctive identification to indicate where to conduct forcible entry<ul style="list-style-type: none"><li>a) Bordered with yellow markings</li><li>b) Red or yellow corner marks</li><li>c) Stenciled with words "Cut Here"</li><li>d) FAA no longer requires "Cut In" marks on commercial aircraft</li></ul></li></ul>	<p>Slide 738 Military Markings</p>
<ul style="list-style-type: none"><li>11. General aviation aircraft &amp; older fixed wing, reciprocating engine aircraft<ul style="list-style-type: none"><li>a) Forcible entry problem often similar to a vehicle/highway wreck situation</li><li>b) Cut in above windows</li><li>c) From hat rack line to top of fuselage</li></ul></li></ul>	<p>Slide 739 General Aviation Crash Chart</p>

# INSTRUCTOR GUIDE

AIRCRAFT FIRE FIGHTING  
AND RESCUE PROCEDURES

PRESENTATION	APPLICATION
<p>F. Turbine powered aircraft</p> <ol style="list-style-type: none"><li>1. Heavier skin &amp; structure due to need for high altitude pressurization</li><li>2. Rip stoppers are incorporated in aircraft skin to prevent minor tears, cracks from causing explosive decompression<ol style="list-style-type: none"><li>a) Impossible to use hand tools</li><li>b) Must use power tools</li></ol></li><li>3. Cut at, around, or between windows<ol style="list-style-type: none"><li>a) Above seat arm level</li><li>b) Must use power tools</li></ol></li><li>4. Can sometimes cut from below hat rack (carry on baggage area) to center line of top fuselage</li><li>5. Windows<ol style="list-style-type: none"><li>a) Difficult to break<ol style="list-style-type: none"><li>1) Pickheaded axe may break out some windows</li></ol></li><li>b) Most windows too small to be useful anyway</li><li>c) Cool plexiglass with CO<sub>2</sub> from an extinguisher prior to striking</li></ol></li></ol>	<p>Slide 740 BAC 146</p> <p>Slide 741 Rip Stoppers</p> <p>Slide 742 Transverse Cutaway Of Transport Aircraft</p> <p>Slide 743 Window Construction</p>
<p>G. Aircraft interior fires can present unique forcible entry problems</p> <ol style="list-style-type: none"><li>1. Unattended on ground, often a delay in detection</li><li>2. Backdraft danger<ol style="list-style-type: none"><li>a) Airtight</li><li>b) Plastics, toxic products of combustion</li></ol></li></ol>	<p>Slide 744 Results Of An Aircraft Interior Fire</p>

# INSTRUCTOR GUIDE

AIRCRAFT FIRE FIGHTING  
AND RESCUE PROCEDURES

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>3. Top ventilation difficult to impossible<ul style="list-style-type: none"><li>a) Especially with a working interior fire</li><li>b) Open all openings, break windows</li><li>c) Turn aircraft to take advantage of wind<ul style="list-style-type: none"><li>1) Cross ventilation</li><li>2) Positive pressure, mechanical ventilation</li></ul></li></ul></li><li>4. Fires often originate in system components<ul style="list-style-type: none"><li>a) Electrical common cause<ul style="list-style-type: none"><li>1) Restrooms</li><li>2) Below cabin floors</li><li>3) Cabin well &amp; ceiling cavities</li></ul></li></ul></li><li>5. Concealed spaces may extend throughout aircraft<ul style="list-style-type: none"><li>a) Uncontrolled spread</li><li>b) May have to breach from interior or exterior</li><li>c) Use elevated platform<ul style="list-style-type: none"><li>1) Scissor roofing material truck is ideal for this type of use</li><li>2) Aircraft food service truck</li></ul></li></ul></li><li>6. Can locate in concealed areas by:<ul style="list-style-type: none"><li>a) Blistered paint</li><li>b) Evidence of smoke</li><li>c) Hot to touch</li></ul></li></ul>	

# INSTRUCTOR GUIDE

AIRCRAFT FIRE FIGHTING  
AND RESCUE PROCEDURES

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>d) Heat (infrared) heat detector</li><li>7. Cargo, baggage area fire<ul style="list-style-type: none"><li>a) Know how to access cargo areas from inside aircraft</li><li>b) Prevent extension of fire into cabin area while attacking fire in cargo area</li></ul></li><li>H. Forcible entry tools &amp; equipment<ul style="list-style-type: none"><li>1. FAA circular 150/5210 6B recommends minimum assortment of tools</li><li>2. Forcible entry tool kit</li> <li>3. Bolt cutters, sledge hammer, fire axe</li><li>4. Standard apparatus tool box</li><li>5. Pry axe</li><li>6. Shovels, pitch fork</li><li>7. Crash axe</li><li>8. Harness knife, seatbelt cutter</li><li>9. Come-a-long &amp; chain</li><li>10. Cable cutter, disarming tool</li><li>11. Pry bars</li><li>12. Impact pry tool</li></ul></li></ul>	<p>Slide 745 Equipment Carried On P-4</p> <p>Slide 746 Forcible Entry Kit</p> <p><u>Instructor Note:</u> Have students identify &amp; discuss tools pictured. Answer any questions</p> <p>Slide 747 Bolt Cutters, Sledge Hammer, Fire Axe</p> <p>Slide 748 Standard Tool Box</p> <p>Slide 749 Pry Axe</p> <p>Slide 750 Shovels, Pitchfork</p> <p>Slide 751 Crash Axe</p> <p>Slide 752 Harness Knife</p> <p>Slide 753 Come-A-Long</p> <p>Slide 754 Cable Cutter</p> <p>Slide 755 Prybars &amp; Bolt Cutter</p> <p>Slide 756 Impact Pry Tool</p>

# INSTRUCTOR GUIDE

AIRCRAFT FIRE FIGHTING  
AND RESCUE PROCEDURES

PRESENTATION	APPLICATION
13. Dux seal or other materials for plugging fuel leaks that develop during operations	Slide 757 Dux Seal, Wooden & Rubber Plugs
14. High-Lift jacks	Slide 758 High-Lift Jacks
15. Assorted jacks	Slide 759 Jacks
16. Cribbing	Slide 760 Cribbing
17. Tarps & portable lights a) Spread tarp out on ground near forcible entry operation to spread out tools on or to work off of	Slide 761 Tarps
18. Gear pins	Slide 762 Gear Pins
19. Canopy tool a) Certain military fighter aircraft have certain tools to operate & open canopy from the outside b) F-4 (used by Air National Guard) uses a wooden dowel	Slide 763 Canopy Tool
20. Piercing nozzle a) Los Angeles City Fire Department is testing a nozzle that can drill through aircraft skin & discharge halon	Slide 764 Wooden Dowel For F-4 Slide 765 Piercing Nozzle
21. Ladders a) Many different types available b) Make sure your ladders reach high enough on the aircraft that use your airport	Slide 766 Ladder On CFR Vehicle
22. Electrical power available for electrical power tools	Slide 767 Electrical Outlet For Onboard Generator On A CFR Vehicle

# INSTRUCTOR GUIDE

## AIRCRAFT FIRE FIGHTING AND RESCUE PROCEDURES

PRESENTATION	APPLICATION
a) Portable generator	Slide 768 Portable Generator
b) Extension cords & portable lights	Slide 769 Extension Cords & Lights
23. Airbags & wooden pallets	Slide 770 Using Airbags
a) Maxiforce or Vetter type airbags	Slide 771 Maxiforce Airbags
24. Aircraft tow bars	Slide 772 Aircraft Tow Bars
25. Porta-power hydraulic equipment	Slide 773 Hydraulic Tools
26. Jaws of life type tools	Slide 774 Hurst Tool
a) Some have aircraft type tips	Slide 775 Aircraft Tips On Hurst Tool
27. Compressed air chisel	Slide 776 Ajax Tool
28. Acetylene cutting torch	Slide 777 Cutting Torch
29. Rescue saw	Slide 778 Rescue Saw
30. Electric saws	Slide 779 Sawzall
31. Winch	Slide 780 Vehicle Winch
32. Specialized rescue apparatus	Slide 781 Rescue Truck
33. Contracted tools & equipment	Slide 782 Tool & Equipment Rental Yard
34. Tow trucks	Slide 783 Tow Truck
35. Cranes	Slide 784 Crane
36. Heavy equipment & tractors	Slide 785 Heavy Equipment
37. Miscellaneous apparatus & equipment available at the airport	Slide 786 Miscellaneous Airport Equipment
	Slide 787 Blank Slide

# INSTRUCTOR GUIDE

AIRCRAFT FIRE FIGHTING  
AND RESCUE PROCEDURES

## SUMMARY

Aircraft fire fighting and rescue procedures can make the critical life and death difference for aircraft passengers and crew. Thorough training in both facets is essential for fire personnel to effectively react to aircraft incidents.

## EVALUATION

The student will be evaluated by completing a written examination.

## ASSIGNMENT

To be determined by the Instructor(s).

# INSTRUCTOR GUIDE

AVIATION EMERGENCY  
DISASTER PRE-PLANNING

## AIRCRAFT CRASH FIRE RESCUE

### LESSON PLAN 11

TOPIC: Aviation Emergency Disaster Pre-Planning

LEVEL: I

TIME: 60 Minutes

#### BEHAVIORAL OBJECTIVES:

Given: A written examination

Performance: The student will be able to identify the need to pre-plan for aircraft incidents, list the guidelines used to establish an aircraft disaster plan and develop a disaster plan

Standard: With 70% accuracy

REFERENCES: IFSTA 206, Aircraft Fire Protection & Rescue Procedures, 2nd Edition, International Fire Service Training Association  
NFPA 1003 - Airport Fire Fighter Qualifications, National Fire Protection Association, 1987  
NFPA 424, Airport/Community Emergency Planning, National Fire Protection Association, 1987

MATERIALS NEEDED: A/V, slide projector

PREPARATION: Each local department must develop a written plan for aircraft disasters and must exercise these plans at regular intervals.

# INSTRUCTOR GUIDE

AVIATION EMERGENCY  
DISASTER PRE-PLANNING

PRESENTATION	APPLICATION
<p>I. Preplanning For Emergencies</p> <p>A. Pre-planning is necessary for all emergencies</p> <ol style="list-style-type: none"><li>1. A system for locating and reaching each accident site in minimum time, with adequate rescue, fire fighting and medical equipment, should be employed at each airport<ol style="list-style-type: none"><li>a) A grid map (or similar equivalent) will be helpful in this connection</li><li>b) Such maps should be prepared for each airport, including the area contiguous to and surrounding the airport, as appropriate<ol style="list-style-type: none"><li>1) A distance of 5 miles extending from the center of the airport is frequently used</li></ol></li><li>c) Copies should be maintained at the airport and local fire stations in the vicinity</li><li>d) At all local hospitals, police and sheriff's office</li><li>e) At all other similar emergency and information centers in the area</li><li>f) In addition, copies of this map should be kept on all vehicles and liaison aircraft emergency</li><li>g) Maps of this type are ruled off in numbered grids and marked for easy identification of any point within the map area</li><li>h) Prominent local features and roads should be shown as well as compass headings to facilitate location of accident sites by aircraft</li></ol></li></ol>	<p>Slide 788 Lesson Plan Title "Aviation Emergency Disaster Pre-Planning"</p> <p>Slide 789 Emergency Pre-Plan</p> <p>Slide 790 Grid Map</p>

# INSTRUCTOR GUIDE

AVIATION EMERGENCY  
DISASTER PRE-PLANNING

PRESENTATION	APPLICATION
<p>1) All maps should be coordinated between other airports in the same geographical area to avoid confusion</p>	
<p>B. Access roads</p> <ol style="list-style-type: none"><li>1. Quick access roads for use by emergency vehicles should extend to airport boundaries and runway to overrun areas wherever practical</li><li>2. They should be usable under all types of weather conditions</li></ol>	<p>Slide 791 Access Roads</p>
<p>C. Fences and gates</p> <ol style="list-style-type: none"><li>1. If the airport is fenced, gates should be placed in strategic locations to provide for the movement of rescue equipment to locations outside of the airport boundary<ol style="list-style-type: none"><li>a) Gates with frangible locks or knockdown fence sections should be installed</li></ol></li></ol>	<p>Slide 792 Fences And Gates</p>
<p>D. Mutual aid</p> <ol style="list-style-type: none"><li>1. A mutual aid program should be worked out with neighborhood fire and rescue units</li></ol>	<p>Slide 793 Mutual Aid Responding Apparatus</p>
<p>E. Drills</p> <ol style="list-style-type: none"><li>1. Local fire departments should be included in aircraft rescue and fire fighting training activities conducted at the airport by participating in drills, tests, and aircraft familiarization programs</li></ol>	<p>Slide 794 Aircraft Accident Drill</p>
<p>F. Communications</p>	

# INSTRUCTOR GUIDE

AVIATION EMERGENCY  
DISASTER PRE-PLANNING

PRESENTATION	APPLICATION
<p>1. Local public fire departments should be tied in closely with airport emergency alarm services, preferably by radio or direct line telephone</p>	
<p>G. Emergency medical services</p>	<p>Slide 795 EMS Crews</p>
<p>1. Ambulance &amp; medical services must also be considered in pre-planning for aircraft emergencies, and are an integral part of the mutual assistance plan</p>	
<p>H. Triage immediate fire aid</p> <p>1. First aid to the injured should be provided by a well equipped, well trained group of available airport employees</p>	<p>Slide 796 Triage Area</p>
<p>I. Ambulance services</p> <p>1. Ambulance services should be provided through prior arrangements with local, private and public ambulance services</p>	<p>Slide 797 Ambulance</p>
<p>J. News media</p> <p>1. The cooperation of local news media should be obtained</p> <p>a) To restrict the dissemination of news via radio or television during the critical period of response by the rescue, fire, and medical services in the interest of traffic control</p>	
<p>K. Security protection</p> <p>1. Adequate security protection should be planned to handle the large crowds that always collect at the scene of an accident</p>	<p>Slide 798 Airport Police</p>
<p>L. Directory</p> <p>1. A directory of all persons who may need to be contacted in emergency</p>	

# INSTRUCTOR GUIDE

AVIATION EMERGENCY  
DISASTER PRE-PLANNING

PRESENTATION	APPLICATION
<p>2. This should include location and telephone number of at least the following:</p> <ul style="list-style-type: none"><li>a) Fire departments providing mutual aid</li><li>b) Police department providing traffic control</li><li>c) Medical personnel and facilities (doctors, hospitals)</li><li>d) Airport officials</li><li>e) Airport tenants concerned or representative of aircraft operator</li><li>f) Appropriate governmental agencies having responsibilities in the USA<ul style="list-style-type: none"><li>1) National Transportation Safety Board</li><li>2) Federal Aviation Administration</li><li>3) Federal Bureau of Investigation</li><li>4) U.S. Post Office Department</li><li>5) U.S. Department of Defense</li></ul></li><li>g) Search and rescue agencies (if applicable)</li><li>h) Clergy</li><li>i) Coroner</li><li>j) This directory shall be checked constantly for accuracy and at least monthly each telephone number should be verified</li></ul> <p>M. Availability of heavy equipment</p> <ul style="list-style-type: none"><li>1. Cranes, jacks, heavy cable, generators, forklifts, etc.</li></ul>	

# INSTRUCTOR GUIDE

AVIATION EMERGENCY  
DISASTER PRE-PLANNING

PRESENTATION	APPLICATION
<p>N. Method of identification</p> <ol style="list-style-type: none"><li>1. All persons who may be called upon to respond in an emergency</li></ol> <p>O. Training procedures and hot drills</p> <ol style="list-style-type: none"><li>1. Airport emergency crews should have a comprehensive training program to become familiar with such subjects as:<ol style="list-style-type: none"><li>a) Aircraft construction</li><li>b) Hazardous materials</li><li>c) Use of hand and powered tools</li><li>d) First aid</li><li>e) Pre-planning for approaches</li><li>f) Operations at aircraft accidents</li></ol></li></ol> <p>P. Mutual aid and pre-planning</p> <ol style="list-style-type: none"><li>1. Pre-planning between the airport emergency crews and neighboring local fire departments as to mutual assignments should be constantly reviewed</li></ol> <p>Q. Developing the plan</p> <ol style="list-style-type: none"><li>1. While no one format will satisfy all requirements, some general considerations are common to all plans</li><li>2. In the preparation of the plan, the questions who, what, when, where, why, and how should be asked</li><li>3. The following outline factors must be considered in each plan:<ol style="list-style-type: none"><li>a) Characteristics<ol style="list-style-type: none"><li>1) Comprehension</li></ol></li></ol></li></ol>	<p>Slide 799 Identification Vests</p> <p>Slide 800 Hot Drill</p> <p>Slide 801 NFPA 424</p> <p><u>Instructor Note:</u> Handout material-give students a scenerio of a crash situation provided in the course and have them follow the work sheet and develop a plan based on the scenerio</p> <p>A very effective tool to use is to break the students into equal groups and have each group develop a plan and give a presentation regarding the plan</p>

# INSTRUCTOR GUIDE

AVIATION EMERGENCY  
DISASTER PRE-PLANNING

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>2) Flexible</li><li>3) Specific</li><li>4) Simple</li><li>5) Workable</li><li>b) Developing a plan<ul style="list-style-type: none"><li>1) Responsibility</li><li>2) Forecast emergency responses</li><li>3) Define authorities</li><li>4) Enlist community resources and cooperation</li><li>5) Evaluate resources</li><li>6) Access additional need</li><li>7) Define the plan</li><li>8) Train the training instructors</li></ul></li><li>4. Notification of emergency forces<ul style="list-style-type: none"><li>a) Primary (emergency forces)<ul style="list-style-type: none"><li>1) Fire</li><li>2) Police</li><li>3) Medical</li></ul></li><li>b) Secondary (support agencies)<ul style="list-style-type: none"><li>1) Airport operations</li><li>2) Air line carrier, owner, as applicable</li><li>3) FAA, if applicable</li><li>4) Military, if applicable</li></ul></li></ul></li></ul>	

# INSTRUCTOR GUIDE

AVIATION EMERGENCY  
DISASTER PRE-PLANNING

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>5) Civil defense, if applicable</li><li>c) Methods of notification<ul style="list-style-type: none"><li>1) Telephone</li><li>2) Radio</li><li>3) Horn, siren, or other general alarm system</li></ul></li><li>5. Type of incident<ul style="list-style-type: none"><li>a) Anticipated accident or unexpected accident</li><li>b) Aircraft crash<ul style="list-style-type: none"><li>1) With fire</li><li>2) Without fire</li></ul></li><li>c) Aircraft incident (other than crash)<ul style="list-style-type: none"><li>1) With fire</li><li>2) Without fire</li></ul></li></ul></li><li>6. Type of aircraft involved<ul style="list-style-type: none"><li>a) Private</li><li>b) Commercial</li><li>c) Military</li><li>d) Size<ul style="list-style-type: none"><li>1) Small aircraft</li><li>2) Large aircraft</li></ul></li></ul></li><li>7. Accident site<ul style="list-style-type: none"><li>a) Location<ul style="list-style-type: none"><li>1) Airport area</li></ul></li></ul></li></ul>	

# INSTRUCTOR GUIDE

AVIATION EMERGENCY  
DISASTER PRE-PLANNING

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li><ul style="list-style-type: none"><li>o Runway</li><li>o Taxiway</li><li>o Apron or ramp</li></ul></li><li>2) Off airport area<ul style="list-style-type: none"><li>o Urban</li><li>o Suburban</li><li>o Rural</li></ul></li><li>b) Exposures<ul style="list-style-type: none"><li>1) Buildings or facilities</li><li>2) Forest lands</li></ul></li><li>c) Terrain<ul style="list-style-type: none"><li>1) Paved or graded</li><li>2) Unimproved</li><li>3) Farmland</li><li>4) Forested</li><li>5) Level</li><li>6) Hilly</li></ul></li><li>d) Weather<ul style="list-style-type: none"><li>1) Winds</li><li>2) Rains</li><li>3) Sleet and/or snow</li><li>4) Effects<ul style="list-style-type: none"><li>o On response to accident site</li></ul></li></ul></li></ul>	

# INSTRUCTOR GUIDE

AVIATION EMERGENCY  
DISASTER PRE-PLANNING

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li><ul style="list-style-type: none"><li>o On site terrain</li><li>o On use of heavy vehicles and equipment</li><li>o On fire fighting and rescue operations</li></ul></li><li>8. Access to accident site<ul style="list-style-type: none"><li>a) Roads<ul style="list-style-type: none"><li>1) Size Appropriate</li><li>2) Condition</li><li>3) Special roads required</li></ul></li><li>b) Bridges<ul style="list-style-type: none"><li>1) Required</li><li>2) Adequate strength and size</li></ul></li><li>c) Fences<ul style="list-style-type: none"><li>1) Knockdown type</li><li>2) Frangible gates</li><li>3) Impassable</li></ul></li><li>d) Grid map<ul style="list-style-type: none"><li>1) Five to fifteen mile radius</li><li>2) Depicts all roads, bridges, hazards, etc.</li></ul></li></ul></li><li>9. Available vehicles and equipment<ul style="list-style-type: none"><li>a) Fire fighting and rescue<ul style="list-style-type: none"><li>1) Required</li><li>2) Assigned</li><li>3) Available through mutual aid</li></ul></li></ul></li></ul>	

# INSTRUCTOR GUIDE

AVIATION EMERGENCY  
DISASTER PRE-PLANNING

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>b) Heavy equipment<ul style="list-style-type: none"><li>1) Cranes</li><li>2) Bulldozers</li><li>3) High-lift</li></ul></li><li>c) Special purpose vehicles and equipment<ul style="list-style-type: none"><li>1) Lighting</li><li>2) Cutting - welding</li><li>3) Tow truck</li><li>4) Boats</li></ul></li></ul> <p>10. Communications</p> <ul style="list-style-type: none"><li>a) Types (portable and fixed)<ul style="list-style-type: none"><li>1) Direct wire</li><li>2) Radio</li><li>3) Telephone</li><li>4) Public address</li></ul></li><li>b) Requirements<ul style="list-style-type: none"><li>1) Radio frequencies<ul style="list-style-type: none"><li>o Number required</li><li>o Number assigned</li><li>o Number available to fire chief</li></ul></li><li>2) Intra-agency capabilities</li><li>3) Inter-agency capabilities</li><li>4) Accident site communications</li></ul></li></ul>	

# INSTRUCTOR GUIDE

AVIATION EMERGENCY  
DISASTER PRE-PLANNING

## PRESENTATION

## APPLICATION

11. Supporting agencies
  - a) Police
    - 1) Local, county, state
    - 2) Military
  - b) Medical
    - 1) Ambulance services
    - 2) Hospital
      - o Fixed (permanent)
      - o Field type
      - o Temporary morgue
12. Military assistance (if applicable)
  - a) Medical
  - b) Explosive ordinance disposal teams
  - c) Disaster control teams
  - d) Aircraft crash recovery teams
13. Mutual aid
  - a) Local, county, state fire organizations
  - b) Federal and military fire organizations
  - c) Civil defense
  - d) Red Cross
14. Reporting an aircraft incident
15. News media
  - a) Radio and television
  - b) Newspaper and magazines

Slide 802 Blank Slide

# INSTRUCTOR GUIDE

AVIATION EMERGENCY  
DISASTER PRE-PLANNING

## SUMMARY

Emergency plans are necessary for aircraft incidents to be properly and effectively handled. Emergency plans must be included in agency training and must be exercised regularly, to include all agencies and resources that would normally respond to the incident.

## EVALUATION

The student will be evaluated by completing a written examination.

## ASSIGNMENT

To be determined by the Instructor(s).

# INSTRUCTOR GUIDE

POST INCIDENT OPERATIONS

## AIRCRAFT CRASH FIRE RESCUE

### LESSON PLAN 12

TOPIC: Post Incident Operations

LEVEL: I

TIME: 60 Minutes

#### BEHAVIORAL OBJECTIVES:

Given: A written examination

Performance: The student will indicate post incident operations and proper preservation of a crash scene. The student will recall how to interact with the various agencies working at a crash site. The student will identify post traumatic stress disorder and its effects and treatment

Standard: With 70% accuracy

REFERENCES: IFSTA 206, Aircraft Fire Protection & Rescue Procedures, 2nd Edition, International Fire Service Training Association  
NFPA 1003 - Airport Fire Fighter Qualifications, National Fire Protection Association, 1987

MATERIALS NEEDED: A/V: slide projector, screen, video tape player, color monitor, video tapes - Reno Air Disaster, Critical Incident Stress

PREPARATION: The instructor must emphasize the importance of each person's responsibility at a post crash scene, and procedures to be followed.

# INSTRUCTOR GUIDE

POST INCIDENT OPERATIONS

PRESENTATION	APPLICATION
<p>I. Preservation Of Crash Scene</p> <p>A. Protection of evidence is one of the first and most important steps to be taken</p> <ol style="list-style-type: none"><li>1. Restraint of the people who might interfere with the wreckage</li><li>2. Wreckage should only be disturbed for the purpose of fire suppression or victim removal when absolutely necessary</li><li>3. If possible, the area should be photographed prior to the above activity</li><li>4. Exercise caution in flight deck area so as not to disturb settings of switches, controls, etc.</li><li>5. Voice and flight recorders should be retrieved by a qualified member of the investigating team as soon as practicable</li><li>6. Security measures at the crash site should be taken as soon as possible</li><li>7. Parts 430.10 and 431.14 of Title XIV of the Code of Federal Regulations dictate specific data on preservation of aircraft wreckage mail, cargo, records, and the release thereof<ol style="list-style-type: none"><li>a) Fire fighters have authority to remove mail and other cargo &amp; records from aircraft</li></ol></li><li>8. Military aircraft - report all crashes of military aircraft to the nearest military base<ol style="list-style-type: none"><li>a) Always assume that the aircraft is carrying explosives (rockets, missiles, etc.)</li><li>b) All spectators must be kept clear of area for at least 2000 ft.</li></ol></li></ol>	<p>Slide 803 Lesson Plan Title "Post Incident Operations"</p> <p>Slide 804 Aircraft Intact</p> <p>Slide 805 Destroyed Aircraft (Reno)</p>

# INSTRUCTOR GUIDE

POST INCIDENT OPERATIONS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>c) Rescue of personnel and fire fighting actions should be conducted from the side of the aircraft</li><li>B. Incident areas must be isolated<ul style="list-style-type: none"><li>1. Because aircraft accidents attract large crowds of spectators, it is important that the incident area be isolated<ul style="list-style-type: none"><li>a) Spectators may disturb valuable evidence</li><li>b) Dangers to themselves</li><li>c) Interferes with CFR personnel</li><li>d) Pre-plan for crowd control</li></ul></li></ul></li><li>C. Essential personnel identification<ul style="list-style-type: none"><li>1. Arm bands</li><li>2. Badges</li><li>3. Uniforms/vest</li><li>4. Establish a news media briefing area<ul style="list-style-type: none"><li>a) Provide vest for areas (distinctive)</li><li>b) Brief press at 20 minute interviews</li><li>c) Escort press into site for photo and video work (information officer assignment)</li></ul></li></ul></li><li>D. Establishment of command post<ul style="list-style-type: none"><li>1. Fire</li><li>2. Law enforcement</li></ul></li></ul>	<p>Slide 806 Crash Scene</p> <p>Slide 807 Identification Vests</p> <p>The fire department is in command of an aircraft crash scene until?</p> <p>Answer: Fire official determines the emergency is over</p> <p>Slide 808 Command Post</p>



# INSTRUCTOR GUIDE

POST INCIDENT OPERATIONS

## PRESENTATION

## APPLICATION

1. Condition and location of wreckage
2. Location of fatalities
3. Location of survivors
4. Extent of fire
5. Problems with knockdown and extinguishment
6. Officer in charge
7. Communications
8. Map
9. Rescue condition
10. Summarize
11. Incident reports

### H. NTSB/FAA

1. Notification times
2. Method of notifications
3. Number and type of apparatus
4. Number of personnel responding
5. Amounts and types of extinguishing agents utilized
6. Response times
7. Training records (important) are requested by FAA post incident

The two agencies who are always notified to investigate an incident are?

Answer: FAA, NTSB

Slide 811 Gridding Off Area (NTSB)

# INSTRUCTOR GUIDE

POST INCIDENT OPERATIONS

## PRESENTATION

## APPLICATION

- I. Search and rescue
  - 1. Search and rescue
  - 2. Fire
  - 3. Police
  - 4. Medical
- J. Police response
  - 1. Interviewing
  - 2. Units
  - 3. Times
  - 4. Personnel
  - 5. Incident reports
- K. Medical response
  - 1. Hospitals alerted
  - 2. Medical personnel
  - 3. Services provided
  - 4. Interview
  - 5. Distribution and disposition
  - 6. Hospital disaster plan
  - 7. Triage locations
    - a) Primary survival scan
    - b) Stabilization where they lie
    - c) Move to casualty support facility
    - d) Hospital

# INSTRUCTOR GUIDE

POST INCIDENT OPERATIONS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>8. Care, removal, and identification of fatalities<ul style="list-style-type: none"><li>a) Operating procedures of coroner</li><li>b) Operating procedures of medical examiner</li><li>c) Removal of bodies<ul style="list-style-type: none"><li>1) Fire and rescue personnel</li><li>2) Photographs or sketches of body locations<ul style="list-style-type: none"><li>o Bodies are photographed in original positions for legal &amp; investigative evidence</li></ul></li><li>3) Coroner's reports</li><li>4) Legal aspects/pain and suffering suits</li></ul></li></ul></li><li>9. Temporary morgue<ul style="list-style-type: none"><li>a) Keep away from public view</li><li>b) Separate:<ul style="list-style-type: none"><li>1) Males</li><li>2) Females</li><li>3) Children</li></ul></li></ul></li><li>10. Body storage during warm weather<ul style="list-style-type: none"><li>a) Refrigerated trucks (cover identification of truck)</li><li>b) Ice skating rinks</li><li>c) Frozen food lockers</li></ul></li></ul>	<p>Body removal should be done? Answer: Under medical supervision</p> <p>Slide 812 Body Parts</p> <p>Slide 813 Marking Locations Of Bodies/Parts</p> <p>Slide 814 Covered Corpses</p>

# INSTRUCTOR GUIDE

POST INCIDENT OPERATIONS

PRESENTATION	APPLICATION
<p>d) Meat lockers</p> <p>11. Identification</p> <p>a) Removed by coroner or ID team</p> <ul style="list-style-type: none"><li>1) Clothing</li><li>2) Jewelry</li><li>3) Etc.</li></ul> <p>b) Tag</p> <ul style="list-style-type: none"><li>1) Unidentifiable bodies</li><li>2) Mutilated or burned beyond recognition</li></ul> <p>II. Disaster Preparedness</p> <ul style="list-style-type: none"><li>A. Airport disaster plan</li><li>B. Community disaster plan</li><li>C. Recent disaster drills</li><li>D. Disaster plans implemented</li><li>E. Interview</li><li>F. Copies</li></ul> <p>III. Critical Incident Stress Disorder: stress, simply put, is the force placed against a person and the psychological, as well as, the physical response to that force. In the terms of emergency response personnel, the psychological stress does not usually occur immediately on the scene, although it can, but sometime later back at the station or even at home. Sometimes the effects do not occur until years later and often the causes and effects are misunderstood. A crisis is a state of emotional turmoil and can be experienced by an individual at anytime during his/her life.</p>	<p>Slide 815 View Of Identification Areas</p> <p>Video: #10 <u>Reno Air Disaster</u></p> <p>Slide 816 Photo/Fire Fighter Stress</p>

# INSTRUCTOR GUIDE

POST INCIDENT OPERATIONS

PRESENTATION	APPLICATION
<p>III. (contd.) CISD is a very real problem to the fire service and when pre-planning for such a devastating accident such as an aircraft crash, CISD should be included in that process</p> <ul style="list-style-type: none"><li>A. Types of crisis<ul style="list-style-type: none"><li>1. Interpersonal</li><li>2. Intrapersonal</li><li>3. Situational<ul style="list-style-type: none"><li>a) Even the most seasoned veteran fire fighter will suffer the affects of post trauma stress disorder from aircraft crash situations</li></ul></li></ul></li><li>B. Categories of stress<ul style="list-style-type: none"><li>1. Frustration</li><li>2. Conflict</li><li>3. Pressure</li></ul></li><li>C. Dealing with stress<ul style="list-style-type: none"><li>1. Pre-plan<ul style="list-style-type: none"><li>a) Have psychology teams ready to respond to scene and evaluate mental status of personnel</li></ul></li><li>2. Debrief personnel<ul style="list-style-type: none"><li>a) Mass debriefing and individual counseling sessions</li></ul></li><li>3. Critical incident stress<ul style="list-style-type: none"><li>a) Debriefing<ul style="list-style-type: none"><li>1) Because of the brutal nature of aircraft crashes, fire fighters must recognize the symptoms of: post trauma stress disorder</li></ul></li></ul></li></ul></li></ul>	<p>Slide 817 Fire Fighter Rehab Area</p>

# INSTRUCTOR GUIDE

POST INCIDENT OPERATIONS

PRESENTATION	APPLICATION
<ul style="list-style-type: none"><li>b) Assessment</li><li>c) Plan</li><li>d) Implementation</li><li>e) Reassessment</li><li>f) Recapping</li></ul> <ol style="list-style-type: none"><li>4. Let them talk about it</li><li>5. Listen</li><li>6. Observe and monitor</li><li>7. Recognize symptoms early</li><li>8. Frequent breaks - remote from crash site</li><li>9. Provide fresh personnel</li><li>10. Professional help at scene</li><li>11. Symptoms of CISD<ul style="list-style-type: none"><li>a) Shutdown (no work)</li><li>b) Joking around at scene</li><li>c) Staring at victims</li><li>d) Nausea, fatigue</li></ul></li></ol> <p>D. Follow-up</p> <ol style="list-style-type: none"><li>1. Goal in crisis intervention</li><li>2. IMPORTANT - because affects of CISD are delayed and differ in severity</li><li>3. Help organize and mobilize resources</li><li>4. Provide time off as needed per individual case provide on-going counseling services</li><li>5. Return to normal</li></ol>	<p>The most effective method of recognizing and dealing with critical incident stress disorder is? Answer: (1 through 10)</p> <p><u>Video Tape #11 Critical Incident Stress</u></p> <p>Slide 818 OSFM Logo</p>

# INSTRUCTOR GUIDE

POST INCIDENT OPERATIONS

## SUMMARY

Post incident operations are critical for legal, investigative, humane, and public health reasons. It is very important that these operations be carefully pre-planned and executed, and that personnel are adequately debriefed following the incident.

## EVALUATION

The student will be evaluated by completing a written examination.

## ASSIGNMENT

To be determined by the Instructor(s).

# APPENDIX A

## **COURSE SCHEDULE**

FIRE CONTROL V  
 AIRCRAFT RESCUE AND FIRE FIGHTING COURSE  
 COURSE SCHEDULE

<u>DAY 1</u>	Time (Minutes)
LP-1 Course Introduction	30
Appendix B Pre-examination	30
LP-2 Airport Familiarization	60
LP-3 Airport Fire Fighting Communications	30
Appendix C Exercise I	30
LP-4 Aircraft Familiarization	60
Lunch	
LP-4 Aircraft Familiarization cont.	120
LP-5 Aviation Fuels	120
 <u>Day 2</u>	
LP-6 Extinguishing Agents	180
LP-7 Protective Clothing/Breathing Apparatus	30
Appendix C Exercise II	30
LP-8 Special Hazards/Hazardous Materials	60
LP-9 Aircraft Fire Fighting Apparatus & Equipment	60
LP-10 Aircraft Fire Fighting & Rescue Procedures	120

FIRE CONTROL V  
AIRCRAFT RESCUE AND FIRE FIGHTING COURSE  
COURSE SCHEDULE

		Time (Minutes)
<u>DAY 3</u>		
LP-10	Aircraft Fire Fighting & Rescue Techniques	60
cont.	Pre-burn Preparation	30
	Live Burn Demonstration	60
	Apparatus Reservicing Operations	60
	Burn Critique	30
	Lunch	
LP-11	Aviation Emergency Disaster Planning	60
LP-12	Post Incident Operations	60
Appendix C	Exercise III	30
	Final Examination/Critique	60
	Closing Remarks/Presentation Of Certificates	30

APPENDIX B

**AIRCRAFT RESCUE and  
FIRE FIGHTING  
PRE-COURSE EXAMINATION**

AIRCRAFT RESCUE AND FIRE FIGHTING  
PRE-COURSE EXAMINATION

AIRCRAFT RESCUE AND FIRE FIGHTING

1. VERY IMPORTANT: USE ONLY #2 PENCIL
2. Use the answer sheet provided. DO NOT write or mark on this test booklet.
3. ON ANSWER SHEET
  - fill in your name
  - subject should read AIRCRAFT RESCUE AND FIRE FIGHTING
  - fill in the date
4. Select the ONE answer that you believe to be the most correct. Mark the letter on your answer sheet that corresponds with the choice you have selected. An item will be scored wrong if more than one answer is selected.

## AIRCRAFT RESCUE AND FIRE FIGHTING

1. The Aircraft Rescue and Fire Fighting Course was designed in accordance with:
  - a. IFSTA 206
  - b. NTSB 329
  - c. NFPA 1003-1987
  - d. FAA Part 139
  
2. Familiarization of airport and surrounding areas will accomplish all EXCEPT:
  - a. Decrease response time
  - b. Become knowledgeable about all operations
  - c. Aid with additional responders
  - d. Decrease life loss and property damage
  
3. A valuable aid to utilize for the airport and surrounding area familiarization is:
  - a. Street locator
  - b. Run cards
  - c. Runway numbering map
  - d. Grid map
  
4. Runway designation numbers are taken:
  - a. Clockwise, from the face of a clock, with 12 o'clock being due north
  - b. Counterclockwise, from the face of a clock, with 12 o'clock being due north
  - c. From compass bearings
  - d. From airport grid maps
  
5. Taxiways are identified by:
  - a. White lights
  - b. Green lights
  - c. Blue lights
  - d. Amber lights

## AIRCRAFT RESCUE AND FIRE FIGHTING

6. Threshold lights are identified by:
  - a. White lights
  - b. Blue lights
  - c. Amber lights
  - d. Green lights
  
7. Runway lights are identified by:
  - a. White lights
  - b. Blue lights
  - c. Amber lights
  - d. Green lights
  
8. Ways of controlling airport vehicle traffic are:
  - a. Telephone and radio communications
  - b. Tower signals and telephone
  - c. Light signals and radio communications
  - d. Ground and runway frequencies
  
9. A standard ground control frequency is:
  - a. 120.4
  - b. 121.7
  - c. 130.0
  - d. 124.0
  
10. A flashing red light from the tower means:
  - a. Stop
  - b. Return to starting point
  - c. Proceed parallel to runway
  - d. Clear active runway immediately

## AIRCRAFT RESCUE AND FIRE FIGHTING

11. Alternating red and green lights from the tower mean:
  - a. Return to starting point
  - b. Clear runway immediately
  - c. Stop
  - d. General warning, exercise extreme caution
  
12. In order to eliminate communication confusion, the International Civil Aviation Organization uses the:
  - a. Greek alphabet
  - b. European aviation alphabet
  - c. Phonetic alphabet
  - d. Universal alphabet
  
13. In the case of an actual crash situation, the tower will initiate a/an:
  - a. Alert II
  - b. Alert III
  - c. Alert I
  - d. Multi-Casualty Plan
  
14. An Alert II response would involve:
  - a. Standing by at the fire station
  - b. Standing by at taxiways adjacent to runways
  - c. Response on the runway involved
  - d. Radio surveillance only
  
15. The main purpose of an aircraft pre-fire plan is to:
  - a. Train all responding agencies
  - b. Satisfy FAA requirements
  - c. Provide basic facts about an aircraft before an incident occurs
  - d. Aid the insurance companies

## AIRCRAFT RESCUE AND FIRE FIGHTING

16. Aircraft pre-fire plans should be found in:
  - a. Airport administration
  - b. Chief's vehicle, command vehicle, station library
  - c. Training Bureau
  - d. Duty Chief's vehicle
  
17. The two main types of aircraft are:
  - a. Single engine and twin engine
  - b. Commercial and corporate
  - c. Propeller and jet driven
  - d. Fixed wing and rotary wing
  
18. The metal skin or covering on most aircraft is duralumin which begins to melt at:
  - a. 3000° F
  - b. 2000° F
  - c. 1500° F
  - d. 1200° F
  
19. Aircraft parts made of magnesium and alloys when burning will react violently when exposed to:
  - a. Air
  - b. Metal
  - c. Water
  - d. Dry chemicals
  
20. Piston engines are found primarily on:
  - a. Helicopters
  - b. Corporate aircraft
  - c. Charter aircraft
  - d. General aviation aircraft

AIRCRAFT RESCUE AND FIRE FIGHTING

21. An engine which incorporates functions of a propeller and a jet engine is:
- a. Turbo-jet
  - b. Supercharged engine
  - c. Ram-jet
  - d. Turbo-prop
22. Air is drawn into the front of a jet engine where it is \_\_\_\_\_, mixed with fuel, ignited, and expelled to produce thrust.
- a. Expanded
  - b. Compressed
  - c. Heated
  - d. Contained
23. Because of the visibility dangers associated with propellers, approach should be made from the:
- a. Front only
  - b. Rear when at all possible
  - c. Side only within 15 feet
  - d. Front and side
24. Jet engine blast velocities are considered undesirable for personnel and equipment above:
- a. 30 miles per hour and 44 feet per second
  - b. 10 miles per hour and 30 feet per second
  - c. 50 miles per hour and 65 feet per second
  - d. 30 miles per hour and 75 feet per second
25. A safe minimum clear zone in front of jet engine intakes for fire department operations is:
- a. 50 feet
  - b. 35 feet
  - c. 25 feet
  - d. 20 yards

## AIRCRAFT RESCUE AND FIRE FIGHTING

26. When exposed to aircraft engine operations, proper health protection would include:
- a. Head protection
  - b. Ear protection
  - c. Eye protection
  - d. All of the above
27. When pre-planning for an aircraft incident, careful consideration should be given to:
- a. Wind velocity
  - b. Aircraft systems and hazards
  - c. Runway length
  - d. Aircraft weight
28. A solid red color code on aircraft piping designation signifies:
- a. High pressure air
  - b. Liquid oxygen
  - c. Fuel
  - d. Electrical
29. The color coding for hydraulic system lines is:
- a. Green and yellow
  - b. Red and brown
  - c. Brown and blue
  - d. Blue and yellow
30. The color code for aircraft electrical systems is:
- a. Brown and red
  - b. Green and yellow
  - c. Orange
  - d. Brown

## AIRCRAFT RESCUE AND FIRE FIGHTING

31. Aircraft hydraulic systems may carry pressures up to:
- 1000 psi
  - 3000 psi
  - 4000 psi
  - 1750 psi
32. Fuel tanks on aircraft are usually located in the:
- Fuselage
  - Tail empennage
  - Wings
  - Belly tanks
33. Two hazards associated with oxygen systems on aircraft are:
- Toxic vapors, smoke generation
  - Intensified burning, explosion
  - Corrosion, skin damage
  - Decomposition, oxidation
34. The danger associated with anti-icing systems is:
- Flammable alcohol
  - Toxic vapors
  - Oxidation
  - Explosive glycerine
35. With large fuel spills from and around aircraft, the following procedures should be followed:
- Monitor operations
  - Shut off electrical power and evacuate the aircraft
  - Notify the Coast Guard
  - Call the tower

AIRCRAFT RESCUE AND FIRE FIGHTING

36. A large fuel spill would be classified as:
- a. Under 10 feet in any direction
  - b. Over 60 square feet
  - c. Over 10 feet in any direction, over 50 square feet of a continuous nature
  - d. Under 50 square feet
37. An ignition source which is often overlooked is:
- a. Sonar
  - b. Radar
  - c. Lightning
  - d. Hot engines
38. Protective clothing should be inspected:
- a. Annually
  - b. Semi-annually
  - c. Daily and after use
  - d. As needed
39. Long sleeve clothing should be worn beneath protective clothing to avoid:
- a. Hypothermia
  - b. Skin rash
  - c. Steam burns
  - d. Heat stroke
40. When fighting aircraft fires, self-contained breathing apparatus is to be donned when:
- a. Directed by the officer in charge
  - b. Depending on wind conditions
  - c. Toxic atmospheres exist
  - d. Extinguishing wheel fires only

## AIRCRAFT RESCUE AND FIRE FIGHTING

41. When fighting aircraft fires involving explosives, a minimum withdrawal distance for fire fighters is:
  - a. 1200 feet
  - b. 2000 feet
  - c. 2500 feet
  - d. 3000 feet
  
42. When fighting an aircraft fire which involves conventional weapons, position fire fighting vehicles at:
  - a. The nose of the aircraft
  - b. A 45 degree angle to the fuselage
  - c. The tail of the aircraft
  - d. An upwind position
  
43. In accidents involving nuclear weapons, fire fighters may be subjected to:
  - a. Detonation
  - b. Gamma fallout
  - c. Alpha contamination
  - d. Beta rays
  
44. Airport fire fighters should learn to recognize radioactive symbols as outlined in:
  - a. NFPA Fire Code No. 406
  - b. U.S. Title 14 Code of Federal Regulations 103
  - c. FAA Part 139
  - d. NTSB 329
  
45. Only when the canopy cannot be opened by primary and secondary systems should it be:
  - a. Cut open
  - b. Jettisoned
  - c. Removed
  - d. Disassembled

## AIRCRAFT RESCUE AND FIRE FIGHTING

46. The safest method of safetying an ejection seat is:
- Pinning the seat
  - Removing the arming handles
  - Cutting the gas (initiator) line
  - Have the pilot safety the seat
47. Only after all normal entrance and exit doors and hatches have been tried for egress should:
- Slides be deployed
  - Emergency cut-in be initiated
  - Cargo compartments be opened
  - Aircraft be dismantled
48. Various dry chemical extinguishing agents:
- Are compatible with each other and can be mixed in portable extinguishers
  - Are non-corrosive
  - Will prevent reflash of fuels after extinguishment
  - Are treated to be water repellent and free flowing
49. Using an aspirating foam nozzle compared to a non-aspirating foam nozzle:
- Does not expand the finished foam as much
  - Increases burnback resistance of finished foam
  - Creates finished foam which lasts longer
  - Answers b and c are both correct
50. Carbon dioxide (CO<sub>2</sub>) as an extinguishing agent:
- Leaves a messy residue after use
  - May crack hot metal
  - Works primarily by removing the fuel side of the fire triangle
  - Eliminates danger of flashback

## AIRCRAFT RESCUE AND FIRE FIGHTING

51. Aircraft fuel vapors:
- Are lighter than air
  - Will not migrate downwind of a fuel spill
  - Can be ignited by hot aircraft engine parts up to twenty (20) minutes after shutdown
  - Are water soluble and water miscible
52. The key word(s) to describe proper foam application techniques is/are:
- Submerge
  - Gently
  - Plunge
  - Wide fog
53. The kerosene grade aircraft fuel used by commercial and some military jets is:
- Jet A
  - Jet B
  - JP-4
  - AVGAS
54. The flash point of AVGAS and Jet B aircraft fuels:
- Is well below ambient temperatures found in California
  - Is well above ambient temperatures found in California
  - Are identical to their autoignition temperatures
  - Are only a problem in a mist form after an aircraft crash
55. Which of the following agents extinguishes aircraft fuel fires and prevents reflash for a period of time?
- Halon 1211
  - Carbon dioxide (CO<sub>2</sub>)
  - Aqueous film forming foam (AFFF)
  - Purple K dry chemical

AIRCRAFT RESCUE AND FIRE FIGHTING

56. Which of the following extinguishing agents works primarily by interrupting the combustion chain reaction?
- Carbon dioxide (CO<sub>2</sub>)
  - Halon 1211
  - Purple K dry chemical
  - Answers b and c are both correct
57. Different types of foam concentrates:
- Can be mixed together prior to proportioning and during storage
  - Must be proportioned separately, but can be applied simultaneously on burning fuel
  - Have almost identical characteristics and properties
  - Have similar 25% drain times
58. Foam concentrates, foam pre-mix solutions, and foam proportioning equipment:
- Have indefinite shelf life
  - Should be tested a minimum of once a year (annually)
  - Are not expensive to purchase
  - Require very little training to use
59. All of the following are advantages of aqueous film forming foam EXCEPT:
- Its foam solution will not break down or drain out
  - Quick knockdown
  - Its foam blanket reheals itself when disrupted by foot traffic or hose lines
  - Has a long shelf life compared to other foams
60. Foam solution is the proper combination of:
- Water and foam concentrate
  - Foam concentrate and air
  - Aqueous film forming foam (AFFF) and purple K
  - Flouorocarbon surfactants and protein polymers

## AIRCRAFT RESCUE AND FIRE FIGHTING

61. When connecting bonding cables during fueling operations:
- Connect to an unpainted metal point on aircraft
  - All necessary bonding cables should be connected prior to start of fueling
  - Use bonding wire of adequate size and construction
  - All of the above are correct statements
62. Which of the following is most important at a large aircraft fuel fire:
- Ambient temperature
  - Water supply
  - Ground composition
  - Ignition sources
63. Airport fire prevention activities involve:
- Monitoring aircraft maintenance and service activities for fire hazards
  - Observing fueling operations for proper procedures
  - Checking portable extinguishers for proper placement and charge
  - All of the above are correct answers
64. The usual method of discharge for twin agent extinguishing systems is:
- High pressure helium
  - A two stage pump
  - Compressed air or nitrogen
  - A balanced pressure proportioner
65. Guidelines for aircraft fire fighting apparatus are found in:
- FAA Regulations
  - NFPA pamphlets
  - U.S. Air Force fire fighting manuals
  - Both a and b are correct answers

AIRCRAFT RESCUE AND FIRE FIGHTING

66. Airport index ratings for required quantities of extinguishing agents are based on the:
- Amount of fuel carried on aircraft using the airport
  - Length of aircraft using the airport
  - Number of passengers using the airport
  - Distance from airport fire station to the farthest runway
67. A minimum of one fire fighting vehicle must be able to reach and discharge agent at the midpoint of the farthest runway within how many minutes?
- 1
  - 2
  - 3
  - 4
68. What is the minimum number of fire fighting vehicles needed to satisfy Index D and E requirements?
- 1
  - 2
  - 3
  - 4
69. To satisfy extinguishing agent requirements on airport fire fighting vehicles, one pound of Halon 1211 is equivalent to how many pounds of dry chemical?
- 1
  - 3
  - 8
  - 16
70. The eight basic elements of aircraft fire fighting, in priority order are:
- Response, Size Up/Approach, Positioning, Control, Rescue, Attack, Extinguishment, Overhaul
  - Response, Size Up/Approach, Positioning, Attack, Control, Rescue, Extinguishment, Overhaul
  - Response, Size Up/Approach, Attack, Positioning, Control, Rescue, Extinguishment, Overhaul
  - Response, Size Up/Approach, Positioning, Control, Rescue, Attack, Overhaul, Extinguishment

AIRCRAFT RESCUE AND FIRE FIGHTING

71. The primary objective of aircraft fire fighting is:
- Extinguishment
  - Rescue
  - Positioning
  - Exposures
72. The last resort to gaining access in aircraft is:
- Hatches and doors
  - Cargo compartments
  - Cutting in procedures
  - Pilot's windows
73. A good way of providing additional means of egress is to:
- Provide additional foam blanketing
  - Cut the fuselage
  - Ladder the wings and pilot's windows
  - Provide additional rescue crews
74. The correct hand signal for "ready for operations" (everything OK) is:
- Thumbs up.
  - Thumbs down
  - Arm across chest
  - Inverted V-signal over head
75. Because of the noise involved with air crash fire fighting, the most effective means of communications between crews is:
- Runners
  - Radios
  - Hand signals
  - All of the above

## AIRCRAFT RESCUE AND FIRE FIGHTING

76. The correct hand signal for "cease operations" is:
- Hands over head in an inverted V-pattern
  - One hand pointing to a location
  - One arm extended, thumb up
  - One arm extended, thumb down
77. The correct hand signal for a fog (dispersed) discharge pattern is:
- Hands over head in an inverted V-pattern
  - One arm across the chest
  - One arm extended, thumb down
  - None of the above are correct
78. The correct hand signal for a straight stream application is:
- One hand across the chest
  - Hands over head in an inverted V-pattern
  - One hand extended and the other hand pointing to desired location
  - One arm extended, thumb up
79. The correct hand signal for a bumper turret operation is:
- Hands over the head
  - One hand pointing to a location
  - One hand across the chest
  - None of the above are correct
80. The best method of extinguishing engine fires is by using:
- Foam
  - Water
  - Dry chemical
  - Halon 1211

## AIRCRAFT RESCUE AND FIRE FIGHTING

81. Because wheel fires involve combustibile metals, fire fighters should:
- Use large amounts of water
  - Use AFFF
  - Wear breathing apparatus
  - Allow the fire to burn out
82. Because aircraft wheel rims have fusible plugs which can explode at 400° F, fire fighters fighting a wheel fire should:
- Evacuate the area
  - Approach from front and rear only
  - Approach from sides only
  - Use mass foam application
83. A good wind indicator when responding to an aircraft incident is:
- Weather report
  - Tower wind vane
  - Wind sock
  - Observation
84. Positioning at the accident may be difficult because of:
- Water supplies
  - Exposures
  - Wreckage and victims
  - Airport traffic
85. Rescue corridors are established with mass application of agent from turret nozzles and maintained with:
- Mutual aid
  - Handlines
  - Portable extinguishers
  - Ladders

## AIRCRAFT RESCUE AND FIRE FIGHTING

86. Handlines are important because they ensure:
- a. Rescue crew protection
  - b. Additional fuselage protection
  - c. Fuel spill coverage
  - d. All of the above
87. In aircraft incidents, complete extinguishment of all fire may not be attempted until:
- a. The pilot is rescued
  - b. Additional crews arrive
  - c. Rescue is complete
  - d. The incident commander directs it
88. Overhaul operations begin at the:
- a. Tail
  - b. Wing
  - c. Engines
  - d. Nose
89. During overhaul, avoid disturbing the wreckage when possible:
- a. To avoid more damage
  - b. To preserve investigation evidence
  - c. To avoid injury
  - d. For insurance purposes
90. Body removal should be done:
- a. With body bags
  - b. Under medical supervision
  - c. With stretchers
  - d. By triage teams

## AIRCRAFT RESCUE AND FIRE FIGHTING

91. Because aircraft accidents attract large crowds of spectators, it is important that the:
- News media be contacted
  - Incident be isolated
  - Tower controls the area
  - Military be notified
92. A appropriate method of identifying authorized personnel at the scene is with:
- I.D. cards
  - Drivers license
  - Vests and arm bands
  - Airport pass
93. All of the following are good practices for news media personnel at a crash scene EXCEPT:
- Provide vests
  - Schedule briefings
  - Escort into crash site
  - Provide constant access
94. The two agencies who are notified to investigate an aircraft incident are:
- FBI, FEMA
  - FAA, NTSB
  - USAF, NASA
  - CIA, DOT
95. Fire fighters have the authority to remove which of the following from crashed aircraft?
- Mail
  - Armaments
  - Flight recorder
  - Emergency locating transmitter

## AIRCRAFT RESCUE AND FIRE FIGHTING

96. The fire department is in command of an aircraft crash scene until?
- Relieved by law enforcement officers
  - The FAA arrives at the scene
  - Fire officials determine the emergency is over
  - The NTSB takes command
97. Bodies are photographed in original positions for:
- Legal and investigative evidence
  - Fire department records
  - Release to relatives
  - Training of airport fire fighters
98. A quick and efficient means of establishing a temporary morgue is by using:
- Ice skating rinks
  - Frozen food storage lockers
  - Refrigerated trucks
  - High school gymnasiums
99. Because of the brutal nature of aircraft crashes, fire fighters must recognize the symptoms of:
- Nausea
  - Headaches
  - Critical incident stress disorder
  - Fatigue
100. The most effective method of recognizing and dealing with Post Traumatic Stress Disorder is to:
- Monitor personnel at scene
  - Provide frequent rest periods and fresh personnel
  - Provide professional counseling at scene
  - All of the above are true statements

AIRCRAFT RESCUE AND FIRE FIGHTING  
JULY 1988  
Key

<u>ANSWER</u>	<u>ANSWER</u>
1. ( C )	26. ( D )
2. ( B )	27. ( B )
3. ( D )	28. ( C )
4. ( C )	29. ( D )
5. ( C )	30. ( A )
6. ( D )	31. ( B )
7. ( A )	32. ( C )
8. ( C )	33. ( B )
9. ( B )	34. ( A )
10. ( D )	35. ( B )
11. ( D )	36. ( C )
12. ( C )	37. ( B )
13. ( B )	38. ( C )
14. ( B )	39. ( C )
15. ( C )	40. ( C )
16. ( B )	41. ( A )
17. ( D )	42. ( B )
18. ( D )	43. ( C )
19. ( C )	44. ( B )
20. ( D )	45. ( B )
21. ( D )	46. ( C )
22. ( B )	47. ( B )
23. ( B )	48. ( D )
24. ( A )	49. ( D )
25. ( C )	50. ( B )

AIRCRAFT RESCUE AND FIRE FIGHTING  
JULY 1988  
Key

<u>ANSWER</u>	<u>ANSWER</u>
51. ( C )	76. ( C )
52. ( B )	77. ( A )
53. ( A )	78. ( C )
54. ( B )	79. ( C )
55. ( C )	80. ( D )
56. ( D )	81. ( C )
57. ( B )	82. ( B )
58. ( B )	83. ( C )
59. ( A )	84. ( C )
60. ( A )	85. ( B )
61. ( D )	86. ( D )
62. ( B )	87. ( C )
63. ( D )	88. ( D )
64. ( C )	89. ( B )
65. ( D )	90. ( B )
66. ( B )	91. ( B )
67. ( C )	92. ( C )
68. ( C )	93. ( D )
69. ( A )	94. ( B )
70. ( B )	95. ( A )
71. ( B )	96. ( C )
72. ( C )	97. ( A )
73. ( C )	98. ( C )
74. ( A )	99. ( C )
75. ( C )	100. ( D )

# APPENDIX C

## EXERCISES I, II, III

# EXERCISE I

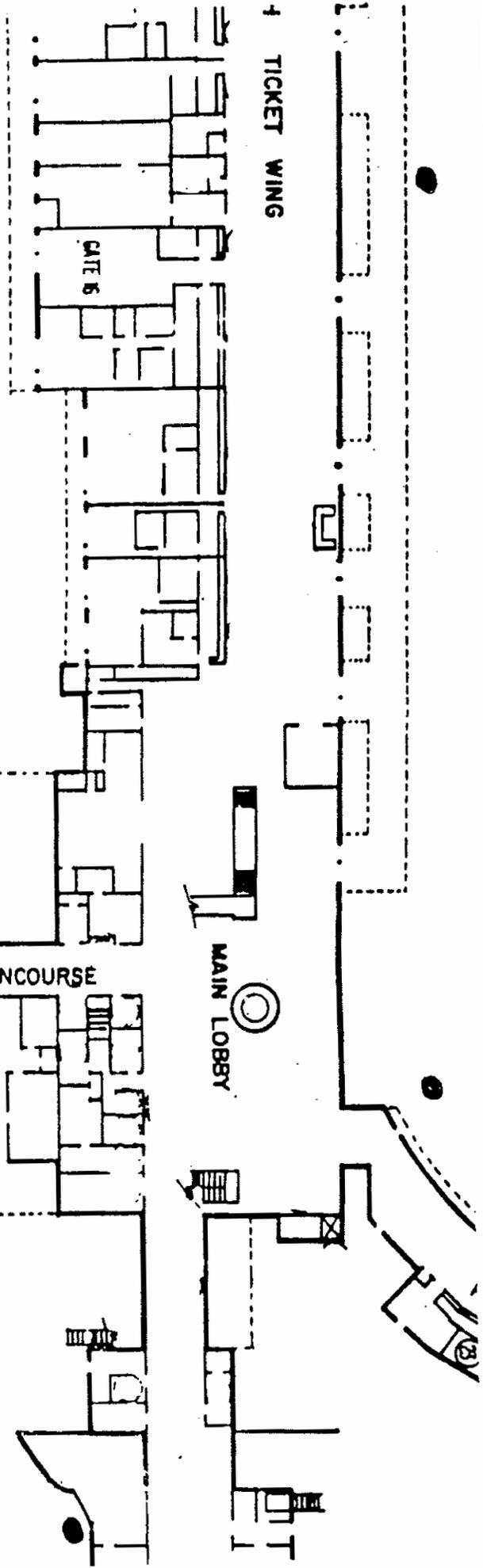
## SITUATION

PSA MD-80  
INTERIOR FIRE  
STARTED IN PORT BULKHEAD, AFT LAVATORY  
ELECTRICAL SHORT  
58 PASSENGERS, CREW OF 6 ON BOARD WHEN FIRE WAS DISCOVERED  
AIRCRAFT WAS IN THE PROCESS OF REFUELING - 8,500 LBS ON  
BOARD, FUELER STILL CONNECTED TO AIRCRAFT  
WEATHER  
WIND, 5-10 MPH FROM THE NORTH  
TEMPERATURE - 95 DEGREES  
TIME 11:30 HOURS

## FIRE DEPARTMENT ARRIVAL

HEAVY SMOKE SHOWING FROM INTERIOR OF AIRCRAFT  
PASSENGERS IN THE PROCESS OF EVACUATING AIRCRAFT  
REAR CONE EVACUATION SLIDE DEPLOYED  
DOOR ONE LEFT OPEN  
OVERWING EMERGENCY EXITS & STARBOARD SERVICE DOOR SECURED  
EXPOSURES  
EAST - MD80 IN PROCESS OF LOADING PASSENGERS  
WEST - BOEING 737 - EMPTY  
SOUTH - TERMINAL  
WATER SUPPLY - ADEQUATE TO HANDLE INCIDENT  
HYDRANTS AROUND TERMINAL

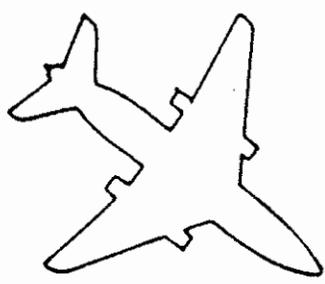
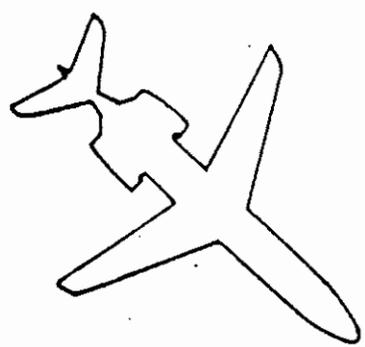
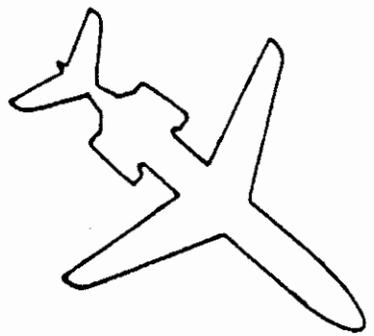
4 TICKET WING



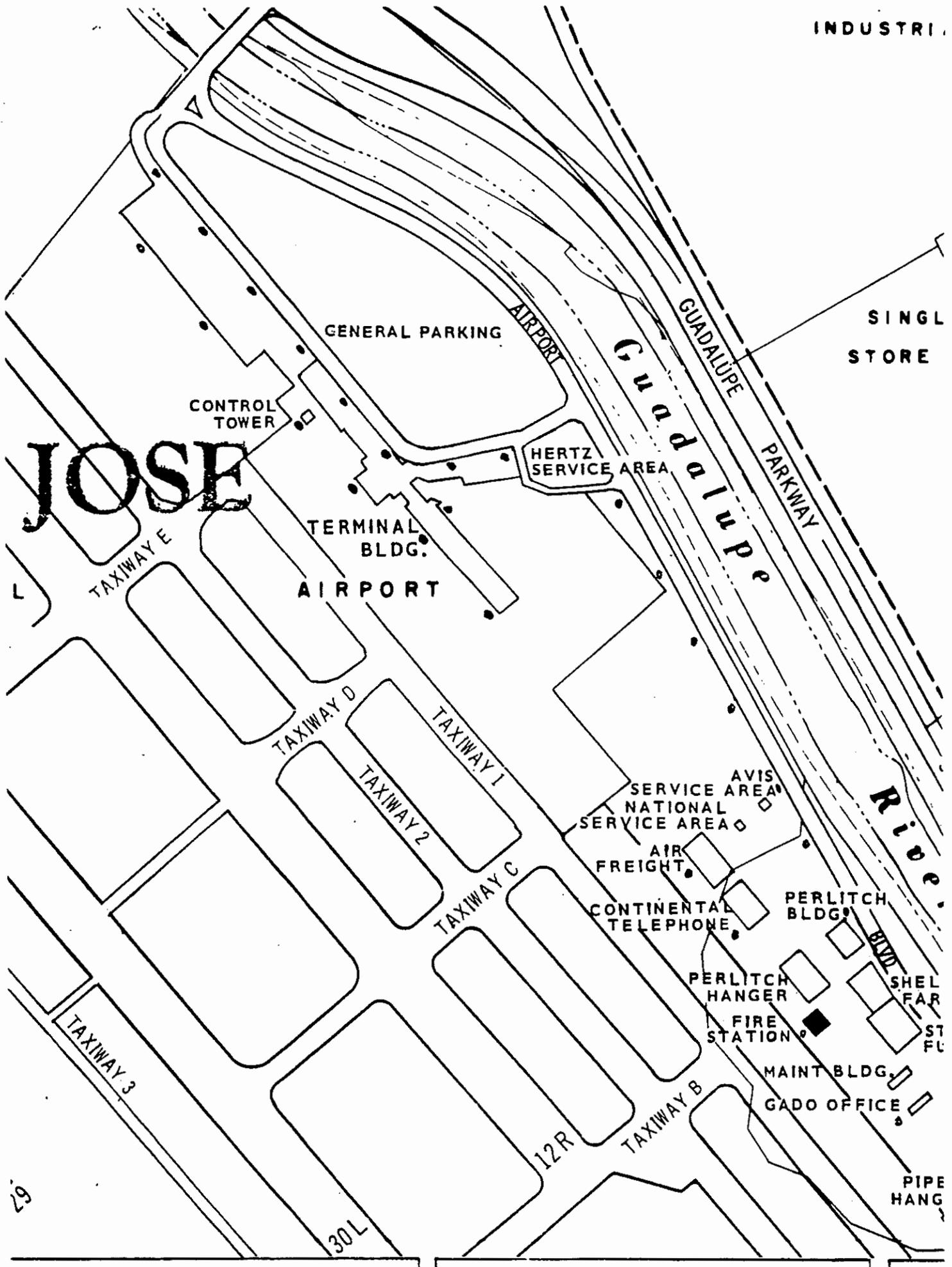
CONTROL TOWER



WIND  
5-10 MPH



INDUSTRI



SINGL  
STORE

**JOSE**

GENERAL PARKING

CONTROL  
TOWER

HERTZ  
SERVICE AREA

TERMINAL  
BLDG.

AIRPORT

TAXIWAY E

TAXIWAY D

TAXIWAY 2

TAXIWAY 1

TAXIWAY C

TAXIWAY 3

AVIS  
NATIONAL  
SERVICE AREA

AIR  
FREIGHT

CONTINENTAL  
TELEPHONE

PERLITCH  
BLDG

PERLITCH  
HANGER

FIRE  
STATION

MAINT BLDG

GADO OFFICE

RIVER  
BLVD

SHEL  
FAR

ST  
FL

PIPE  
HANG

12R

30L

57

# EXERCISE II

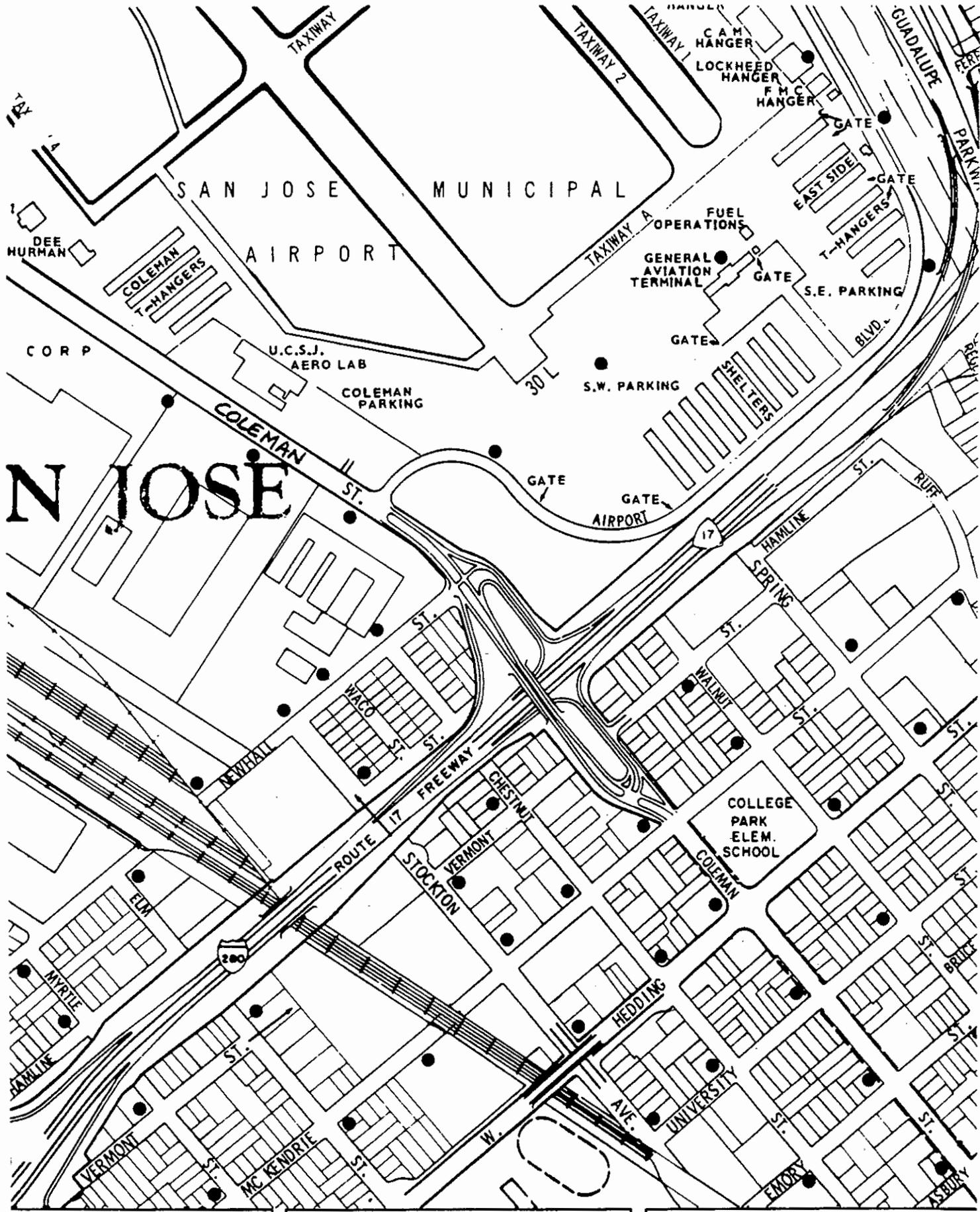
## SITUATION - ALERT 3

UNITED BOEING 727  
ABORTED TAKEOFF  
COLLAPSED LEFT MAIN GEAR  
RUPTURED LEFT WING FUEL TANK  
12,000 LBS OF FUEL ON BOARD  
FIRE, DIRECT FUSELAGE FLAME CONTACT  
PARTIALLY OFF RUNWAY  
86 PASSENGERS, CREW OF 6  
WEATHER  
WIND, 5-10 MPH FROM THE NORTHWEST  
95 DEGREES  
TIME: 1130 HOURS

## FIRE DEPARTMENT ARRIVAL

HEAVY FLAME & SMOKE ON RIGHT SIDE OF AIRCRAFT  
LIGHT FLAME & SMOKE UNDER WING ON LEFT SIDE  
DOOR ONE LEFT OPEN & SLIDE DEPLOYED  
PASSENGERS ATTEMPTING TO EXIT OVERWING ON LEFT SIDE  
SEVERAL ON FIRE DUE TO RADIATED HEAT





# SAN JOSE

C

94

D

E

# EXERCISE III

## INCIDENT

MIDDLE CLASS NEIGHBORHOOD ADJACENT TO AIRPORT  
1 & 2 STORY SINGLE FAMILY DWELLINGS  
SHAKE ROOFS

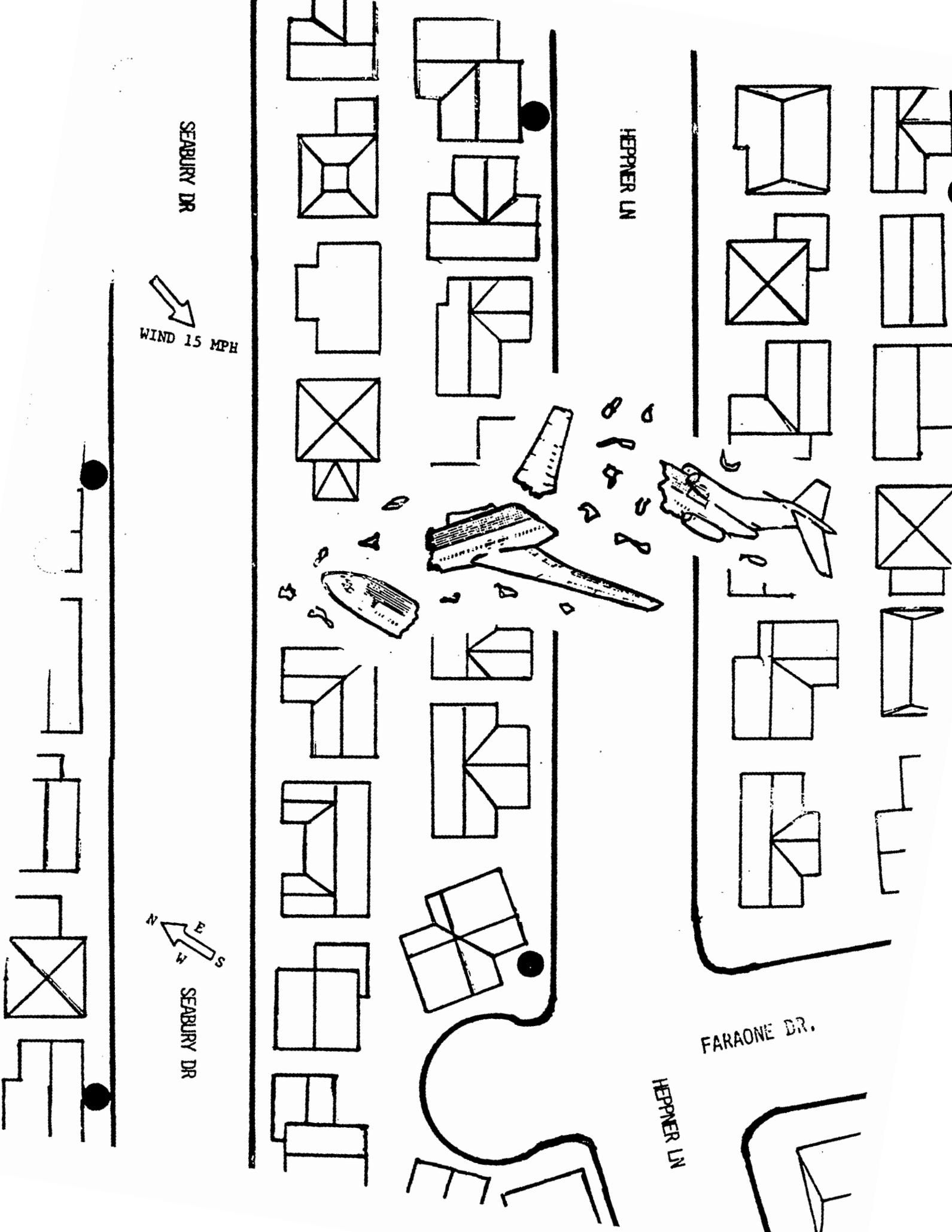
### WEATHER

HOT & DRY, 95 DEGREES  
WIND - 15 MPH FROM NORTH

UNITED BOEING 727  
12,000 LBS OF FUEL ON BOARD  
71 PASSENGERS ON BOARD, CREW OF 6

## FIRE DEPARTMENT ARRIVAL

AIRCRAFT FUSELAGE BROKEN INTO 3 SECTIONS  
FRONT & MID SECTIONS OF AIRCRAFT WELL INVOLVED IN FIRE  
60 PLUS FATALITIES IN OR ABOUT FUSELAGE  
12 PLUS PASSENGERS TRAPPED IN TAIL SECTION, SERIOUSLY  
INJURED  
11 INJURED ON GROUND  
6 MISSING IN HOUSES  
SEVERAL DWELLINGS WELL INVOLVED ON ARRIVAL  
WIND SPREADING FIRE DOWNWIND



SEABURY DR

WIND 15 MPH

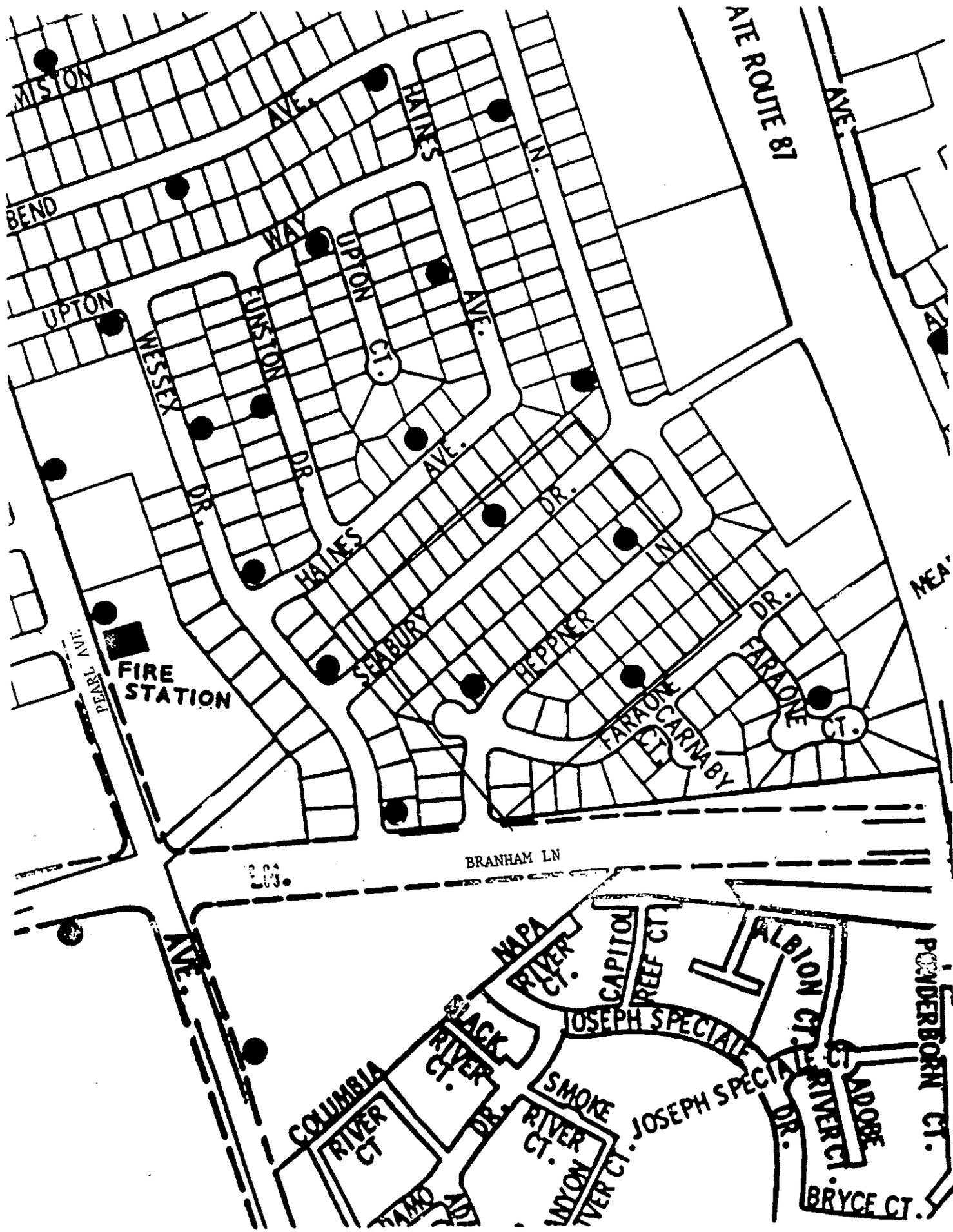


SEABURY DR

HEPPNER LN

FARAONE DR.

HEPPNER LN



## APPENDIX D

# STRUCTURED NOTES

# STUDENT NOTES

## AIRCRAFT FIRE PROTECTION & RESCUE STRUCTURED NOTES

- I. Introduction
- II. Airport Familiarization
  - A. Airport Map
  - B. Aircraft Taxiways
    1. Have yellow centerlines to guide aircraft
    2. Are designed as either parallel or cross taxiways
    3. Parallel taxiways are numbered 1, 2, 3, 4, etc.
    4. Cross taxiways are designated as Alpha, Bravo, Charles, etc. (phoenetic alphabet).
    5. Vehicle traffic must have permission to use taxiways
  - C. Runways
    1. Runways are laid out on compass headings
    2. If multiple runways are in use and if they are parallel, one is designated as left and the other is the right
      - a) Both runways would share the same numbering
    3. Runway landing patterns change due to wind shifts
    4. Runways have white centerlines
      - a) Vehicle traffic must have permission to use or cross runways
  - D. Airport lighting systems
    1. Blue lights
    2. White lights
    3. Green lights
    4. Red lights
    5. Amber lights
  - E. Vehicle traffic areas
    1. Designated by Green striping or other striping other than yellow or white

# STUDENT NOTES

---

- a) Tower permission is not required while driving in these areas
    - b) Exercise caution
  - F. Fuel distribution areas
  - G. Water distribution system
  - H. Airport structures
    - 1. Air freight buildings
    - 2. Aircraft hangers (special hazards)
    - 3. Airport terminal areas
    - 4. Airport ramp areas (jetways)
    - 5. Airport tower
    - 6. Tower traffic control
      - a) Radios
      - b) Signal lights
  - I. Grid Maps
    - 1. Encompasses a 5 to 15 mile radius from the control tower, including at least the traffic pattern and control zones
- III. Aircraft Fire And Rescue Communications Systems
- A. Direct communications
  - B. Emergency signals
  - C. Telephones
  - D. Radios
  - E. Light signal communications
    - 1. Steady green light

# STUDENT NOTES

---

2. Steady red light
  3. Flashing red light, or on and off flashing runway lights
  4. Flashing white light
- G. Communications terminology
1. Phonetic alphabet
  2. Standard words and phrases
- H. Audible alarms
- IV. Types Of Aircraft
- A. Categories
1. Single engine
  2. Two engine prop driven
  3. Four engine prop driven
  4. Turbo-prop driven A/C
  5. Military jet powered A/C
  6. Multi-engine jet powered A/C
  7. Helicopters
- B. Structural materials of A/C
1. Materials
    - a) Duraluminum
    - b) Magnesium and alloys
    - c) Plywood
    - d) Steel
    - e) Titanium
    - f) Wood

# STUDENT NOTES

---

## 2. Engines

- a) Piston engines
  - 1) Propeller dangers
- b) Jet engines
  - 1) Jet engine danger
- c) Turbo prop

## C. Systems

### 1. Color codes

- a) Fuel systems
  - 1) Fuel tanks
  - 2) Fuel lines
- b) Installed fire extinguishing systems
- c) Electrical systems
- d) Hydraulic systems
- e) Oxygen systems
- f) Anti-icing and de-icing systems
- g) Escape systems
  - 1) Normal doors and hatches
  - 2) Emergency cut-in areas

## V. Aviation Fuels

A. Aircraft fuel is the biggy, the enemy

B. When responding to an aircraft incident you need to know three (3) types

of information to properly deal the aircraft fuel

- 1. Amount of fuel on board

# STUDENT NOTES

---

2. Type of fuel
  3. Wind direction
- C. Two (2) general categories of aviation fuel
1. Aviation gasoline
  2. Turbine or jet fuels
    - a) Jet A or JP-5
    - b) Jet B or JP-4
  3. Referred to in pounds
    - a) 5.7 pounds per gallon - Avgas
    - b) 6.7 pounds per gallon - Jet A
      - 1) Rule of thumb - 1000 pounds of Jet A equals 150 gallons
  4. All are hydrocarbons
  5. Burn vigorously with a bright orange flame
  6. Give off large quantities of thick, black smoke
  7. Vapors are heavier than air
  8. Have a color, either naturally or dyed
  9. Are nonwater soluble, nonmiscible in water
  10. Skin irritant
- D. Avgas - aviation gasoline
1. Fuel for reciprocating (piston) engine aircraft
  2. Color coded, dyed
    - a) Grade 80/87 (red)
    - b) Grade 100LL (low lead) (blue)
    - c) Grade 100/130 (green)

# STUDENT NOTES

---

- d) Grade 115/145 (purple)
- 3. Fuel handling equipment is also color coded for the corresponding fuel it handles
- 4. Avgas has a strong tendency to vaporize
- 5. It is a flammable liquid
  - a) Flash point is below 100 degrees F
  - b) Avgas is always ready to burn
  - c) All that is needed is an ignition source
  - d) Avgas vapors actively go looking for an ignition source
  - e) There are many ignition sources present at an aircraft incident
- 6. Flame spread
- E. Jet A (also Jet A-1)
  - 1. Military designation JP-5
  - 2. Used in:
    - a) Turbojet, pure jet
    - b) Propeller or turboprop
  - 3. Closely fractionalized kerosene fuel
    - a) Low tendency to vaporize
  - 4. It is a combustible liquid
    - a) Its flash point is above 100 degrees F
  - 5. Jet A can act like gasoline or a flammable liquid under certain conditions
    - a) Three (3) ways
      - 1) Warm it up
      - 2) Wicking
      - 3) Fuel mist

# STUDENT NOTES

---

- F. When dealing with large amounts of aircraft fuels at an incident, there is a constant threat of ignition, reignition & flashback
  - 1. Some possible ignition sources include friction
  - 2. Electrical short circuits
  - 3. Hot exhaust gases, hot engine surfaces
  - 4. Static electric discharges
  - 5. Fire apparatus engines & electrical systems
  - 6. Flash, video cameras, or lights
  - 7. Dropped flashlight
  - 8. Telephones
  - 9. Radios
  - 10. Combustible gas detector
  - 11. Dropping a tool
  - 12. Operating aircraft auxiliary & ground power units, heaters, other support equipment
  - 13. Flares, smoking materials
  - 14. Static electricity
  - 15. Energy from radar equipment
- G. Jet B aircraft fuel
  - 1. Military designation - JP-4
  - 2. Broad cut fuel made from unleaded gasoline & kerosene fractions
    - a) Basically a blend of 65% gasoline (Avgas) & 35% (Jet-A)
    - b) Jet B has worst characteristics of both materials
  - 3. Like Avgas, a spill of Jet B (JP-4) is always ready to burn
- H. Other important principles & characteristics of aircraft fuels

# STUDENT NOTES

---

1. There is very little difference in heat of combustion among the different fuels
  2. Aircraft fuels will burn away at 6-12 inches per hour
  3. Vapor density
  4. All aircraft fuel vapors are heavier than air
    - a) Aircraft fuel vapors will travel or migrate along the ground, downwind
    - b) Approach flammable liquids from upwind and uphill
    - c) Wear full turnout
  5. Specific gravity
    - a) All aircraft fuels are less than one (lighter) & will float on water
    - b) All aircraft fuels are nonsoluble and nonmiscible in water
- I. Other aircraft systems that use flammable or combustible liquids
1. Hydraulic fluids
    - a) Skydrol
      - 1) Most commonly used in large jet aircraft
      - 2) Synthetic
      - 3) Purple in color
      - 4) Will destroy most materials except metals & butyl rubber
    - b) Mineral oil hydraulic fluids
    - c) Vegetable oil hydraulic fluids
    - d) Hydraulic pumps & reservoirs, called accumulators, can be found anywhere on aircraft
    - e) Stored under pressure
  2. Lubricating oils

# STUDENT NOTES

---

3. Deicing systems & fluids
    - a) Alcohol
  4. Pist
  5. Hypergolic mixtures
    - a) Mixture or combination of
      - 1) Fuel
      - 2) Oxidizer
    - b) Used in jet assisted take off (JATO) systems
    - c) May cause frostbite, poisoning and/or burns
    - d) Normal, regular turnouts are not adequate protection
- J. Aircraft fuel servicing
1. Fuel transfer can be accomplished several ways
    - a) Tank vehicle
    - b) Hydrant vehicle
    - c) Fueling island
    - d) Fueling pit
  2. Two (2) fueling methods
    - a) Overwing
    - b) Underwing
  3. Overwing fuel servicing
  4. Underwing fueling
    - a) Single point fueling
- K. Several types of wing tanks
1. Separate units installed between aircraft structural framework

# STUDENT NOTES

---

2. Built as part of wing
  3. Anticipate fuel tanks in the wings, but may be found elsewhere
- L. Fuel lines/tubing
1. Fuel pumps
  2. Fuel tanks are vented
  3. Drain cocks
  4. Manual shutoff valves to stop fuel to engines
- M. Fire prevention measures during fuel servicing are mainly directed towards prevention of fuel spillage & elimination or control of potential ignition sources
1. Portable extinguishers are required on aircraft service ramps
  2. Fuel spillage
- N. Static electricity
1. Aircraft similar to any rubber tired vehicle and has the ability to build up a static charge when in movement or at rest
  2. Static charges build up by air currents passing over aircraft surfaces
  3. Certain maintenance operations can produce static charges
  4. Elimination of static electricity is paramount during fueling operations
    - a) Use bonding wire of adequate size
    - b) Keep wire in good condition
    - c) Before fueling, connect bonding wires in proper engines
    - d) Static ground electrode
  5. Degree static charge builds up depends on several variables
- O. Radar ignition hazards

# STUDENT NOTES

---

## VI. Extinguishing Agents - Foam

### A. There are many different aircraft fire fighting situations

1. There is no perfect, all purpose extinguishing agent for every situation
2. Most of our equipment is set up to extinguish aircraft fuel, class B fires
3. Foam is the primary extinguishing agent
  - a) Los Angeles (Van Nuys) Aircraft incident
  - b) Hawaii storage tank fire

### B. Foam is a complex subject

### C. Understanding terms

1. Foam concentrate
  - a) Properly mixed or proportioned with water
  - b) Makes foam solution
2. Called proportioning
3. Two (2) commonly used proportioning concentrations/percentages
4. Next air is turbulently introduced into the foam solution
  - a) Happens at nozzle
  - b) Called aeration or expansion
5. Expansion ratio

### D. Two types of nozzles are used to add air to the foam solution or in other words make finished foam

1. Air-aspirating foam nozzle
  - a) Aspirates, induces air into the foam solution as it passes through the nozzle
  - b) Used only for making foam

# STUDENT NOTES

---

- c) Expansion ratio is 10 to 1
- d) Air-aspirating foam nozzles make thicker, longer lasting foam
- 2. Standard fog nozzle (non air-aspirating)
  - a) Air is added to the foam solution after the solution leaves the nozzle
  - b) 4 to 1 expansion ratio
  - c) The foam solution picks up air as it sails, tumbles through the air
  - d) The foam solution picks up more air as it impacts object(s) in the spill and/or fire area
  - e) A straight stream makes the best foam
  - f) A fog nozzle provides better protection
  - g) Foam from a fog nozzle penetrates the fire's thermal updraft better
- E. Foam eliminates all three (3) sides of the fire triangle
- F. Qualities of a good fire fighting foam
  - 1. Expansion ratio
  - 2. Fire performance
  - 3. Mobility
  - 4. Burnback resistance
  - 5. Cohesion characteristics
  - 6. Shelf life
  - 7. 25% drain time
- G. There are many types & manufacturers of foam
- H. Aqueous film forming foams
  - 1. Developed by the U.S. Navy & 3M Company during the 1960's

# STUDENT NOTES

---

2. Available in 1, 3, & 6% concentrates
  3. AFFF added a new dimension to fire fighting foams, an aqueous film
  4. The low surface tension of AFFF solution provides rapid penetration on Class A, ordinary combustibles
  5. AFFF is a heavier, soupier, wetter foam
  6. AFFF has a powerful detergent action & is a strong penetrant
  7. AFFF can be premixed & will stay in solution form for long periods of time
  8. AFFF requires relatively low energy to expand the solution into foam
  9. Completely synthetic, has a much longer shelf life
- I. Application rate
1. There are different minimum application rates for different flammable liquid fire situations
    - a) Gasoline tank truck fire
    - b) Storage tank fire
    - c) Application rates are more accurate on large fires
    - d) Application rates were determined by the NFPA
    - e) Aircraft incidents
      - 1) Mass application
    - f) Using foam is directly related to the surface area burning
    - g) Besides the foam needed to extinguish the fire, additional foam will be needed to keep the fire out
    - h) Preplan & preestablish where to get more foam
- J. Other foam facts
1. Absolutely do not mix different types of foam concentrate in the same storage tank or container

# STUDENT NOTES

---

2. Different foam concentrates can be proportioned from different proportioners & applied in succession or simultaneously on the same fire
  3. Foams will not work on high vapor pressure flammable liquids like LPG
  4. Never direct or plunge a straight stream of foam into the center of a flammable liquid spill
  5. If possible, approach & begin foam application from upwind and downhill
  6. Caution should be observed when using water streams in conjunction with foam lines
  7. All personnel involved in the foam operation should be in full turnouts
  8. Foamed areas can be very slippery
  9. Never turn your back on a flammable liquid spill or fire
  10. Maintain the foam blanket
  11. Obviously, do not enter an unfoamed spill
  12. Aircraft foam apparatus & equipment should be subjected to proportioning & flow tests quarterly (4 times per year)
- K. Premixed foam solution & systems
- L. Other types of foam available
1. Chemical foam
  2. Mechanical foam
  3. Protein foam
  4. Fluoroprotein foam concentrate
  5. Alcohol type foam concentrates, ATC
    - a) Polar hydrocarbons will destroy AFFF

# STUDENT NOTES

---

b) Alcohol type concentrates, are regular foams, such as AFFF, with a special additive that forms a physical barrier between the foam bubbles & the polar solvent liquid

6. Film forming fluoroproteins
7. High & medium expansion foams
8. Hazardous material foams
9. Wildland fire fighting foams

M. Inline eductors

1. Inline eductors have certain limitations & strict procedures that must be followed
2. Thoroughly rinse all equipment used with plain water

VII. Extinguishing Agents - Dry Chemical

A. Specially prepared mixtures of finely divided salts

1. Treated to:
  - a) Make water repellent
  - b) Prevent caking (caused by moisture)
  - c) Improve foam compatibility
  - d) Prevent packing (caused by vibration)
  - e) Improve flow capabilities
  - f) Limit abrasive action

B. Dry chemicals work principally by chemically inhibiting the combustion chain reaction

C. Other properties of dry chemicals

1. Nonconductive
2. Minimal toxicity
3. Very slight smothering capability

# STUDENT NOTES

---

4. Very slight radiation shielding
  5. Easy to recharge extinguishers or systems
  6. Good flooding characteristics
  7. Good on aircraft wheel fires
  8. Messy, cleanup is a problem
  9. No securing capabilities
  10. Adversely affected by wind & rain
  11. Training & experience plays a big role in success using dry chemicals
- D. Caking and packing
- E. Dry chemical is usually used for initial attack or quick knockdown
1. Twin agent unit
  2. A minimum rate of flow is critical
  3. Test extinguisher before approach fire
  4. Direct stream at base of fire, six (6) inches in front of nearest edge
  5. Sweep nozzle back & forth until fire is extinguished
  6. Work fire to back of spill
  7. Obstacles in the spill may require a multiple attack
  8. Do not walk in spill
- F. Types of dry chemicals
1. Sodium bicarbonate
  2. Potassium bicarbonate (Purple K)
  3. Potassium chloride
  4. Monnex
  5. Monoammonium phosphate

# STUDENT NOTES

---

## G. Types of extinguishers

### VIII. Extinguishing Agents - Halons

#### A. Halogenated hydrocarbons

#### B. Naming halons

#### C. Characteristics of halogenated extinguishing agents

1. Colorless
2. Odorless
3. Nonconductive, Class C rated
4. Limited corrosive residue
5. High liquid densities
6. Vapors are heavier than air

#### D. Mechanism of extinguishment

1. Halons interrupt the combustion chemical chain reaction sequence
2. Excellent on three (3) dimensional fires - liquid spraying, flowing under pressure, etc.
3. Extinguishing concentrations of 4-6% volume of air
4. On Class A, ordinary combustibles, may require a soaking time for the halon vapor to reach deep seated fire
5. Lack sufficient cooling or vapor sealing affect

#### E. Other characteristics of halons

1. High cost of agents
2. Specialized nature of systems
3. Affected by wind
4. Does not reduce visibility like carbon dioxide or dry chemical

# STUDENT NOTES

---

- F. Types of halons used today
  - 1. Halon 1301
  - 2. Halon 1211
  - 3. Halon 2402
- G. Halons can be corrosive to metals in the presence of moisture
- H. 1301 & 1211 can be toxic
- I. Halon decomposition, combustion breakdown products are very toxic

## IX. Extinguishing Agents - Carbon Dioxide

- A. Normally used in aircraft fire fighting as a supplementary, secondary agent
- B. Colorless, nonflammable, almost odorless, tasteless
- C. Properties that made CO<sub>2</sub> desirable as an extinguishing agent
  - 1. Inexpensive
  - 2. Readily & easily available
  - 3. Noncombustible, does not react with most substances
  - 4. Provides its own pressure for discharge
  - 5. Displaces oxygen
  - 6. Excellent flooding characteristics
  - 7. Nonconductive, will not conduct electricity
  - 8. Leaves no residue, eliminates cleanup
  - 9. Noncorrosive, nondamaging to aircraft electrical & mechanical parts & systems
  - 10. Under normal conditions is naturally a gas
- D. Two ways to store CO<sub>2</sub> for fire fighting applications
  - 1. High pressure cylinders

# STUDENT NOTES

---

2. Low pressure, refrigerated & insulated containers
- E. Reduces oxygen content of atmosphere by dilution to a point where no longer will support combustion
  1. Application, extinguishing concentrations varies from 21 to 62% ratio to air depending on the material burning
- F. Drawbacks of using carbon dioxide
  1. Nonpermanent, temporary extinguishing agent
  2. Atmospheric conditions, particularly wind, may interfere with effectiveness
  3. Discharge of carbon dioxide generates static electricity
  4. Carbon dioxide can be toxic in sufficient concentrations
- X. Extinguishing Agents - Dry Powders
  - A. Class D, combustible/exotic metal extinguishing agents
  - B. Aircraft structural metals that can burn
    1. Magnesium
    2. Titanium
    3. Aluminum
    4. Composite materials
  - C. Hazards of magnesium & titanium
    1. Hazards the same for both materials
    2. Burn at extremely high temperatures
    3. Explosive reaction with certain extinguishing agents
    4. Continue to burn even in inert atmospheres
    5. Burning combustible metals give off toxic products of combustion

# STUDENT NOTES

---

- D. Despite a large amount of investigation, no really successful material or agent has been developed to halt the vigorous, high temperature oxidation of burning combustible metals
- E. Application/extinguishment techniques
  - 1. Dry powder extinguishers
  - 2. Large burning metal pieces
  - 3. Small pieces
- F. Met-L-X dry powder
  - 1. Most common dry powder used
  - 2. Sodium chloride base with additives
  - 3. Nontoxic
  - 4. Nonabrasive
  - 5. Nonconductive
  - 6. Indefinite shelf life
  - 7. Found in bulk containers or portable extinguishers
  - 8. Ability to cling to vertical surfaces
- G. Other commercially available dry powders or combustible metal agents
  - 1. G 1 powder
  - 2. TMB - Trimethoxyboroxine
  - 3. Inert gas blanketing
  - 4. Lith-X powder
  - 5. Foundry Flux
  - 6. Pyromet powder
  - 7. Common cement

# STUDENT NOTES

---

## XI. Extinguishing Agents - Water

- A. Tremendous potential for an ordinary Class A fire on large jet aircraft
- B. Water fog may be used effectively in certain aircraft situations
- C. Different technique with water than with foam
- D. Water has limited extinguishing ability on large flammable liquid fires
- E. Improper use of water can make fuel fire situations worse
- F. Wetting agents may be used to increase the extinguishing efficiency of water

## XII. Protective Clothing & Breathing Apparatus

- A. Standards for aircraft fire fighting protective clothing
- B. Regular/standard structural type protective clothing
- C. Approach & proximity suits
- D. Entry suits
- E. Fire fighting protective clothing is made up of three (3) layers
  - 1. Outer shell
    - a) Vacuum deposited aluminum reflective material
  - 2. Vapor barrier
  - 3. Inner lining or thermal clothing
- F. Care of protective clothing
- G. The other parts of the aircraft fire fighting protective clothing system
  - 1. Hood
  - 2. Boots
  - 3. Gloves

# STUDENT NOTES

---

## H. Self contained breathing apparatus

1. Standards
2. Many toxic gases are produced when aircraft burn
3. Helmets & hoods should be designed to accommodate SCBA face piece mask

## XIII. Special Hazards/Hazardous Materials

### A. Special hazards

1. Canopy actuation
  - a) Normal opening (sliding type)
  - b) Electrical (clamshell type)
  - c) Pneumatic
  - d) Hydraulic
2. Canopy jettisoning
3. Seat ejection
  - a) Ejection seat safetying procedures
4. Armament and explosive cargo
  - a) Storage locations on aircraft
  - b) Classes of explosive cargo
  - c) Bombs
  - d) Rockets
  - e) Munitions fire fighting procedures
    - 1) Vehicles should be positioned approximately at 45° angles to the fuselage
    - 2) Time factors start when explosives are enveloped in fire

# STUDENT NOTES

---

- f) Emergency procedures for non-fire fighting personnel
- g) Nuclear weapons
- h) Nuclear weapon characteristics
  - 1) Time factors
  - 2) Precautionary measures

## XIV. Hazardous Materials Associated With Aircraft

- A. 1973, a Pan American Boeing 707 cargo freighter crashed due to hazardous materials being transported
- B. Almost everything can & is transported by aircraft
- C. Hazardous materials can be found on passenger aircraft
- D. There are two (2) sets of regulations applicable to hazardous materials shipped by air
  - 1. CFR 49
  - 2. IATA Dangerous Goods regulations
- E. Many carriers of hazardous cargo
- F. Aircraft that carry only cargo are called freighters
- G. Each hazardous material shipment will have a corresponding shipping paper
  - 1. Called an:
    - a) Airbill
    - b) Shippers declaration of dangerous goods
  - 2. Distinctive red border
  - 3. Filled out, completed by shipper
  - 4. The airbill lists a lot of information important to fire fighters

# STUDENT NOTES

---

- a) Name of shipper
  - b) Consignee
  - c) Transporting airline
  - d) Airports of departure & destination
  - e) Whether material can be transported on passenger or just cargo aircraft
  - f) Radioactive or nonradioactive
  - g) Proper shipping name, hazard class & hazard class number
  - h) UN or NA (Regulated only in North America) numbers
  - i) Subsidiary risk
  - j) Quantity & type of packaging
  - k) DOT or IATA approved container or package
  - l) Additional handling information
5. Some unique package labels may be encountered
- H. When dealing with hazardous materials follow recommended procedures
- 1. Always wear SCBA & proper protective clothing
  - 2. Stay upwind & uphill
  - 3. Isolate the area of nonessential personnel
  - 4. Avoid contact with material(s)
  - 5. Rescue injured only if prudent
  - 6. Identify materials & determine conditions
  - 7. Request necessary assistance & resources
  - 8. Take other control actions as may be deemed appropriate from information available
  - 9. Decontaminate

# STUDENT NOTES

---

- I. Reference materials that should be carried on apparatus
  - J. Military transports large quantities of hazardous materials by air
  - K. Tremendous potential for an aircraft incident involving an agricultural spraying or crop dusting operation
  - L. Crop dusting operation
    - 1. Conducted by fixed or rotary wing aircraft (helicopters)
  - M. Many different types of materials used
  - N. Most accidents occur at or near job site
  - O. Materials being used are:
    - 1. Organophosphates
    - 2. Carbamates
    - 3. Organochlorines
    - 4. Nitro & Chlorophenols
    - 5. Some dusting sulphur
  - P. Emergency response personnel must be able to recognize an aircraft hazardous material incident
  - Q. Learn to recognize signs & symptoms of pesticide exposure in victims & emergency response personnel
  - R. Sources of information and/or help
  - S. Scene organization
    - 1. Three (3) zones
- XV. Aircraft Fire Fighting Apparatus & Equipment
- A. Studies by the International Federation of Airline Pilots & the Airline Pilots Association
  - B. After 1973, could not operate an airport serving any Civil Aeronautics Board Certified Air Carrier with an "Airport Operating Certificate"

# STUDENT NOTES

---

1. Required a minimum level of fire fighting & rescue equipment
  2. Trained personnel
- C. Part 139, Title 14, Code of Federal Regulations
1. Levels of required fire fighting & rescue capability determined by an index based on frequency & length of aircraft using airport
  2. Five indexes, designated A through E
    - a) Five (5) or more departures of largest (longest length) transport aircraft
      - 1) Index A - Less than 90 feet long
      - 2) Index B - 90 to 126 feet
      - 3) Index C - 126 to 160 feet
      - 4) Index D - 160 to 200 feet
      - 5) Index E - Over 200 feet long
    - b) Specific number of apparatus & amounts of extinguishing agent required for each index
  3. Federal financial assistance was provided to help airports purchase fire fighting apparatus
- D. FAA also issued Advisory Circular 150/5210-6B
1. Recommended higher levels than FAR part 139
  2. NFPA #403
  3. NFPA #414
  4. NFPA #412
- E. Guidelines for aircraft fire fighting
1. First fire fighting vehicle must arrive & discharge agent at the midpoint of the farthest runway within three (3) minutes
  2. Response vehicles must be able to control fire within one (1) minute after arrival

# STUDENT NOTES

---

3. Indexes require a lightweight, quick response vehicle
4. Can substitute other agents
5. Vehicles must be self contained units
6. Vehicle must be able to discharge large quantities of extinguishing agent within a short period of time
7. Minimum application rates recommended
8. Vehicles must be able to discharge agent while moving
9. Strategically located hydrants required on airport and/or tank vehicle(s) to refill CFR apparatus
10. CFR vehicles must be capable of performing on & off pavement
11. Recommended minimum acceleration rates
12. Two way radio for communication with tower
13. Flashing beacon & marked for rapid & positive identification
14. Cover for vehicle must be provided if prolonged temperatures below 33 degrees F
15. One or more turrets
16. One or more handlines are required
17. Optional ground sweep or under apparatus nozzles
18. Foam is primary agent
  - a) Must carry twice the foam concentrate needed for amount of water carried
19. Reserve supply of extinguishing agent(s) stored at fire station
20. Secondary agent may be:
  - a) Dry chemical (Purple K)
  - b) Halon 1211
  - c) Carbon dioxide (CO<sub>2</sub>) (rarely used)

# STUDENT NOTES

---

F. Types of aircraft fire fighting vehicles

1. Rescue vehicle
2. Dry chemical (DC) truck
3. Do not overload vehicles
4. Major rescue & fire fighting apparatus

G. Municipal structural fire fighting apparatus can be set up for or utilized on aircraft incidents

H. Access for vehicles & apparatus to & from airport during an aircraft incident

XVI. Aircraft Fire Fighting And Rescue Procedures

A. Types of aircraft incidents

1. In-flight emergencies
2. Type of crashes
  - a) Wheels-up or belly landing
  - b) Hillside crashes
  - c) Water crashes
  - d) Nose dive crashes
  - e) Crashes into buildings
  - f) Helicopter crashes
  - g) No fire crashes
3. Wheel, brake and tire fires
  - a) Braking problems in jetlines
  - b) Fusible tire plugs
  - c) Brake or wheel fires
  - d) Extinguishing or cooling

# STUDENT NOTES

---

- e) Use of dry chemical on wheel fires
- 4. "Class A" fires in aircraft
- B. Hand signals for fighting aircraft fires
  - 1. Five basic hand signals
    - a) Ready for operations
    - b) Straight stream from the top turret
    - c) Bumper turret
    - d) Dispersed (FOG) pattern
    - e) Cease (STOP) operations
- C. Fighting aircraft fires
  - 1. There are eight basic aircraft fire fighting procedures
    - a) Response
    - b) Size-up and approach
    - c) Positioning
    - d) Attack
    - e) Control
    - f) Rescue
    - g) Extinguishment
    - h) Overhaul
  - 2. Response procedures
    - a) Type of aircraft involved
    - b) Nature of emergency
      - 1) In flight, what emergency exists
      - 2) Crash, condition of aircraft

# STUDENT NOTES

---

- c) Amount of fuel on board
  - d) Number of passengers and crew
    - 1) Their locations, if possible
    - 2) Injuries, if known
  - e) Location
  - f) Runway to be used, if crashed
  - g) Cargo of critical significance
  - h) Wind direction and speed
  - i) While speed is essential to any emergency procedure, response of fire fighting vehicles must be tempered with discretion
- 3. Undeclared Emergency Response Procedures
  - 4. Size-up and approach
  - 5. Positioning
  - 6. Attach
  - 7. Control
  - 8. Rescue
    - a) Occupants and rescue areas
    - b) Ventilation
    - c) Hazardous areas
  - 9. Extinguishment
    - a) Rescue corridors
    - b) Let perimeter fires burn unless they are interfering or threatening the rescue area
    - c) Deep seated fires in cargo and luggage areas
    - d) Large pieces of burning magnesium

# STUDENT NOTES

---

- e) Reexamine and reapply foam
- f) Additional water supplies
- g) Additional foam supplies
- h) Additional breathing apparatus
- i) Additional manning

## 10. Overhaul

- a) Thorough inspection of the entire aircraft
- b) Heavy equipment-may have to lift parts of the aircraft
- c) Batteries must be disconnected and other ignition sources be eliminated
- d) Fuel lines must be crimped or plugged
- e) All hot spots should be cooled down
- f) Exercise extreme care while working overhaul due to jagged metal edges
- g) Avoid disturbing all evidence
- h) Remove only those parts of the aircraft which hamper the fire fighting effort
- i) If aircraft parts or controls must be moved for fire fighting or victim removal efforts must be made to record the original location of the parts
- j) Body removal during overhaul for fire fighting purposes should be done under medical supervision only
- k) Stakes should be placed in the spot where the body was removed. Also photographs should be taken

## XVII. Aircraft Forcible Entry Procedures & Equipment

- A. The primary objective in any aircraft incident is rescue of occupants
  - 1. Crash, may come to rest in any position

# STUDENT NOTES

---

2. Fuselage may be broken open or compacted by impact
  3. Each accident presents different problems
  4. Disarrangement of aircraft may be severe
  5. Survivable accident
- B. Training, preplanning is imperative
1. Practice using forcible entry tools
  2. Know how to operate
    - a) Normal doors & hatches
    - b) Emergency doors, hatches & windows
    - c) Wide variety of escape systems
  3. Review crash charts
  4. Become familiar with the aircraft that frequent your airport/area
  5. Arrange to attend airline flight crew emergency training schools
  6. Become familiar with aircraft construction materials
- C. Aircraft construction materials in regards to forcible entry
1. Duraluminum
  2. Magnesium & alloys
  3. Titanium
  4. Steel
  5. Wood
- D. Forcible entry through skin should be attempted only after all other means of entry have failed
1. Last resort
  2. First try to force normal or emergency doors & windows

# STUDENT NOTES

---

3. Stabilize aircraft prior to forcible entry
  4. Create a mental picture of interior arrangement
  5. Visualize location of trapped crew & passengers
  6. Try to avoid aircraft systems underneath outer skin
  7. Avoid heavy structural members
- E. Military cargo & passenger type aircraft have distinctive identification to indicate where to conduct forcible entry
- F. General aviation aircraft & older fixed wing, reciprocating engine aircraft
- G. Turbine powered aircraft
- H. Windows
- I. Aircraft interior fires can present unique forcible entry problems
1. Unattended, on ground, often a delay in detection
  2. Back draft danger
  3. Top ventilation difficult to impossible
  4. Fires often originate in system components
  5. Concealed spaces may extend throughout aircraft
  6. Can locate fire in concealed areas by:
    - a) Blistered paint
    - b) Evidence of smoke
    - c) Hot to touch
    - d) Heat (infrared) heat detector
  7. Cargo, baggage area fire
- J. Forcible entry tools & equipment

# STUDENT NOTES

---

- XVIII. Preplanning For Emergencies
- A. Preplanning is necessary for all emergencies
1. Access roads
  2. Fences and gates
  3. Mutual aid
  4. Drills
  5. Communications
  6. Emergency Medical Services
    - a) Triage immediate first aid
    - b) Ambulance services
  7. News media
  8. Security protection
  9. Directory
    - a) Fire department providing mutual aid
    - b) Police department
    - c) Medical personnel and facilities
    - d) Airport officials
    - e) Airport tenants
    - f) Appropriate governmental agencies
    - g) Search and rescue agencies
    - h) Clergy
    - i) Coroner
  10. Availability of heavy equipment
  11. Method of identification

# STUDENT NOTES

---

12. Training procedures and hot drills
13. Mutual aid and preplanning
14. Developing the plan
15. Notification of emergency forces
  - a) Primary (emergency forces)
  - b) Secondary (support agencies)
  - c) Methods of notification
16. Type of incident
17. Access to accident site
18. Available vehicles and equipment
19. Communications
20. Supporting agencies
21. Military assistance (if applicable)
  - a) Medical
  - b) Explosive ordinance disposal teams
  - c) Disaster control teams
  - d) Aircraft crash recovery teams
22. Mutual aid
  - a) Local, county & state
  - b) Federal and military
  - c) Civil defense
  - d) Red Cross
23. Reporting an aircraft incident
24. News media

# STUDENT NOTES

---

- a) Radio and television
- b) Newspaper and magazines

25. Photography at the scene

## XIX. Post Incident Operations

### A. Preservation of crash scene

1. Protection of evidence is one of the first and most important steps to be taken
2. Incident areas must be isolated
3. Essential personnel identification
4. Establishment of command post
5. FAA
6. Human factors investigation
7. CFR response interviews (FAA) (NTSB)
8. NTSB/FAA
9. Search and rescue
10. Police response
11. Medical response
12. Care, removal and identification of fatalities
13. Disaster preparedness

### B. Post traumatic stress disorder

1. Types of crisis
2. Categories of stress
3. Dealing with stress
  - a) Pre-plan

# STUDENT NOTES

---

- b) Debrief personnel
- c) Critical incident stress
- d) Let them talk about it
- e) Listen
- f) Observe and monitor
- g) Recognize symptoms early

# APPENDIX E

## **STUDENT HANDOUT MATERIALS**

# Winning Against HAZARDOUS CARGO

By Charles Spence

**A**t 20 minutes past midnight on Feb. 1, 1975, the first call from a line pilot came into the small office at the Air Line Pilots Association's Washington office, where Hazardous Materials Committee pilot members and staff were manning a bank of telephones. The caller's manifest showed hazardous materials and the pilot wanted to know if they were on the "safe to carry list." Operation STOP had begun.

STOP—Safe Transportation of People—was ALPA's program to ensure safety while the association worked toward uniform shipping standards and strict regulation enforcement. STOP began on that Saturday morning in 1975 and was officially suspended at the November 1984 ALPA Board of Directors meeting, after the program had forced progress in both domestic and international shipping standards.

Today, hazardous cargo travels in the United States under the Code of Federal Regulations (CFR) 49 or, optionally, the ICAO (International Civil Aviation Organization) Technical Instructions (TIs).

Capt. Larry Farris (Delta), chairman of the ALPA Hazardous Materials Committee, says the difference between the ICAO and the CFR technical instructions is one of degree rather than substance. ALPA favors the ICAO standard, among other considerations, because of its worldwide acceptance. He adds both have strong areas as well as weak areas that his committee is addressing.

**Shipments of hazardous materials in passenger aircraft routinely violated FAA packaging and labeling regulations until pilots said 'no more' and began Operation STOP.**

Arriving at this point, however, has required a long and persistent effort by committee members, ALPA staff personnel, and counterpart committee members in the International Federation of Air Line Pilots Associations.

Suspension of STOP is the latest benchmark of progress in the safe transportation of hazardous materials aboard commercial air transports—an active project of ALPA for more than 35 years. The association began its initial work in this field when Capt. Ed A. Tappe, of then Capital Airlines, spearheaded the first Hazardous Cargo Study Committee. He got involved after live polio virus spilled in his aircraft. This was prior to development of a polio vaccine.

In the early 1970s attention focused on carriage of medical substances and radioactive materials. As ALPA's work progressed, discoveries of widespread mislabeling, improper packaging, and outright deceit in listing contents became common. Uncovering these dangers, ALPA in 1971 formed a Hazardous Materials Subcommittee of the Flight Security Committee. This has since grown into a full committee.

ALPA's warning, in congressional committee testimony in December 1971, of possible consequences resulting from air shipment of hazardous cargo proved painfully prophetic. That same month a spill of radioactive materials in the cargo compartment of a Delta Air Lines passenger plane exposed more than 900 people in 11 cities to radiation and contaminated the equipment.

ALPA petitioned the Federal Aviation Administration to ban hazardous materials from passenger flights. The government failed to act.

The association's concern was echoed by a General Accounting Office report to Congress: "Each year hundreds of new materials are developed; thousands of shipments are made daily, presenting an increasing danger to public safety." The report cited an interagency study of 300 inspected packages of air shipments revealing 175 had violated FAA regulations: 85 packages had incorrect or no labels, 72 packages had radiation levels exceeding the amount stated on the package, 10 packages had radiation levels exceeding the amount authorized per package, and 8 packages had nonapproved or improperly marked containers.

This GAO report came less than two months after another request by ALPA for government action, this time in congressional testimony before the Government Activities Subcommittee in March 1973. Still, ALPA's alerts for alarm fell, for the most part, on deaf ears in government and the industry.

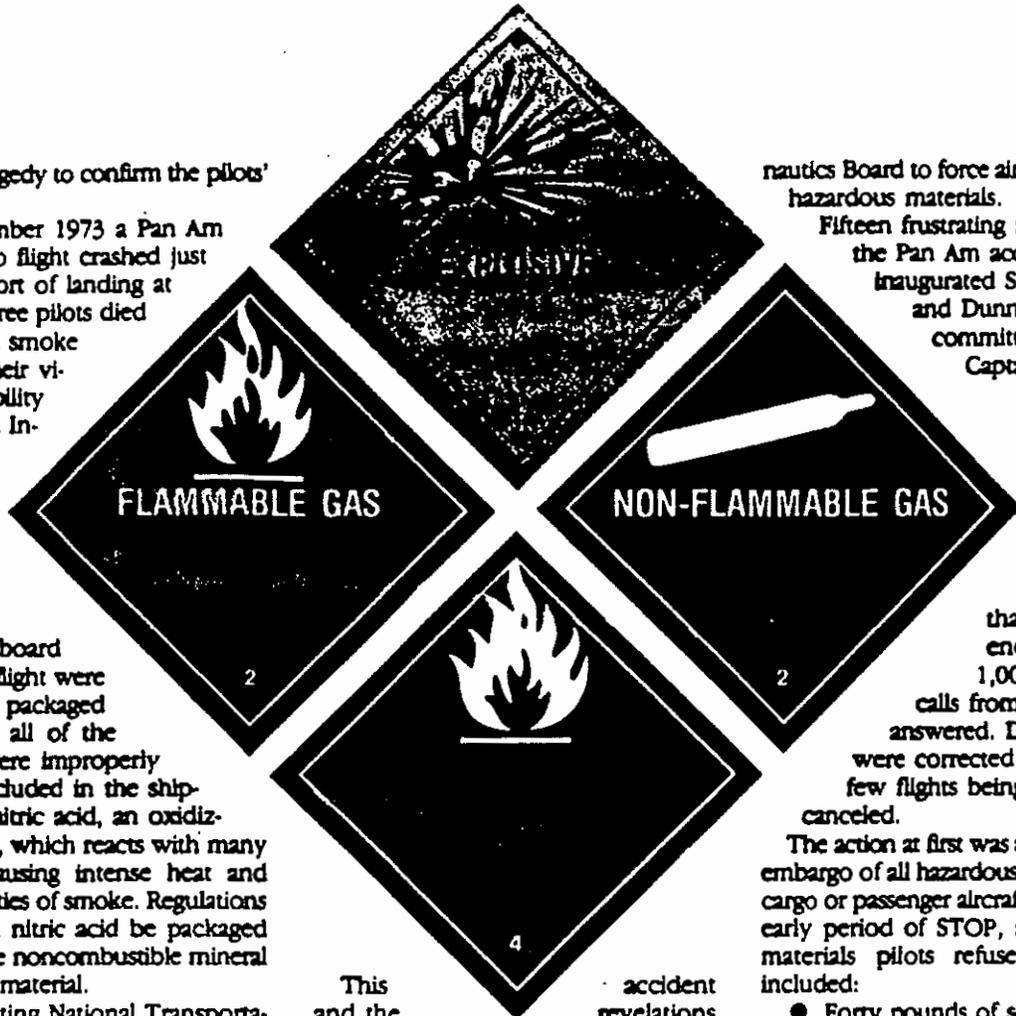
It took a tragedy to confirm the pilots' worries.

In December 1973 a Pan Am B-707 cargo flight crashed just minutes short of landing at Boston. Three pilots died when acrid smoke impaired their vision and ability to function. Investigation revealed that more than half of the 15,000 pounds of chemicals aboard their cargo flight were improperly packaged and almost all of the packages were improperly marked. Included in the shipment was nitric acid, an oxidizing material, which reacts with many materials causing intense heat and large quantities of smoke. Regulations require that nitric acid be packaged with suitable noncombustible mineral cushioning material.

The resulting National Transportation Safety Board investigation found "boxes used for the outer packaging were not manufactured to DOT [Department of Transportation] specification . . . bottles were not packed in metal containers, and the cushioning material used was combustible sawdust. Some of the chemicals were in sealed igloo containers listed as holding 'electrical appliances'."

This brought an end to patience. Captains Donald Dunn and James Eckols—both of Ozark Air Lines and co-chairmen of the Hazardous Material Committee—escalated their already intense efforts.

At the NTSB inquiry into the Pan Am accident, Capt. Ronald McDonald (Air Canada) acted as an ALPA adviser. Active in fire prevention, McDonald quickly saw the dangers associated with carrying hazardous materials and returned to tell his own government, "We've got a problem." He has remained active in IFALPA hazardous materials work, serving as chairman of the committee.



This and the accident revelations of the NTSB hearing brought to glaring public attention the dangerous conditions ALPA had been trying to get government action to improve. Congress passed and President Ford signed a Hazardous Materials Transportation Act. ALPA said it was "a step in the right direction" but that it failed to establish assured safety conditions.

Confirmation that the legislation with its \$10,000 penalty per violation would not solve the problem came when a shipment of nitric acid stored in half-gallon bottles and packed in fiber boxes was shipped from Los Angeles to Atlanta aboard a passenger aircraft. The boxes were marked "electrical appliances"! Six months after the Pan Am accident a potential tragedy for 75 passengers aboard an Aero-mexico DC-9 was narrowly averted when its crew discovered that a shipment of nitric acid had spilled in the cargo compartment.

Still DOT failed to act. To the contrary, DOT pressured the Civil Aero-

navics Board to force airlines to carry hazardous materials.

Fifteen frustrating months after the Pan Am accident, ALPA inaugurated STOP. Eckols and Dunn, along with committee members Captains Bill Cox (United) and Paul Jordan (Seaboard) and ALPA staff, coordinated the action. On that first weekend more than 1,000 telephone calls from pilots were answered. Discrepancies were corrected with only a few flights being delayed or canceled.

The action at first was almost a total embargo of all hazardous materials on cargo or passenger aircraft. During the early period of STOP, some of the materials pilots refused to carry included:

- Forty pounds of sodium bisulfate and hydrochloric acid (taken from a passenger aircraft in St. Louis);
- Almost 150 pounds of flammable liquids (removed from another passenger flight);
- Containers of xylene, a chemical with a low flash point (refused on a flight from Houston);
- Sixty pounds of compressed gas (refused by a flight crew in San Francisco).

Gradually, improved packaging, more enforcement of CFR 49, and increased cooperation from shippers, airline companies, and government reduced the need for STOP's stringent actions. While the pilots' refusal to carry dangerous goods was keeping passengers safe, ALPA's efforts were also enlightening and influencing decision makers within DOT and FAA, as well as causing movement in the international arena at ICAO.

Edward A. "Andy" Altemos, international standards chief of DOT's office of hazardous materials regulation, is the U.S. government delegate to

## Four Continuing Concerns

Substantial progress has been made in packaging and marking hazardous materials and in enforcing regulations relating to hazardous cargo, but Capt. Larry Farris, committee chairman, cites four areas receiving continuing concerted committee effort:

- **Notification time:** "The crew doesn't know early enough what cargo is being carried. It's not unusual," Farris says, "for the agent to stick the paper in the airplane just as he is closing the door. This doesn't give the captain sufficient time to examine the information and make a calculated judgment about the safety of the cargo and its packaging and placement in the cargo hold." ALPA advocates a standard notification time of from 30 minutes to an hour for originating flights and of at least 15 minutes on a connecting flight.

- **Checked baggage:** Some recent changes are improvements, such as limits on curb-side checking, but

the unknowns of checked baggage remains a potential threat to safety.

- **Carry-on items:** Passengers unknowingly carry aboard items that have a destruction potential. Education programs are needed to supplement the present screening.

- **Postal bags:** "The Post Office has a set of regulations that is pretty good," Farris says, "but they don't enforce them." Although a postal employee may question the sender about what is in a package, there is no assurance that the answer is correct. No one but a postal inspector has the authority to open mail or parcel post. All efforts to find a practical solution to the dangers of potentially dangerous substances and material sent through the mail have been rebuffed by postal authorities. "They stonewall us," says Farris. "They won't even allow us to come to meetings and discuss it. But we think we may be able to reach them by working through their union." CS

ICAO's dangerous goods panel. His alternate and adviser is Walter Greiner, aviation security specialist at FAA. "These people have a serious interest in the subject and are forceful in their efforts," Farris says.

Serious interest has also been shown in ICAO where McDonald says "even the Russians vote with me 99 percent of the time." However, progress at gaining agreement among 154 world states has moved at a glacial pace.

After STOP gained the U.S. government's attention, another year and a half was needed, Farris reports, to motivate action on the international level. Over the months and years, delegates hammered out a program that included identifying hazardous materials, classifying them, determining shipping and packaging standards, marking and labeling, setting quantities that could be shipped on pas-

senger flights and on cargo flights, and citing materials that may be banned altogether.

By the fall of 1981, an ICAO manual for transition planning had been produced. A year later, refinements in the manual created an edition that could be used voluntarily. Finally, in September 1983 the third edition was published with a mandatory effective date of Jan. 1, 1984. Subsequent editions of *Technical Instructions for Safe Transport of Dangerous Goods by Air* are updated annually. These updates are produced following twice-a-year meetings of the ICAO Dangerous Goods Panel.

Each dangerous substance is given a United Nations code number, which must be included on the shipping papers. This shipping name and U.N. number is part of the entry for each substance listed in the ICAO manual. The packaging group to which the



Current and past chairmen of ALPA's Hazardous Material Committee have played key roles in overturning the dangerous cargo threat: (top to bottom) Captains Larry Farris, James J. Eckols, and Donald L. Dunn.

substance is assigned indicates a level of danger. Group 1 shows great danger; Group 2, medium danger; and

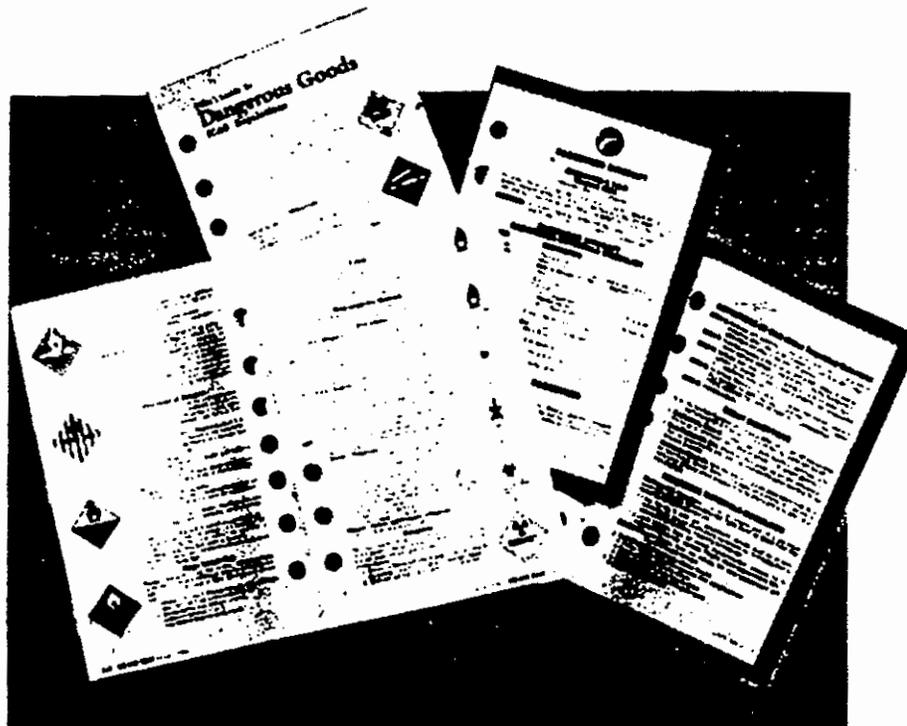
Group 3, minor danger. The manual lists packaging instructions, the net amounts of the substance that may be transported (on passenger or cargo flights), and the required labeling. Any variations by countries are also shown. Nine different classifications of substances and materials that could pose a risk are identified by color-coded labels illustrated to identify the contents' class.

ICAO TIs are voluntarily used for about 80 percent of the hazardous cargo moving by air within the United States and must be used by shippers for international transfer. Both Farris and McDonald say the wave of the future is toward accepting the ICAO TIs as a single standard. All parties agree the shippers have shown an interest and a commitment to safety. Rick Kessel, ALPA's staff representative, points to continuous training and education efforts by companies such as Dow Chemical, DuPont, and 3M, among others.

Although the mechanism is in place for control of dangerous cargo, oversight effort is not being relaxed. ALPA has embarked on a joint program with FAA to conduct inspections of selected cargo facilities. FAA's Greiner says his personnel will do about 6,000 inspections at more than 500 airports every year. ALPA committee members are included when their schedules permit. They have checked out facilities at such places as Miami, Salt Lake City, Washington Dulles, Los Angeles, Denver, and San Francisco.

FAA issues from 600 to 800 violations a year, but most of them, Greiner says, are for administrative actions such as improper paperwork instead of for unsafe conditions. Shipping facilities in other nations are being inspected as well, McDonald says. These include locations in Canada, Germany, the United Kingdom, and the Netherlands, with other nations expected to be included soon.

FAA requires airline companies to include hazardous materials instructions in their training programs for all persons who may be involved. Facility checks include inspection of these training programs, but ALPA is concerned that some carriers are giving



*ICAO's dangerous goods regulations form a symbolic overlay to ALPA's Operation STOP hazardous materials checklist, as the 10-year-old ALPA rules on the carriage of such goods give way to what pilots hope will become standard rules. The ICAO pamphlet is available from ALPA's Engineering and Air Safety Department.*

only superficial attention to this important subject.

In addition to inspection and enforcement, Farris sees four other current areas of concern: notification time to pilots about what cargo is being carried, checked baggage, carry-on items, and the content of postal bags (see "Four Continuing Concerns," page 18).

Farris is quick to note, "I've been involved in this for only about five years and took over the chairmanship after it was vacated by Capt. Paul Beach (Republic). Even though we've made great strides since the Pan Am accident and STOP has been suspended, it doesn't mean we are relaxing our standards or our efforts," he said.

Farris added that the hazardous Materials Committee has available a pilot guide for the acceptance of dangerous goods and a copy of ICAO regulations that discuss the program in terms readily usable by a line pilot. The guide may be secured by writing to Rick Kessel, ALPA Engineering and Air Safety Department, 535 Herndon

Parkway, P.O. Box 1169, Herndon, VA 22070.

ALPA's efforts through the tough STOP program, legislative work, DOT and FAA contact, and ICAO negotiations have affected the air transportation industry worldwide. "Every pilot in the world has a lot to thank Eckols and Dunn for," says Canada's McDonald, "because they saw a genuine need and worked hard to make improvements to ensure safer transport of hazardous goods. IFALPA owes a vote of thanks to ALPA for its dedicated and continuing work."

That sentiment can be echoed by every passenger who steps aboard a commercial jet transport. ←

*A free-lance writer based in the Washington, D.C., area, Charles Spence has worked in aviation communications for over 24 years. He has been on the staff of Flying magazine and the Aerospace Industries Association, and most recently served as senior vice-president for public relations at the Aircraft Owners and Pilots Association.*

# Preparing for an Aircraft Incident



*Amid growing national concern about flight safety, fire departments and their communities are questioning their own preparedness. In San Jose, Calif., those questions prompted a three-part training program.*

JOHN N. CARR

Captain, Training Officer  
San Jose Fire Department Bureau of Training  
San Jose, California

**I**f you can answer yes to the following questions, then your department and your city can feel confident when confronted with an aircraft incident.

- Have your senior staff members, battalion commanders, airport crew officers and airport managers been trained in managing aircraft incidents?
- Have your airport fire fighters received training to satisfy NFPA 1003, Airport Fire Fighter Professional Qualifications, and the Federal Aviation Regulations, FAR, Part 139?
- Have you provided basic guidelines to your entire department on responding to and handling aircraft incidents?

The San Jose Fire Department responded to those questions and then, under the direction of Fire Chief Robert Osby, provided its personnel with aircraft incident training programs.

The department's director of training, Battalion Chief Richard Wattenbarger, selected Captain John Carr as the manager of all aircraft emergency training

**About the department**

The career San Jose Fire Department has 710 personnel and protects a 250-square-mile city area and a 44-square-mile unincorporated area, with a population of about 750,000. The department has 28 stations and operates 27 engines, 5 hose wagons, 10 truck companies, 3 crash fire-rescue (CFR) airport apparatus and a hazardous materials unit. Typical manning is four on single engine companies, five on two piece companies, and six on the CFR unit. During 1985-1986, the department responded to 37,393 incidents, of which 22,985 were EMS and rescue.

programs. The selection was made because of Carr's aviation background and his position as a training officer with the fire department. Captain Carr then began to plan, organize and manage the following training programs:

- an aircraft incident management course;
- a comprehensive training program for airport fire fighters; and
- a program designed to inform the entire fire department

about responding to aircraft incidents.

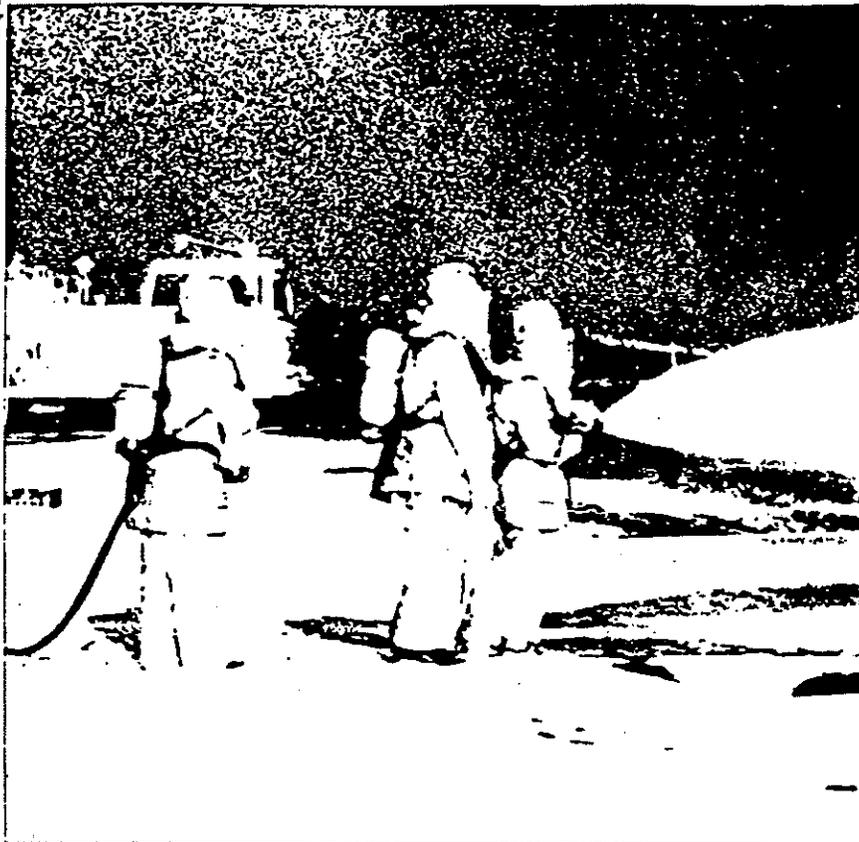
In August 1985, Captain Carr designed an Aircraft Incident Management Seminar that was sponsored by the San Jose Fire Department and taught through Louisiana State University (LSU). The instructor, Larry Williams of LSU, traveled to San Jose to deliver the course. The participants consisted of airport fire chiefs, battalion commanders, airport fire fighting officers, airport managers and disaster planning officials.

The seminar covered a wide range of topics and included a classroom exer-

**FOR MORE INFORMATION**

- Contact the author at the San Jose Fire Department, Bureau of Training, 255 South Montgomery Street, San Jose, CA 95110.

*Opposite page: The author attended the Chanute Air Force Base's state of the art Aircraft Firefighting Training Facility, in Illinois*



The climax of the Airport Firefighter Certification Course was a "hot" drill using 1500 gallons of Jet B fuel and incorporating handline operations.

cise on a simulated disaster, using state of the art simulation equipment. The seminar proved successful in all aspects, and especially in the interaction among participants. Ironically, two major air crashes occurred—one in Japan and one in Texas—during the week the seminar was held. It was the most dev-

facility provided instruction in the most up-to-date technology in aircraft fire suppression and rescue techniques.

After completing this in-depth course, Captain Carr began to develop the curriculum for San Jose's Airport Firefighter Training Program. Close attention was given to NFPA 1003 and to

**Airport fire fighting is a very specialized and critical field. The life hazard is extreme and every second counts. In aircraft emergencies, there is no second chance. This is what prompted San Jose to develop its training program.**

astating week in aviation history, in terms of major aircraft accidents with significant loss of life.

The next objective was to develop a comprehensive airport fire fighter training program. To accomplish this, Captain Carr determined he first must attend the United States Air Force Aircraft Firefighting Training Facility, at Chanute Air Force Base, Illinois. This

FAR, Part 139, to ensure that all topics were covered to satisfy certification requirements.

The Airport Firefighter Certification Course was delivered to airport fire fighting crews and officers stationed at the San Jose International Airport in December 1985. Special emphasis was given to second-arriving company officers and respective battalion commanders.

Also, invitations to attend were sent to neighboring airports, and San Francisco International Airport and Moffett Field N.A.S. sent airport fire personnel to participate.

The 24-hour course was delivered over three days. It covered all aspects of NFPA 1003. Also included was a class on flammable liquids and extinguishing agents, instructed by Captain Les Omans of the San Jose Fire Department. The course climax was a "hot" drill using 1500 gallons of Jet B fuel and incorporating handline operations, rescue procedures, and massive applications of foam. The remainder of the course included a critique, a final exam and a lesson emphasizing post traumatic stress disorder (PTSD). The effects of PTSD on emergency response personnel were discussed and its symptoms and treatment were defined.

In conjunction with the San Francisco International Airport Fire Department and United Airlines, Captain Carr arranged for all San Jose Airport fire fighting crews to attend the United Airlines Aircraft Familiarization Course. This training was delivered in July 1986 and was conducted at United's maintenance base at the San Francisco International Airport. The training provided instruction on evacuation procedures and on aircraft systems common to United's fleet.

Also scheduled for delivery to the department's entire force of 625 fire personnel is a basic course on handling aircraft accidents. This course is designed specifically for line fire companies. This portion of the overall training is extremely important, because statistics show that 80 percent of all aircraft accidents occur on approach to or departure from airports.

Airport fire fighters must be highly trained experts in a very specialized and critical field, where the life hazard is extreme and every second counts. In aircraft emergencies there is no second chance. This is what prompted the San Jose Fire Department to develop its Airport Firefighter Training Program.

An article that appeared in the NFPA Aviation Section Newsletter about the San Jose Fire Department's program has triggered national response. The department is receptive to sharing training information; however, we believe that programs of this magnitude should be administered through local, state and/or federal agencies. The California State Fire Marshal's Office presently is developing a statewide certification program for airport fire fighters.

In conclusion, we believe our program will serve as a model for other state or federal agencies. Support from these agencies is critical to the successful implementation of airport fire fighting management and training programs.

# AIRPORT SERVICES

**Management:** The business magazine for managers of aviation services and airports®

## THE NEW FAR PART 139



Fueling training programs make FBOs safer

Lawsuit is lesson in consultant choice

FBO profits from market flexibility

# Introducing the new FAR Part 139

The FAA's revised certification rule for air-carrier airports takes effect this month. Here's what airport officials say about the new rule and its effect on their facilities and operations

By Karl Bremer

**F**AA's Christmas present to airports last year was the new FAR Part 139. After two years of debate and speculation, the revised document for air carrier airports calls for significant changes in the areas of CFR and refueling. It requires minor adjustments in other aspects of airport operations.

Part 139 governs the certification and operation of airports served by scheduled and unscheduled air carrier aircraft with seating capacity of more than 30 passengers.

Industry observers agree that most airports will be able to adapt to the new rule with little difficulty, although the financial burden may be greater for some than others. Says Bruce Putnam, aviation and transit director for Billings (MT) International Airport: "I don't think there's anything in here (Part 139) that gives us a particularly lot of heartburn."

The original Jan. 1 deadline for compliance and filing for exemptions from the new Part 139—barely a month after the document was issued—caused some consternation among airport operators. However, that deadline was extended to Feb. 29 as a result of negotiations between industry groups and FAA. The American Association of Airport Executives has further requested that FAA grant all airports a "blanket exemption" from the new rule until July 1. As of press time, that request had not been granted.

According to Bill Southerland, man-



Under the new FAR Part 139, airports may not fall below minimum equipment levels for their aircraft rescue and fire-fighting index for more than 48 hours.

ager of certification and compliance in FAA's Office of Airport Standards, compliance dependent on work or purchases scheduled for completion under AIP grants applied for, for example, would qualify an airport for exemptions from the new rule's deadline. Southerland says AIP grant requests for work or equipment needed to comply with the new Part 139 will be given priority consideration by FAA.

## CFR becomes ARFF

Crash-fire-rescue operations—now called aircraft rescue and fire fighting (ARFF)—is the area most affected by the new Part 139. The most notable change is a reduction in the time allowed for airports to return to minimum equipment levels after breakdowns.

Previously, if a vehicle failure brought an airport's fire-fighting capability below the minimum required for its index

*Karl Bremer is managing editor of ASM.*

rating, 10 days were allowed to return to the required level of readiness before air carrier operations would have to be restricted. Under the new rule, airports may not fall below minimum equipment requirements for more than 48 hours before air carrier operations must be reduced to the next lowest index rating.

(An airport's ARFF index is determined by a combination of two factors: 1) length of aircraft serving the airport; and 2) average number of daily departures of air carrier aircraft in a single index group, calculated during the busiest three months of the previous year.)

R.C. Smith, manager of Modesto (CA) City-County Airport, says the 48-hour requirement "is going to be tough on airports that have one piece of equipment." In the event of a major vehicle breakdown, he notes, "It takes 48 hours to get the parts. I think this is a little more restrictive than it needs to be."

For many airports the new rule will require better care of their vehicles. At Billings, Putnam relates, "We have a preventive maintenance program in place that tries to the best of our ability to prevent breakdowns." To ensure that the airport wouldn't fall below minimum requirements for its ARFF index in the event of a breakdown, Putnam says, "We went to a larger truck unit, anticipating there might be some changes (in Part 139) down the road."

Ed Storer, manager of Natrona County Airport, Casper, WY, says he may consider using the local fire department's equipment to meet the 48-hour requirement if a breakdown occurs. "We feel like there's enough availability in the community to satisfy that," he remarks. "But whether that's something the FAA will accept, we'll have to ask that question."

According to Southerland, if water and chemical capacity requirements and minimum response times can be met, such mutual-aid agreements with off-airport fire departments would satisfy the new Part 139 standards. However, he adds, FAA would not want to see such agreements used as a permanent solution to an airport's ARFF needs. He urged airports to discuss the matter with their regional FAA certification officers.

Dan Gudas, assistant director of airport services at San Antonio International Airport, says he feels the 48-hour requirement is justified to maintain adequate emergency readiness on airports. But, he adds, "I just hope the people at

Oshkosh and Walters and Emergency One (fire truck manufacturers) can supply the parts to get the equipment back on line in 48 hours."

Dick Pollock, general sales manager for municipal products at Oshkosh Truck Corp., says his company already is feeling the impact of the new rule. "Some of the specs that are coming in are asking us to be responsive to this new 48-hour requirement," he says.



Aircraft rescue and fire-fighting crews must conduct at least one "hot-fire" drill a year to comply with the new Part 139.

"It's virtually impossible to maintain 100% parts inventory on the shelf for a truck 15 years old," Pollock continues. If a part is not in inventory for an Oshkosh truck, he says, "We are capable of recreating that part or finding an appropriate substitute to maintain that truck through its service life." Still, he says, the 48-hour requirement calls for changes in the company's service program.

"We have a large inventory of parts. We're going to review that inventory. We're going to expand on that inventory where we think we're weak. We're going to be canvassing our customers and we're going to be offering them a parts list of what we think will be high-mortality items and consumable items that they need in stock. We're also going to be offering a truck for lease in case of catastrophic failure."

Besides stocking parts for their own needs, Pollock suggests, "Those airports that are buying the same configuration truck maybe should start a parts club and have a parts pool managed by an independent person, maybe the manufacturer."

Bob Relyea, president of Crash Rescue Equipment Service Inc., a Dallas

company that refurbishes emergency vehicles, says the 48-hour rule has caused some airports to hang onto old trucks rather than trade them in when buying new ones. "Instead of getting rid of a piece they'll call us and say we'd like to update this and add it to our fleet," he relates. "For the past two years we have encouraged people to keep their equipment and consider keeping that old truck as a reserve unit."

Relyea says his company will increase its inventory of lease and loan equipment as a result of the new requirement. That will include strategic placing of equipment around the United States to meet the needs of airports as their equipment goes down, he says.

Airports with ARFF index ratings of "B" or "C" now have a choice of options under the new Part 139 for meeting minimum equipment requirements. At Index "B" airports, the requisite amount of water, foam and/or chemical can be carried on either one or two vehicles rather than the previously required two; Index "C" airports can comply with the rule using either two or three vehicles rather than three as required before.

The change could allow some airports to eliminate one emergency vehicle and thus reduce maintenance and operational expenses. "Some communities having to bite the bullet on a budget crunch may be looking at that," says San Antonio's Gudas.

Relyea says his company already has heard from some airports wanting to do just that. "A couple of airports decided to add a couple hundred pounds of halon or chemical so it would meet the new criteria," he says. "Instead of spreading your personnel out, you consolidate your vehicles where you can use your manpower more efficiently."

Jay Stucki, Worcester (MA) Airport director, says this option "will permit Worcester the ability to reach an Index 'C' level with two trucks . . . it's definitely going to save us money from the standpoint of man-hours."

The option also may save Worcester future building expenses. Worcester now is an Index "B" airport. If it were to move up to Index "C" under the old Part 139, he notes, the airport would need three vehicles and have to expand its CFR bay.

ARFF vehicles now in service that met the chemical and/or water capacity requirements of the old Part 139 will satisfy an airport's requirements under ▶

the new rule until those trucks are replaced or rehabilitated.

Regarding ARFF operations, the new Part 139 also requires:

- all rescue and fire-fighting personnel to participate in at least one live-fire drill every 12 months. The drill does not have to be conducted on the airport.
- the first ARFF vehicle to respond to the midpoint of the farthest runway within three minutes and the remaining vehicles to respond within four minutes (the old rule required a four-and-one-half minute response time for follow-up vehicles),
- at least one fire-fighting person on duty during air carrier operations who has been trained and is current in emergency medical care,
- on-board foam extinguishing agents, where required, to consist of aqueous film-forming foam (AFFF), rather than protein foam as specified under the old rule (the new rule also allows the option of using either dry chemical or halon 1211),
- roads that are designated for use as emergency access roads for ARFF vehicles to be identified in the certification manual and maintained in a condition

that will support those vehicles during all weather conditions, and

- a full-scale airport emergency drill to be conducted at least once every three years. A detailed emergency plan must be included in the airport's certification manual and be reviewed annually. Included should be provisions, to the extent practicable, for rescue of crash victims from bodies of water on or adjacent to the airport.

**Refueling operations**

The new Part 139 relieves airports of the responsibility for tenant aircraft fueling procedures and fuel quality control. However, airports retain responsibility for refueling operations with respect to safety from fire and explosions.

Gudas says this change was the result of an incident at San Antonio in 1983. A Piper Navajo was misfueled at a San Antonio FBO and crashed, killing all on board. "At that time the FAA came back to us and said 'Airport, you're responsible,' and we didn't think we were. Since we're not responsible for flying the airplane or maintenance of the airplane, why was fueling left to us to be responsible for?"

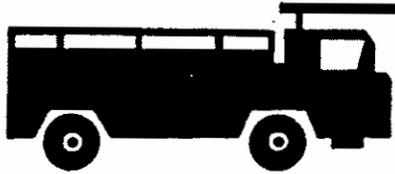
"We petitioned the FAA to change that ruling," Gudas continues. "They denied our petition. When we heard 139 was going to be re-written we lobbied very heavily for some changes."

FAA initially proposed to require licensing or certification of aircraft refueling personnel. Because of the success of voluntary refueling safety training programs that have been implemented in the industry, however, that proposal was abandoned.

Part 139 now requires airports to establish and maintain acceptable standards for protecting against fire and explosions in storing, dispensing and handling of fuel, as well as other hazardous materials. The airport operator must inspect the facilities of each fueling agent on the field at least once every three months to ensure compliance with safety procedures outlined in Part 139.

In addition, at least one supervisor at each refueling operation must complete an aviation fuel training course in fire safety that covers the subjects outlined in Part 139. All other employees who handle fuel must receive at least on-the-job training in fire safety from that supervisor. (For more on aircraft fueling

NEED PARTS  
IN A HURRY?  
WE STOCK IT.



NEED TO LEASE  
A CRASH TRUCK?  
WE HAVE IT.

**CRASH RESCUE EQUIPMENT SERVICE<sup>INC.</sup>**

**ARE YOU PREPARED FOR THE PART 139 CFR REVISIONS??**

**CRASH RESCUE EQUIPMENT SERVICE, INC.**, is gearing up to help support the aviation community in meeting these stringent requirements. Over the next few months we will be strategically locating various pieces of CFR equipment throughout the U.S. to be shipped at a moments notice to your airport should the need arise. For further information call 800-826-0989 or write:

NEED PERIODIC  
PREVENTIVE  
MAINTENANCE?  
WE CAN  
DO IT.

**CRASH RESCUE EQUIPMENT SERVICE, INC.**  
P.O. BOX 29044  
Dallas, TX 75229

NEED A COMPLETE  
OVERHAUL OR  
RENOVATION?  
WE CAN  
HANDLE  
IT.

Write No. 71 on Reader Inquiry Card

training programs, see "Fueling Training Programs Make FBOs, Skies Safer" on page 43.)

Each refueling operation must certify to the airport operator annually that that training has been given. According to FAA's Southerland, that does not mean that training must be administered to employees once a year.

Bill Power, director of legislative and industry affairs for the National Air Transportation Association, the trade group representing fixed-base operators, says that group is working with FAA to develop a fire safety training program to satisfy the new requirements.

"We want to put together a syllabus that that supervisor can take to their local fire department or the CFR facility and say 'Train me on these things'—things like knowing what the fire sources could be on the ramp, or what the potential for fire is, knowing when to fight a fire and when to run, training in the use of fire extinguishers."

Part 121 and Part 135 air carriers are not required to comply with the new refueling training provisions. However, the new rules do apply to corporate self-fuelers.

#### Other revisions

Numerous other areas of airport operations have been changed by the new Part 139, although to a lesser degree than CFR and refueling operations. Among them are:

- **Snow and ice control.** Airports "where snow and icing conditions regularly occur" must prepare and implement a snow and ice control plan as part of their certification manual. Requirements of this plan are outlined in Part 139.

- **Wildlife hazard management.** In the event of aircraft incursions with wildlife or birds, or when wildlife or birds in sufficient numbers to cause incursions have access to the airport flight pattern or movement area, an ecological study must be conducted to analyze the problem. FAA can arrange to have the study conducted by the federal Department of Agriculture at no cost to the airport. Implementation of a wildlife management plan then may be required by FAA, depending on the outcome of the study. Requirements of this plan are outlined in Part 139.

- **Pavement maintenance.** Airports must maintain and promptly repair the

pavement of runways, taxiways and aircraft loading ramps and parking areas; this includes holes larger than five inches in diameter with a slope greater than 45 degrees and/or depth of more than three inches. Also, pavement cracks large enough to affect the directional control of air carrier aircraft must be repaired. The old rule applied to holes greater than three inches in diameter and more than three inches deep. The new rule does not apply to runways used only for general aviation operations.

- **Runway/taxiway markings and signs.** Airports must provide and maintain: runway markings sufficient for the approach with the lowest minimums authorized for each runway; taxiway centerline and edge markings; signs identifying taxiing routes on the movement area; runway hold markings or signs at intersections; ILS critical area markings or signs. The new requirements are more explicit than under the old rule as to where markings and signs must be provided.

- **Lighting.** Airports must provide and maintain: runway lighting for the approach with the lowest minimums au- ▶

**Still Leading the Way!**

- Facilities Planning
- Environmental Planning
- Financial & Management Consulting

**Landrum & Brown**  
Aviation Consultants since 1949

Cincinnati 513-984-5455      Chicago 312-726-4967      San Francisco 415-331-1148

Write No. 72 on Reader Inquiry Card

# T-HANGARS

**FULFAB, Inc.**

1525 WHIPPLE AVE. S.W.  
CANTON, OHIO  
44710

Phone  
Area 216  
477-7211

Write No. 73 on Reader Inquiry Card



**Aviation Planning Associates, Inc.**

- Financial and Economic Analyses
- Airport Master Planning
- Aviation System Planning
- Environmental and Noise Control Studies
- Terminal/Facilities Planning
- Air Service Analysis
- Organization and Management Studies
- Airport Automation/Computer Applications
- Public Coordination Programs

421 Arch Street  
Cincinnati, Ohio 45202  
(513) 381-4610

7600 Red Road  
Miami, Florida 33143  
(305) 666-2993

AvPlan

Write No. 74 on Reader Inquiry Card

authorized for each runway; taxiway centerline lighting and/or reflectors and taxiway edge lighting and/or reflectors; an airport rotating beacon; approach lighting for the approach with the lowest minimums authorized for each runway (unless provided and maintained by FAA or another agency); and obstruction marking and lighting as appropriate.

The above changes to Part 139 are not all-inclusive. Southerland advises airports with questions about the new Part 139 to contact their regional FAA airport certification inspector.

A workshop on the new Part 139 was sponsored by the American Association of Airport Executives in Washington last month. The meeting was video-taped and will be made available to airports sometime this month. Other workshops may be conducted by individual FAA regional offices.

"I think they've done a real good job with it from my perspective," says San Antonio's Gudas of the FAA's revision of Part 139. "I think they have made an honest attempt to listen to the industry. I don't think there's going to be any real problems from the alphabet groups."

## **TSR** "The Design & Manufacture Of Aircraft Refuelers." **It's Our Business.**

**Over 200 REFUELERS DELIVERED IN 1987**

**750 GALLON  
AVGAS REFUELER**



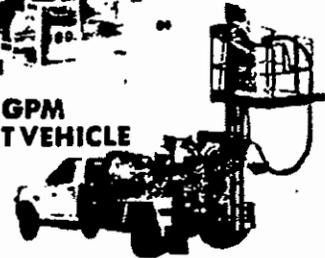
**2200 GALLON  
JET REFUELER**



**10,000 GALLON  
JET REFUELER**



**750 GPM  
HYDRANT VEHICLE**



**Setting The Industry Standard**  
**Design, Quality, Performance & Service**

Call or Write To Receive Our  
Latest Product Brochure.

**800-351-4747**

**TRI-STATE REFUELER CO.**

539 South 10th Street Kansas City, Kansas 66105  
913-342-5600 / TLX 535119 / FAX 913-342-0638

Write No. 75 on Reader Inquiry Card



U.S. Department  
of Transportation  
Federal Aviation  
Administration

# Advisory Circular

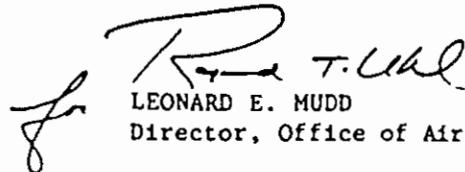
## ANNOUNCEMENT OF AVAILABILITY

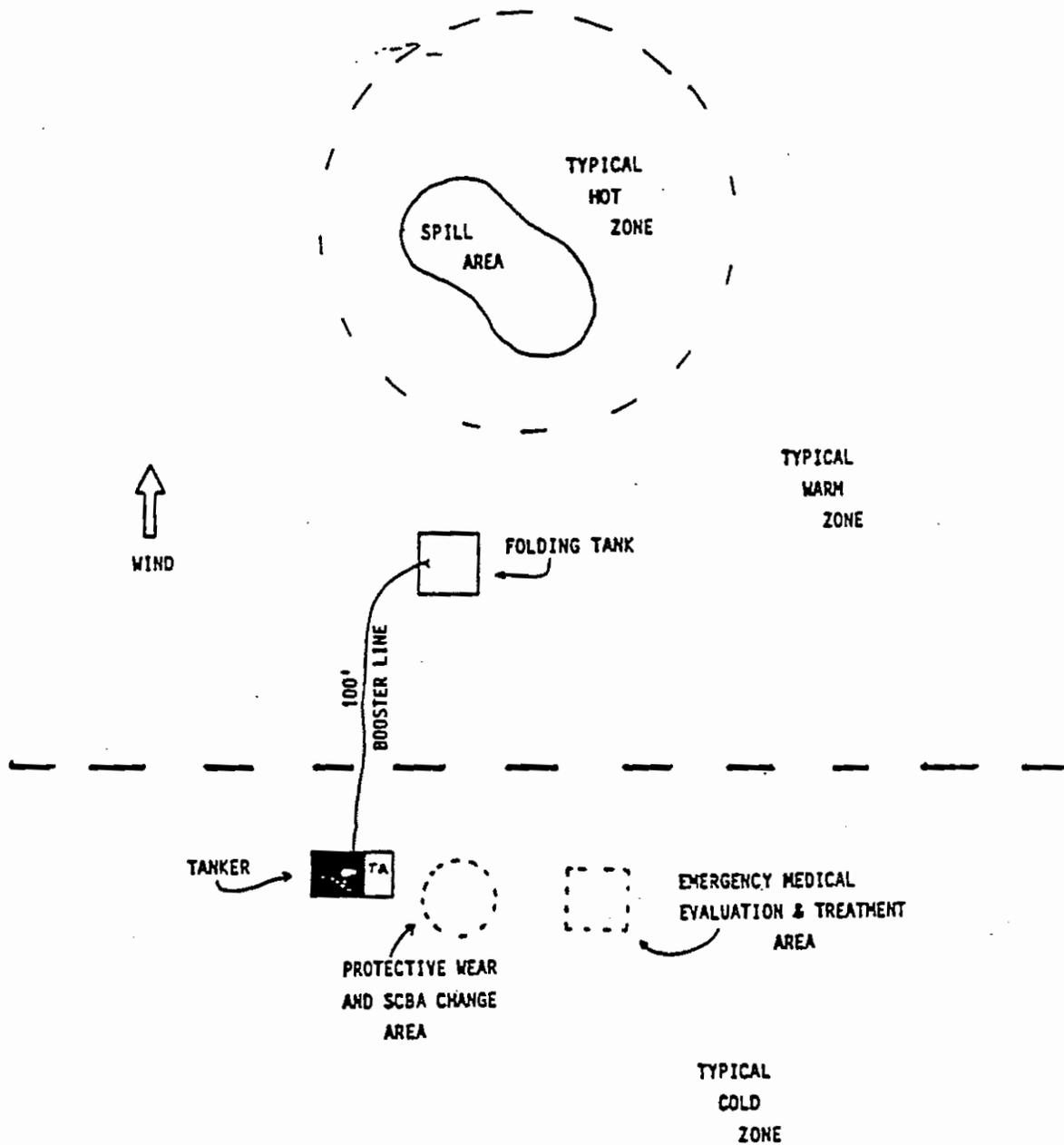
**Subject:** THE NATIONAL FIRE PROTECTION  
ASSOCIATION'S STANDARD FOR PROFESSIONAL  
QUALIFICATIONS FOR AIRPORT FIRE FIGHTERS  
(NFPA 1003-1987)

**Date:** 9/1/87.  
**Initiated by:** AAS-100

**AC No:** 150/5200-27B  
**Change:**

1. PURPOSE. This advisory Circular (AC) explains the nature of the NFPA Standard and tells how it can be obtained for use as an airport fire fighter training program guide.
2. CANCELLATION. AC 150/5200-27A, Announcing the Availability of the National Fire Protection Association's Standard for Airport Fire Fighter Professional Qualifications (NFPA 1003-1978), dated February 1, 1984, is cancelled.
3. FOCUS.
  - a. This standard was developed by the NFPA Technical Committee on Fire Fighter Professional Qualifications. It specifies in terms of performance objectives the minimum requirements of professional competence required for service as an airport fire fighter. It does not restrict any jurisdiction from exceeding the minimum requirements set forth in the standard.
  - b. An airport fire fighter training program which leads to the fulfillment of the professional qualifications identified in NFPA 1003-1987 is a means acceptable to the Administrator of providing fire fighting and rescue personnel with the training considered necessary to perform their duties at airports.
4. HOW TO ORDER. Copies of NFPA 1003-1987, Standards for Professional Qualifications for Airport Fire Fighters, may be obtained from the National Fire Protection Association, Publications Sales Division, Batterymarch Park, Quincy, Massachusetts 02269 for \$10.50 a copy. Telephone inquiries should be directed to 1-800-344-3555.

  
LEONARD E. MUDD  
Director, Office of Airport Standards



## HAND SIGNALS FOR FIGHTING AIRCRAFT FIRES

Because of the noise at the scene of an aircraft crash fire, a set of hand signals has been developed to enable a company or chief officer to communicate his desires to the vehicle operator. Each fire department may find it necessary to modify the signals to meet their specific needs. The following explanations are illustrated in Figure 13-8.

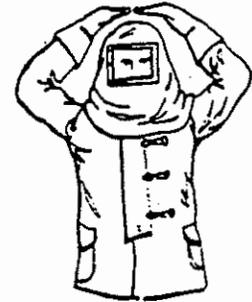
### HAND SIGNALS FOR CRASH OPERATIONS



Ready for Operations/  
Everything OK



Straight Stream Top  
Turret (lower hand  
directs stream)



Dispersed Pattern  
Turret (full fog)



Bumper Turret  
Operation



STOP Operations/  
Malfunction

APPLICABILITY AND REQUIREMENTS OF INDICES - AIRPORT FIRE FIGHTING AND RESCUE SERVICES (FAR PART 139).

<u>APPLICABILITY</u>		<u>REQUIREMENTS</u>	
	<u>A/C LENGTH</u>	<u>VEHICLE</u>	<u>AGENT &amp; ACTIVITY</u>
INDEX A	NOT MORE THAN 90 FT.*	(1)	500#DC OR 450#DC AND 50 GAL. AFFF. NOTE: UNSCHEDULED OPERATIONS ONLY INDEX A VEHICLE REQUIRED; INDEX B AIRCRAFT WITH LESS THAN 5 DAILY DEPARTURES 500 GAL. WATER 300#DC.
INDEX B	MORE THAN 90 FT. BUT NOT MORE THAN 126 FT.	(2)	5 OR MORE DAILY DEPARTURES. INDEX A VEHICLE PLUS 1500 GAL. WATER EXCLUDING FOAM CONCENTRATE.
INDEX C	MORE THAN 126 FT. BUT NOT MORE THAN 160 FT.	(3)	5 OR MORE DAILY DEP. INDEX A VEHICLE PLUS (2) WITH TOTAL 3000 GAL. WATER EXCLUDING FOAM CONCENTRATE.
INDEX D	MORE THAN 160 FT. BUT NOT MORE THAN 200 FT.	(3)	5 OR MORE DAILY DEP. INDEX A VEHICLE PLUS (2) WITH TOTAL 4000 GAL. WATER EXCLUDING FOAM CONCENTRATE
INDEX E	MORE THAN 200 FT.	(3)	5 OR MORE DAILY DEP. INDEX A VEHICLE PLUS (2) WITH TOTAL 6000 GAL. WATER EXCLUDING FOAM CONCENTRATE.

\*Also applicable to all airports receiving CAB-certificated air carriers in scheduled or unscheduled operations with small aircraft, and unscheduled operations with large aircraft.

EXTINGUISHING AGENTS IN USE FOR AIRCRAFT FIRES.

<u>Situation</u>	<u>Agents</u>
a. Spill of Fuel without Fire	AFFF or Protein or Fluoroprotein Foam Blanket Water Spray Flushing
b. Spill Fire	AFFF Dry Chemical Powder Protein or Fluoroprotein Foam
c. Nacelle	Dry Chemical Powder Halocarbons CO <sub>2</sub>
d. Wheel Fire	Dry Chemical Powder Halocarbons
e. Magnesium Fire	TEC Magnesium Extinguishing Agent Met-L-X extinguishers
f. Fires in Unoccupied enclosed spaces	CO <sub>2</sub> Halocarbons <sup>1/</sup> Water Spray
g. Fires in Occupied enclosed spaces	Water Spray
h. 3-D Exterior Fires with Spilling Fuel	AFFF, Protein Foam or Fluoroprotein Foam in combination with dry Chemical Powder or Halocarbons

<sup>1/</sup> Primarily intended for application outdoors, they are, however, recognized as being effective on fires in unoccupied enclosed spaces such as nacelles. However, because of their TOXICITY, these agents require training in use and application.

## FLIGHT #255 PRESENTATION

### I. ACKNOWLEDGEMENTS

OPENING REMARKS BEFORE PRESENTATION

### II. METRO FACTS

1000 FLIGHTS A DAY/365,000 PER YEAR  
62% ARE NORTHWEST  
16 MILLION PASSENGERS A YEAR  
100 MILLION POUNDS OF MAIL A YEAR  
185 MILLION POUNDS OF FREIGHT A YEAR

MOST RECENT FACT: ON AUGUST 16, 1987, NW FLIGHT 255 WITH 155 PASSENGERS AND CREW CRASHED. ALL 154 PASSENGERS WERE KILLED, 1 SURVIVED (CECELIA). THERE WERE 2 GROUND VICTIMS. THIS WAS THE 2ND WORST AIR DISASTER IN UNITED STATES HISTORY.

### III. FLIGHT 255 RESPONSE FACTS

(NOT INCLUDING WAYNE COUNTY OR ROMULUS FORCES)

39 LOCAL POLICE DEPARTMENTS  
17 FIRE DEPARTMENTS  
1 OUTSIDE COUNTY FIRE DEPARTMENT  
9 OUTSIDE COUNTY LOCAL POLICE DEPARTMENTS  
6 SHERIFF'S DEPARTMENTS  
1 SHERIFF'S DEPARTMENT FROM OHIO  
5 MSP POSTS (YPSI/NORTHVILLE/ERIE/FLAT ROCK/DETROIT)  
3 UNIVERSITY'S (DETROIT/MICHIGAN/WAYNE)  
25 PRIVATE SECTOR BUSINESS AND CORPORATIONS  
9 RESTAURANTS  
4 ORGANIZED VOLUNTEER GROUPS (RED CROSS/SALVATION ARMY/CIVIL AIR PATROL/HAMS)  
7 PRIVATE SECTOR EMS PROVIDERS  
4 HOSPITAL EMERGENCY ROOMS  
14 MENTAL HEALTH AGENCIES  
7 FEDERAL AGENCIES  
6 EMERGENCY MANAGEMENT DIVISION AGENCIES  
3 STATE AGENCIES

160 AGENCIES AT A MINIMUM

WELL OVER 1000 RESPONDERS

50 CARS WERE DESTROYED, ANOTHER 120 DAMAGED, \$940,450 TOTAL LOSS.

THE AIRCRAFT COST 25 MILLION DOLLARS

ECONOMIC IMPACT ON GOVERNMENT..... OVER \$400,000

PSYCHOLOGICAL IMPACT ON WORKERS... FAMILY PROBLEMS, WORK PROBLEMS, ETC. IN THESE TERMS WE'LL BE PAYING FOR THIS DISASTER FOR YEARS AND YEARS TO COME.

#### IV. RESPONSE CHRONOLOGY

ON SUNDAY EVENING, AUGUST 16TH, AT 8:46 P.M., NORTHWEST FLIGHT 255 CRASHED WHILE ATTEMPTING TO TAKEOFF FROM DETROIT METRO AIRPORT.

CRASH OBSERVED BY AIR TRAFFIC CONTROL TOWER, ROMULUS POLICE, WCSO, AIRPORT FIRE DEPARTMENT, AND AMATEUR RADIO STATION AT THE NATIONAL WEATHER SERVICE.

THE AIR TRAFFIC CONTROL TOWER IMMEDIATELY ACTIVATED THE CRASH ALARM TO ALERT THE AIRPORT FIRE DEPARTMENT OF THE CRASH, AND THEN NOTIFIED THE AIRPORT FIRE DEPARTMENT, AIRPORT OPERATIONS, AND COUNTY CENTRAL COMMUNICATIONS OF THE SITUATION VIA THE EMERGENCY TELEPHONE HOTLINE. AT THE SAME TIME THE ROMULUS POLICE, WCSO, AND AIRPORT FIRE DEPARTMENT STAFF WHO HAD WITNESSED THE CRASH ADVISED THEIR DISPATCH POINTS OF THE SITUATION.

BY 8:47 P.M. THE FOLLOWING ACTIVITY HAD OCCURRED:

THE AIRPORT EMERGENCY OPERATING PLAN WAS ACTIVATED.

AIRPORT FIRE DEPARTMENT WAS OUT AT THE SCENE AND HAD BEGUN TO SUPPRESS THE FIRE.

AIRPORT FIRE DEPARTMENT HAD NOTIFIED HEMS TO ACTIVATE THE HOSPITAL DISASTER RESPONSE PLAN, AND REQUESTED FIRE MUTUAL AID ASSISTANCE FROM WESTERN WAYNE COUNTY.

AIRPORT OPERATIONS HAD CLOSED THE AIRPORT, NOTIFIED ALL TENANTS OF THE CRASH, AND DISPATCHED CREWS TO INSPECT RUNWAY 3 CENTER AND TO ASSIST AT THE SITE.

AIRPORT MAINTENANCE WAS DISPATCHED TO ASSIST AT THE SITE.

THE WAYNE COUNTY EMERGENCY OPERATIONS PLAN WAS ACTIVATED.

CENTRAL COMMUNICATIONS HAD DISPATCHED UNITS OF THE SHERIFF'S AIRPORT DIVISION TO THE SITE, AND TO BLOCKADE POINTS AROUND THE AREA OF THE CRASH. AN ALL CALL REQUEST FOR ASSISTANCE FROM LOCAL POLICE DEPARTMENTS HAD BEEN BROADCAST. HEMS HAD BEEN NOTIFIED OF THE SITUATION AND THE TRIAGE TEAM FROM WESTLAND MEDICAL HOSPITAL WAS NOTIFIED AND PLACED ON ALERT. PRIVATE SECTOR EMS PROVIDERS WERE NOTIFIED OF THE SITUATION AND MOBILIZED.

THE ROMULUS EMERGENCY OPERATIONS PLAN WAS ACTIVATED.

ROMULUS POLICE HAD DISPATCHED ALL AVAILABLE UNITS TO THE CRASH SITE. ROMULUS POLICE WERE OUT AT THE SCENE. ROMULUS FIRE WAS MOBILIZED.

THE HOSPITAL DISASTER PLAN FOR WESTERN AND DOWNRIVER WAYNE COUNTY WAS ACTIVATED AND EMERGENCY ROOMS NOTIFIED OF SAME.

THE AMATEUR RADIO EMERGENCY SERVICE HAD ACTIVATED THEIR AIRCRAFT DISASTER EMERGENCY OPERATIONS PLAN.

BY 8:48 P.M. THE FOLLOWING ACTIVITY HAD OCCURRED:

ROMULUS FIRE DEPARTMENT WAS AT THE ACCIDENT SITE AND ASSISTING IN FIRE SUPPRESSION.

CLOSE-IN ACCESS CONTROL POINTS ESTABLISHED BY ROMULUS AND SHERIFF'S OFFICERS.

CENTRAL COMMUNICATIONS HAD MOBILIZED WCSO ID, DB, AND K-9, AND THE MEDICAL EXAMINER.

AMATEUR RADIO UNITS ENROUTE TO CLOSE-IN HOSPITALS AND THE EOC.

AIRPORT OPERATIONS AND MAINTENANCE HAD NOTIFIED AND MOBILIZED ALL OFF DUTY STAFF AND HAD UNITS OUT AT THE SITE. STAFF DISPATCHED TO EOC.

AIRPORT FIRE DEPARTMENT HAD BEGUN NOTIFICATION OF THEIR OFF DUTY FIRE FIGHTERS.

AN INSPECTION OF RUNWAY 3 CENTER WAS UNDERWAY.

THE HOSPITAL DISASTER PLAN WAS IN FULL GEAR.

PRIVATE EMS PROVIDERS WERE ARRIVING AT THE SCENE.

BY 8:50 P.M. THE FOLLOWING ACTIVITY HAD OCCURRED:

ALL AVAILABLE WCS AND ROMULUS UNITS OUT AT ACCIDENT SITE.

LOCAL POLICE AND FIRE DEPARTMENTS BEGAN ARRIVING AT THE SITE.

BLOCKADE POINTS ESTABLISHED.

CENTRAL COMMUNICATIONS NOTIFIED EDISON, MICHIGAN BELL, MICHIGAN CONSOLIDATED GAS, FBI, POSTMASTER, GRAND TRUNK RAILROAD OF SITUATION.

MSP UNITS BEGAN CLOSING DOWN I-94 AND REROUTING TRAFFIC.

RESCUE OPERATIONS WERE INITIATED.

WCS ID AND CENTRAL PHOTO ENROUTE TO ACCIDENT SITE.

WCS DB MOBILIZED AND ENROUTE TO ACCIDENT SITE

MEDICAL EXAMINER ENROUTE TO ACCIDENT SITE.

DPD HELICOPTER AND K-9 BODY RECOVERY TEAM ENROUTE TO ACCIDENT SITE.

FUEL TANKER THAT HAD SERVICED NW 255 WAS IMPOUNDED.

BY 9:00 P.M. THE FOLLOWING ACTIVITY HAD OCCURRED:

ROMULUS AND COUNTY EMD STAFF NOTIFIED OF INCIDENT. CEO MCNAMARA AND MAYOR MACANNALY ADVISED AND ENROUTE TO EOC. DEPARTMENT HEADS NOTIFIED OF SITUATION.

COUNTY HEALTH, STATE WELFARE, COUNTY FIRE OPERATIONS OFFICER, WCS OPERATIONS OFFICER NOTIFIED AND ENROUTE TO EOC.

MOST FIRE SUPPRESSION ACTIVITIES GEARING DOWN. RESCUE EFFORT GEARING UP.

MOST MUTUAL AID AND PRIVATE EMS RESPONDERS OUT AT SITE.

NTSB & FAA NOTIFIED OF SITUATION BY CONTROL TOWER AND MOBILIZING STAFF.

BY 9:30 P.M. THE FOLLOWING ACTIVITY HAD OCCURRED:

DPD AIR SUPPORT AT SITE

EDISON AT SITE. HOT WIRES CLEARED.

THE EOC WAS FULLY OPERATIONAL. ALL AGENCIES ADVISED OF SAME. MAYOR MACANNALY AND CEO MCNAMARA AND STAFF OUT AT EOC. DOWNRIVER POLICE AND FIRE MATF ACTIVATED.

MAJOR FIRE OPERATIONS AS SITE CONCLUDE. RESCUE EFFORT IN FULL GEAR.

HAM OPERATORS AT ALL CLOSE-IN HOSPITAL EMERGENCY ROOMS. HAM STATION AT EOC FULLY OPERATIONAL.

RECEPTION CENTER AT ROMULUS FIRE STATION #4 ACTIVATED. RECEPTION CENTER STAFF ENROUTE. RED CROSS, HEALTH DEPARTMENT, WELFARE, ROMULUS EMD STAFF, LAW ENFORCEMENT, CHAPLAINS ENROUTE OR AT FIRE STATION #4.

CIVIL AIR PATROL MOBILIZED. STAFF REPORTING TO EOC.

SALVATION ARMY MOBILIZED. STAFF REPORTING TO ROMULUS STATION #4 AND CRASH SITE.

PERIMETER SECURITY ESTABLISHED. SITE COMMAND POST ESTABLISHED.

MEDICAL EXAMINER, WCSO ID & DB & CENTRAL PHOTO AT SITE, DB BEGAN IDENTIFYING WITNESSES AND ENROUTE TO AREA HOSPITAL EMERGENCY ROOMS.

MEDICAL EXAMINER, NORTHWEST, AP OPERATIONS, AP MANAGEMENT, AP MAINTENANCE, FBI, HEALTH DEPARTMENT, WELFARE, OFFICE OF PUBLIC SERVICES, PUBLIC INFORMATION, POSTAL INSPECTOR, FAA SECURITY, LAW ENFORCEMENT AND FIRE OPERATIONS OFFICERS AT EOC.

AIRPORT RUNWAY INSPECTION COMPLETE, AIRPORT OPEN.

OPS SIGN AND STOREROOM OPENED. GAS PUMPS ACTIVATED.

DENTAL FORENSIC TEAM ENROUTE TO EOC.

NOMADS APPROVED USE AS TEMPORARY MORGUE. AIRPORT MAINTENANCE AND EMD STAFF BEGIN PREPARATIONS.

RADIOLOGICAL MONITORING TEAM OUT AT EOC.

BY 11:00 P.M. THE FOLLOWING ACTIVITY HAD OCCURRED:

COAST GUARD AIR SUPPORT AT SITE.

ALL OUTSIDE ID AGENCIES ON SITE.

ALL AGENCIES UP TO FULL STAFF LEVELS.

CARGO MANIFEST REVEALED NO HAZMAT.

AREA CLEARED BY RADIOLOGICAL TEAM

AP/FD RECOVERS BLACK BOX.

RESCUE EFFORT ESSENTIALLY COMPLETE. HEMS NOTIFIED TO STAND DOWN ALERT. PERIMETER FULLY ESTABLISHED.

SITE CLEARED OF ALL BUT ESSENTIAL PERSONNEL. I.D. AND M.E. TEAMS PLOTTING STRATEGY. WITNESSES BEING INTERVIEWED. RECEPTION CENTER FULLY OPERATIONAL AND TAKING CALLS.

MORGUE CONSTRUCTION IN FULLY GEAR. REFRIGERATOR TRUCKS ENROUTE TO LOCATION.

BRIDGE INSPECTORS CHECKED I-94 AND R/R OVERPASS STRUCTURES.

MSP/EMD AT EOC.

AREA ACCESS CONTROL SPECIFICS FULLY IMPLEMENTED.

MENTAL HEALTH EFFORT BEGINS.

CIVIL AIR PATROL ASSISTING ON ACCESS CONTROL.

BY 2:30 A.M. THE FOLLOWING ACTIVITY HAD OCCURRED:

RECEPTION CENTER MOVED TO AIRPORT HOTEL. NTSB OUT. MENTAL HEALTH STAFF ESTABLISHED STRATEGIC PLAN FOR COMPLETE COVERAGE.

NORTHWEST COMMAND POST ESTABLISHED.

SITE ACTIVITY BROUGHT TO A STAND-STILL. ID AND BODY RECOVERY OPERATIONS TO HOLD OFF UNTIL DAY BREAK.

HAMS EOP PHASED OUT.

AT 6:00 A.M. MONDAY MORNING ID AND MORGUE TEAMS BEGIN SITE PREPARATION FOR BODY AND PROPERTY RECOVERY.

BY 8:00 A.M. MONDAY MORGUE WAS FULLY OPERATIONAL. INCLUDED FIRE/EMS, POLICE, NORTHWEST, EMS PROVIDERS, RED CROSS, HEALTH DEPARTMENT, CIVIL AIR PATROL, AIRPORT MAINTENANCE AND OPERATIONS, FORENSIC DENTAL TEAM, FUNERAL DIRECTORS ASSOCIATION, UNIVERSITY REPRESENTATIVES.

BY 4:00 P.M. THE FOLLOWING ACTIVITY HAD OCCURRED:

ALL BODIES RECOVERED AND AT THE MORGUE. NTSB SUPERVISING MAJOR STRUCTURE REMOVAL. FBI DISASTER IDENTIFICATION TEAM AT WORK. FORENSIC DENTAL TEAM EFFORT FULLY UNDERWAY.

MASSIVE MENTAL HEALTH EFFORT UNDERWAY.

DURING THE FOLLOWING WEEK CONTINUED SECURITY ON THE SITE AND AT THE TEMPORARY MORGUE AS INVESTIGATION AND IDENTIFICATION FUNCTIONS CONTINUED.

ALL IDENTIFICATIONS WERE COMPLETED BY FRIDAY AT NOON.

MEDICAL EXAMINER BEGAN RELEASING DECEASED ON WEDNESDAY AFTERNOON.

SITE RELEASED BY NTSB FOR CLEAN UP ON SATURDAY MORNING (22ND). MASSIVE CLEAN UP EFFORT BEGINS.

SUNDAY EVENING (23RD) JUST BEFORE 9:00 P.M. THE SITE WAS OPENED TO THE PUBLIC.

BY TUESDAY EVENING (25TH) NOMADS CLEANED AND TURNED OVER TO TENANT.

BY THURSDAY (SEPT 3RD) REFRIGERATOR TRUCKS APPROVED AND RELEASED TO VENDORS.

PROPERTY RETURNS TO SURVIVING RELATIVES WILL CONTINUE FOR MONTHS.

#### V. ADVICE

MEDIA OPERATIONS  
STAFFING  
STRATEGIC RECOVERY  
COMMUNICATIONS  
RECORDS  
VISITORS

VOLUNTEER GROUPS  
SURVIVORS  
RESOURCES  
COORDINATORS  
CREDENTIALS  
SITE DIRECTOR

#### VI. SUMMARY/CLOSING

SMOOTHEST OPERATIONS CONCEIVABLE.

COOPERATION BOMB ALWAYS EXPLODES - IN THIS INSTANCE THE RESPONSE HAD AN ESTABLISHED ORGANIZATION AND PLANS TO FIT INTO.

PROXIMITY TO ATOMIC POWER PLANT.

JOINT TRAINING.

THANKS TO MSP/EMD AND LT. HOSTUTLER FOR GUIDANCE.

THOSE OF US THAT WERE INVOLVED IN THE EMERGENCY RESPONSE EFFORT WILL ALWAYS REMEMBER FLIGHT 255 WHEN WE HEAR OR SEE AN AIRPLANE. FIRST WE WILL REMEMBER THE INCONCEIVABLE HORROR OF THE TRAGEDY. THEN WE WILL REMEMBER THE SYMPATHY AND COMPASSION WE FELT FOR THE VICTIMS AND THEIR SURVIVING LOVED ONES. BUT MOST OF ALL, WE WILL REMEMBER WITH PRIDE THE COOPERATIVE AND SUCCESSFUL EFFORT.

THANK YOU.

THE SCENE WHERE FLIGHT 255 CRASHED AUGUST 16TH IS NOW QUIET AND MUCH THE SAME AS IT WAS BEFORE THE ACCIDENT. LESS THAN A MILE SOUTH OF THE ACCIDENT SITE, ON THE SAME ROAD AS THE CRASH, IS THE WAYNE COUNTY CRIMINAL JUSTICE CENTER. HOUSED THERE ARE THE OFFICES OF THE EMERGENCY MANAGEMENT DIVISION, WHERE OUTBRIEFINGS ARE CONTINUING TO HELP COPE WITH THE PSYCHOLOGICAL TRAUMA WHICH CONTINUES LONG AFTER AN ACCIDENT LIKE THIS. THERE ARE MANY CHALLENGES FACING A FIRE DEPARTMENT WHEN A DISASTER OF THIS MAGNITUDE OCCURS. COMMUNICATIONS, RESOURCES, SURVIVORS, MEDIA RELATIONS, RECORDS, AND STRATEGIC RECOVERY ARE ONLY A FEW OF THE ITEMS WE MUST CONSIDER WHEN PREPARING OURSELVES FOR THE WORST CHALLENGE A FIRE DEPARTMENT CAN FACE, AN AIRCRAFT ACCIDENT. THERE ARE MANY OPPORTUNITIES FOR US TO PREPARE OURSELVES BEFORE THE FACT. DISASTER PLANNING, STANDARD OPERATING PROCEDURES, "PRE-TRAINING", AND STUDYING OF PAST INCIDENTS ALL CAN HELP TO IDENTIFY AREAS FOR IMPROVEMENT WITHIN OUR OWN DEPARTMENT.

DISASTER MANAGEMENT IS NOT NEW TO THE DETROIT METROPOLITAN AIRPORT. THIS WAS THE THIRD AIR DISASTER SINCE 1981 HANDLED BY THE METRO AIRPORT FIRE DEPARTMENT. THE EMERGENCY MANAGEMENT OF THIS PARTICULAR INCIDENT LASTED SOME TEN DAYS AND INVOLVED OVER 160 SEPARATE AGENCIES. IN TERMS OF COORDINATED OPERATIONS, PLANNING WAS THE KEY TO THEIR SUCCESS. GOOD PLANNING AND "PRE-TRAINING" ON USE OF THE DISASTER PLAN MADE IT (THE PLAN), USABLE WHEN THE TIME CAME. IT WAS REALIZED IN 1981 THAT "IT TAKES MORE THAN JUST A FIRE CHIEF AND A POLICE CHIEF MAKING DECISIONS TO EFFECTIVELY MANAGE AN AIRCRAFT INCIDENT", ACCORDING TO CHIEF MICHAEL BRESNAHAN, OF THE METRO AIRPORT FIRE DEPARTMENT. IT WAS IN 1981 THAT A UNITED AIRLINES CARGO PLANE CRASHED WHICH CAUSED A RESPONSE FROM MANY OF THE AREA EMERGENCY SERVICE AGENCIES. WITH THE RESPONSE CAME THE REALIZATION THAT IN TIMES OF LARGE SCALE EMERGENCIES, MULTI-AGENCY RESPONSES WILL NEED TO BE COORDINATED TO INSURE PROPER UTILIZATION OF RESOURCES. A MAJOR EFFORT WAS LAUNCHED TO DEVELOP A PLAN THAT COULD BE UTILIZED IN THESE SITUATIONS. MARK R. SPARKS, DIRECTOR OF THE EMERGENCY MANAGEMENT

DIVISION STATED, "IN 1982 THE COUNTY BEGAN TO DEVELOP AN OVERALL PLAN TO HANDLE EMERGENCIES SUCH AS THIS." IT WAS THROUGH THE COORDINATION EFFORTS INVOLVING ALL LEVELS OF GOVERNMENT THAT ULTIMATELY RESULTED IN THE PRESENT PLAN. AGENCIES SUCH AS FEMA, MICHIGAN STATE POLICE, COUNTY EMERGENCY MANAGEMENT, AND STATE EMERGENCY MANAGEMENT ALL WORKED TOGETHER TO SET-UP, ESTABLISH, ENACT, AND TRAIN ON THE DISASTER PLAN. "PRE-TRAINING" WAS DEFINED AS A VERY POSITIVE STEP IN OVERALL SUCCESS OF THE DISASTER PLANNING PROCESS. ALL AGENCIES EXPECTED TO PLAY A PART IN THE PLAN MUST BE INCLUDED IN THE PROCESS, INCLUDING THE TRAINING ASPECT.

ON AUGUST 16TH WHEN DISASTER STRUCK AGAIN, THE PLAN WAS PUT TO THE ULTIMATE TEST. ON A SUNDAY EVENING, AT 8:46 P.M., NORTHWEST FLIGHT #255 CRASHED WHILE ATTEMPTING A TAKEOFF FROM THE DETROIT METRO AIRPORT. THE CRASH ITSELF WAS OBSERVED BY THE AIR TRAFFIC CONTROL TOWER, ROMULUS POLICE DEPARTMENT, WAYNE COUNTY SHERIFF'S DEPARTMENT, AND AN AMATEUR RADIO STATION AT THE NATIONAL WEATHER SERVICE OFFICE. IT WAS ALSO OBSERVED BY A METRO FIRE DEPARTMENT UNIT RETURNING FROM THE CRIMINAL JUSTICE CENTER. IMMEDIATELY THE AIR TRAFFIC CONTROL TOWER NOTIFIED THE AIRPORT FIRE DEPARTMENT, CENTRAL COMMUNICATIONS, AND AIRPORT OPERATIONS, BUT USE OF THE CRASH PHONE. THE AIRPORT EMERGENCY OPERATING PLAN WAS ACTIVATED.

FIRE DEPARTMENT RESPONSE WAS IMMEDIATE. AIRPORT OPERATIONS CLOSED THE AIRPORT AND RESPONDING UNITS HAD CLEAR ACCESS TO THE SITE, JUST OFF THE NORTHEAST CORNER OF THE AIRPORT PROPERTY. UPON ARRIVAL FIRE FIGHTERS FIRST ENCOUNTERED THE AVIS CAR RENTAL AGENCY FACILITY WITH ITS ROOF ABLAZE AND SOME 50 CARS BURNING IN FRONT OF THE BUILDING. IT WAS APPARENT THE BUILDING HAD BEEN STRUCK BY THE MD-80 THAT HAD CRASHED. A TURRET APPLICATION OF AFFF FROM AN OSHKOSH M-15 QUICKLY KNOCKED DOWN THE MAJOR FIRE. CRASH CREWS WHO WERE EXPECTING TO FIND WRECKAGE, REALIZED THAT ONLY CARS WERE BURNING AT THIS SPOT, THEY

THEN CONTINUED NORTH ON MIDDLEBELT ROAD. AS THEY TRAVELED PAST THE AVIS BUILDING THE PATHWAY WAS OBSCURED BY SMOKE, THIS MADE THE RESPONSE DIFFICULT AND SLOW. A SPOTTER WAS PLACED IN FRONT ON FOOT TO INSURE THE PATH WAS CLEAR OF SURVIVORS. IT HAD NOW BECOME APPARENT THERE WERE A LARGE NUMBER OF FATALITIES AND WRECKAGE WAS SCATTERED OVER A LARGE AREA. THE AIRCRAFT HAD CONTACTED A RAILROAD BRIDGE, BROKEN APART AND BURNING DEBRIS WAS ALL THAT WAS LEFT.

AIRCRAFT ACCIDENTS TAKE THEIR TOLL. ALTOGETHER 156 PEOPLE DIED - 154 ABOARD THE ILL-FATED JET AND 2 PERSONS IN VEHICLES ON THE GROUND. ONLY ONE HAD SURVIVED, FOUR YEAR OLD CECELIA.

FIRE FIGHTING WAS NOT A PROBLEM, IN FACT MOST RESPONDING VEHICLES USED ONLY ABOUT 50 PERCENT OF THEIR AGENT. SOME SPOT FIRES, IN FACT, WERE EXTINGUISHED USING ONLY A HAND EXTINGUISHER. THE REAL OPERATION IN THIS INCIDENT WOULD BE POST-INCIDENT. WITHIN MINUTES OF THE NOTIFICATION OF THE ACCIDENT, HEMS WAS NOTIFIED. HEMS IS HEALTH EMERGENCY MEDICAL SYSTEM, A NETWORK USED TO OBTAIN CERTAIN INFORMATION CRITICAL IN OPERATIONS SUCH AS THIS. HEMS NOTIFIES ALL HOSPITALS TO INACT THEIR DISASTER RESPONSE PLANS, AND MUTUAL AID ASSISTANCE WAS REQUESTED FROM WESTERN WAYNE COUNTY. SUCH THINGS AS BED AVAILABILITY, HOSPITAL STAFFING, EQUIPMENT, AND HOSPITAL STATUS ARE ITEMS COVERED UNDER THE HEMS SYSTEM. ALL OF THIS INFORMATION IS FED INTO THE COUNTY EOC (EMERGENCY OPERATIONS CENTER) WHICH IS STAFFED WITH VARIOUS AGENCY HEADS WHO WILL BE MAKING DECISIONS.

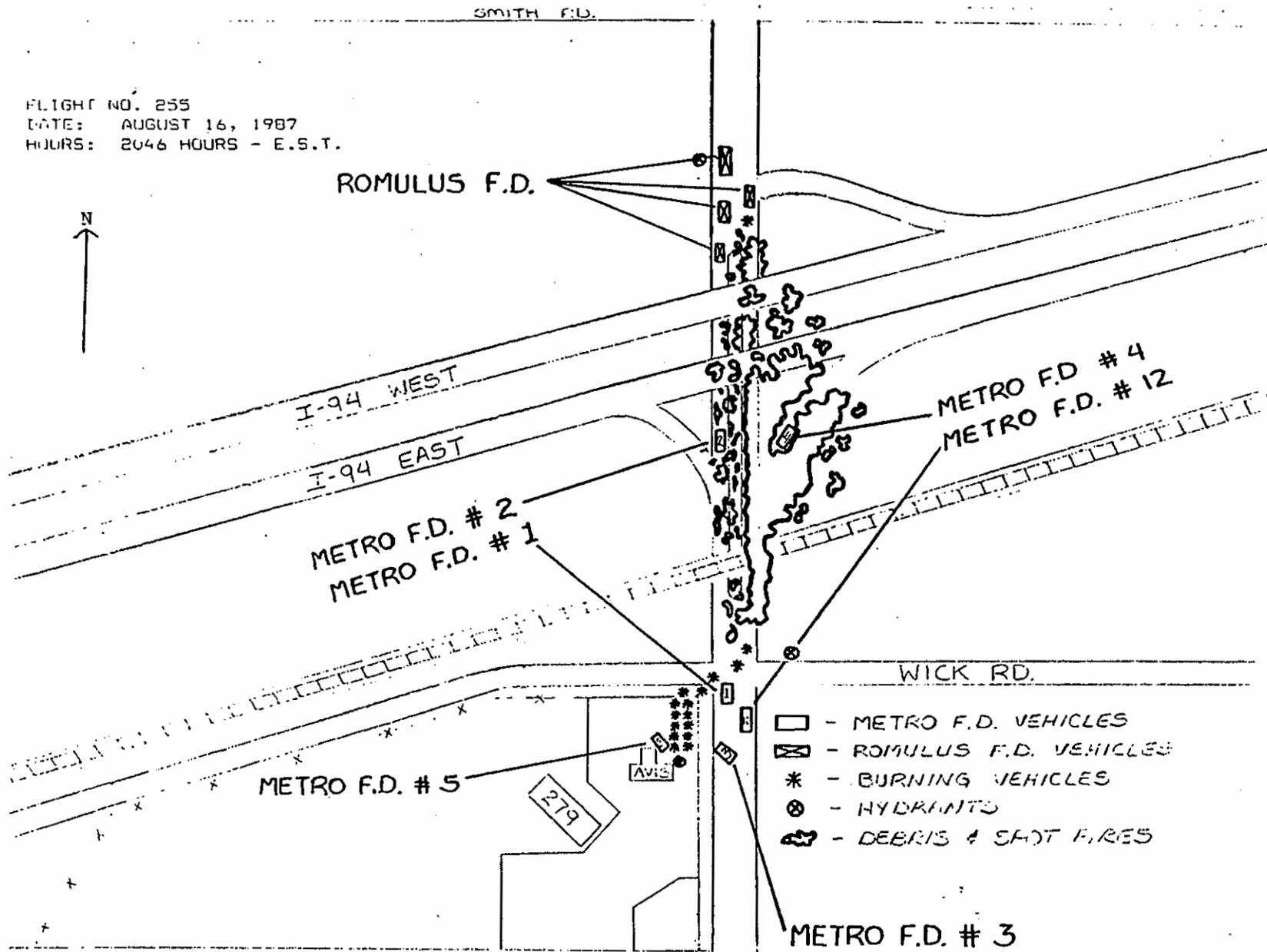
BY 9:00 P.M., 14 MINUTES AFTER THE CRASH, THE FOLLOWING ACTIVITY HAD TAKEN PLACE. ROMULUS FIRE DEPARTMENT WAS AT THE SCENE AND ASSISTING IN THE FIRE SUPPRESSION ACTIVITIES. A PERIMETER WAS BEING ESTABLISHED AROUND THE SCENE BY THE ROMULUS POLICE OFFICERS AND SHERIFF'S OFFICERS. OFF-DUTY FIRE FIGHTERS WERE BEING CALLED IN TO ASSIST IN THE OPERATION AND A PLAN WAS BEING ESTABLISHED TO MAINTAIN

OPERATIONS FOR AN EXTENDED PERIOD OF TIME. ALL HOSPITALS WERE NOTIFIED OF THE SITUATION AND HOSPITAL DISASTER PLANS WERE IN FULL GEAR. PRIVATE EMS PROVIDERS WERE ARRIVING AT THE SCENE. CENTRAL COMMUNICATIONS HAD NOTIFIED UTILITY COMPANIES, FBI, POSTMASTER, AND THE RAILROAD OF THE SITUATION. COUNTY HEALTH, STATE WELFARE, NTSB AND THE FAA HAD ALSO BEEN NOTIFIED. IT WAS CLEAR NOW THAT ACTIVITIES WERE EXPANDING AND OPERATIONS WERE BECOMING MORE AND MORE INVOLVED. WITHOUT A WORKABLE DISASTER PLAN, IN THIS SITUATION IT WOULD BE IMPOSSIBLE TO CONTROL THE ACCESS AND FUNCTION OF ALL THE AGENCIES INVOLVED IN JUST A SHORT FEW MINUTES.

AS THE OPERATION CONTINUED, SHIFTS WERE ESTABLISHED AND ALL FUNCTIONS WERE HANDLED BY THE COMMAND POST AND THE EMERGENCY OPERATIONS CENTER. BODY RECOVERY WAS ACCOMPLISHED AND COMPLETED BY 4:00 P.M. MONDAY, LESS THAN 24 HOURS AFTER THE ACCIDENT. THE SITE WAS RELEASED FOR CLEAN UP ON SATURDAY MORNING THE 22ND. MASSIVE CLEAN UP EFFORTS ALLOWED THE SITE TO BE OPENED TO THE PUBLIC JUST BEFORE 9:00 P.M. ON SUNDAY EVENING THE 23RD, ONE WEEK AFTER THE DISASTER.

IT IS CLEAR IN SITUATIONS INVOLVING RESPONSE FROM ANY AGENCY THAT A PLAN MUST BE USED TO INSURE EFFECTIVE OPERATIONS. IN THE AFTERMATH OF AN AIRPLANE ACCIDENT, IT IS IMPOSSIBLE TO GAIN CONTROL OF THE SITUATION WITHOUT THE AGENCIES INVOLVED KNOWING EXACTLY WHAT THEIR DUTIES AND RESPONSIBILITIES ARE. WE WANT THE SMOOTHEST OPERATIONS CONCEIVABLE TO BE EFFECTIVE. IT TAKES A LARGE SCALE EFFORT, WHICH DOES NOT HAPPEN BY ACCIDENT OR OVER NIGHT. IT IS A PROCESS WHICH IS PROACTIVE AND CONTINUAL. IT IS UP TO US TO TAKE THE TIME AND MAKE THE EFFORT TO START AND CONTINUE A PRE-DISASTER PLANNING PROCESS. ACCIDENTS LIKE NORTHWEST FLIGHT #255 DO NOT OCCUR OFTEN, BUT WHEN THEY DO, AND IT'S IN YOUR JURISDICTION, ARE YOU PREPARED?

FLIGHT NO. 255  
DATE: AUGUST 16, 1987  
HOURS: 2046 HOURS - E.S.T.





U.S. Department  
of Transportation  
**Federal Aviation  
Administration**  
Office of  
Aviation Safety

# Airport Safety Alert

**SUBJECT:** AIRPORT VEHICLE OPERATOR PRACTICES

**TO:** Operators of Airport Vehicles

This **AIRPORT SAFETY ALERT** provides persons operating vehicles on an airport with some tips on good operating practices, a glossary of terminology that a driver may encounter in radio communications, and some examples of typical radio communications. Although the emphasis in this **ALERT** is on vehicle operations on airports with a control tower, there are numerous tips which would also be applicable to vehicle operators on airports without a control tower.

Could this happen  
to you?



Operating a vehicle on an airport presents the driver with some factors that would not be encountered on the highway. Several of these operational differences are associated with the presence of aircraft such as speed, the vertical dimension of flight, and jet blast or prop wash. Others are associated with the airport environment such as radio communications, marking, signing, and runway and taxiway designations. In addition the airport's appearance changes drastically at night and during periods of low visibility or inclement weather.



Always be aware of the presence of aircraft.

## VEHICLE OPERATING TIPS

### General

- Know and obey all airport rules or regulations pertaining to vehicle operations.
- Always yield the right-of-way to emergency vehicles and aircraft, unless otherwise instructed by the control tower.
- Remember that, especially in large aircraft, the pilot's view of ground areas immediately in front and adjacent to the sides of the aircraft is limited and to any areas behind the wings of the aircraft is nonexistent. Whenever possible approach the aircraft from a direction where the pilot can see you.

DC-10 pilot could not see this vehicle in front of landing gear when he began to taxi.



## **Operating On Or Adjacent To The Runway**

- Never proceed onto a runway without control tower approval.
- Look in both directions on the runway surface and in the approaches before entering the runway. (This is a good practice even when you have been approved to enter or cross the runway by the control tower.) Be aware of non-standard approach paths, particularly for helicopters.
- Turn on vehicle lights and beacon especially on overcast days or during inclement weather.
- Move in an expeditious manner across runway when crossing.
- Operate on an active runway in direction opposite to the air traffic flow, whenever possible.
- Contact control tower at regular intervals to remind them of your presence when on the active runway for an extended period of time.
- Broadcast presence periodically and continuously monitor the Common Traffic Advisory Frequency (CTAF) at an airport without an operating control tower.

The last transmission between the operator of this snow sweeper and the control tower occurred approximately six minutes before a landing aircraft collided with it.

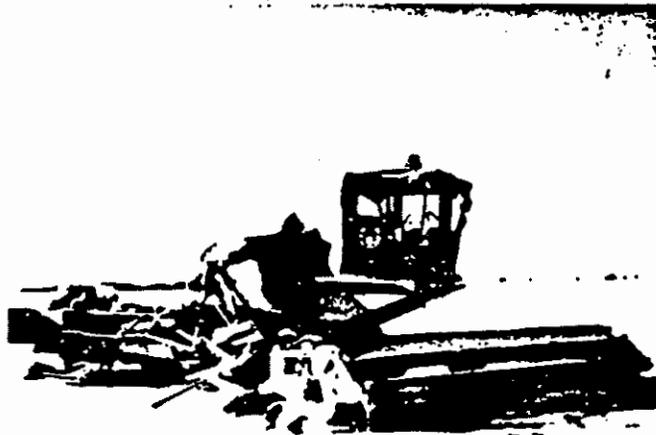


Figure 1. Distance at which engine exhaust is 25 mph.

Type of Thrust	Aircraft Type			
	B-727	DC-8	DC-10/ L-1011	B-747, B-767, B-757, A-300, and all re-engined B-707/ DC-8 aircraft
Takeoff Thrust	550 Ft.	700 Ft.	2,100 Ft.	1,752 Ft.
Breakaway Thrust	200 Ft.	400 Ft.	850 Ft.	1,250 Ft.
Idle Thrust	150 Ft.	100 Ft.	350 Ft.	620 Ft.

### Jet Blast/Prop Wash

- Be aware of the possibility of jet blast/prop wash when positioned behind an aircraft.
- An operating rotating beacon on an aircraft usually indicates that the engines are running or are about to be started.
- An aircraft just starting to move will generate considerably more jet blast or prop wash than one that is idling (see Figure 1). Consequently a vehicle that may be in a safe position for idle thrust may be subject to a mishap when breakaway thrust is applied. Other situations to be aware of include when an aircraft is turning or using reverse thrust to back up.

Figure 2. Air traffic control tower light gun signals

MEANING			
COLOR AND TYPE OF SIGNAL	MOVEMENT OF VEHICLES, EQUIPMENT AND PERSONNEL	AIRCRAFT ON THE GROUND	AIRCRAFT IN FLIGHT
Steady green	Cleared to cross, proceed or go	Cleared for takeoff	Cleared to land
Flashing green	Not applicable	Cleared for taxi	Return for landing (to be followed by steady green at the proper time)
Steady red	STOP	STOP	Give way to other aircraft and continue circling
Flashing red	Clear the taxiway/runway	Taxi clear of the runway in use	Airport unsafe, do not land
Flashing white	Return to starting point on airport	Return to starting point on airport	Not applicable
Alternating red and green	Exercise extreme caution	Exercise extreme caution	Exercise extreme caution

## **Communications**

- Use accepted terminology (see glossary) when communicating with the control tower.
- Communicate on and continuously monitor the designated tower frequency (usually ground control) whenever the vehicle is on the movement area; i.e., areas of the airport which require authorization from air traffic control to enter or operate on.
- Include in order the following items when requesting a clearance to operate on the movement area:
  1. Name of facility being called.
  2. Your vehicle identity.
  3. Your present location.
  4. Your request.
  5. Say the word "Over" when your request is completed.

NOTE: If your request is lengthy or frequency is busy, use only items 1 and 2 to establish initial contact. Also if it is obvious that you expect a response item 5 may be omitted. For subsequent contacts during the same conversation, the name of the facility being called may be eliminated.

- Read back instructions to tower for confirmation before acting. (During peak traffic periods the frequency may be congested and it may be necessary to forgo a readback of the entire message. However, a good practice is always to read back any "hold short" instructions.)
- Regardless of traffic volume or frequency congestion, never hesitate to ask for clarification if uncertain of the tower's instructions
- Acknowledge all instructions received from the control tower. (Be sure to include vehicle identity in your acknowledgment.)
- Be cognizant of other ongoing radio conversations so as not to interrupt another transmission.
- Turn vehicle toward control tower and flash headlights if radio should become inoperative while on movement area unless some other procedure has been established by the airport management.
- Know the meaning of the tower light gun signals (see Figure 2). Cut out Figure 2 and attach it to your vehicle's sun visor or dashboard.

## GLOSSARY OF TERMINOLOGY

**ACKNOWLEDGE**—Let me know that you have received my message.

**ADVISE INTENTIONS**—Tell me what you plan to do.

**AFFIRMATIVE**—Yes.

**FINAL**—Commonly used to mean that an aircraft is on the final approach course or is aligned with a landing area.

**HOLD**—Stay in place; where you are currently located.

**HOW DO YOU HEAR ME?**—A question relating to the quality of the transmission or to determine how well the transmission is being received.

**IMMEDIATELY**—Used by ATC when such action compliance is required to avoid an imminent situation.

**NEGATIVE**—"No," or "permission not granted," or "that is not correct."

**OUT**—The conversation is ended and no response is expected.

**OVER**—My transmission is ended; I expect a response.

**PROCEED**—Authorization to begin/continue on authorized routes.

**READ BACK**—Repeat my message back to me.

**ROGER**—I have received all of your last transmission. It should not be used to answer a question requiring a yes or a no answer. (See Affirmative, Negative.)

**SAY AGAIN**—Used to request a repeat of the last transmission. Usually specifies transmission or portion thereof not understood or received; e.g., "Say again all after ABRAM VOR."

**SPEAK SLOWER**—Used in verbal communications as a request to reduce speech rate.

**STAND BY**—Means the controller or pilot must pause for a few seconds, usually to attend to other duties of a higher priority. Also means to wait as in "stand by for clearance." If a delay is lengthy, the caller should reestablish contact.

**THAT IS CORRECT**—The understanding you have is right.

**UNABLE**—Indicates inability to comply with a specific instruction, request, or clearance.

**VERIFY**—Request confirmation of information; e.g., "verify assigned altitude."

**WITHOUT DELAY**—With a sense of urgency, proceed with approved instructions in a rapid manner.

**WILCO**—I have received your message, understand it, and will comply with it.

## PHONETIC ALPHABET

A—Alfa  
B—Bravo  
C—Charlie  
D—Delta  
E—Echo  
F—Foxtrot  
G—Golf  
H—Hotel  
I—India  
J—Juliett  
K—Kilo  
L—Lima

M—Mike  
N—November  
O—Oscar  
P—Papa  
Q—Quebec  
R—Romeo  
S—Sierra  
T—Tango  
U—Uniform  
V—Victor  
W—Whiskey  
X—Xray

Y—Yankee  
Z—Zulu  
0—Zee-ro  
1—Wun  
2—Too  
3—Tree  
4—Fow-er  
5—Fife  
6—Six  
7—Sev-en  
8—Ait  
9—Nin-er

## EXAMPLES OF VEHICLE/TOWER COMMUNICATIONS

Below are three scenarios of typical vehicle/tower communications that a driver of an airport vehicle may encounter.

### Scenario 1:

This scenario involves the request to cross a runway during a relatively heavy traffic period. As a result, vehicle operator does not include request in initial contact. Also, controller has the vehicle standby before approving crossing and approves crossing without delay.

Vehicle: Boston Ground, Mobile One.

G.C.: Mobile One, Boston Ground, over.

Vehicle: Ground, Mobile One at the approach end of runway 27, would like to cross the runway.

G.C.: Mobile One, Ground, Standby.

G.C.: Mobile One, Ground, without delay cross runway 27.

Vehicle: Mobile One, roger.

### Scenario 2:

This scenario involves a request to drive on two active runways to check runway lights. Note that except for first reply, the vehicle operator does a complete readback of the controller's instructions. In the exception, the vehicle operator only reads back the hold short instructions and "rogers" the rest of the message.

Vehicle: Boston Ground, Mobile 59 at the Fire Station would like to check runway lights on runways 4 right and 4 left.

G.C.: Mobile 59, Boston Ground, proceed to the approach end of runway 4 left, hold short on Taxiway E.

Vehicle: Ground, Mobile 59 roger, will hold short of 4 left on Taxiway E.

Vehicle: Ground, Mobile 59, holding short on Taxiway E.

G.C.: Mobile 59, Ground, proceed on runway 4 left to the end, hold short of 4 right/22 left.

Vehicle: Mobile 59 proceeding on runway 4 left, will hold short of 4 right/22 left.

Vehicle: Ground, Mobile 59 is clear of runway 4 left, holding short of 4 right/22 left.

G.C.: Mobile 59, Ground, proceed on runway 4 right/22 left, report clear of runway.

Vehicle: Mobile One, roger.

Vehicle: Ground, Mobile One clear of 4 right/22 left.

**Scenario 3:**

This scenario involves a vehicle responding to an emergency.

Vehicle: Boston Ground, Rescue One responding to a fuel leak at the boat house.

G.C.: Rescue One, Boston Ground, proceed to the boat house via taxiways charlie and delta, hold short of runway 33 left.

Vehicle: Ground, Rescue One proceeding via charlie and delta, will hold short of runway 33 left.

Vehicle: Ground, Rescue One holding short of runway 33 left at delta.

G.C.: Rescue One, Ground, cross runway 33 left, proceed to the boat house.

Vehicle: Rescue One, roger.

**NEED ADDITIONAL COPIES?**

Additional copies of this **ALERT** can be obtained by contacting your FAA Airports District Office or FAA Regional Airports Division. Also, you may reproduce this **ALERT** without further authorization.

U.S. Department  
of Transportation  
**Federal Aviation  
Administration**

800 Independence Ave., S.W.  
Washington, D.C. 20591

Official Business  
Penalty for Private Use \$300

Postage and Fees Paid  
Federal Aviation  
Administration  
DOT 515



# British Aerospace BAe 146-100

Length: 85'11"  
Wing Span: 86'5"  
Height: 28'3"

Occupancy: 2 + 82/93

Fuel Type: Jet "A"

Fuel Capacity: 3,403 gallons

Fuel Weight: 22,800 lbs.

Fuel System: Single point pressure refueling.

Fueling System Location:  
Lower surface of right wing, outboard of outer (#4) engine.

# of Engines: 4 ALF 502-R Turbopfans.

Oxygen Service Location:  
Right side of baggage compartment, on forward bulkhead.

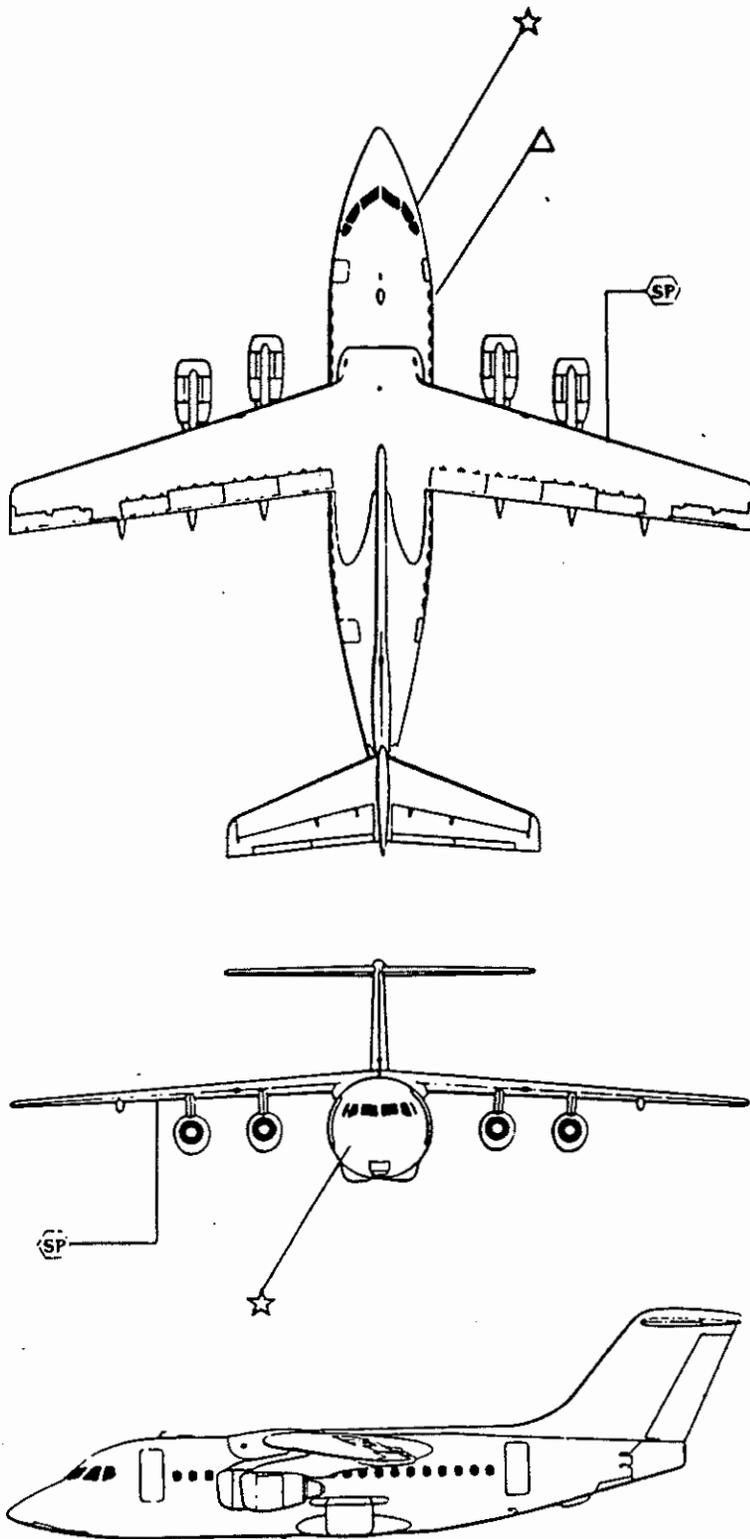
Type Windshield: Glass, coated with a shatter-proof vinyl covering.

A.P.U. Location: Aft of the rear pressure bulkhead in the tail cone.

A.P.U. Extinguishers: A.P.U. emergency shut-down switches are located at rear of air conditioning bay access and at refuel panel.

Master Electrical Switches: Overhead pilot's panel.

Battery Location: In a bay beneath the flight deck and front vestibule. Access can be gained to the bay through a door on the right side of the fuselage or through a door in the flight deck area.



Engine Extinguishers: 4 Fire Handles for engines 1-4. Pull through rotary baulk to fullest extent.

Engine Extinguishers Location: Overhead panel between pilot and Co-pilot's seats.

Emergency Access and Rescue:

Forward and rear service doors: pull handle to fullest extent, rotate clockwise to open door.

Co-pilot's window panel exit: opens from inside inwards left to right.

Forward and rear passenger doors: pull handle to fullest extent, rotate clockwise to open door.

Break in rescue panels: cut here in emergency.



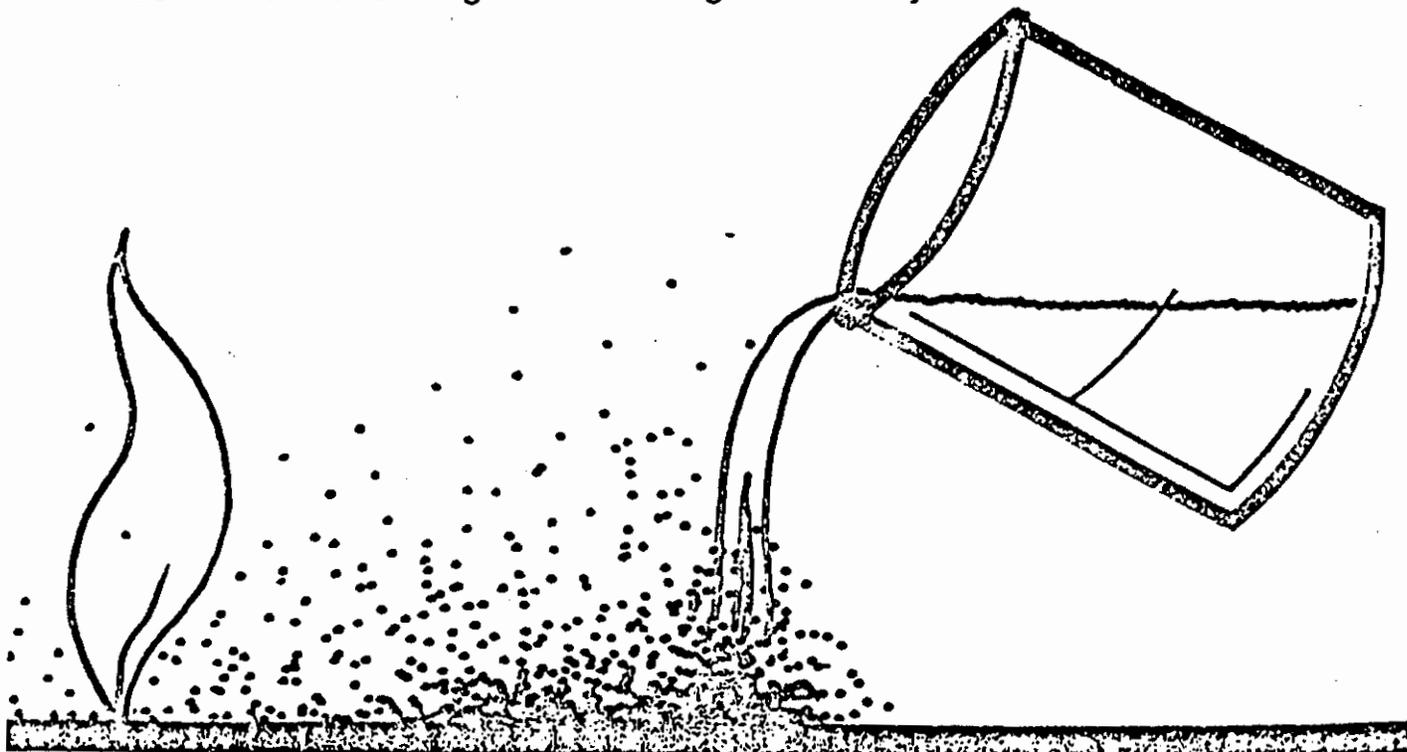
## FUEL CHARACTERISTICS

### FLAMMABLE RANGES

MATERIAL	FLASH POINT	IGNITION TEMPERATURE	LOWER % BY VOLUME IN AIR	UPPER % BY VOLUME IN AIR	SPECIFIC GRAVITY (w) = 1.0	VAPOR DENSITY (A) = 1.0	WATER SOLUBLE	BOILING POINT
ETHYL ALCOHOL	55 F 13 C	685 F 363 C	3.3	19.0	0.8	1.6	YES	173 F 78 C
ACETONE	-4 F -20 C	869 F 465 C	2.15	13.0	0.8	2.0	YES	133 F 56 C
ACETYLENE GAS	-118 F	581 F 305 C	2.5	100.0	---	0.91	NO	-118 F -83 C
BUTANE	-31 F -1 C	550 F 287 C	1.6	8.5	0.582	2.0	NO	31 F -1 C
PROPANE	-44 F	842 F 432 C	2.1	9.5	0.509	1.6	NO	-44 F -42 C
HYDROGEN	---	932 F 500 C	4.0	75.0	---	0.1	SLIGHT	-422 F -252 C
GASOLINE	-45 F -43 C	536 F 280 C	1.4	7.6	0.8	3.0 -4.0	NO	100-400 F 38-204 C
KEROSENE	110-162 F 43- 72 C	410 F 210 C	0.7	5.0	0.9	---	NO	304-574 F 151-301 C



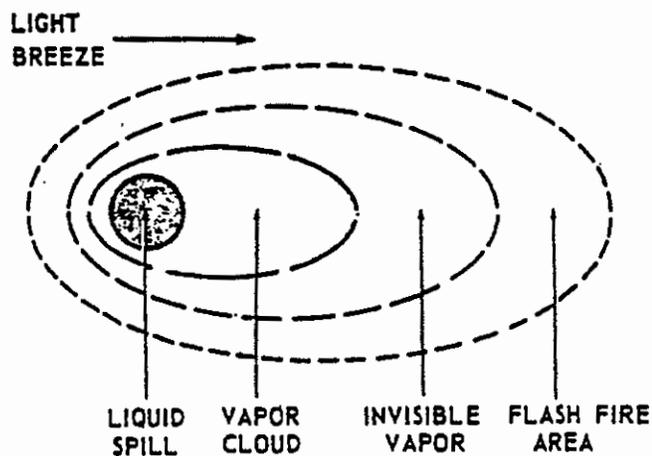
the lower the Boiling Point of a spilled liquid, the greater will be the vapor spread. Thus, the farther and faster the vapor will tend to move away from the surface of the spilled liquid. And, since ignition always occurs from the lean end, the lower the B.P. of the spilled liquid, the better the chance of ignition occurring farther away. \*

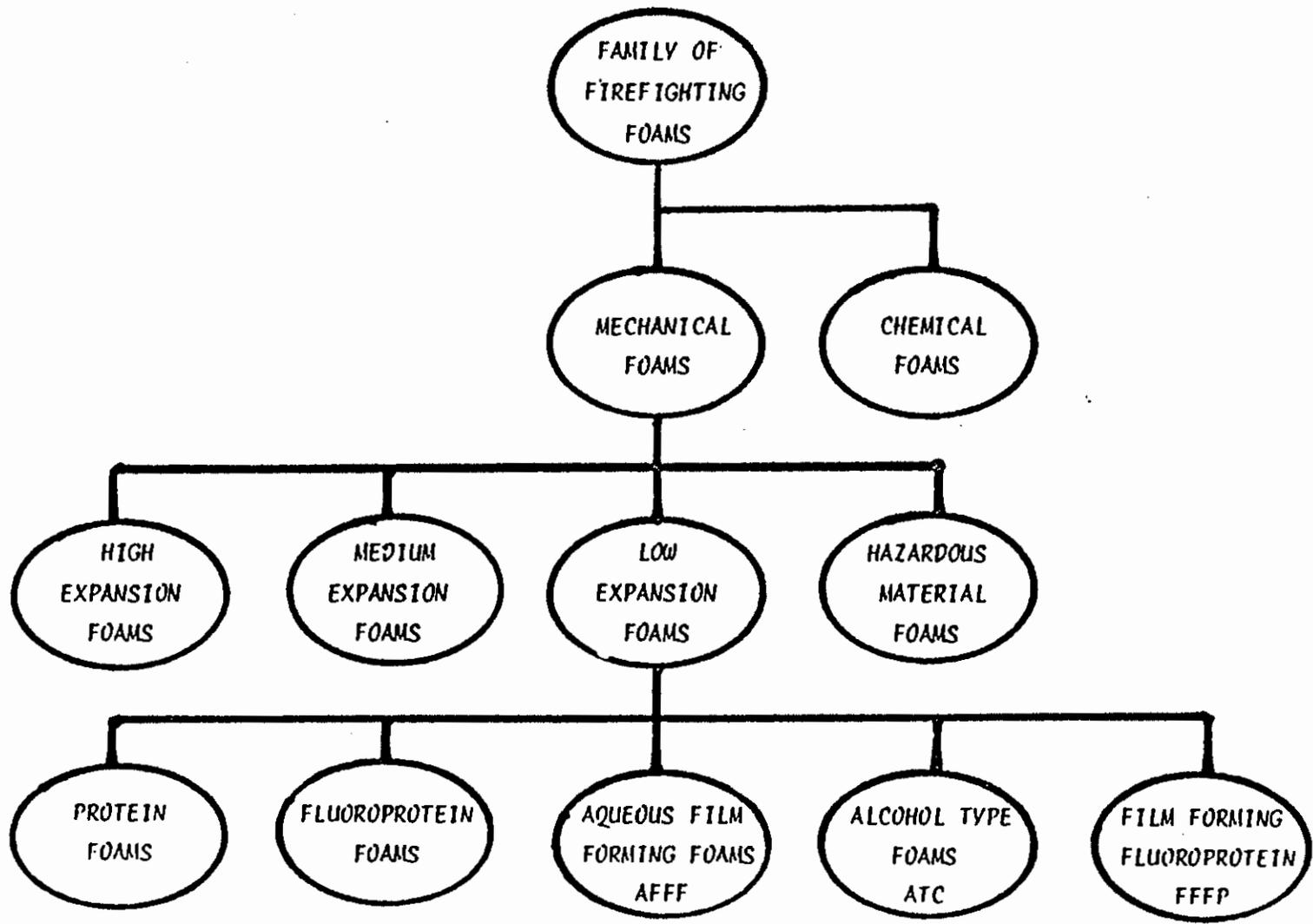


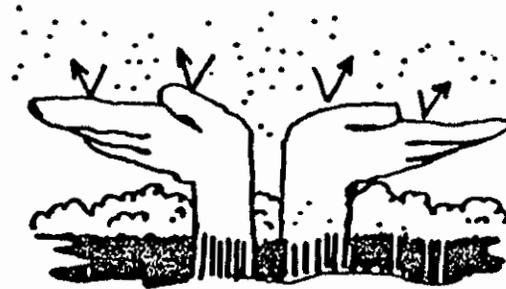
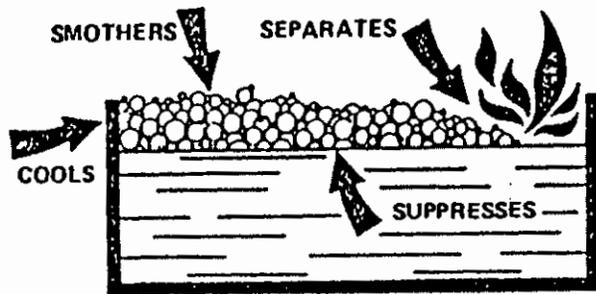
- \* Note: Since most organic liquid vapors are heavier than air, they settle to the ground in a spill and follow the lay of the land much the way water flows. So, ignition in a spill is more likely to occur closer to ground level.

Table 7.1. Flash Points and Flammable Limits of Some Common Liquids and Gases

LIQUID (OR GAS AT ORDINARY TEMPS.)	FLASH POINT		FLAMMABLE LIMITS (PERCENT BY VOLUME)
	°F	(°C)	
Acetylene		(Gas)	2.5 to 81.0*
Benzene	12	(-11)	1.3 to 7.1
Ether (ethyl ether)	-49	(-45)	1.9 to 36.0
Fuel oil			
(Domestic, No. 2)	100 (min.)	(38)	None at ordinary temps.
(Heavy, No. 5)	130 (min.)	(54)	None at ordinary temps.
Gasoline (high test)	-36	(-38)	1.4 to 7.4
Hydrogen		(Gas)	4.0 to 75.0
Jet Fuel (A & A-1)	110 to 150	(43 to 65)	None at ordinary temps.
Kerosine			
(Fuel oil, No. 1)	100 (min.)	(38)	0.7 to 5.0
LPG (propane-butane)		(Gas)	1.9 to 9.5
Lacquer solvent (butyl acet.)	72	(22)	1.7 to 7.6
Methane (natural gas)		(Gas)	5.0 to 15.0
Methyl alcohol	52	(11)	6.7 to 36.0
Turpentine	95	(35)	0.8-(undetermined)
Varsol (standard solv.)	110	(43)	0.7 to 5.0
Vegetable oil (cook, peanut)	540	(282)	(Ignition temp. = 833°F)







Exclude air from the flammable vapors

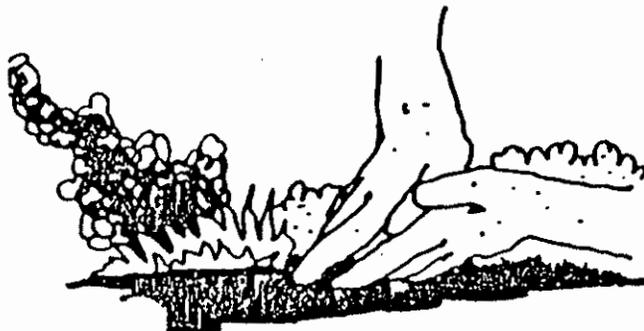


Eliminate vapor release from the fuel surface

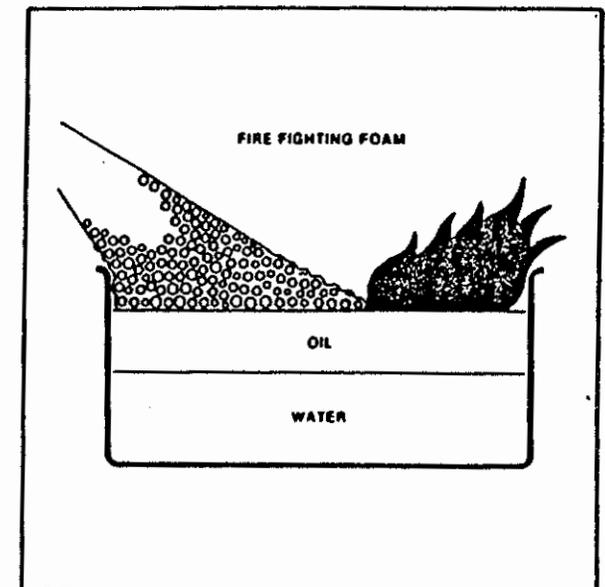
### HOW FOAM WORKS

**FIREFIGHTING FOAMS ARE FORMULATED IN SEVERAL WAYS FOR FIRE EXTINGUISHING ACTION. ALL FOAMS EXTINGUISH FIRE IN FOUR WAYS.**

- 1. SMOTHERING – PREVENTING AIR FROM MIXING WITH FLAMMABLE VAPORS.**
- 2. VAPOR SUPPRESSION – PREVENTING RELEASE OF FLAMMABLE VAPORS. FLAMMABLE LIQUIDS WITH HIGH RVP ARE DESTRUCTIVE TO REGULAR FOAMS.**
- 3. FLAME BARRIER – SEPARATION OF FLAMES FROM FUEL SURFACE.**
- 4. COOLING – REMOVING HEAT FROM FUEL SURFACE.**



Separate the flames from the fuel surface

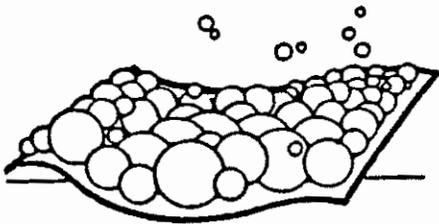




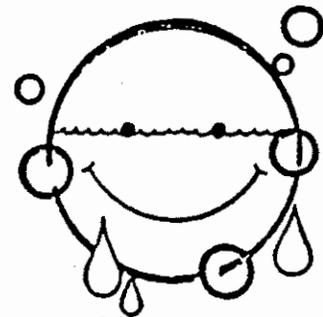
**Unignited Spills.** Where flammable liquids have spilled, fires can be prevented by prompt coverage of the spill with a foam blanket. Additional foam may be necessary from time to time to maintain the blanket for extended periods, until the spill has been cleaned up.



**Resists the product**



**Produces a stable blanket**



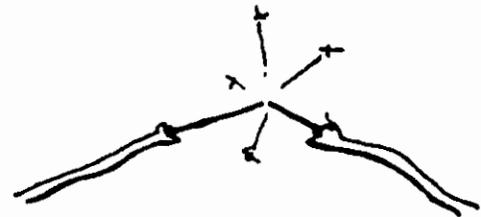
**Has slow drainage rate**

**Good  
Low  
Expansion  
Foam**

**{** Vapor-tight blanket  
High adhesion  
High water retention  
Tiny, tough bubbles  
High heat resistance

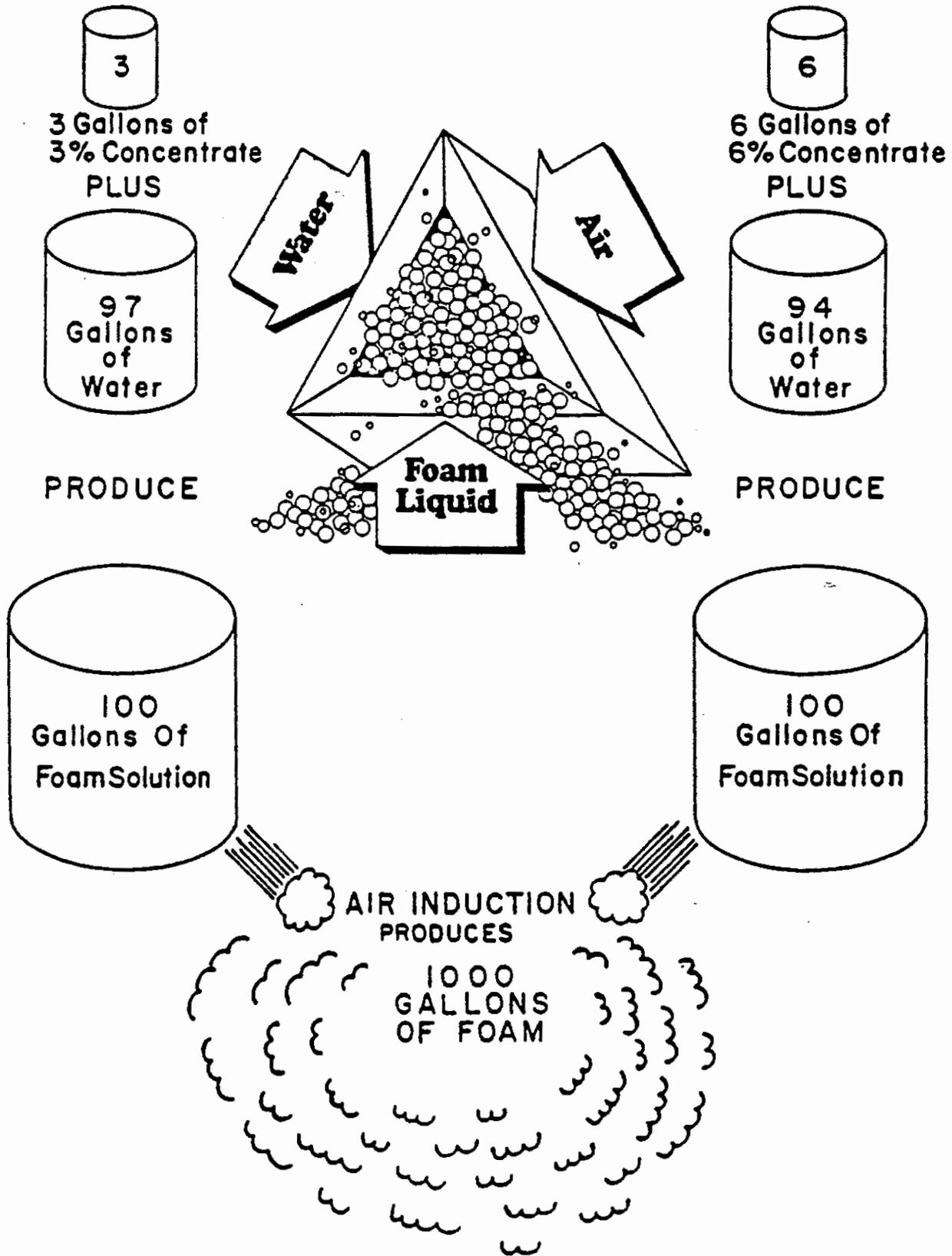


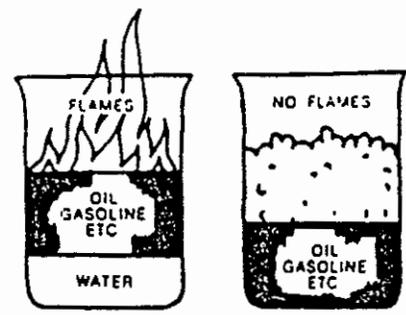
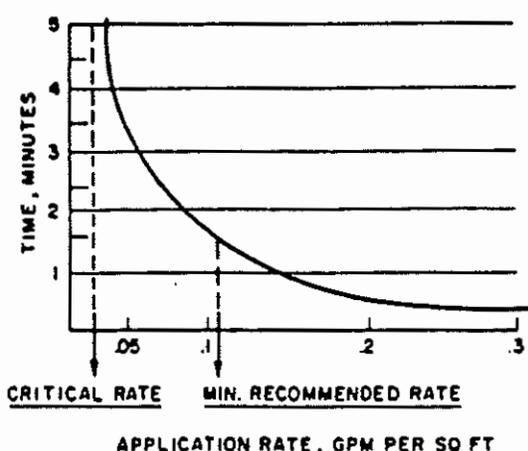
**Vaporized Liquids.** Foam is not recommended for use on materials which may be stored as liquids, but are normally vapor at ambient conditions, such as propane, butadiene, and vinylchloride. Foam is not recommended for use on materials which react with water.



**Electrical Fires.** Foam should be considered nearly the same as water when used on electrical fires, and is, therefore, not generally recommended. If it is used, a spray rather than a straight stream is safer; however, because foam is cohesive, even a dispersed (spray) foam stream is more conductive than a water fog.

5 gallons of 6% will produce 800gal. + foam solution  
5 gallons of 3% will produce 1600gal. foam solution



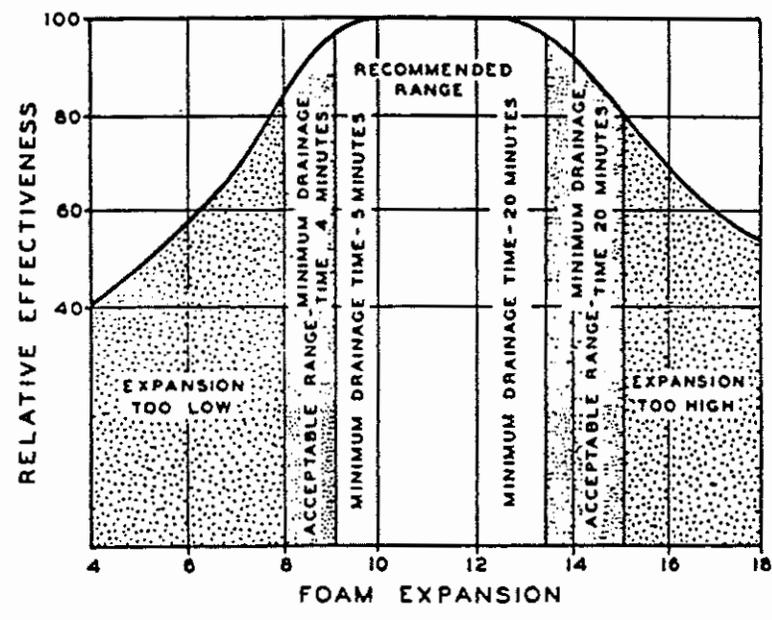


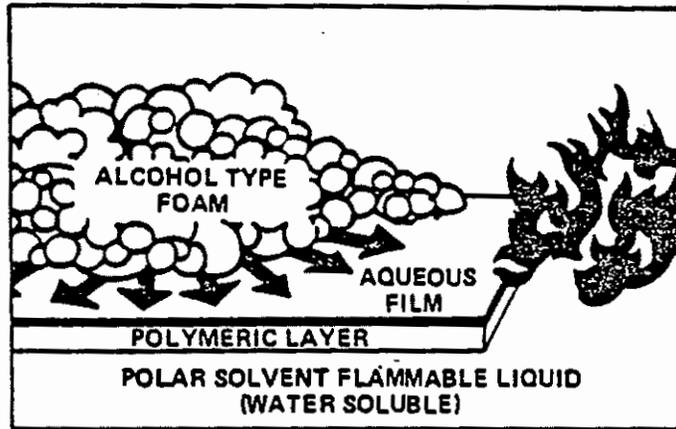
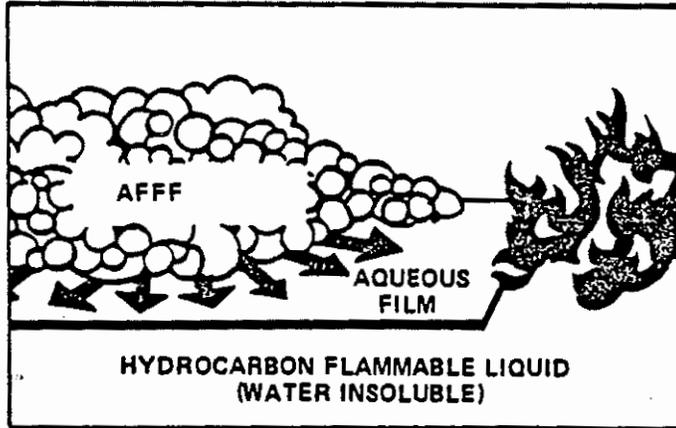
Water is heavier than non miscible flammable liquids, sinks to bottom. Foam floats on flammable liquids, smothers flames.

Fig. 18-4A. General relationship of foam application rate to time of application necessary for extinction.

The foam industry has developed a wide variety of foam concentrates to meet specific requirements. The following generalizations for use of low-expansion foams, however, set the application boundaries:

- The hazard must be a liquid.
- The hazard must be below its boiling point at the ambient condition of pressure and temperature.
- Care must be taken if the bulk temperature of the liquid is higher than 100°C.
- The hazard must not be unduly destructive to the foam selected.
- The hazard must not be water-reactive.
- The fire must be a surface fire. Three-dimensional fires cannot be extinguished by foam unless the hazard has a relatively high flashpoint and can be cooled by the water in the foam.
- The quantity of foam applied and rate of application must be matched to the size, fuel and character of the fire. See Fig. 21.1.



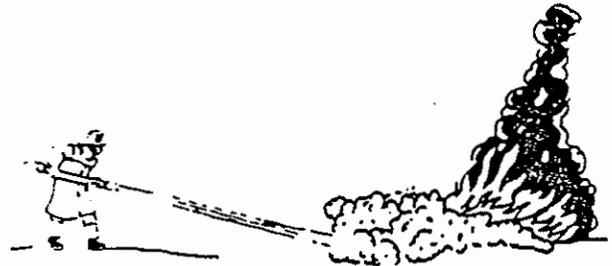


## Application Techniques



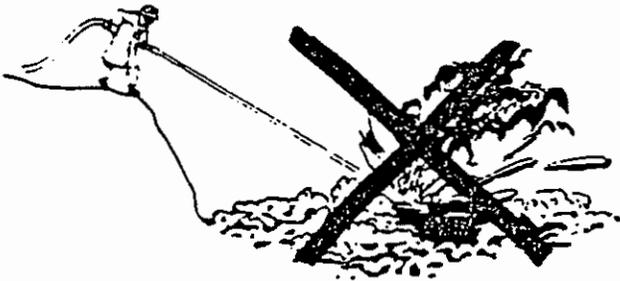
Banking foam off wall.

When foam nozzles are used, particular care should be taken to apply the foam as gently as possible. For straight stream use, the foam should be banked off the side of a wall or other obstruction. Foam can also be rolled onto the surface by hitting the ground in front of the spill.

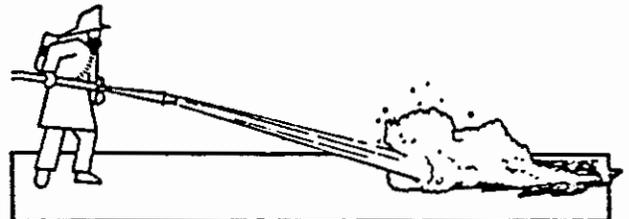
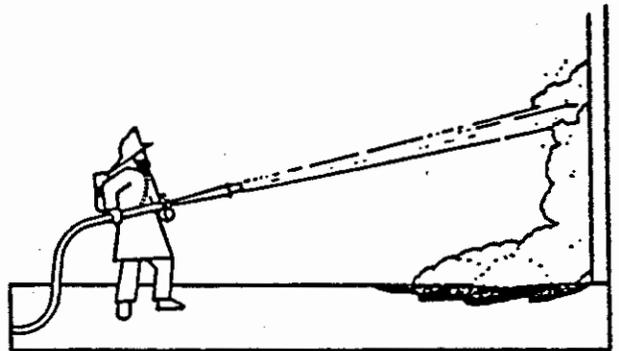


Striking ground in front of fire.

If the foam nozzle is equipped with a spray stream attachment, it should be used to provide the most gentle application possible and reduce the mixing of foam and fuel. Only as a last resort should a straight stream be directed into the center of a pool or spill. Under this condition, the efficiency of the foam will be only  $\frac{1}{3}$  or less than when applied by the recommended methods.



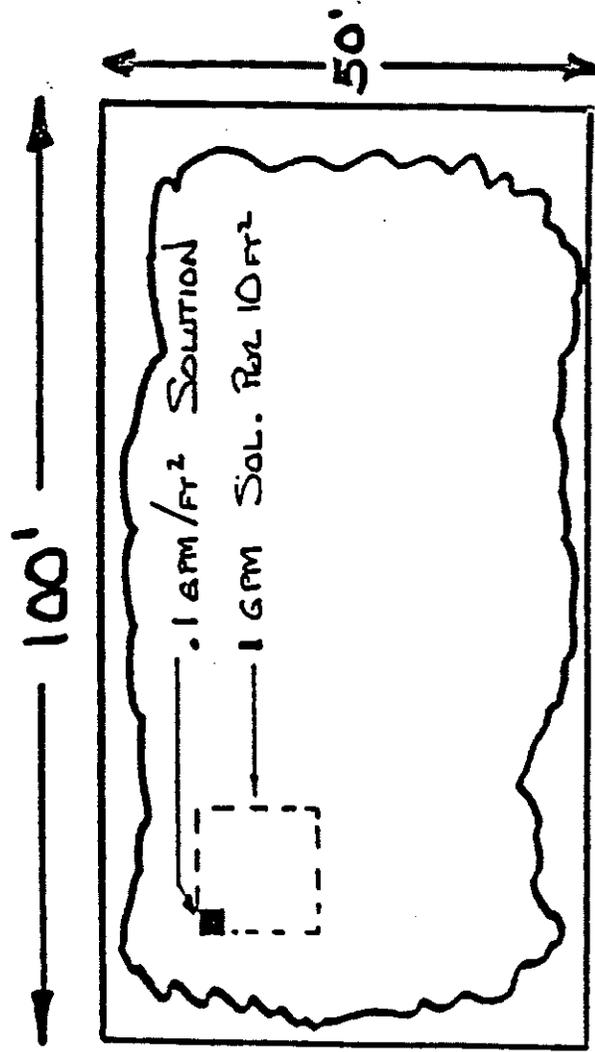
Do not use water streams in such a way as to physically disrupt a foam blanket. Water streams may be used for cooling adjacent areas or as a fine spray to reduce flame radiant heat.



Foam can be effectively applied by banking it off a wall or by discharging it onto the ground in front of the spill and rolling it gently onto the spill.

# APPLICATION REQUIREMENTS

SPILL FIRES



$$50 \times 100 = 5000 \text{ FT}^2 \times .1 = 500 \text{ GPM (SOLUTION)}$$

$$\frac{5000 \text{ FT}^2}{10} = 500 \text{ GPM (SOLUTION)}$$

### Basic Component Summary

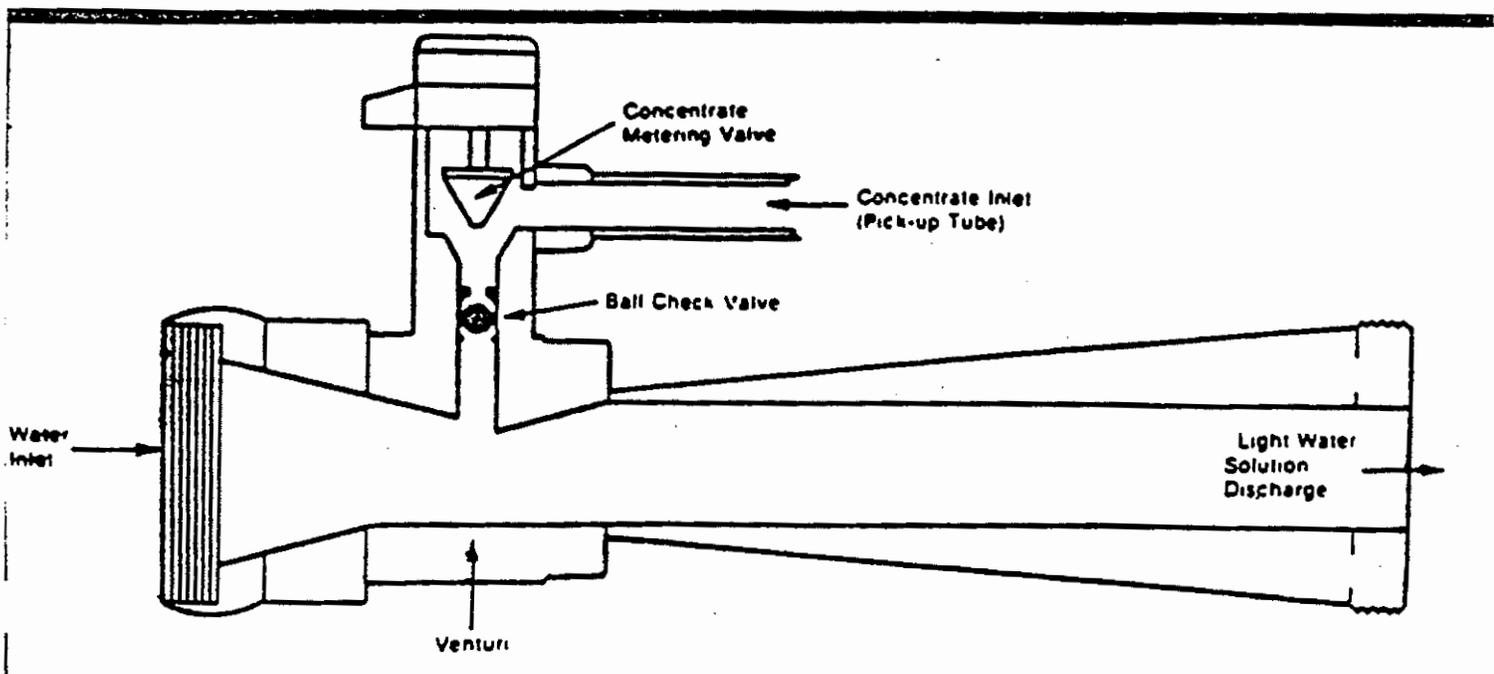
Hazard	Water Supply	Concentrate Supply	Proportioning Device	Foam Generating Device
Fuel Spill Areas	Drafting Pond	Premix	Premix	Water Nozzle (Long Range)
Storage Tanks	Fire Water Loop (Municipal)	5 Gallon Pail	Positive Displacement Pump	Fog/S.S. Nozzle
Process Areas		55 Gallon Drum	Orifice Plate	Foam Nozzle
Warehouses	Fire Water Loop with Pump (Municipal)	Bulk Trailer	Eductor	Monitor Nozzle
Airports		Storage Tank	Around the Pump	Manual
Truck Loading Racks	Fire Water Tank with Pump (Private)	Diaphragm (Bladder) Tank	Balanced Pressure Systems with Pump	Automatic
Military Installations			Orifice Pairs	Foam Chamber
Shipping Dock	Fire Water Pumper Truck		Dual Rotometer	Forcing Foam Maker
Offshore Platforms			Concentrate Controller	Sprinkler Heads
Heliports	Premix		Balanced Pressure System with Diaphragm	Staxlard (Open or Closed)
Rail Car Loading/ Unloading Facilities			Total Bladder	Foam/Water
Hangars			Split Tank Diaphragm	Spray Nozzle
Etc.				

# FOAM PROPORTIONING

CONCENTRATE MIXED WITH WATER AT MFR'S RECOMMENDATIONS

FOAM CONCENTRATE %	+	WATER %	=	100% <u>SOLUTION</u>
6% (PARTS)	+	94% PARTS	=	100%
3% "	+	97% "	=	100%
1% "	+	99% "	=	100%

"LINE PROPORTIONER"  
"IN-LINE EDUCTOR"  
"EJECTOR"

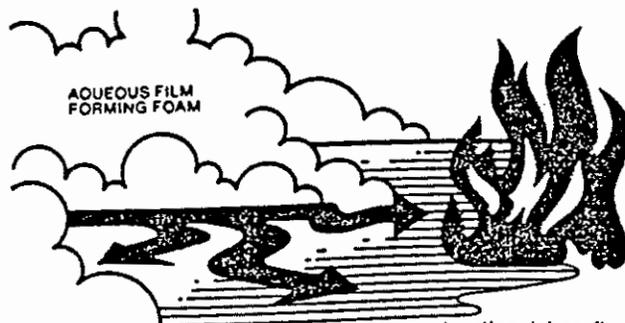
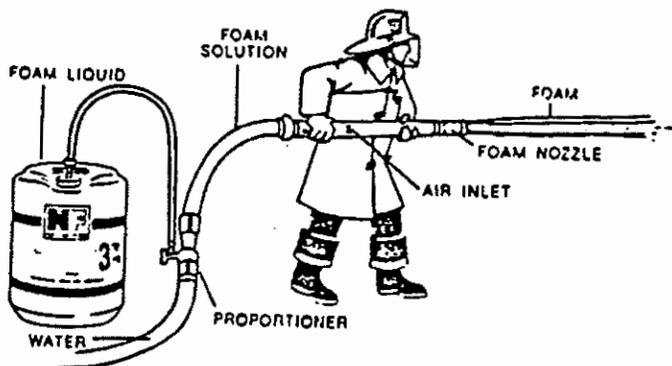
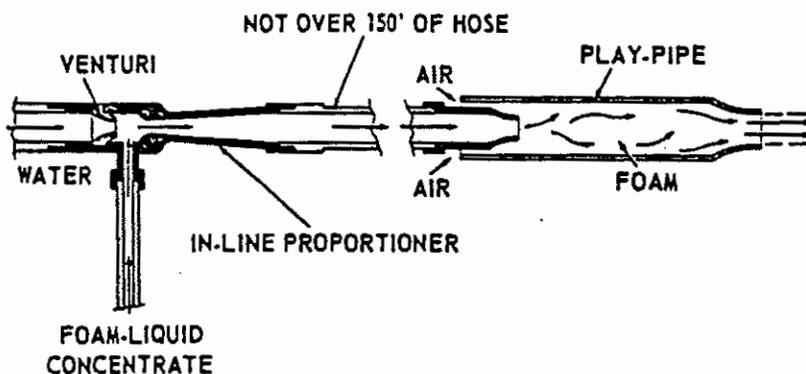


In-Line Eductor Cutaway Drawing

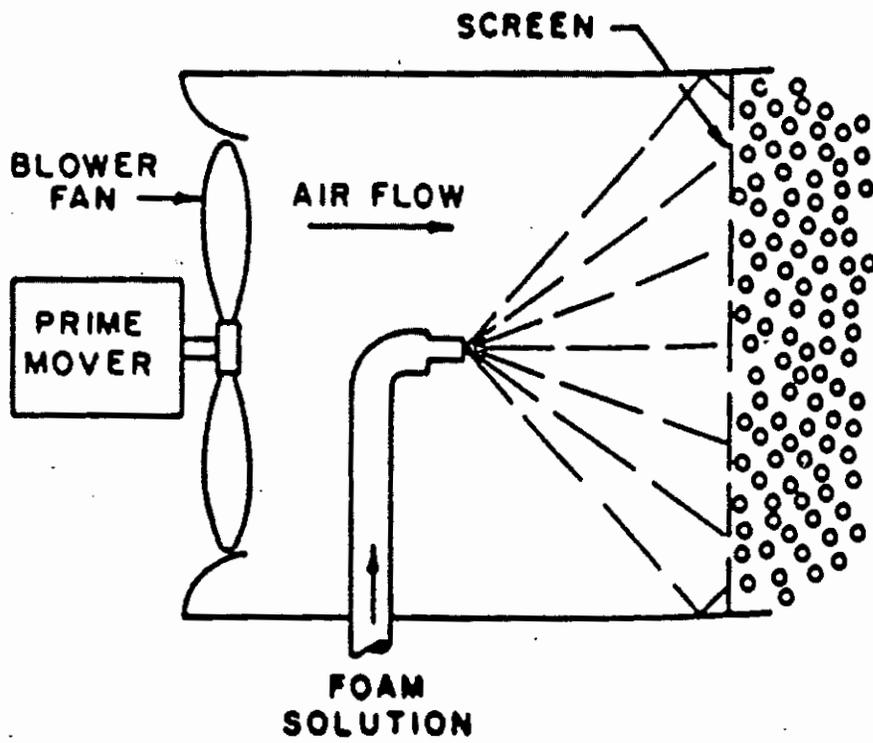
HOW COME I DIDN'T GET ANY FOAM AND WHY DIDN'T THE FIRE GO OUT ?

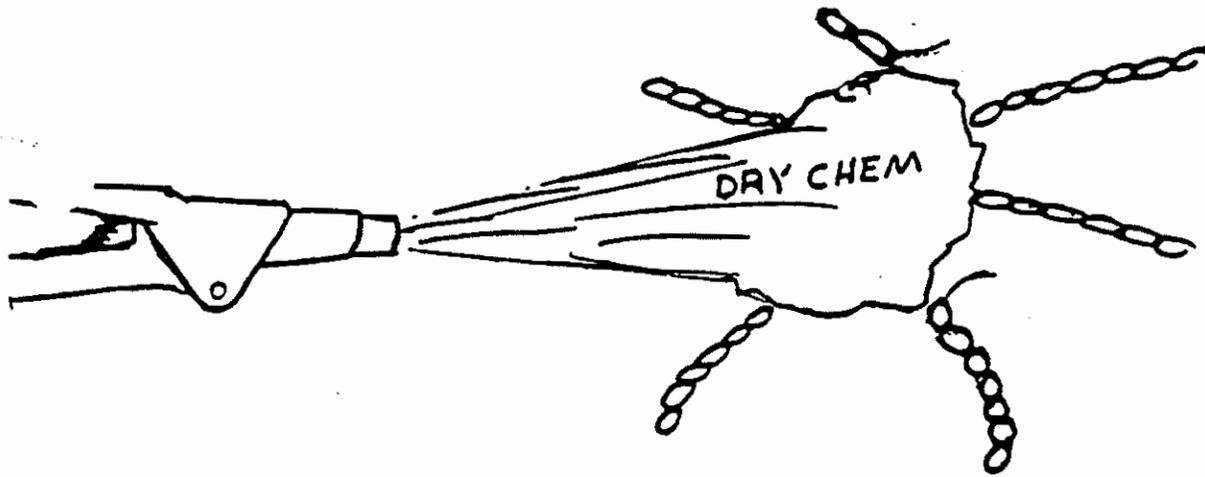
SOME OF THE FOLLOWING WILL HELP TO EXPLAIN THE ABOVE:

1. NOZZLE AND EDUCTOR DIFFERENT GALLONAGE.
2. HOSE LINE KINKED
3. WRONG FOAM USED
4. HYDRAULICS INCORRECT
5. CHECK VALVE STUCK
6. METERING VALVE PLUGGED
7. APPLICATION RATES INCORRECT
8. CONCENTRATE OUTDATED
9. NOZZLE PARTIALLY CLOSED



Aqueous film spreads across surface and extinguishes fire.





## THE CHAIN BREAKER

TWO TYPES USED IN REFINERY ARE PURPLE K AND PLUS 50

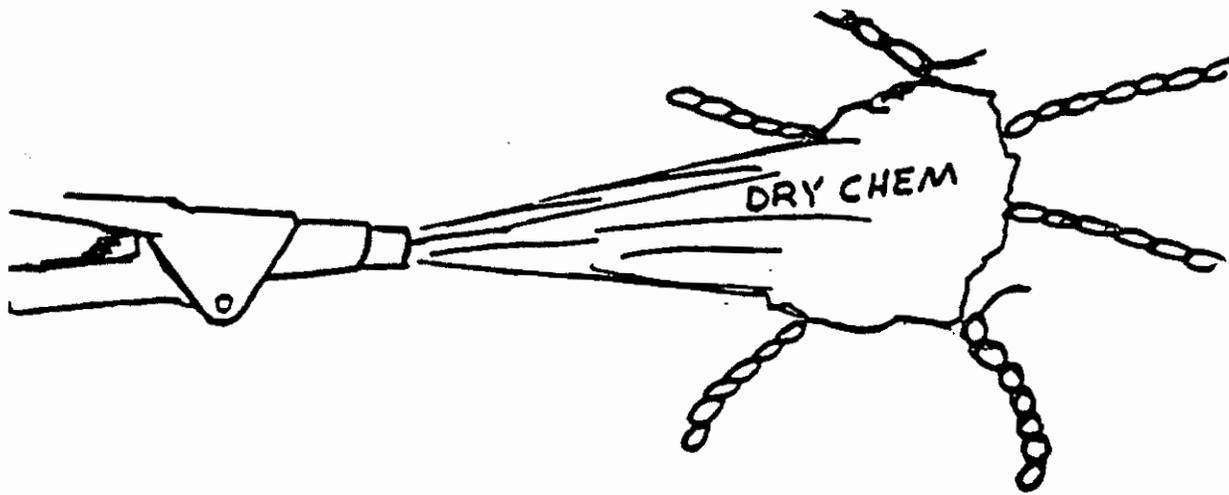
PURPLE K INTERACTS QUICKER WITH THE COMBUSTIBLE CHAIN

ADVANTAGES OF DRY CHEM ARE:

1. QUICK KNOCK DOWN
2. INTERRUPTS COMBUSTION CHAIN
3. HAS AN INDEFINITE SHELF LIFE
4. SUPPRESSES A, B AND C CLASS FIRES
5. CAN BE MADE TO BE COMPATIBLE WITH FOAM
6. CAN BE USED IN CONJUNCTION WITH FOG STREAMS

DISADVANTAGES OF DRY CHEM ARE:

1. HAS NO COOLING EFFECT
2. LIMITED RANGE, LIMITED AMOUNT OF AGENT
3. HAS TENDENCY TO PACK OVER LONG PERIODS OF TIME  
(REQUIRES ANNUAL INSPECTION)
4. DOES NOT SUPPRESS VAPORS (SUBJECT TO REFLASH)
5. UNLESS SILICONES ARE ADDED, CHEMICAL CAN DESTROY FOAM  
BLANKETS



## THE CHAIN BREAKER

### CORRECT PROCEDURE:

1. APPLY AGENT APPROXIMATELY 8 FT. AWAY AND 6 IN. IN FRONT OF THE BASE OF THE FIRE.
2. APPROACH WITH THE WIND AT YOUR BACK IF POSSIBLE.
3. WHEN APPLYING DRY CHEMICAL, USE A SIDE-TO-SIDE MOTION AND CONTINUE TO PUSH THE FIRE BACK UNTIL IT IS EXTINGUISHED.
4. BACK OUT OF THE AREA.
5. LAY EXTINGUISHER ON ITS SIDE WHEN FINISHED. THIS WILL SHOW THAT IT HAS BEEN USED.

### NEVER DO THE FOLLOWING:

1. WALK INTO THE EXTINGUISHED AREA FOR FEAR OF REFLASH.
2. AIM NOZZLE AT THE BASE OF THE FLAMES. NOZZLE IS DESIGNED TO SHOOT POWDER DOWNWARD.
3. TURN YOUR BACK ON THE EXTINGUISHED FIRE.
4. APPLY DIRECTLY INTO THE LIQUID. THIS WILL ONLY AGITATE FLAMES.
5. RETURN A USED EXTINGUISHER TO ITS STATION WITHOUT SERVICING IT, NO MATTER HOW LITTLE POWDER YOU HAVE USED.

(Flammable Gas Pressure Fire)

1. Caution. Flammable gas pressure fires should not be extinguished unless the fuel supply can be isolated.
2. Approach the fire from the upwind side. Direct the dry chemical stream at the fuel source. (Fig. 1)
3. Move the dry chemical up the stream of escaping gas. (Fig. 2) Continue moving the dry chemical stream upwind until the fire ball is extinguished. (Fig. 3)

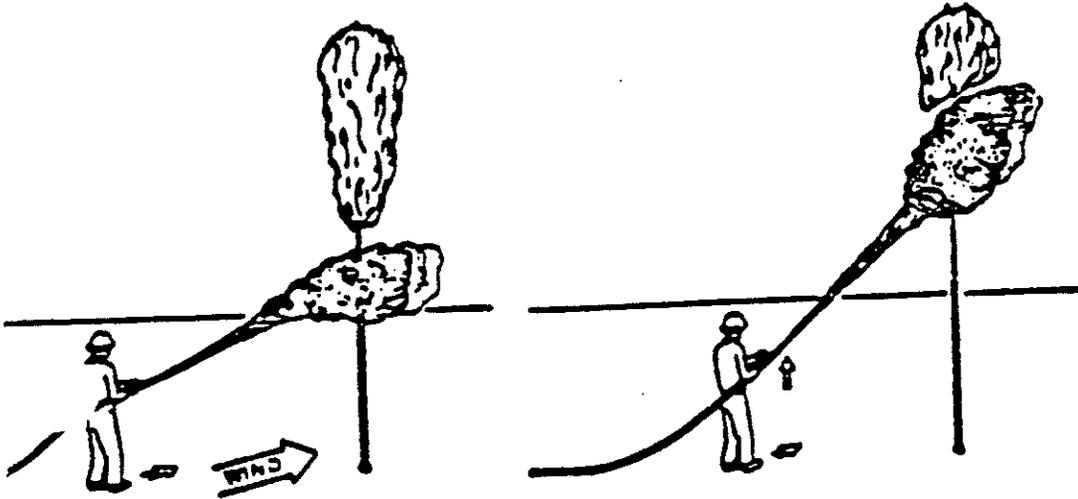


Fig. 1

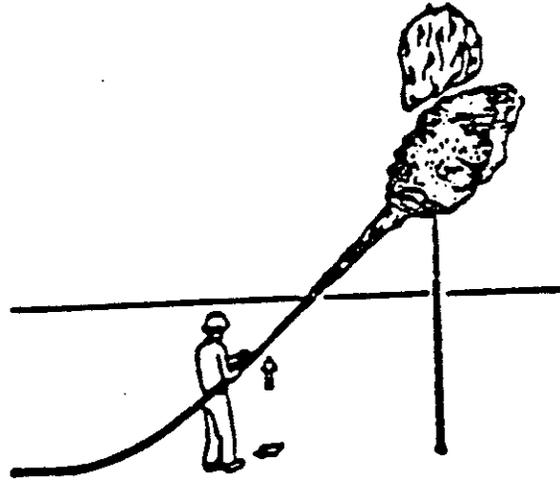


Fig. 2

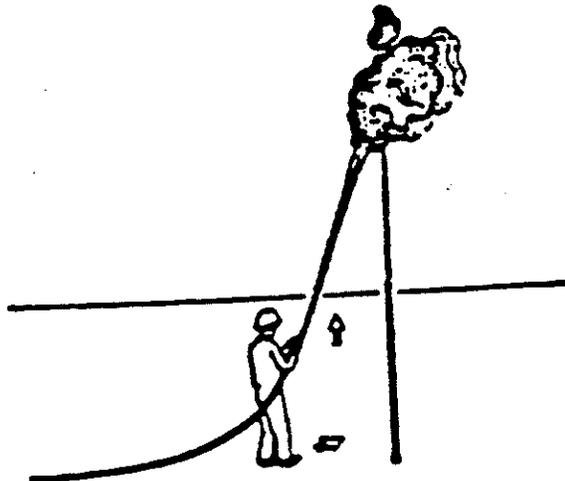


Fig. 3

**Flammable Liquid Pressure Fire**

1. Approach the fire from the upwind side. Direct the dry chemical stream at the fuel source. (Fig. 1)
2. Move the dry chemical down the stream of escaping fuel. Extinguish the remaining spill fire using a rapid side to side sweeping motion. (Fig. 2)

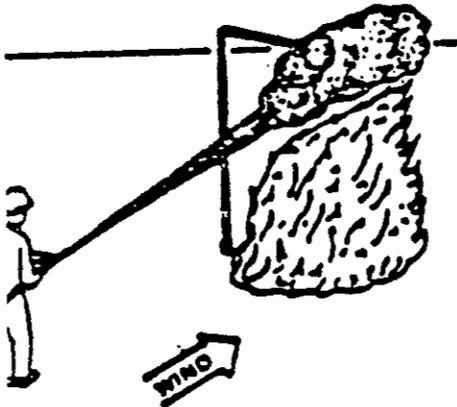


Fig. 1

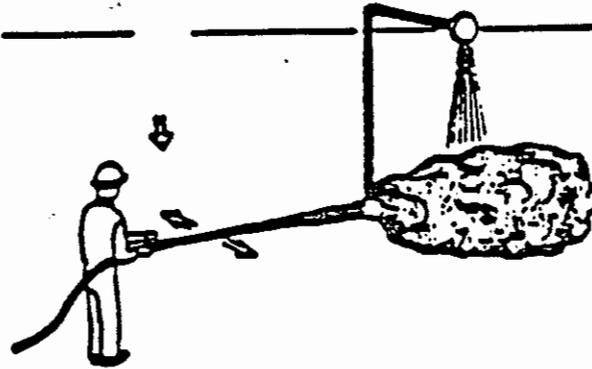


Fig. 2

3. Caution. It may not be desirable to extinguish this fire unless the fuel supply can be isolated. **Flammable Gas Pressure Fire**

## Gravity Fed Fire Using Dry Chemical

1. Gravity fed fires are often difficult to control because they are multi-dimensional fires. They are a spill fire with an elevated leak feeding the spill. This type of fire often requires a multiple extinguisher attack approach. (Fig. 1)
2. Approach the fire from the upwind side. Extinguish the flammable liquid spill first using a side to side sweeping motion (use your arm not your wrist). (Fig. 2)

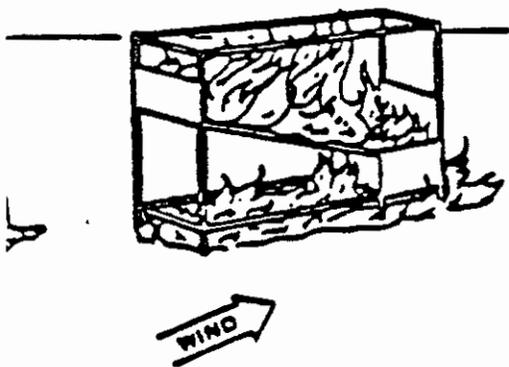


Fig. 1

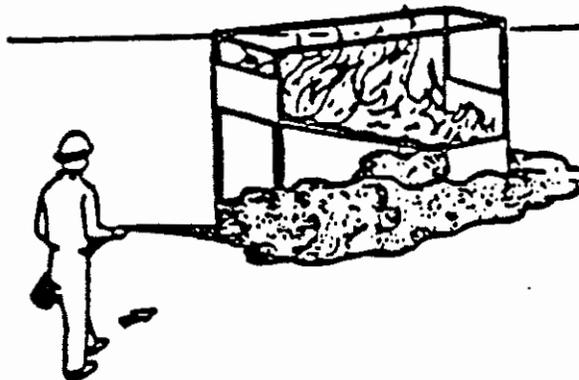


Fig. 2

3. The spill fire must be completely out before attacking the elevated fire. Raise the powder stream slowly up the path of the fire extinguishing the fire as you go. (Fig. 3) Push the fire towards the fuel source. Extinguish the fuel source last. (Fig. 4)
4. In all cases the fuel source should be quickly isolated to prevent a reflash of the fire.

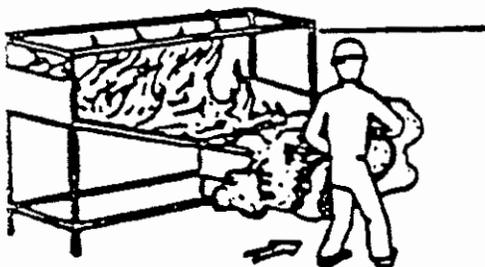


Fig. 3

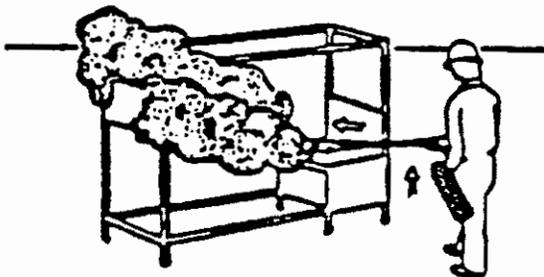


Fig. 4

*Nomenclature and Physical Properties of Selected Halons*

<i>Agent</i>	<i>Formula</i>	<i>Halon No.</i>	<i>Boiling point (° F)</i>	<i>Melting point (° F)</i>	<i>Specific gravity of liquid at 68° F</i>
Bromochloromethane	CH <sub>2</sub> BrCl	1011	151	-124	1.93
Dibromodifluoromethane	CBr <sub>2</sub> F <sub>2</sub>	1202	76	-223	2.28
1, 2- dibromotetrafluoroethane	CBrF <sub>2</sub>   CBrF <sub>2</sub>	2402	117	-167	2.17
Bromotrifluoromethane	CBrF <sub>3</sub>	1301	-72	-270	1.57
Dichlorodifluoromethane	CCl <sub>2</sub> F <sub>2</sub>	122	-22	-252	1.31
Bromochlorodifluoromethane	CBrClF <sub>2</sub>	1211	25	-257	1.83
1, 2-dichlorotetrafluoroethane	CClF <sub>2</sub>   CClF <sub>2</sub>	242	39	-137	1.44

**Development of Halon 1211 Design Concentrations  
for Flame Extinguishment  
In 77°F Air at 1 atm (25°C at 1 atm)**

**Concentration in Air in Volume Percent**

<b>Fuel</b>	<b>Average<sup>a</sup></b>	<b>Safety Factor</b>	<b>Total</b>	<b>Design<sup>***</sup></b>	<b>Ref<sup>**</sup></b>
Acetone	3.6	+ 0.7	= 4.3	5.0	(5) (6) (7)
Benzene	2.9	+ 0.6	= 3.5	5.0	(5) (6) (7)
Ethanol	4.2	+ 0.8	= 5.0	5.0	(5) (6) (7)
Ethylene	7.2	+ 1.4	= 8.6	8.6	(5) (6) (7)
Methane	3.5	+ 0.7	= 4.2	5.0	(5) (6) (7)
n-Heptane	4.1	+ 0.8	= 4.9	5.0	(5) (6) (7)
Propane	4.8	+ 1.0	= 5.8	5.8	(5) (6) (7)

**Halon 1301 Design Concentrations for Flame Extinguishment  
(In 25°C at 1 atm)**

<b>Fuel</b>	<b>Minimum Design Concentration, % by Volume</b>
Acetone	5.0
Benzene	5.0
Ethanol	5.0
Ethylene	8.2
Methane	5.0
n-Heptane	5.0
Propane	5.2

## Characteristics of Important Halogenated Agents

	AGENT		
	BROMO- CHLORO- METHANE	BROMO- CHLORO- DIFLUORO- METHANE	BROMO- TRIFLUORO- METHANE
Chemical formula	BrCH <sub>2</sub> Cl	BrCClF <sub>2</sub>	BrCF <sub>3</sub>
Halon no.	1011	1211	1301
UK name	CB	BCF	BTM
Type of agent	Liquid	Liquid Gas	Liquid Gas
Boiling point:			
°F	151.0	25.0	- 72.0
°C	66.0	- 4.0	- 58.0
Density	1.93	1.83	1.57
Efficiency:			
(Wt. required per unit B Rating)			
Lbs.	2.0	0.6	0.6
Kilo	0.85	0.25	0.25
Lethal concentration (ppm)			
Vapor	65,000	324,000	832,000
Fire decomp. vapor	4,000	7,650	14,000

### Permitted Exposure Times to Halon 1301 and Halon 1211

	Concentration Percent by Volume	Permitted Time of Exposure
Halon 1301	Up to 7	15 min
	7-10	1 min
	10-15	30 sec
	Above 15	Prevent exposure
Halon 1211	Up to 4	5 min
	4-5	1 min
	Above 5	Prevent exposure

### Decomposition Products of Halon 1211

Compound	A.L.C. for 15 Minute Exposure, ppm by Volume in Air	Dangerous Con- centration, ppm by Volume in Air
Hydrogen Bromide (HBr)	4750	—
Hydrogen Chloride (HCl)	4750	1000 - 2000
Hydrogen Fluoride (HF)	2500	50 - 250
Bromine (Br <sub>2</sub> )	550	50**
Chlorine (Cl <sub>2</sub> )	350	50
Fluorine (F <sub>2</sub> )	375	—
Carbonyl Bromide (COBr <sub>2</sub> )	100 - 150***	—
Carbonyl Chloride (COCl <sub>2</sub> )	100 - 150	50
Carbonyl Flu. ride (COF <sub>2</sub> )	1500	—

	<u>1301</u>	<u>1211</u>	<u>2402</u>
B.P. (°F)	-72	25	117
V.P. (@ 70° F)	199 psig	20.5 psig	11.4 in. Hg
Density (lb./ft <sup>3</sup> )	98	144	140
Toxicity	Least	in between	Most

	<u>1301</u>	<u>1211</u>	<u>2402</u>
Approximate lethal concentration	83%	32%	13%
Maximum acceptable concentration for human exposure	10%	4%	.5%

Minimum Carbon Dioxide Concentrations for Extinguishment

Material	Theoretical Min. CO <sub>2</sub> Concentration (%)	Minimum Design CO <sub>2</sub> Concentration (%)
Acetylene	55	66
Acetone	27*	34
Aviation Gas Grades 115/145	30	36
Benzol. Benzene	31	37
Butadiene	34	41
Butane	28	34
Butane - 1	31	37
Carbon Disulfide	60	72
Carbon Monoxide	53	64
Coal or Natural Gas	31*	37
Cyclopropane	31	37
Diethyl Ether	33	40
Dimethyl Ether	33	40
Dowtherm	38*	46
Ethane	33	40
Ethyl Alcohol	36	43
Ethyl Ether	38*	46
Ethylene	41	49
Ethylene Dichloride	21	34
Ethylene Oxide	44	53
Gasoline	28	34
Hexane	29	35
Higher Paraffin Hydrocarbons C <sub>n</sub> H <sub>2n</sub> + 2m - 5	28	34
Hydrogen	62	75
Hydrogen Sulfide	30	36
Isobutane	30*	36
Isobutylene	26	34
Isobutyl Formate	26	34
JP-4	30	36
Kerosene	28	34
Methane	25	34
Methyl Acetate	29	35
Methyl Alcohol	33	40
Methyl Butene - 1	30	36
Methyl Ethyl Ketone	33	40
Methyl Formate	32	39
Pentane	29	35
Propane	30	36
Propylene	30	36
Quench. Lube Oils	28	34

**Maximum Effectiveness of Underwriters' Laboratories Listed Extinguishers\*\* for Class B Fires (Weights and Volume**

Denote Nominal Charge)

Underwriters' Laboratories Class B Ratings	Sodium Bicarbonate Base <sup>a</sup> (lb)	Multi-purpose <sup>a</sup> (lb)	Potassium Chloride <sup>a</sup> (lb)	Potassium Bicarbonate <sup>a</sup> (lb)	Urea-Potassium Bicarbonate <sup>a</sup> (lb)	Carbon Dioxide <sup>a</sup> (lb)	Halon 1301 <sup>a</sup> (lb)	Halon 1211 <sup>a,b</sup> (lb)	AFFF Foam <sup>a</sup> (lb (gal))	Loaded Stream <sup>a</sup> (lb (gal))
1-B										28.7 (2½)
2-B	1	1					2½			
5-B	2					5		2½		
10-B	2½	2½	2½	2½		10		5		
20-B		5½ <sup>a</sup>	6	4½		50			20.8 (2½)	
30-B	5½			5½						
40-B	6	6 <sup>a</sup>	9½			100		13		
60-B	10	8 <sup>a</sup>	12	6						
80-B		18 <sup>a</sup>	22	10	9			17		
120-B	20	30 <sup>a</sup>		20	17					
160-B			135		23				275 (33)	
240-B	150	125 <sup>a</sup>								
320-B	350	300 <sup>a</sup>		125						
480-B					175					
640-B				300						

\*Also listed as suitable for Class C fires.

\*\*Also listed as suitable for Class A fires.

**Approximate Relative Extinguishing Effectiveness of Underwriters' Laboratories Listed Extinguishers on Class B Fires (Basis: Comparative weights of extinguishing agents for equal class B rating)**

Agent	Relative Effectiveness
Urea-potassium bicarbonate-base	100
Potassium bicarbonate-base	91
Multipurpose	75
Sodium bicarbonate-base	57
Potassium chloride-base	55
Halon 1211	53
Halon 1301	26
Carbon dioxide	21
AFFF	7

- Legend
- Satisfactory
  - Limited
  - Not General (Depends upon Composition and Fuel)
  - ] Unsatisfactory

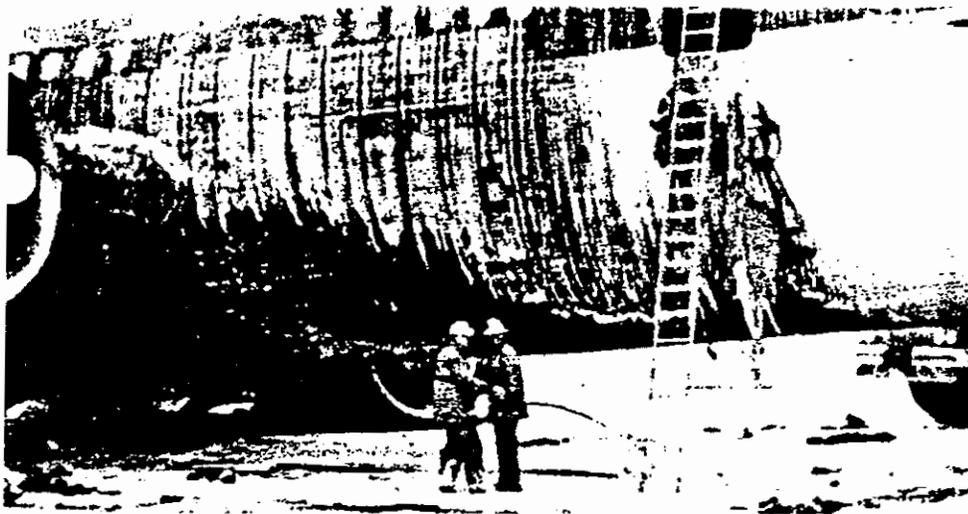
Generalized Description of Fire Extinguishing Agent  
Exclusive of Additives for Specified Physical and Chemical Properties

Classification	Classification				Method of Fire Extinguishment				
	A	B		C	D	Covering of or Coating of Fuel (Fuel Shutoff)	"Cooling" (Reduction of Heat)	"Blanketing" (Reduction of Air)	Inhibition of Flame Chain Reactions
Surface Fires Solid Mat'ls	Liquid Flammable Fuels		Elect. Hazards	Metallic Fires					
	Non-water Soluble	Water Soluble							

											Remarks		
Gases	1	Nitrogen, Argon, Etc.	□	●	●	●	□			✓		Seldom used	
	2	Carbon Dioxide	□	●	●	●	□		✓	✓			
	* 3	Halogenated Hydrocarbon	□	●	●	●	□				✓		
Liquids	* 4	Halogenated Hydrocarbon	○	●	●	●	□				✓		
	Aqueous Modified	5	Water (Solid Stream)	●	□	□	□	□		✓			
		6	Water (Spray or Fog)	●	●	●	●	○		✓	✓		
		7	Water + Detergent	●	■	■	□	□	✓	✓			
		8	Water + Thickening Agent	●	□	□	□	□	✓	✓			
		9	Water Slurry	●	□	□	□	□	✓	✓			
		10	Water + Alkaline Salt	●	■	■	□	□	✓	✓			"Loaded Stream," Fire Retardant
		11	Foam (Protein or Deter. Base)	●	●	□	□	□	✓				Both Chemical & Air Foam
		12	Foam (Protein & Insol. Soap Base)	●	○	●	□	□	✓				
		* 13	Synthetic Fluids	●	□	□	●	●	✓				
Solids		Alkali	14	Sodium Bicarbonate Base Powder	□	●	●	●	□		✓	✓	
	15		Potassium Bicarbonate Base Powder	□	●	●	●	□		✓	✓		Extra Effective Dry Chemical
	16		Potassium Carbamate Base Powder	□	●	●	●	□		✓	✓		Double Extra Effective Dry Chemical
	17		Neutral Potassium Chloride	□	●	●	●	□		✓	✓		Equally Effective with Comparison to #15
	18		Acidic Ammonium Phosphate Base Powder	●	●	●	●	■	✓	✓	✓		ABC or Multi-purpose Dry Chemical
	19		Granular Graphite or Salt	□	□	□	□	●	✓				

- Examples {
- 3—Methyl Bromide (CH<sub>2</sub> Br), Bromotrifluoromethane (CF<sub>3</sub> Br), Dibromodifluoromethane (CF<sub>2</sub> Br<sub>2</sub>)
  - 4—Carbon Tetrachloride (CCl<sub>4</sub>), Chlorobromomethane (CH<sub>2</sub> ClBr)
  - 9—Aqueous Suspension of Sodium and/or Calcium Borates
  - 13—Cyclic Boron compounds; high order Phosphate or Phthalate Esters

EXTINGUISHING CHARACTERISTICS OF FIRE EXTINGUISHING AGENTS



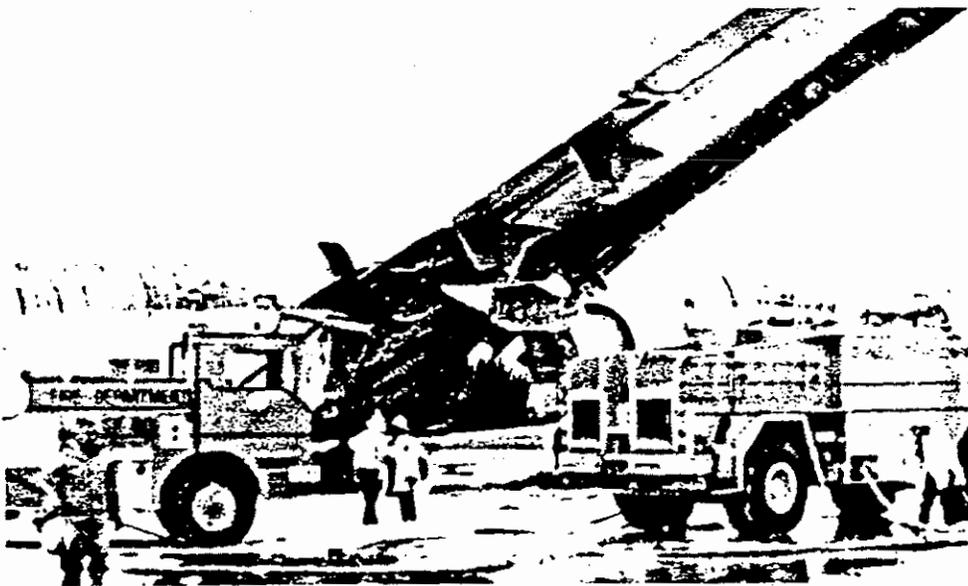
Drenched in foam that looks like a coating of ice, the huge plane lies still in the wake of catastrophe. Above, two firefighters complete some last tasks, and one of the huge crash rigs can be seen below the plane at right. Mute testimony to the horror is given by the charred yellow escape chute hanging burned and useless from the plane's doorway. Two red flags at left mark respectfully covered bodies of the only dead, further witness to the operation that saved 195 — perhaps to be chronicled as most nearly perfect crash rescue in airport history.

# 90 Seconds to Hell: Teamwork to Thwart Death

By Paul C. Ditzel

The incredible story of what really happened on Runway 6-Right in the heroic rescue of 195 out of 197 persons in the recent DC-10 airport crash . . .

In the aftermath of passenger rescue operations Los Angeles firefighters complete their search for unnoticed fire sources, re-pack their rigs and return to Airport Crash Station 80. Turret gun that spewed merciful, flame-quenching foam is still extended on the rig at left. Tilted to burned side, the plane points one wing skyward.



Airport Crash Firefighter Jim McJannet glanced out the window of his station near the edge of Los Angeles International Airport Runway 6-Right — and instantly knew the DC-10 was in trouble. He saw that at least one tire was disintegrating on the left landing gear as the Continental airliner flashed past on takeoff, with 197 people aboard.

McJannet grabbed the direct-connect telephone that automatically rang the other airport crash fire station nearby, and at the same time called for Tommy Kaiser, his crash rig driver. Kaiser ran to the airport crash firefighting wagon — a mammoth rig carrying water and foam concentrate — and started its two engines. McJannet quickly jumped in beside Kaiser, and the huge crash wagon swung out onto the rain-swept taxiway heading for the end of the runway — nearly a mile away — where thick clouds of ugly black smoke and flames were already erupting from the aircraft.

The crew of the DC-10 had been unable to successfully abort the takeoff, or even to slow the jet before it overshoot the runway. The thin asphalt covering beyond the runway could not support the heavy jet, and the left landing gear dug a long, deep groove through the asphalt and into the ground before it collapsed, causing the left wing to scrape. More than 10,000 gallons of kerosene fuel gushed from the ruptured wing tank and ignited almost instantly.

As the firefighters sped down the taxiway, McJannet radioed for more fire and rescue equipment, including paramedics. At about 400 feet from the blazing jet, Kaiser switched one of the crash rig's two propulsion engines to its automatic pumping mode. This gave McJannet control of the pump, the foam-throwing turret gun mounted on the roof, the front-bumper mounted groundsweep nozzles, and two showerhead-like nozzles under the rig.

Even as they came up on the aircraft McJannet triggered the turret gun, and a mixture of water and aqueous film forming foam (AFFF) gushed from the cannon at the rate of 750 gallons per minute.

Most passengers had evacuated the aircraft, many by polyester chute, but some of the chutes failed to completely inflate or were quickly melted by the intense

Dozens of passengers and many crew members who had either used the chutes, jumped, or slid down a rope from the flight crew's compartment were milling dazed and injured in the fire area or lying hurt on the ground.

Some passengers were aflame. McJannet doused their fires with foam and then, using a sweeping application of 750 gallons per minute foam discharge from the turret gun, swiftly swept the flames under the fuselage and away from the passengers and crew so as to open a fire-free path for them to escape.

#### Help Arrives

After no more than three to four minutes had passed, McJannet and Kaiser noticed additional streams arcing over the aircraft's fuselage as they were joined by more air crash firefighting rigs from the other airport crash station.

Soon these huge foam-carrying wagons were joined by conventional pumping engines and aerial ladder companies. Firefighters from some of these companies made rescues, while others used hose lines to enlarge the blanket of fire-smothering AFFF — and to supply water to the crash wagons in which the foam concentrate was proportioned, mixed with water, and pumped onto the fire and fuel spill.

Thanks to the diligence and training of the airport firefighters who had for years practiced and prepared for just such an emergency — and the effectiveness of the AFFF — the fire was out in minutes.

Only two of the 197 persons aboard were killed. † Of the 73 injured, casualties included only a few burn victims. Most injuries were caused by jumping from the plane or hitting the ground while going down the chute.

#### Remarkable Achievement

The news media made much of the miraculously low number of casualties. There was also high praise not only for the firefighters but for the

*†Investigators said the two who died probably would have survived had they heeded a stewardess who told them not to open an escape door on the flaming side of the wreckage. The elderly man and wife exited onto the wing and slipped or jumped into the smoke. They were asphyxiated.*

Shown below is a crash wagon turret gun in action, still spraying the life-saving foam that instantly quenched flames on burning passengers, preventing further injury from fire.



DC-10 crew — and especially the pilot, Captain Gene Hersche, who was making his final flight prior to retirement after a career of 32 accident-free years. Captain Hersche adroitly maneuvered the skidding aircraft to avoid structures on the field as well as a parking lot filled with automobiles.

To firefighting and security personnel, however, there was much more to the miracle of Runway 6-Right. They summed it up with two words: PRE-PLANNING and TRAINING — for emergencies.

Transcripts of reported radio and telephone conversations along with timings of these messages offer stark testimony to the value of preplanning for emergencies:

McJannet called in the first alarm at 9:23 that Wednesday morning, March 1, 1978. In just over 90 seconds his rig was showering a blanket of fire-smothering foam on the crashed aircraft. The other crash rigs were spouting more foam in four minutes after the initial alarm.

Over 10,000 gallons of blazing fuel was contained in one minute through the sweeping action of the turret nozzles, and firefighters manning handlines. The fire was completely extinguished in five minutes.

Further testimony to the effectiveness of preplanning and training was the fact that the entire incident was completed with only insignificant flaws that had no effect upon the outcome. This is all the more remarkable considering that not one of those involved had ever before been called upon to react to a major fire involving a huge jet with many passengers aboard. Although Los Angeles International Airport (LAX) is among the few busiest commercial fields in the United States, it had never lost a passenger in its 32-year history of operation.

#### New Considerations

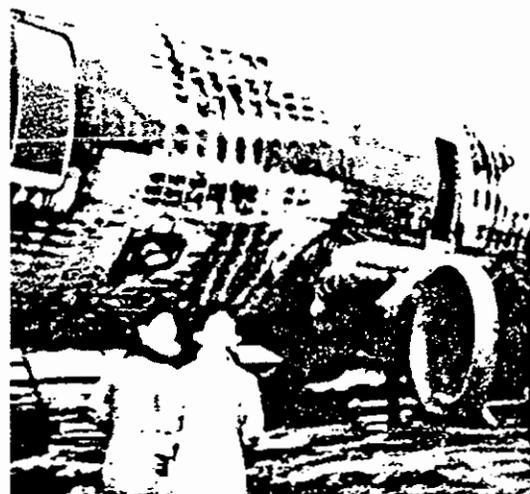
Airport authorities were in virtually unanimous agreement that there would have been no casualties if the escape doors had remained closed and the chutes had not been deployed. Opening the doors put passengers and crew in direct contact with heat, smoke, and toxic gases that swept into the passenger compartment. (Even at that, fire damage inside was minimal.)

Sliding down the chutes only put passengers and crew in worse peril as they came in contact with the fuel spill or dangerously close to the smoke and flames. But experts cautioned that neither the airline personnel nor the passengers should be faulted.

“It's totally unrealistic to expect passengers to remain aboard an aircraft

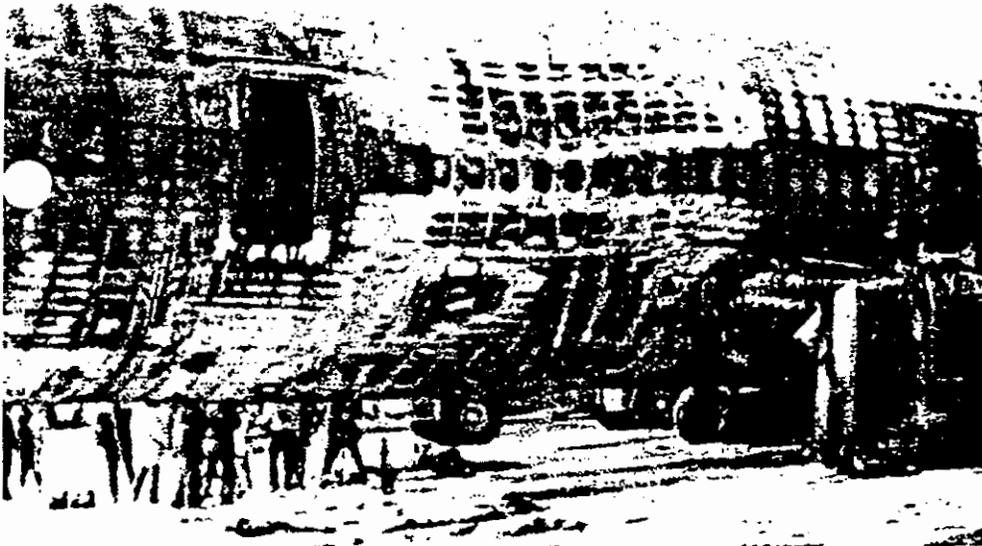


Above, a wing flap disengaged during the crash stands up off the ground some distance from the aircraft, while remainder of wing on the burned side of the DC-10 lies against the fuel-soaked earth, blanketed in foam. Below, a view of plane shows oddly contrasting door that was apparently open during intense part of fire and spontaneously closed after the flames were doused. This is particularly interesting because it illustrates the degree to which flames and intense heat are localized by structure of DC-10 and quick action of firefighters. ▼



Firefighter inside the aircraft stands amid crash-damaged ceiling and wall panels. Astonishingly little fire damage to the interior testifies, again, to the speed at which men and equipment reached the crash site and doused 2300° F fire, confining its damage to the left and outside of the aircraft. ▼





Burning fuel flooded over the ground from ruptured left wing tank and caused the plane to burn across its belly and up the right side. In photo above, taken from the plane's left side, we see an engine dropped from the burned wing, while under the belly of the plane, where shortly before was a sea of flaming fuel, rescue and assistance personnel waded through white foam that now gives the scene a snow-like appearance, as they carry out the emergent business at hand.

involved with fire and the terrifying clouds of thick black smoke that accompany flammable liquid fires," said one official with more than 20 years' experience as an air crash fire protection authority.

Whatever the case, the Los Angeles crash is expected to result in some rethinking of air crash procedures that involve opening of aircraft doors and deployment of today's non-fire-resistant escape chutes. Especially will this be true where there is a strong probability that passengers and crew will be sliding into a far deadlier predicament than if they remained aboard the aircraft with the doors closed.

The excellent structural integrity of today's jets also would seem to argue for rethinking of evacuation proce-

dures. Tests have shown that if the crash impact does not rupture the fuselage of a commercial jet, it will remain intact under most fire conditions for about 90 seconds. During this time, the temperature buildup inside the fuselage will approach a non-lethal 440°F. If the fuselage ruptures on impact or by 90 seconds of flame impingement, however, the interior temperature soars to a lethal 700°F.

As a result of these tests, the Federal Aviation Administration requires that aircraft in commercial use must have the capability of complete evacuation through only half the number of potential exits in a maximum of 90 seconds.

Arguing against the stay-aboard theory are at least three risky possibilities:

- (1) There might not be an alert airport crash firefighter like McJannet or somebody else close by to spot trouble and give the alarm before the crash.
- (2) There might not be an adequate AFFF-and-water-carrying air crash apparatus immediately available to answer the alarm, along with trained firefighters whose fulltime job it is to stand by for crash alert.
- (3) It is probably impractical to expect that air crash firefighting wagons can be at the crash site and in operation in 90 seconds or less.

#### The High Cost of Security

The essence of the security business is that you plan for the worst that may happen, then wait for it to happen. When it does not occur, it sometimes becomes difficult for security-responsible officers to justify the ongoing costs of everything from personnel to equipment.

Even at LAX, despite a safety record that no other major airport of similar size and activity could boast, preplanning and training is an ongoing program that is not without its high cost and resulting concern among responsible officials.

It is true, of course, that commercial airports have the benefit of federal funds to soften the high cost of protection. But nobody at LAX will argue against the fact that the high costs of security more than paid off that day.

The fire station nearest the crash, for example, is as modest in its amenities as it is possible to be. Yet the building cost \$110,000 to make it conform to OSHA noise requirements. The crash rig at the station, moreover, is today valued at \$246,000. Including the salaries of the crash firefighters assigned to the station, it is, of course, an expensive operation.

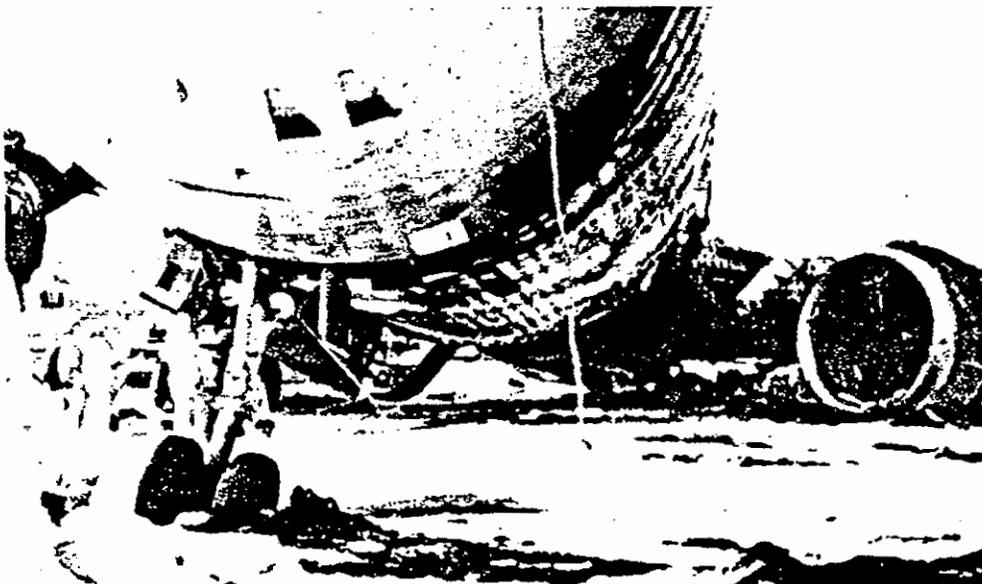
But all who were there that Wednesday morning agreed that the investment paid off with that one crash, and with the saving of perhaps 195 lives because administrators had the foresight to properly locate the crash station at its strategic site.

#### An Outstanding Example

The crash offers a textbook example for corporate and government officials as well as other personnel responsible for emergency procedures, security, and related services. Each organization went into action without delay and worked in tandem with others exactly as training and re-training prescribed and evidenced a thorough familiarity with emergency procedures manuals.

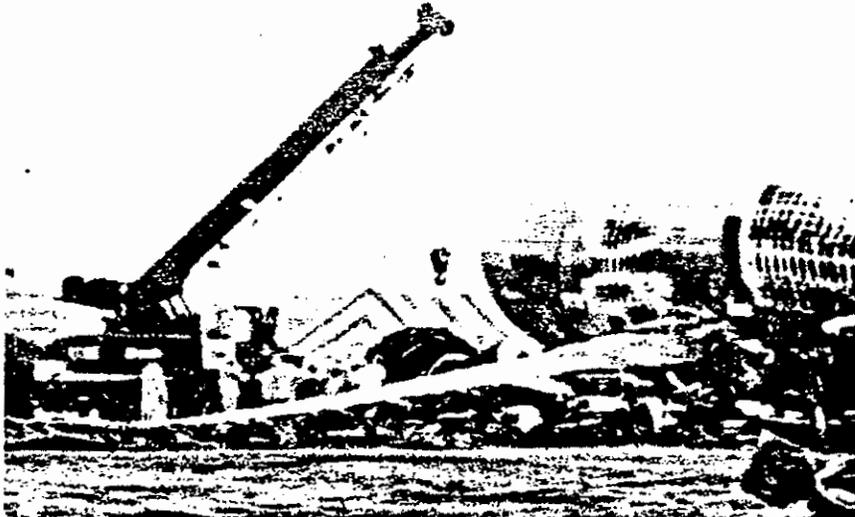
The experience of the various agencies involved at the Los Angeles crash can be adapted for installations other than airports because what happened at

Below, well forward of the fire area, we see a rope let down from the crew section that permitted a number of passengers to escape. Far left, the escape chute hanging unburned but useless, was speculated about as ripped by shoes someone had forgotten to remove or suffering other unforeseen calamity. At right is another escape chute, detached from its exitway and badly charred. The burned-out engine and left wing lie behind it.

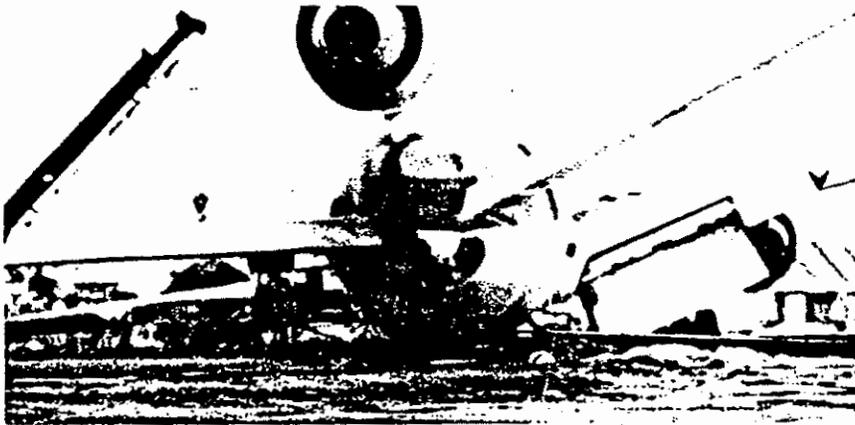




Being examined on the ground after it had been charred by fire and fallen away from the exit to which it was attached are remnants of escape chute, made of lightweight polyester material. Circular metal object, originally thought to be plane's recorder, turned out to be merely hardware debris. ▲



Above, giant crane is used in efforts to lift left wing and level the DC-10 so it can be moved into a hangar, off the field. Though badly charred after the rupture of its fuel tank, and having dropped one of its engines, the wing is still strong enough to be used by the crane to lever the entire plane into an even position. Below, a view from the plane's tail shows the same crane in action — as well as extreme tilt of the aircraft with right stabilizer at about 45° to the ground. Wooden towers were eventually built under the left wing of the plane so that it could be kept level and placed on trucks to be moved. ▼



Taken under the left wing of the aircraft after leveling, photo below gives a clear view of jet engine knocked loose from that wing during the crash and burned out by the intense heat from the 2300° F fuel fire. ▼



LAX could be fairly closely duplicated in a variety of industrial and commercial occupancies. For example:

#### Fire Protection

How quickly can your company's fire brigade or public fire department respond to an alarm in your facility? Do your personnel know the fastest way to not only give an alarm but to provide accurate information, under stress, about the location and type of problem? Is your fire equipment, and that of the public fire companies closest to you, adequate to make a quick, effective knockdown of a fire, however large?

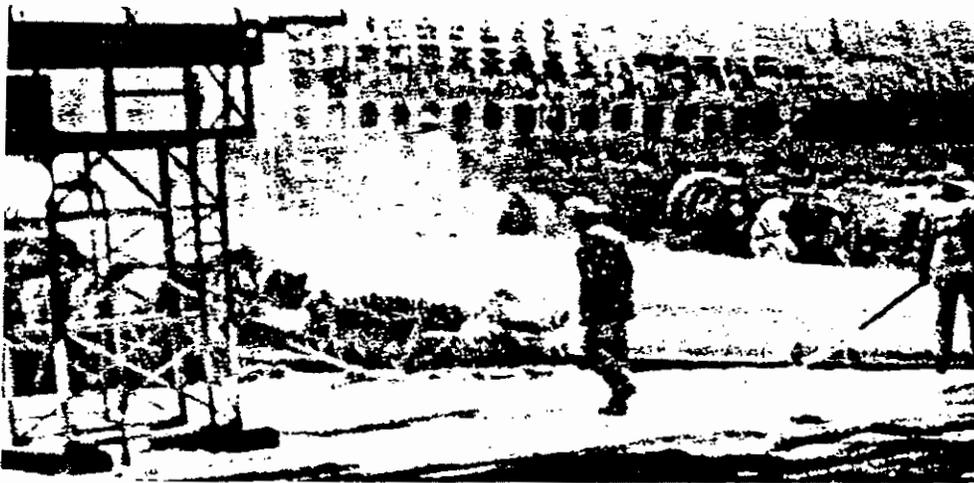
Do you have enough manpower in your brigade and is your community's apparatus adequately manned? Insufficient manning of apparatus is a growing problem among fire departments here and abroad. Is your fire brigade adequately trained and does it schedule regular practice sessions and critiques?

Let's examine the situation at LAX. There are two air crash firefighting stations, both strategically located adjacent to the four main runways. They are (by federal law) placed in such a manner that the maximum response time from the alarm to the first application of the extinguishing agent is no more than three minutes for the first crash wagon to arrive, four minutes for the second and 4½ minutes for all other firefighting and rescue vehicles.

There is a third fire station on LAX property — a conventional firehouse that includes a pumper, a hose-carrying wagon with an elevating platform, an aerial ladder company, and a rescue-ambulance. Close to the airport are additional firehouses with engine and ladder companies and a paramedic rescue unit. These paramedics arrived at the crash scene within two minutes.

Airport-based companies and those stationed nearby constantly train together for a variety of aircraft emergencies. All companies are adequately manned well above the national average. A recent survey showed many fire departments are operating with three firefighters or less on engine and ladder companies. Los Angeles operates with five men on the engines and six on the ladder companies. The air crash rigs also are adequately manned. In addition to routine training, monthly "hot drills" are scheduled. Discarded aircraft fuel and other flammable liquids provided by the airlines is ignited in a training area and the firefighters practice dousing the flames involving simulated aircraft with AFFF.

Airport fire protection is predicated upon fast attack with specially-designed apparatus capable of fighting



Still actively fighting the leftover flame in the photo above, one firefighter climbs through the foam on the wing to enter the aircraft and check there, another holds a foam nozzle still being applied to the area, and others in the firefighting force go about their preplanned, well-trained-for part in the emergency. Particularly significant is the light tower, one of several in that section of the field that the DC-10 pilot miraculously managed to avoid hitting with any part of the aircraft. Both pilot and firefighters demonstrated great skill in handling never-before-experienced emergencies with considerable effectiveness, perhaps even better classified as heroism.



## TEAMWORK

the worst possible crash fire. A Boeing 747, for example, can carry 50,000 gallons of fuel. Ignition is probable with virtually every crash. Tests have shown that the fire may involve up to 20,000 square feet of area. How do you insure that you have adequate equipment to quickly get to the scene and make a fast containment of the flames and final extinguishment?

The nucleus of air crash fire protection at LAX consists of four mammoth rigs, plus reserve apparatus. Flagship of the fleet is a rapid intervention vehicle which carries 500 gallons of pre-mixed AFFF, plus dry chemicals for

Section of the aircraft most severely burned is shown clearly below. Before fighting the DC-10, this area was braced with a cribbing of solid oak planks, laid parallel around the circumference of the plane. Placed just to the right of the closed door shown, this bracing was necessary to prevent the plane from breaking apart where the fire had done the greatest structural damage.



other types of fires. The three other crash rigs are identical and each contains 3000 gallons of water and 500 gallons of AFFF, thus giving them a first-line capability of 9000 gallons of water and 1500 gallons of AFFF. All vehicles carry peripheral chemical extinguishing agents, hose, rescue tools and related equipment. The water and foam carried was more than sufficient to douse the DC-10 flames.

It is pertinent to note that Los Angeles was a pioneer in the use of AFFF after the U.S. Navy developed it in 1962. At least 90% of American commercial airports rely upon AFFF as the primary extinguishing agent, although at least three large airports on the eastern seaboard continue to use the older protein foam which experience has shown has severe drawbacks. It is a curious commentary that each of these airports has experienced catastrophic losses of life from air crash fires.

AFFF is effective because it has the ability to make water float on flammable liquids. As AFFF covers the fuel, an aqueous film drains from the foam bubbles and floats over the fuel surface, creating a vapor seal which rapidly extinguishes flames and prevents reignition. When AFFF is applied to non-ignited spills, the floating AFFF suppresses vapors and seals out oxygen and thus prevents ignition.

The older protein foams, on the other hand, are derived from animal or vegetable proteins and consist of mechanical blankets which are applied to hydrocarbon vapors, thus forming a smothering blanket that inhibits the evaporation of these flammables.

"AFFF is superior to protein," says Captain Bob Engel, for 21 years an air crash specialist with the LAFD and recognized as a national authority on

the subject. "Its superiority lies in the fact that you don't have to methodically apply a mechanical blanket as you do with protein foam. Protein foam blankets are easily punctured by hose streams or firefighters walking through them, thus permitting flammable vapors to escape and recreate a high-hazard situation and probably a rekindle of the fire.

"With AFFF, on the other hand, if you can get it in the area of the fire or fuel spill it will form its own blanket. You can apply it directly onto a fire, a valuable feature not possible with protein foam. With protein you must always worry about the possibility of renewing your problem by breaking the blanket and releasing flammable vapors that can easily reignite."

Indicative of the value of training and preplanning, Captain Engle, commander of the crash rigs at the DC-10 incident, recalled, "This was a superb example of the necessity of having well-trained, full-time, highly-motivated air crash personnel. There was very little radio conversation between the men on the rigs. I had to give only a few commands. Each man did his assigned part of the job exactly according to the way he had been trained. They did what they were supposed to do before anybody had to tell them."

### Emergency Medical

The Los Angeles County Medical Alert Center was notified by the fire alarm headquarters and others two minutes after the crash. Triage teams and 18 hospitals, including three burn centers, were quickly notified. Seventeen ambulances were called and radio messages to their drivers directed them to the nearest entrance to the crash site. In addition, 11 LAFD Rescue-Ambulances, all but one of them staffed by paramedics, were quickly converging on the airport.

City and county fire, plus sheriffs' helicopters were on the way. Triage teams were airlifted by them to the crash site and to Marina Mercy Hospital, the nearest hospital which was designated as the burn casualty staging area. Triage teams (generally consisting of a physician, one or two physicians' assistants and/or a registered nurse) came from three hospitals.

Within 17 minutes after the crash, the first casualties, many of whom were already treated and were medically stabilized by paramedics were being transported to hospitals. One critically burned victim was helicoptered to the County-University of Southern California burn center.

### Airport Security

When McJannet picked up the direct line to give his first alarm, the message was also transmitted to LAX Opera-

tions and Security Headquarters. Six security personnel were immediately sent by radio, the first arriving at the crash within one minute. They would shortly be joined by around 11 more officers. A command post was set up near the fire chief's sedan.

Lieutenant Ken Parsons, assistant chief of security, explained that procedure calls for the security officer in charge to immediately begin liaison with and work under the direction of the fire chief in command.

Security's other immediate objectives were twofold: Set up a perimeter line around the crash site to prohibit unauthorized persons from entering the area and to protect evidence or parts of the wreckage that might help investigators find the cause of the crash.

Secondly, security personnel provided escort service for emergency vehicles and authorized personnel into and out of the airport. "Escorting in an emergency is vital in any large complex to avoid the possibility of ambulances or other emergency vehicles getting lost coming or leaving."

The billowing clouds of ugly black smoke and news media broadcasts attracted thousands of sightseers. Security's work was eased somewhat because the aircraft stopped within the confines of the fenced airport. A secondary perimeter was established and patrolled along the fence lines to prevent sightseers from climbing over them. Two men who did were arrested and cited for interfering at the scene of a disaster.

"The entire incident went down well," said Lt. Parsons who recalled two earlier training programs, Operation Big Boy 1 and 2. Parsons said one of these simulated crash programs was almost a duplicate of the DC-10 incident. "I think we ran into more problems during the simulated incident than we did when the actual crash occurred," said Parsons.

#### Airport Police

A Los Angeles Police Department sub-station is located on the airport. Officers took charge of the dead body reports and made a routine plane crash report. There was little for them to do with security having the situation well in hand. Their major contribution was to set up traffic control on thoroughfares contiguous to the airport and to assist with expediting the passage of emergency vehicles.

#### Airport Maintenance

Emergency procedures direct that maintenance department personnel immediately report to the field's supply yard.

During the next few hours, some 100 maintenance personnel were busy providing ropes, barricades, and portable lighting equipment to a decreased

security force that stood guard around the plane. Buses to transport uninjured passengers and crew to Continental's cafeteria staging and treatment area were required, along with several loads of dirt to dam a large flow of kerosene fuel along the trench gouged by the aircraft's landing gear. The damming was done to avoid the flow of the pollutant into storm drains leading to the ocean.

#### Public Relations

Whether it's an airport or a large industrial complex, a major fire is guaranteed to attract print and broadcast media. LAX public relations has for years developed a rapport with Los Angeles area media and the emergency plan for assisting them went off without a hitch.

Public Relations Director Virginia Black happened to glance out the window while the DC-10 was on takeoff. She saw it was in trouble just as it disappeared behind a building as the hot-line rang. Almost immediately she saw the column of black smoke. Ms. Black and her staff quickly activated their emergency procedure.

Three public relations staff members were immediately sent to the crash site to await the flood of media personnel who were directed to enter through the security post nearest the crash site for escort. As the media arrived, each was given an orange armband for quick identification. In the public relations offices, meanwhile, a rash of telephone calls from media throughout the world and from relatives of those aboard the plane kept personnel busy for hours. Extra personnel from other departments were brought in to help field the calls. Ms. Black, whose department has participated in earlier emergency drills, said afterwards, "No drill ever went as well as the real thing did."

#### Critique

A vital factor in emergency planning is to critique the incident — real or simulated — as soon as possible. Critiques started at the crash site by triage teams and fire department rescue personnel soon after the final victim was transported from the area.

"We had a critique that evening and again the following day with the airport general manager," said Lt. Parsons. Separate and joint critiques quickly followed among firefighting personnel and others who played major roles in successfully coping with what was, without question, the worst emergency in the history of the airport. The critiques will long serve as models to follow — and from which to learn — a future training sessions. It was a day that preplanning, training and constant teamwork paid off.



Taken through the door of the DC-10 from inside, this photo shows members of the firefighting and emergency forces still going about their final responsibilities in taking care of the emergency. Patterned material at the bottom of the door appears to be paneling from the inside of the aircraft dislodged by the crash. Below, recovery operation is well underway to bring the aircraft to level position and remove it from field with the aid of trucks.



Taken inside the plane at approximately the section shown lower left on the facing page, this photo illustrates the limited amount of internal damage and again points up the effectiveness and speed of the rescue effort that prevented the incredible heat of the fuel fire outside the crash from doing more than this much harm inside the DC-10.



## About Our Author .....

**Paul C. Ditzel**



As an internationally recognized authority on firefighting and fire protection, Mr. Ditzel has written four books about the fire service, serves as staff correspondent for *Fire Engineering*, and authors articles that appear frequently in *Firehouse Magazine* and other publications. He has been closely associated with the fire service for more than 25 years.

Mr Ditzel has a BS and an MS in journalism from Northwestern University and upon graduation was elected to membership in Kappa Tau Alpha, which honors distinction in journalistic performance. He was recently elected to the American Society of Journalists and Authors, as well as holding membership in the Authors Guild, and the Authors League of America.

Copyright © 1978 by Security World Publishing Co., Inc.  
Los Angeles, California, U.S.A.

Reprinted with permission from SECURITY WORLD Magazine,  
Vol. 15, No. 4, (April, 1978) pp. 28, 29, 32, 33, 92, and 93.

---

# Flight 498:

## Portrait of a Disaster



GORDON LEVINE

*Although disasters can result from a variety of circumstances, airplane collisions often wreak the most havoc. The following article takes an inside look at EMS response to what has been deemed the worst air disaster in LAX history.*

By Laura M. Gilbert



PAT OLSON

It was an unusually warm August morning in Los Angeles County, so paramedic operations coordinator, Fire Capt. Clint Mills, decided to take his coffee break outside Station 30. Stepping outside, he noticed smoke pouring from a neighboring street. Before he had time to respond, a car pulled up and its occupants yelled, "There's a HUGE fire!"

"Huge fire in the Carmenita [Road] area," he shouted to the crew as he ran inside. "Let's go!" And, for the first time in Mills' 27-year career, the entire crew jumped directly onto their rigs and took off without even a momentary check outside to locate the fire for themselves. The first alarm sounded as they sailed down the street.

On this particular day, August 31, 1986, the entire crew at Station 30 happened to consist of two paramedic squads, five engine companies and two truck companies. Ironically, several local crews were gathered at one station to participate in a multicasualty incident command drill. But that drill took on a gruesome reality as they were called to what has been deemed the worst air disaster in LAX history.

Six thousand feet above their usually quiet suburban neighborhood in Cerritos, Calif., a DC-9 jetliner and a light plane collided just before noon, leaving a trail of carnage and wreckage in the fiery wake. The Aeromexico Flight 498 leveled four houses and triggered a fireball that torched 18 other homes, killing all 64 people on board as well as the three occupants of the

light plane. Fifteen people on the ground were killed—the majority of whom had been attending a family reunion.

Preparing for the worst, 218 LA County emergency personnel, including six paramedic units, 19 ambulances and four medical cache units, responded to the incident that sent flames shooting 50 feet above the Carmenita homes. There was a heavy emphasis on emergency medical support teams being called in, but it was readily apparent that this was a firefighter operation. "The heat was so intense, I immediately realized we didn't have anything that could possibly survive," Mills said.

A medical division was set up under the Incident Command System (ICS). But the triage and search teams made up of paramedics and sheriffs found nothing. There were nine injuries—all were minor and all occurred to firefighters and overzealous bystanders after the crash.

Harder to handle than the minor on scene injuries, were the interfering bystanders, looters and, in Capt. Mills' words, an "obnoxious" news media that was "right on top" of them.

"When the media is uncooperative, it places us in a very untenable position," he said. "If an explosion occurs and a photographer or reporter is injured, they'll print that it was unsafe, but that they were allowed in the area anyway. Dealing with the media is the one area we haven't got worked out yet—we're at a stand off with them."

Although the Cerritos disaster involved relatively little EMS intervention, Capt. Mills said they are fully prepared for mass casualty incidences should they occur. In the event of such a situation his crews, with mutual aid and additional agency assistance, are set up to handle 500 critically injured patients at any given time.

Los Angeles County's multicasualty plan consists of 50 EMS strike teams, each comprised of three paramedic units and two EMT engines. Each team is capable of handling 50 to 70 injuries, 25 to 50 of those critical. The strike teams try to maintain a 1-to-1 ratio of EMT to patient. "Our limit is a 7 to 1 ratio, but we're not even sure we can handle that," Mills said.

Triage, during an airline disaster or other multicasualty incident, is determined by a 60-second preliminary survey. The first priority is to remove patients from dangerous areas regardless of their injuries. Next, the ABCs are performed and the patients are tagged for immediate, delayed or minor care. Patients with a respiratory status of slower than 10 breaths per minute or greater than 30

**"The heat was so intense, I immediately realized we didn't have anything that could possibly survive," Fire Capt. Clint Mills said.**

receive immediate care. Head injuries are also top priority. A patient is tagged "dead" if he or she is nonbreathing and pulseless. In Los Angeles alone, more than 2,400 people are trained in triage assessment.

Mills, a veteran of airline disasters, has seen tremendous change in EMS disaster preparedness. "Each incident teaches us about our capabilities and the changes we need to make for the future," he said. "By gearing up for the worst (500 critically injured) we are more than prepared for the smaller disasters."

One relatively new form of preparedness was put into practice at the Cerritos disaster—on the spot counseling for the emergency workers. A team of psychologists was dispatched alongside the emergency units. The psychologists, who volunteered their time, set up shop in close proximity to the disaster scene.

"The heat had so vaporized the bodies, that later we had to scrape body parts and tissue off our vehicles." Mills said. "Not surprisingly, this affected some of our people. There was a tremendous need for immediate counseling."

The overwhelming wreckage and broken bodies mass casualty incidents leave behind for emergency responders to deal with has dramatically increased the need to recognize and meet the special needs of a disaster's "secondary victims." Historically, EMS workers have been told to keep a stiff upper lip, but recently it's been found that this can lead to severe emotional problems or career burnout. Studies have shown that emergency personnel suffer from the same and often worse aftereffects of stress, as workers do in other stressful professions. Without proper counseling, emergency workers can develop anything from stress-related skin rashes to permanent disabilities that lead to early retirement.

The counseling provided to all Cerritos rescue personnel was in the form of debriefing sessions. As soon as the firefighters and EMS personnel were released from their duties at the scene, they were counseled on a one-on-one basis when possible, or in a group session. All 218 responders were debriefed in a single night.

During the session, each responder described his or her role during the disaster and how it felt to be there. As it is common for emergency service workers to run the incident over and over in their minds to try and make sure they handled their part correctly, intense feelings often came to the surface during this session. The two main rules, said LACFD Health Programs Coordinator Marguarite Jordon, were to listen to what was going on inside the others and to not criticize. To get the discussion moving, the psychologist would ask questions such as "How did you feel when that happened, and how do you feel now?" "Have you ever felt anything like this in your life before?"

Following the discussion, they were told what symptoms to expect, such as nightmares and flashbacks. The psychologists used this as an opportunity to explain that these are normal reactions to an abnormal situation. Afterwards, they explained some basic stress management techniques such as diet—eating wholesome foods with extra vitamins B and C, and exercising—such as swimming or jogging. Avoiding stressful situations at home or on the job for a while, was also emphasized.

Jordon said that the counseling was mandatory to remove any stigma. "By

making it mandatory, fellow workers couldn't embarrass each other by saying, 'You needed counseling and I didn't.'"

Capt. Mills agreed, "Many people involved with this kind of work are kind of, although I hate to use the word, macho, and would usually opt out of counseling. There's still a stigma attached to psychology and this helped to lessen it."

The counseling, derived from Dr. Jeffrey

### **As soon as the firefighters and EMS personnel were released from their duties at the scene, they were counseled on a one-on-one basis when possible, or in a group session.**

Mitchell's Model of Critical Incident Stress Debriefing, is a simple and effective tool to help emergency workers cope with what they've seen, avoid burnout and continue working with minimal long-term effects. Miller, himself, is a certified EMT-A instructor and has served as an EMS coordinator and a firefighter/paramedic. Jordon said that he and other psychologists have compared emergency workers' transition from a disaster situation back to a daily routine, to that of Vietnam vets' transition from the war-torn jungles back to an urban life style. Both are so rapid there is no way to acclimate oneself—no one to turn to who understands.

"So, just by being at the scene, we showed how much our department supports its personnel, and that we are moving ahead in a caring way," she said.

Often during the counseling session, a plan of action is devised to help eliminate the feelings of frustration or anger over the event. Dr. Mitchell gives an example of a plan of action one crew took after a drunk driving incident. In this case, the drunk driver had killed several people and received a light sentence. The EMS personnel appeared at the trial in full uniform as a form of protest against the sentence. This gave them a sense of unity and purpose.

Mitchell recommends that a follow-up counseling session is held no more than two weeks after the incident. The firefighters and emergency medical personnel at the Cerritos incident met for their session 10 days after the crash. It was held away from the station and no one was on call. This was done to eliminate outside stress and interference. At this time, persistent psychological and physical

reactions were dealt with, and any loose ends were tied up.

"The peer group discussions," Capt. Mills added, "are one of the greatest methods for eliminating stress. For years we've been sitting around the table at the station during lunch or dinner, and discussing whatever just happened—now we know how therapeutic it really is."

The follow-up session(s) also gave the emergency workers information on how they could receive additional, free-of-charge counseling. For those who may still be haunted by the memory months later, a hotline number was passed out. But, for the majority of the Cerritos responders, the counseling was successful in eliminating latent problems. By recreating the scene and re-experiencing their emotions, they could leave many of the memories behind.

"Because of the counseling, I won't have to deal with the airline disaster years after it happened, but only for the 10 to 14 hours it occurred," Mills said. "And when I do have flashbacks or nightmares, I know that is normal and I don't have to worry about it."

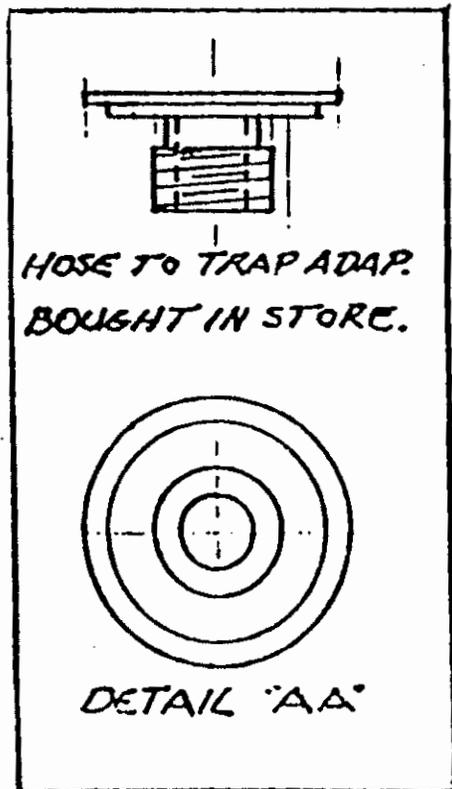
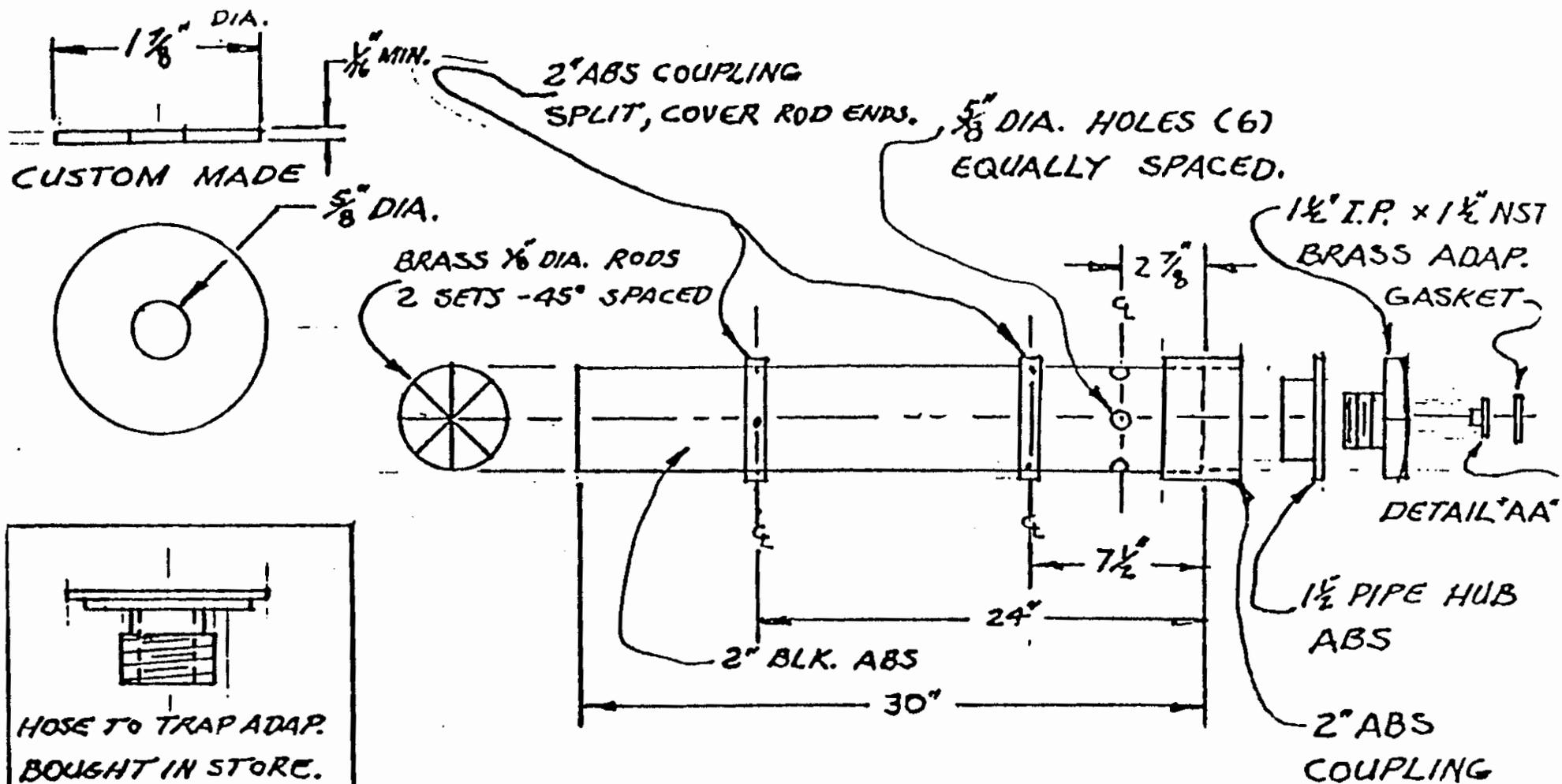
**W**hile the emergency responders struggled to erase the tragic memories, the residents also began to rebuild their shattered lives. Within one week of the crash, the California Department of Transportation and the City of Los Angeles leveled the entire area and removed all debris. For the residents who chose to move back, new homes were quickly erected.

In total, 11 homes were destroyed and between five and 25 vehicles partially or totally demolished—setting the loss at an estimated \$2.7 million, not counting the aircraft. And, of course, no cost can be attached to the tremendous loss of lives.

Reflecting on the incident, firefighters and EMS workers agree that the whole emergency operation ran smoothly, mostly due to teamwork, mutual aid from Santa Fe Springs, Buena Park and Orange County Fire Departments, and the use of the ICS system.

"I've responded to airline disasters before that were much, much harder to deal with than this one because the victims were still alive, slowly burning to death in the wreckage, and we were unable to get to them before they died," recalled Mills. "But with the Cerritos incident, there were no burns, no loss of limbs, no stopping of bleeding—only the realization that they all lost their lives in a split second." ❄

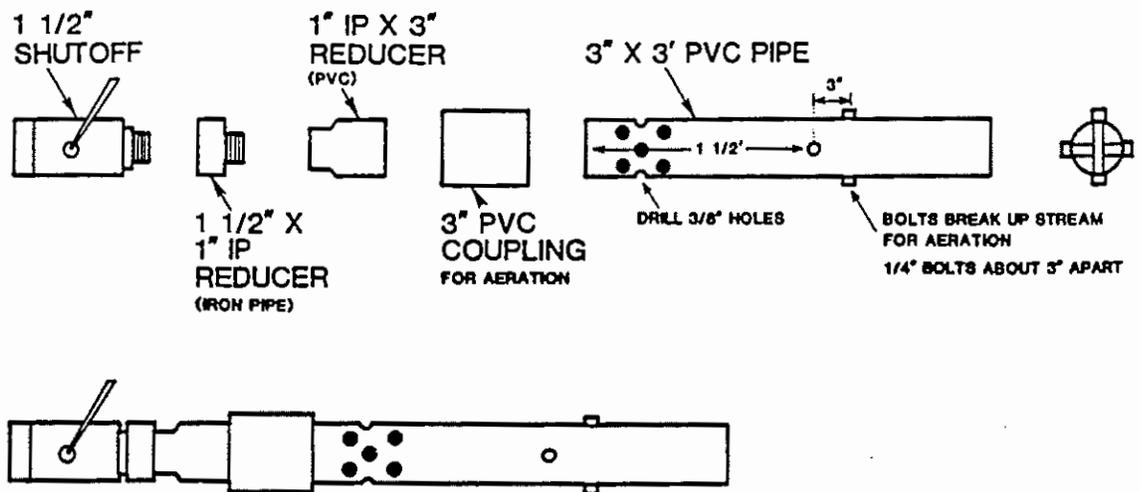
Laura Gilbert is the associate editor



FOAM NOZZLE DIAGRAM

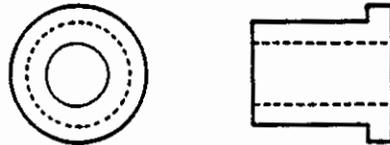
5/8" HOLES IN THE PLAY PIPE SHOULD  
 NOT BE OBSTRUCTED IN ANY WAY  
 (BY HANDS OR ANYTHING ELSE.)

II. Homemade Aerated Foam Nozzle - "THE FATFOAMER" - This works well as long as its matched up to the proper eductor

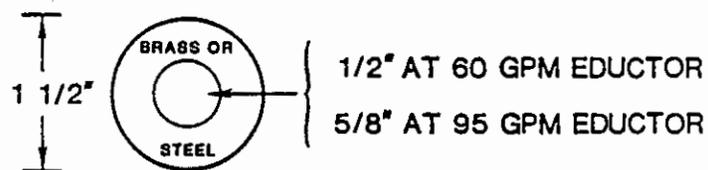


Two types of inserts

1. An insert that is pressed into the waterway



2. A disk with the proper hole size



Hole size: For a 60 GPM eductor - hole size 1/2"

For a 95 GPM eductor - hole size 5/8"

To find out the GPM of an eductor, look inside and determine the size of the orifice at the venturi.

3/8" = 60 GPM

1/2" = 95 GPM

# AIRPORT FIRE FIGHTING AND RESCUE SERVICE

	<u>A/C LENGTH</u>	<u>VEHICLE</u>	<u>REMARKS</u>
<b>INDEX A</b>	NOT MORE THAN 90 FT.	(1)	500#DC OR 450#DC AND 50 GAL. AFF. NOTE: INDEX B A/C WITH LESS THAN 5 DAILY DEPARTURES 500 GAL. WATER 300#DC.
<b>INDEX B</b>	MORE THAN 90 FT. BUT NOT MORE THAN 126 FT.	(2)	5 OR MORE DAILY DEPARTURES. INDEX A VEHICLE PLUS 1500 GAL. WATER EXCLUDING FOAM CONCENTRATE.
<b>INDEX C</b>	MORE THAN 126 FT. BUT NOT MORE THAN 160 FT.	(3)	5 OR MORE DAILY DEP. INDEX A VEHICLE PLUS (2) WITH TOTAL 3000 GAL. WATER EXCLUDING FOAM CONCENTRATE.
<b>INDEX D</b>	MORE THAN 160 FT. BUT NOT MORE THAN 200 FT.	(3)	5 OR MORE DAILY DEP. INDEX A VEHICLE PLUS (2) WITH TOTAL 4000 GAL. WATER EXCLUDING FOAM CONCENTRATE.
<b>INDEX E</b>	MORE THAN 200 FT.	(3)	5 OR MORE DAILY DEP. INDEX A VEHICLE PLUS (2) WITH TOTAL 6000 GAL. WATER EXCLUDING FOAM CONCENTRATE.

**FIRE FIGHTING INDEX**



# MATERIAL SAFETY DATA SHEET

## DIVISION ADDRESS

MOBAY CHEMICAL CORPORATION  
 AGRICULTURAL CHEMICALS DIVISION  
 P.O. Box 4913, Hawthorn Road  
 Kansas City, Missouri 64120

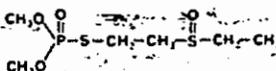
ISSUE DATE 06/30/86  
 SUPERSEDES 05/31/85

TRANSPORTATION EMERGENCY: CALL CHEMTREC  
 TELEPHONE NO: 800-424-9300; DISTRICT OF COLUMBIA: 202-483-7616

MOBAY NON-TRANSPORTATION EMERGENCY NO.:  
 (816) 242-2582

### I. PRODUCT IDENTIFICATION

PRODUCT NAME.....: METASYSTOX-R S.C.  
 PRODUCT CODE NUMBER.....: Formula No. 011111  
 CHEMICAL FAMILY.....: Organophosphorous Pesticide  
 CHEMICAL NAME.....: S-[2-(Ethylsulfinyl)ethyl] 0,0-dimethyl phosphorothioate  
 SYNONYMS.....: Metasystemox, Oxydemeton-methyl  
 T.S.C.A. STATUS.....: Registered under FIFRA  
 STRUCTURE.....:



### II. HAZARDOUS INGREDIENTS

COMPONENTS:	CAS #	Z:	CURRENT TLV:
METASYSTOX-R	301-12-2	25	NE
Ingredient 1836	(Trade Secret)	1-10	NE
or Ingredient 1936	(Trade Secret)	1-10	NE
or Ingredient 1961	(Trade Secret)	1-10	NE
Ingredient 1406	(Trade Secret)	10-20	NE
Methyl Isobutyl Ketone	CAS# 108-10-1	40-50	50 ppm

### III. PHYSICAL DATA

APPEARANCE.....: Liquid  
 COLOR.....: Yellow/Amber  
 ODOR.....: Sulfur compounds  
 MOLECULAR WEIGHT.....: 246.3 (AI)  
 MELT POINT.....: 0°F  
 BOILING POINT.....: 114-144°C  
 VAPOR PRESSURE.....: 16 mm Hg @ 20°C  
 VAPOR DENSITY (AIR=1).....: Unknown  
 SPECIFIC GRAVITY.....: 0.95 @ 20°C  
 BULK DENSITY.....: NA  
 SOLUBILITY IN WATER.....: Complete  
 Z VOLATILE BY VOLUME.....: 100%

### IV. FIRE & EXPLOSION DATA

FLASH POINT °F(°C).....: 69°F (TCC)  
 FLAMMABLE LIMITS -  
 Lel.....: 1.2%  
 Uel.....: NE  
 EXTINGUISHING MEDIA.....: Water Spray, DCP, CO<sub>2</sub>, Foam

Product Code: 011111

Page 1 of 5

**SPECIAL FIRE FIGHTING PROCEDURES/UNUSUAL FIRE OR EXPLOSION HAZARDS:**

Keep out of smoke. Cool exposed containers with water spray. Fight fire from upwind position. Use self-contained breathing equipment. Contain runoff by diking to prevent entry into sewers or waterways. Equipment or materials involved in pesticide fires may become contaminated.

**V. HEALTH EFFECTS DATA****ANIMAL TOXICITY -****ORAL, LD50**

(INGESTION).....: Male rat 125mg/kg  
Female rat 138 mg/kg

**DERMAL, LD50**

(SKIN CONTACT).....: Male rabbit 359 mg/kg  
Female rabbit 253 mg/kg

**INHALATION, LC50.....:**

One-hour exposure: Male and female rat greater than 1.69 mg/l (analytical concentration) or greater than 2.0 mg/l (extrapolated nominal concentration).  
Six-hour exposure (analytical concentrations):  
Male rat - 0.703 mg/l; Female rat - 0.600 mg/l

**FISH, LC50.....:**

Rainbow Trout 23 ppm (96 hr.);  
Bluegill 26 ppm (96 hr.)

**EYE EFFECTS.....:**

Moderate eye irritation (rabbit)

**SKIN EFFECTS.....:**

Moderate irritation (rabbit). The active ingredient (Oxydemeton-methyl) is a contact allergen in guinea pigs. Prolonged or frequently repeated skin contact causes allergic reactions in some individuals.

**OTHER.....:**

The results of one animal study indicate that METASYSTOX-R may have an adverse effect on rat testes and overall reproductive performance. Based on the results of this animal study, the reproductive no-effect level for METASYSTOX-R is 1 ppm in the diet or 0.05 mg/kg based on body weight, which is the same as the chronic feeding cholinesterase no-effect level in rats.

**HUMAN EFFECTS****OF OVEREXPOSURE.....:**

METASYSTOX-R is a toxic chemical, which like other organophosphate compounds inhibits the enzyme cholinesterase. Uncontrolled exposure to METASYSTOX-R can produce symptoms such as nausea, sweating, a sense of tightness in the chest and constricted pupils. Increasing exposure can produce more serious symptoms such as stomach pains, vomiting and diarrhea, while grossly excessive exposure can produce symptoms of life threatening effects, such as muscular tremors, uncontrolled mucous secretion, convulsions and coma.

**EXPOSURE GUIDELINES.....:**

No specific exposure guidelines have been established for airborne concentrations of METASYSTOX-R. However, workers should avoid breathing vapors and mists containing METASYSTOX-R. Skin contact with the liquid should also be avoided.

VI. EMERGENCY & FIRST AID PROCEDURES

- IN CASE OF POISONING.....: Call a physician or poison control center.
- EYE CONTACT.....: Hold eyelids open and flush with a steady gentle stream of water for 15 minutes. Get medical attention.
- SKIN CONTACT.....: Wash skin immediately with soap and water. If irritation occurs, get medical attention.
- INHALATION.....: Remove to fresh air. If not breathing, give artificial respiration, preferably mouth to mouth. Get medical attention.
- INGESTION.....: Administer water freely and induce vomiting by giving one dose (1/2 oz. or 15 ml) of syrup of ipecac. If vomiting does not occur within 10-20 minutes, administer second dose. If syrup of ipecac is not available, induce vomiting by sticking finger down throat. Repeat until vomit fluid is clear. Never give anything by mouth to an unconscious person. Professional medical assistance should be secured immediately.
- TO PHYSICIAN.....: ANTIDOTE - Administer atropine sulfate in large therapeutic doses. Repeat as necessary to the point of tolerance. 2-PAM is also antidotal and may be administered in conjunction with atropine.

Compound inhibits cholinesterase resulting in stimulation of the central nervous system, the parasympathetic nervous system and the somatic motor nerves. Do not give morphine. Watch for pulmonary edema which may develop in serious cases of poisoning even after 12 hours. At first sign of pulmonary edema, the patient should be placed in an oxygen tent and treated symptomatically.

When treating poisoning victims, be aware that this formulation contains 10-20% aromatic petroleum distillates and 40-50% methyl isobutyl ketone.

In case of poisoning, it is also requested that Mobay Corporation, Agricultural Chemicals Division, Kansas City, Missouri, be notified.  
Telephone: 816-242-2000; nights or week-ends:  
816-242-2582.

**VII. EMPLOYEE PROTECTION RECOMMENDATIONS**

- EYE PROTECTION**.....: Splash-proof goggles  
**SKIN PROTECTION**.....: Latex or Neoprene Gloves; rubber boots & apron  
**RESPIRATORY PROTECTION**....: Wear a pesticide respirator jointly approved by the Mining Enforcement & Safety Administration (formerly U.S. Bureau of Mines) and by the National Institute for Occupational Safety & Health under the provisions of 30 CFR Part 11. In Canada, obtain this information from your dealer.  
**VENTILATION**.....: Maintain exposure levels as low as possible through use of general and local exhaust ventilation.  
**OTHER**.....: Launder clothing daily after use. Wash thoroughly after handling.

**VIII. REACTIVITY DATA**

- STABILITY**.....: Stable  
**POLYMERIZATION**.....: Will not occur.  
**CONDITIONS TO AVOID**.....: Temperatures above 212°F. Subject to hydrolysis  
Unstable in alkaline media.  
**INCOMPATIBILITY**  
**(MATERIALS TO AVOID)**....: Strong oxidizing agents, alkaline materials  
**HAZARDOUS DECOMPOSITION**  
**PRODUCTS**.....: P<sub>2</sub>O<sub>5</sub>, CO, SO<sub>2</sub>

**IX. SPILL OR LEAK PROCEDURES**

**STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED:** Contain spilled material through use of diking or absorbent materials. Absorb spilled material with absorbent and scrub area with detergent and bleach. Repeat and rinse with water. Avoid skin contact and breathing vapors.

**WASTE DISPOSAL METHOD:** Bury absorbed material and contaminated material in EPA-approved landfill or burn in an incinerator approved for pesticide destruction.

**X. SPECIAL PRECAUTIONS & STORAGE DATA**

- STORAGE TEMPERATURE**  
**(MIN./MAX.)**.....: 0°F / 30 day average not to exceed 100°F  
**SPECIAL SENSITIVITY**  
**(HEAT, LIGHT, MOISTURE):** Heat, moisture  
**PRECAUTIONS TO BE TAKEN**  
**IN HANDLING AND STORING:** Store in a cool dry area. Store the liquid formulations away from excessive heat and open flame. Store in an area designated specifically for pesticides. Do not store near any material intended for use or consumption by humans or animals.

XI. SHIPPING DATA

D.O.T. SHIPPING NAME.....: Organophosphorus Pesticide, Mixture, Liquid, N.O.S.  
TECHNICAL SHIPPING NAME...: Oxydemeton-methyl  
D.O.T. HAZARD  
CLASSIFICATION.....: Flammable Liquid  
UN/NA NO.....: UN 2784  
REPORTABLE QUANTITY.....: NA  
D.O.T. LABELS REQUIRED...: Flammable  
D.O.T. PLACARDS.....: Flammable  
FRT. CLASS BULK.....: Insecticide, Agricultural, Liquid  
FRT. CLASS PKG.....: Insecticide, Agricultural, Liquid

XII. DOCUMENTATION

REASON FOR ISSUE.....: Revise Health Effects Data  
APPROVED BY.....: William J. Brinkman  
TITLE.....: Industrial Hygiene Manager  
DATE APPROVED.....: June 30, 1986

# GASOLINES: AVIATION (< 4.86g lead/gal)

GAV

<p><b>Common Synonyms</b></p> <p>Wet/dry liquid Red, blue, green, brown or purple Gasoline odor</p> <p>Floats on water. Flammable, irritating vapor is produced.</p>	
<p>Stop discharge if possible. Keep people away. Shut off ignition sources and call fire department. Stay upwind and use water spray to "knock down" vapor. Isolate and remove discharged material. Notify local health and pollution control agencies.</p>	
<b>Fire</b>	<p><b>FLAMMABLE</b> Flashback along vapor trail may occur. Vapor may explode if ignited in an enclosed area. Extinguish with dry chemical, foam or carbon dioxide. Water may be ineffective on fire. Cool exposed containers with water.</p>
<b>Exposure</b>	<p><b>CALL FOR MEDICAL AID</b></p> <p><b>VAPOR</b> Irritating to eyes, nose and throat. If inhaled will cause dizziness, headache, difficult breathing or loss of consciousness. Move to fresh air. If breathing has stopped, give artificial respiration. If breathing is difficult, give oxygen.</p> <p><b>LIQUID</b> Irritating to skin and eyes. If swallowed, will cause nausea or vomiting. Remove contaminated clothing and shoes. Flush affected areas with plenty of water. IF IN EYES: hold eyelids open and flush with plenty of water. IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk. <b>DO NOT INDUCE VOMITING</b></p>
<b>Water Pollution</b>	<p><b>HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS</b> Floating to shoreline. May be dangerous if it enters water intakes.</p> <p>Notify local health and wildlife officials. Notify operators of nearby water intakes.</p>
<b>1. RESPONSE TO DISCHARGE</b> (See Response Methods Handbook)	<b>2. LABEL</b>
<p>Issue warning-high flammability. Evacuate area. Disperse and flush.</p>	<p>2.1 Category: Flammable liquid 2.2 Class: 3</p>
<b>3. CHEMICAL DESIGNATIONS</b>	<b>4. OBSERVABLE CHARACTERISTICS</b>
<p>3.1 CG Compatibility Class: Not listed 3.2 Formula: Not pertinent 3.3 RMO/UN Designation: 3.1/1203 3.4 DOT ID No.: 1203 3.5 CAS Registry No.: Data not available</p>	<p>4.1 Physical State (as shipped): Liquid 4.2 Color: Red, blue, green, brown, purple 4.3 Odor: Gasoline</p>
<b>5. HEALTH HAZARDS</b>	
<p>5.1 Personal Protective Equipment: Protective goggles, gloves 5.2 Symptoms Following Exposure: <b>INHALATION</b> causes irritation of upper respiratory tract; central nervous system stimulation followed by depression of varying degrees ranging from dizziness, headache, and incoordination to anesthesia, coma, and respiratory arrest; irregular heartbeat is dangerous complication. <b>ASPIRATION</b> causes severe lung irritation with coughing, gagging, dyspnea, substernal distress, and rapidly developing pulmonary edema; later, signs of bronchopneumonia and pneumonitis; acute onset of central nervous system excitement followed by depression. <b>INGESTION</b> causes irritation of mucous membranes of throat, esophagus, and stomach; stimulation followed by depression of central nervous system; irregular heartbeat. 5.3 Treatment of Exposure: Seek medical attention. <b>INHALATION</b> maintain respiration; give oxygen if needed. <b>ASPIRATION</b>: enforce bed rest, administer oxygen. <b>INGESTION</b> do NOT induce vomiting; lavage carefully if appreciable quantity was ingested; guard against aspiration into lungs. <b>EYES</b> wash with copious quantity of water. <b>SKIN</b>: wipe off and wash with soap and water. 5.4 Threshold Limit Value: 300 ppm 5.5 Short Term Inhalation Limit: 500 ppm for 30 min. 5.6 Toxicity by Ingestion: Grade 2; LD<sub>50</sub> = 0.5 to 5 g/kg 5.7 Late Toxicity: None 5.8 Vapor (Gas) Irritant Characteristics: Vapors cause a slight stinging of the eyes or respiratory system if present in high concentrations. The effect is temporary. 5.9 Liquid or Solid Irritant Characteristics: Minimum hazard. If spilled on clothing and allowed to remain, may cause stinging and reddening of the skin. 5.10 Odor Threshold: 0.25 ppm 5.11 IDLH Value: Data not available</p>	

<p><b>6. FIRE HAZARDS</b></p> <p>6.1 Flash Point: -50°F C.C. 6.2 Flammable Limits in Air: 1.2%-7.1% 6.3 Fire Extinguishing Agents: Foam, carbon dioxide, dry chemical 6.4 Fire Extinguishing Agents Not to be Used: Water may be ineffective 6.5 Special Hazards of Combustion Products: None 6.6 Behavior in Fire: Vapor is heavier than air and may travel a considerable distance to a source of ignition and flash back. 6.7 Ignition Temperature: 624°F 6.8 Electrical Hazard: Class I, group D 6.9 Burning Rate: 4 mm/min 6.10 Adiabatic Flame Temperature: Data not available 6.11 Stoichiometric Air to Fuel Ratio: Data not available 6.12 Flame Temperature: Data not available</p> <p><b>7. CHEMICAL REACTIVITY</b></p> <p>7.1 Reactivity With Water: No reaction 7.2 Reactivity with Common Materials: No reaction 7.3 Stability During Transport: Stable 7.4 Neutralizing Agents for Acids and Caustics: Not pertinent 7.5 Polymerization: Not pertinent 7.6 Inhibitor of Polymerization: Not pertinent 7.7 Molar Ratio (Reactant to Product): Data not available 7.8 Reactivity Group: Data not available</p> <p><b>8. WATER POLLUTION</b></p> <p>8.1 Aquatic Toxicity: 80 ppm/24 hr/<math>\mu</math>vertebrate American shed/TL<sub>50</sub>/fresh water 81 ppm/24 hr/<math>\mu</math>vertebrate American shed/TL<sub>50</sub>/salt water 8.2 Waterfowl Toxicity: Data not available 8.3 Biological Oxygen Demand (BOD): 8%, 5 days 8.4 Food Chain Concentration Potential: None</p> <p><b>9. SHIPPING INFORMATION</b></p> <p>9.1 Grades of Purity: Grades 80/87, 100/130, and 115/145. Specification MIL-G-5572e 9.2 Storage Temperature: Ambient 9.3 Inert Atmosphere: No requirement 9.4 Venting: Open (flame arrester) or pressure-vacuum</p>	<p><b>10. HAZARD ASSESSMENT CODE</b> (See Hazard Assessment Handbook) A-T-U-V-W</p> <p><b>11. HAZARD CLASSIFICATIONS</b></p> <p>11.1 Code of Federal Regulations: Flammable liquid 11.2 HAS Hazard Rating for Bulk Water Transportation:</p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;">Category</th> <th style="text-align: right;">Rating</th> </tr> </thead> <tbody> <tr> <td>Fire</td> <td style="text-align: right;">3</td> </tr> <tr> <td>Health</td> <td style="text-align: right;">1</td> </tr> <tr> <td>Vapor Irritant</td> <td style="text-align: right;">1</td> </tr> <tr> <td>Liquid or Solid Irritant</td> <td style="text-align: right;">1</td> </tr> <tr> <td>Poisons</td> <td style="text-align: right;">2</td> </tr> <tr> <td>Water Pollution</td> <td style="text-align: right;">1</td> </tr> <tr> <td>Human Toxicity</td> <td style="text-align: right;">1</td> </tr> <tr> <td>Aquatic Toxicity</td> <td style="text-align: right;">2</td> </tr> <tr> <td>Aesthetic Effect</td> <td style="text-align: right;">2</td> </tr> <tr> <td>Reactivity</td> <td style="text-align: right;">0</td> </tr> <tr> <td>Other Chemicals</td> <td style="text-align: right;">0</td> </tr> <tr> <td>Water</td> <td style="text-align: right;">0</td> </tr> <tr> <td>Self Reaction</td> <td style="text-align: right;">0</td> </tr> </tbody> </table> <p>11.3 NFPA Hazard Classification:</p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;">Category</th> <th style="text-align: right;">Classification</th> </tr> </thead> <tbody> <tr> <td>Health Hazard (Blue)</td> <td style="text-align: right;">1</td> </tr> <tr> <td>Flammability (Red)</td> <td style="text-align: right;">3</td> </tr> <tr> <td>Reactivity (Yellow)</td> <td style="text-align: right;">0</td> </tr> </tbody> </table> <p><b>12. PHYSICAL AND CHEMICAL PROPERTIES</b></p> <p>12.1 Physical State at 15°C and 1 atm: Liquid 12.2 Molecular Weight: Not pertinent 12.3 Boiling Point at 1 atm: 160-340°F = 71-171°C = 344-644°K 12.4 Freezing Point: &lt;78°F = &lt;24.4°C = &lt;297.6°K 12.5 Critical Temperature: Not pertinent 12.6 Critical Pressure: Not pertinent 12.7 Specific Gravity: 0.711 at 15°C (liquid) 12.8 Liquid Surface Tension: 19-23 dynes/cm = 0.019-0.023 N/m at 20°C 12.9 Liquid Water Interfacial Tension: 49-51 dynes/cm = 0.049-0.051 N/m at 20°C 12.10 Vapor (Gas) Specific Gravity: 3.4 12.11 Ratio of Specific Heats of Vapor (Gas): (see) 1.054 12.12 Latent Heat of Vaporization: 130-150 Btu/lb = 71-81 cal/g = 3.0-3.4 X 10<sup>4</sup> J/kg 12.13 Heat of Combustion: -18,720 Btu/lb = -10,400 cal/g = -43.4 X 10<sup>4</sup> J/kg 12.14 Heat of Decomposition: Not pertinent 12.15 Heat of Solution: Not pertinent 12.16 Heat of Polymerization: Not pertinent 12.18 Heat of Fusion: Data not available 12.26 Limiting Value: Data not available 12.27 Reid Vapor Pressure: Data not available</p>	Category	Rating	Fire	3	Health	1	Vapor Irritant	1	Liquid or Solid Irritant	1	Poisons	2	Water Pollution	1	Human Toxicity	1	Aquatic Toxicity	2	Aesthetic Effect	2	Reactivity	0	Other Chemicals	0	Water	0	Self Reaction	0	Category	Classification	Health Hazard (Blue)	1	Flammability (Red)	3	Reactivity (Yellow)	0
Category	Rating																																				
Fire	3																																				
Health	1																																				
Vapor Irritant	1																																				
Liquid or Solid Irritant	1																																				
Poisons	2																																				
Water Pollution	1																																				
Human Toxicity	1																																				
Aquatic Toxicity	2																																				
Aesthetic Effect	2																																				
Reactivity	0																																				
Other Chemicals	0																																				
Water	0																																				
Self Reaction	0																																				
Category	Classification																																				
Health Hazard (Blue)	1																																				
Flammability (Red)	3																																				
Reactivity (Yellow)	0																																				
<b>NOTES</b>																																					

GAV

## GASOLINES: AVIATION (&lt; 4.86g lead/gal)

12.17 SATURATED LIQUID DENSITY		12.18 LIQUID HEAT CAPACITY		12.19 LIQUID THERMAL CONDUCTIVITY		12.20 LIQUID VISCOSITY	
Temperature (degrees F)	Pounds per cubic foot (estimate)	Temperature (degrees F)	British thermal unit per pound-F	Temperature (degrees F)	British thermal unit-inch per hour- square foot-F (estimate)	Temperature (degrees F)	Centipoise (estimate)
35	45.040	10	.486	40	.909	35	.519
40	44.880	15	.488	50	.900	40	.501
45	44.730	20	.471	60	.891	45	.485
50	44.570	25	.474	70	.883	50	.469
55	44.410	30	.476	80	.874	55	.454
60	44.260	35	.479	90	.865	60	.440
65	44.100	40	.482	100	.856	65	.426
70	43.950	45	.484	110	.847	70	.414
75	43.790	50	.487	120	.838	75	.401
80	43.630	55	.490	130	.829	80	.390
85	43.480	60	.482	140	.821	85	.379
90	43.320	65	.495	150	.812	90	.368
95	43.160	70	.498	160	.803	95	.358
100	43.010	75	.500	170	.794	100	.348
105	42.850	80	.503	180	.785	105	.339
110	42.700	85	.506	190	.776	110	.330
115	42.540	90	.508			115	.322
120	42.380	95	.511			120	.314
125	42.230	100	.514			125	.306
130	42.070	105	.516			130	.299
135	41.920					135	.291
140	41.760					140	.285
145	41.600					145	.278
150	41.450					150	.272
155	41.290					155	.266
160	41.140					160	.260

12.21 SOLUBILITY IN WATER		12.22 SATURATED VAPOR PRESSURE		12.23 SATURATED VAPOR DENSITY		12.24 IDEAL GAS HEAT CAPACITY	
Temperature (degrees F)	Pounds per 100 pounds of water	Temperature (degrees F)	Pounds per square inch	Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F
	I N S O L U B L E		D A T A  N O T  A V A I L A B L E		N O T  P E R T I N E N T		D A T A  N O T  A V A I L A B L E

# Material Information Bulletin

(Approved - "Essentially Similar" to Form OSHA 20, Material Safety Data Sheet)



CHEVRON Avgas 100

CPS 200205

**DANGER!** HARMFUL OR FATAL IF SWALLOWED  
VAPOR HARMFUL  
LONG-TERM EXPOSURE TO VAPOR HAS CAUSED CANCER IN  
LABORATORY ANIMALS  
MAY CAUSE EYE AND SKIN IRRITATION  
EXTREMELY FLAMMABLE  
CONTAINS LEAD  
KEEP OUT OF REACH OF CHILDREN

## TYPICAL COMPOSITION

Variable blend of paraffins, naphthenes, aromatics and olefins including 1-5% benzene (CAS 71-43-2), 1-5% n-hexane (CAS 110-54-3), and 5-15% toluene (CAS 108-88-3) plus xylene (CAS 1330-20-7) > 99%  
Tetraethyl Lead (CAS 78-00-2) ≤ 4.0 ml/gal.

## EXPOSURE STANDARD

The Threshold Limit Value (TLV) (1982) for gasoline is 300 ppm (parts of vapor per million parts of air) for a daily 8-hour exposure. This TLV was recommended by ACGIH before the results of the study discussed in the Additional Health Data section of this bulletin were available. There is no OSHA exposure standard.

## PHYSIOLOGICAL & HEALTH EFFECTS

Eye irritation may result from contact with the liquid or exposure to the vapor. The scientific literature warns that vapor concentrations above 500 ppm are irritating.

Prolonged or frequently repeated liquid contact may cause skin irritation or may cause the skin to become cracked or dry from the defatting action of this material.

Breathing gasoline vapor at airborne concentrations exceeding 1000 ppm can cause headache, dizziness, weakness and loss of coordination. Vapor concentrations in excess of 5000 ppm may cause loss of consciousness, coma and death. Prolonged and repeated breathing of gasoline vapor at levels below 1000 ppm may be harmful. See Additional Health Data.

This material is expected to have slight acute toxicity by ingestion. **Note to Physician:** Ingestion of this product or subsequent vomiting can result in aspiration of light hydrocarbon liquid which can cause pneumonitis. See Additional Health Data.

## EMERGENCY & FIRST AID PROCEDURES

### Eyes

Wash eyes with fresh water for at least 15 minutes. If irritation continues, see a doctor.

### Skin

Wash skin thoroughly with soap and water. See a doctor if any of the signs and symptoms described in this bulletin develop or if any skin irritation occurs. Launder contaminated clothing.

### Inhalation

If there are signs and symptoms, as described in this bulletin, due to breathing this material, move the person to fresh air. If breathing has stopped, apply artificial respiration. Call a doctor immediately. See Respiratory Protection on Page 2.

### Ingestion

If swallowed, DO NOT make person vomit. Call a doctor immediately.

## ADDITIONAL HEALTH DATA

See Page 3.

### SPECIAL PROTECTIVE INFORMATION

**Eye Protection:** Keep away from eyes. Eye contact can be avoided by wearing chemical safety goggles.

**Skin Protection:** Keep away from skin. Skin contact can be minimized by wearing impervious protective clothing including rubber gloves.

**Respiratory Protection:** Avoid prolonged breathing of vapor. In open areas, such as outdoor gasoline transfer areas, ventilation is usually adequate to prevent prolonged breathing of high gasoline vapor concentrations. If vapor levels are high enough to cause eye irritation, the use of an approved respirator is recommended. See Additional Health Data.

**Ventilation:** Use this material only in well ventilated areas.

**Other:** If eye or skin contact can occur, washing facilities for eyes and skin should be available nearby.

### FIRE PROTECTION

This product presents an extreme fire hazard. Liquid very quickly evaporates, even at low temperatures, and forms vapor (fumes) which can catch fire and burn with explosive violence. Invisible vapor spreads easily and can be set on fire by many sources such as pilot lights, welding equipment, and electrical motors and switches.

**Flash Point:** (PM) < -45°C

**Autoignition Temp.:** NDA

**Flammability Limits:** 1.4-7.6%

**Extinguishing Media:** CO<sub>2</sub>, Dry Chemical, Foam, Water Spray.

**Special Fire Fighting Procedures:** For fires involving this material, do not enter any enclosed or confined fire space without proper protective equipment. This may include self-contained breathing apparatus to protect against the hazardous effects of normal products of combustion or oxygen deficiency. Read the entire bulletin.

### SPECIAL PRECAUTIONS

See Page 3

## ENVIRONMENTAL PROTECTION

**Environmental Impact:** Certain geographical areas have air pollution restrictions concerning the use of materials in work situations which may release volatile components to the atmosphere. Air pollution regulations should be studied to determine if this material is regulated in the area where it is to be used.

**Precautions if Material is Released or Spilled:** Eliminate all sources of ignition in vicinity of spill or released vapor. Clean up spills as soon as possible, observing precautions in Special Protective Information and on product label. Absorb large spills with absorbent clay, diatomaceous earth or other suitable material. A fire or vapor hazard may exist since these cleanup materials will only absorb liquid; they will not absorb vapor.

**Waste Disposal Methods:** Place contaminated materials in disposable containers and bury in an approved dumping area.

### REACTIVITY DATA

**Stability (Thermal, Light, etc.):** Stable  
**Incompatibility (Materials to Avoid):** May react with strong oxidizing materials.

**Hazardous Decomposition Products:** Normal combustion forms carbon dioxide and water vapor; incomplete combustion can produce carbon monoxide.

**Hazardous Polymerization:** Will not occur.

### PHYSICAL PROPERTIES

**Solubility:** Soluble in hydrocarbons; insoluble in water.

**Appearance (Color, odor, etc.):** Green liquid.

**Boiling Range:** 100-338°F

**Freezing Point:** Below -60°C

**Specific Gravity:** ~0.7

**Vapor Pressure:** 5.5-7.0 psia (max.) @ 100°F

**Vapor Density (Air = 1):** 3-4

**Percent Volatile (Volume %):** 99+%

**Evaporation (= 1):** NDA

n/a = Not Applicable

NDA = No Data Available

The above information is based on data of which we are aware and is believed to be correct as of the date hereof. Since the information contained herein may be applied under conditions beyond our control and with which we may be unfamiliar and since data made available subsequent to the date hereof may suggest modifications of the information, we do not assume any responsibility for the results of its use. This information is furnished upon the condition that the person receiving it shall make his own determination of the suitability of the material for his particular purpose.

# Material Information Bulletin

CHEVRON Avgas 100

CPS 200205

## ADDITIONAL HEALTH DATA

Ingestion of gasoline or inhalation of vapor at airborne concentrations exceeding 1000 ppm may cause signs and symptoms of central nervous system depression such as headache, dizziness, loss of appetite, weakness and loss of coordination. Brief exposures to high vapor concentrations may cause pulmonary edema and bronchitis.

Leaded gasolines have occasionally been used as drugs of abuse. When the vapor is inhaled in excessively high concentrations during this type of abuse, effects on the central nervous system can result with clinical manifestations that may include convulsions, delirium, hallucinations and other symptoms of lead poisoning. These manifestations are not known to occur following accidental inhalation of vapor or skin contact with leaded gasolines during normal operations.

The American Petroleum Institute (API) sponsored studies where laboratory animals were exposed to 67, 292 and 2056 ppm unleaded gasoline vapor six hours/day, five days/week for approximately two years. Each exposure group consisted of 200 rats and 200 mice. A dose-related incidence of microscopic kidney tumors was detected in the male rats. Two tumors were found in the low exposure group, and five were found in the high exposure group. The size of the tumors were unrelated to the dose since all were approximately the same microscopic size and not considered life threatening. These kidney tumors were primarily found at the 24-month sacrifice. Female rats and both male and female mice did not show this type of lesion. It was noted in the study that the animals that were exposed to gasoline vapor lived longer than controls. Thus, the significance of the tumor findings is difficult to evaluate at this time. Additional findings in the API sponsored study, which were observed only at the highest dose tested (2056 ppm), included (1) failure to gain body weight, (2) increased incidence of hepatocellular carcinomas (liver cancer) in female mice and, (3) lung inflammation in male and female rats.

The significance to man of the results of the study discussed above is not known. While we believe that low level or infrequent exposure to gasoline vapor is not likely to cause cancer or other serious disease, in light of the above information, the precautions outlined in this bulletin should be carefully observed. If strong odor of gasoline is present or if any irritation occurs, individuals should leave the area or institute suitable protective measures (see page 2 - Special Protective Information).

## SPECIAL PRECAUTIONS

NEVER siphon gasoline by mouth.

READ AND OBSERVE ALL PRECAUTIONS ON PRODUCT LABEL.

Contains Petroleum Naphtha and Lead.

Use only as a motor fuel. Do not use for cleaning, pressure appliance fuel, or any other such use.

DO NOT USE OR STORE near flame, sparks or hot surfaces. USE AND STORE ONLY IN COOL, WELL VENTILATED AREA.

Keep container closed.

DO NOT TRANSFER LIQUID TO AN UNLABELED CONTAINER.

DO NOT weld, heat or drill container.

Replace cap or bung. Emptied container still contains hazardous or explosive vapor or liquid.

# JET FUELS: JP-4

JPF

Common Synonym	Watery liquid	Colorless	Fuel oil odor
Floats on water.			
Stop discharge if possible. Keep people away. Shut off ignition sources and call fire department. Avoid contact with liquid. Isolate and remove discharged material. Notify local health and pollution control agencies.			
<b>Fire</b>	<b>FLAMMABLE.</b> Extinguish with dry chemical, foam, or carbon dioxide. Water may be ineffective on fire. Cool exposed containers with water.		
<b>Exposure</b>	CALL FOR MEDICAL AID <b>LIQUID</b> Irritating to skin and eyes. Harmful if swallowed. Remove contaminated clothing and shoes. Flush affected areas with plenty of water. IF IN EYES, hold eyelids open and flush with plenty of water. IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk. <b>DO NOT INDUCE VOMITING.</b>		
<b>Water Pollution</b>	Dangerous to aquatic life in high concentrations. Fouling to shoreland. May be dangerous if it enters water intakes. Notify local health and wildlife officials. Notify operators of nearby water intakes.		
<b>1. RESPONSE TO DISCHARGE</b> (See Response Methods Handbook) Issue warning-high flammability Mechanical containment Should be removed Chemical and physical treatment		<b>2. LABEL</b> 2.1 Category: Flammable liquid 2.2 Class: 3	
<b>3. CHEMICAL DESIGNATIONS</b> 3.1 CG Compatibility Class: Miscellaneous Hydrocarbon Mixture 3.2 Formula: C <sub>12</sub> H <sub>26</sub> 3.3 IMO/IUN Designation: 3.2/1853 3.4 DOT ID No.: 1853 3.5 CAS Registry No.: Data not available		<b>4. OBSERVABLE CHARACTERISTICS</b> 4.1 Physical State (as shipped): Liquid 4.2 Color: Colorless to light brown 4.3 Odor: Like fuel oil	
<b>5. HEALTH HAZARDS</b> 5.1 Personal Protective Equipment: Protective gloves; goggles or face shield. 5.2 Symptoms Following Exposure: Vapor causes slight irritation of eyes and nose. Liquid irritates stomach; if taken into lungs, causes coughing, diarrhea, and rapidly developing pulmonary edema. 5.3 Treatment of Exposure: <b>ASPIRATION:</b> enforce bed rest; administer oxygen; call a doctor. <b>INGESTION:</b> do NOT induce vomiting; call a doctor. <b>EYES:</b> wash with plenty of water. SKIN: wipe off and wash with soap and water. 5.4 Threshold Limit Value: 200 ppm 5.5 Short Term Inhalation Limits: 2500 mg/m <sup>3</sup> for 80 min. 5.6 Toxicity by Ingestion: Grade 2; LD <sub>50</sub> = 0.5 to 5 g/kg 5.7 Lethal Toxicity: Data not available 5.8 Vapor (Gas) Irritant Characteristics: Vapors cause a slight stinging of the eyes or respiratory system if present in high concentrations. The effect is temporary. 5.9 Liquid or Solid Irritant Characteristics: Minimum hazard. If spilled on clothing and allowed to remain, may cause stinging and reddening of the skin. 5.10 Odor Threshold: 1 ppm 5.11 IDLH Value: Data not available			

<b>6. FIRE HAZARDS</b>
6.1 Flash Point: -10°F to +30°F C.C. 6.2 Flammable Limits in Air: 1.3%-8.0% 6.3 Fire Extinguishing Agents: Foam, dry chemical, or carbon dioxide 6.4 Fire Extinguishing Agents Not to be Used: Not pertinent 6.5 Special Hazards of Combustion Products: Not pertinent 6.6 Behavior in Fire: Not pertinent 6.7 Ignition Temperature: 464°F 6.8 Electrical Hazard: Not pertinent 6.9 Burning Rate: 4 mm/min. 6.10 Adiabatic Flame Temperature: Data not available 6.11 Stoichiometric Air to Fuel Ratio: Data not available 6.12 Flame Temperature: Data not available

<b>7. CHEMICAL REACTIVITY</b>
7.1 Reactivity With Water: No reaction 7.2 Reactivity with Common Materials: No reaction 7.3 Stability During Transport: Stable 7.4 Neutralizing Agents for Acids and Caustics: Not pertinent 7.5 Polymerization: Not pertinent 7.6 Inhibitor of Polymerization: Not pertinent 7.7 Molar Ratio (Reactant to Product): Data not available 7.8 Reactivity Group: 3

<b>8. WATER POLLUTION</b>
8.1 Aquatic Toxicity: 500 ppm <sup>a</sup> /salmon lingering/lethal/fresh water *Time period not specified 8.2 Waterfowl Toxicity: Data not available 8.3 Biological Oxygen Demand (BOD): 53%, 5 days 8.4 Food Chain Concentration Potential: None

<b>9. SHIPPING INFORMATION</b>
9.1 Grades of Purity: 100% 9.2 Storage Temperature: Ambient 9.3 Inert Atmosphere: No requirement 9.4 Venting: Open flame arrester or pressure-vacuum

<b>10. HAZARD ASSESSMENT CODE</b> (See Hazard Assessment Handbook) A-T-U
--

<b>11. HAZARD CLASSIFICATIONS</b>																													
11.1 Code of Federal Regulations: Flammable liquid																													
11.2 HAZ Hazard Rating for Bulk Water Transportation:																													
<table style="width: 100%; border-collapse: collapse;"> <tr> <th style="text-align: left; border-bottom: 1px solid black;">Category</th> <th style="text-align: right; border-bottom: 1px solid black;">Rating</th> </tr> <tr> <td>Fire</td> <td style="text-align: right;">3</td> </tr> <tr> <td colspan="2">Health</td> </tr> <tr> <td>Vapor Irritant</td> <td style="text-align: right;">1</td> </tr> <tr> <td>Liquid or Solid Irritant</td> <td style="text-align: right;">1</td> </tr> <tr> <td>Poison</td> <td style="text-align: right;">1</td> </tr> <tr> <td colspan="2">Water Pollution</td> </tr> <tr> <td>Human Toxicity</td> <td style="text-align: right;">1</td> </tr> <tr> <td>Aquatic Toxicity</td> <td style="text-align: right;">1</td> </tr> <tr> <td>Aesthetic Effect</td> <td style="text-align: right;">3</td> </tr> <tr> <td colspan="2">Reactivity</td> </tr> <tr> <td>Other Chemicals</td> <td style="text-align: right;">0</td> </tr> <tr> <td>Water</td> <td style="text-align: right;">0</td> </tr> <tr> <td>Self Reaction</td> <td style="text-align: right;">0</td> </tr> </table>	Category	Rating	Fire	3	Health		Vapor Irritant	1	Liquid or Solid Irritant	1	Poison	1	Water Pollution		Human Toxicity	1	Aquatic Toxicity	1	Aesthetic Effect	3	Reactivity		Other Chemicals	0	Water	0	Self Reaction	0	
Category	Rating																												
Fire	3																												
Health																													
Vapor Irritant	1																												
Liquid or Solid Irritant	1																												
Poison	1																												
Water Pollution																													
Human Toxicity	1																												
Aquatic Toxicity	1																												
Aesthetic Effect	3																												
Reactivity																													
Other Chemicals	0																												
Water	0																												
Self Reaction	0																												
11.3 NFPA Hazard Classification:																													
<table style="width: 100%; border-collapse: collapse;"> <tr> <th style="text-align: left; border-bottom: 1px solid black;">Category</th> <th style="text-align: right; border-bottom: 1px solid black;">Classification</th> </tr> <tr> <td>Health Hazard (Blue)</td> <td style="text-align: right;">1</td> </tr> <tr> <td>Flammability (Red)</td> <td style="text-align: right;">3</td> </tr> <tr> <td>Reactivity (Yellow)</td> <td style="text-align: right;">0</td> </tr> </table>	Category	Classification	Health Hazard (Blue)	1	Flammability (Red)	3	Reactivity (Yellow)	0																					
Category	Classification																												
Health Hazard (Blue)	1																												
Flammability (Red)	3																												
Reactivity (Yellow)	0																												

<b>12. PHYSICAL AND CHEMICAL PROPERTIES</b>
12.1 Physical State at 15°C and 1 atm: Liquid
12.2 Molecular Weight: Not pertinent
12.3 Boiling Point at 1 atm: 348-548°F = 178-287°C = 448-580°K
12.4 Freezing Point: < -34°F = < -48°C = < 225°K
12.5 Critical Temperature: Not pertinent
12.6 Critical Pressure: Not pertinent
12.7 Specific Gravity: 0.81 at 20°C (liquid)
12.8 Liquid Surface Tension: (est.) 25 dynes/cm = 0.025 N/m at 20°C
12.9 Liquid Water Interfacial Tension: (est.) 80 dynes/cm = 0.05 N/m at 20°C
12.10 Vapor (Gas) Specific Gravity: Not pertinent
12.11 Ratio of Specific Heats of Vapor (Gas): (est.) 1.00
12.12 Latent Heat of Vaporization: 140 Btu/lb = 78 cal/g = 2.5 x 10 <sup>4</sup> J/kg
12.13 Heat of Combustion: -18,640 Btu/lb = -10,300 cal/g = -431.24 x 10 <sup>4</sup> J/kg
12.14 Heat of Decomposition: Not pertinent
12.15 Heat of Solution: Not pertinent
12.16 Heat of Polymerization: Not pertinent
12.25 Heat of Fusion: Data not available
12.26 Limiting Value: Data not available
12.27 Reid Vapor Pressure: Data not available

NOTES

JPF

## JET FUELS: JP-4

12.17 SATURATED LIQUID DENSITY		12.18 LIQUID HEAT CAPACITY		12.19 LIQUID THERMAL CONDUCTIVITY		12.20 LIQUID VISCOSITY	
Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F	Temperature (degrees F)	British thermal unit-inch per hour- square foot-F	Temperature (degrees F)	Centipoise
34	51.740	0	.444	0	.926	-35	2.106
36	51.670	10	.449	10	.924	-30	1.994
38	51.600	20	.454	20	.921	-25	1.890
40	51.530	30	.459	30	.919	-20	1.794
42	51.460	40	.464	40	.917	-15	1.705
44	51.390	50	.469	50	.915	-10	1.622
46	51.320	60	.474	60	.913	-5	1.544
48	51.260	70	.479	70	.911	0	1.472
50	51.190	80	.484	80	.909	5	1.405
52	51.120	90	.489	90	.907	10	1.342
54	51.050	100	.494	100	.905	15	1.283
56	50.980	110	.499	110	.903	20	1.228
58	50.910	120	.504	120	.901	25	1.176
60	50.840	130	.509	130	.899	30	1.128
62	50.770	140	.514	140	.897	35	1.082
64	50.700	150	.519	150	.895	40	1.039
66	50.630	160	.524	160	.893	45	.999
68	50.560	170	.529	170	.891	50	.961
70	50.490	180	.534	180	.889	55	.925
72	50.420	190	.539	190	.887	60	.891
74	50.350	200	.544	200	.885	65	.859
76	50.280	210	.549	210	.883	70	.829
78	50.220					75	.800
80	50.150						
62	50.080						
64	50.010						

12.21 SOLUBILITY IN WATER		12.22 SATURATED VAPOR PRESSURE		12.23 SATURATED VAPOR DENSITY		12.24 IDEAL GAS HEAT CAPACITY	
Temperature (degrees F)	Pounds per 100 pounds of water	Temperature (degrees F)	Pounds per square inch	Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F
	I	0	.319		N		D
	N	10	.411		O		A
	S	20	.525		T		T
	O	30	.663				A
	L	40	.829		P		
	U	50	1.028		E		N
	B	60	1.264		R		O
	L	70	1.542		T		T
	E	80	1.868		I		
		90	2.246		N		A
		100	2.684		E		V
		110	3.187		N		A
		120	3.762		T		I
		130	4.418				L
		140	5.155				A
		150	5.988				B
		160	6.922				L
		170	7.965				E
		180	9.125				
		190	10.410				
		200	11.830				
		210	13.390				

# Material Information Bulletin

(Approved - "Essentially Similar" to Form OSHA 20, Material Safety Data Sheet)



**TURBINE FUEL, AVIATION JP-4**

**CMS 202260**

**DANGER! HARMFUL OR FATAL IF SWALLOWED  
EXTREMELY FLAMMABLE  
KEEP OUT OF REACH OF CHILDREN**

## TYPICAL COMPOSITION

Paraffins	77-95%
Aromatics	5-20%
Olefins	0-3%
Additives	0.2%

## EXPOSURE STANDARD

The suggested Threshold Limit Value is 200 ppm (parts of vapor per million parts of air) for a daily 8-hour exposure. No OSHA exposure standard has been established for this material.

## PHYSIOLOGICAL & HEALTH EFFECTS

Expected to cause no more than minor eye irritation.

May cause skin irritation on prolonged or frequently repeated contact.

Breathing the vapors at concentrations above the exposure standard can cause central nervous system depression. See Additional Health Data.

Not expected to be acutely toxic by ingestion. **Note to Physician:** Ingestion of this product or subsequent vomiting can result in aspiration of light hydrocarbon liquid which can cause pneumonitis.

## EMERGENCY & FIRST AID PROCEDURES

### Eyes

Wash eyes with fresh water for at least 15 minutes. If irritation continues, see a doctor.

### Skin

Wash thoroughly with soap and water following skin contact. Launder contaminated clothing.

### Inhalation

If there are signs or symptoms, as described in this bulletin, due to breathing this material, move the person to fresh air. If breathing has stopped, apply artificial respiration. Call a doctor immediately.

### Ingestion

If swallowed, **DO NOT** make person vomit. Call a doctor immediately.

## ADDITIONAL HEALTH DATA

See Page 3.

## SPECIAL PROTECTIVE INFORMATION

**Eye Protection:** Avoid contact with eyes. Eye contact can be avoided by wearing chemical safety goggles.

**Skin Protection:** Avoid prolonged or frequently repeated skin contact with this material. Skin contact can be minimized by wearing impervious protective clothing including rubber gloves.

**Respiratory Protection:** Wear approved respiratory protection such as an organic vapor cartridge respirator or an air-supplying respirator unless ventilation equipment is adequate to keep airborne concentrations below the exposure standard.

**Ventilation:** Use adequate ventilation to keep the airborne concentrations of this material below the exposure standard.

## FIRE PROTECTION

This product presents an extreme fire hazard. Liquid very quickly evaporates, even at low temperatures, and forms vapor (fumes) which can catch fire and burn with explosive violence. Invisible vapor spreads easily and can be set on fire by many sources such as pilot lights, welding equipment, and electrical motors and switches.

**Flash Point:** (P-M)  $-46^{\circ}\text{C}$   
**Autoignition Temp.:** NDA  
**Flammability Limits:** NDA

**Extinguishing Media:**  $\text{CO}_2$ , Dry Chemical, Foam, Water Spray.

**Special Fire Fighting Procedures:** For fires involving this material, do not enter any enclosed or confined fire space without proper protective equipment. This may include self-contained breathing apparatus to protect against the hazardous effects of normal products of combustion or oxygen deficiency. Read the entire bulletin.

## SPECIAL PRECAUTIONS

See Page 3.

## ENVIRONMENTAL PROTECTION

**Environmental Impact:** Certain geographical areas have air pollution restrictions concerning the use of materials in work situations which may release volatile components to the atmosphere. Air pollution regulations should be studied to determine if this material is regulated in the area where it is to be used.

**Precautions if Material is Released or Spilled:** Eliminate all sources of ignition in vicinity of spill or released vapor. Clean up spills as soon as possible, observing precautions in Special Protective Information. Absorb large spills with absorbent clay, diatomaceous earth, or other suitable material. A fire or vapor hazard may exist since these cleanup materials will only absorb liquid; they will not absorb vapor.

**Waste Disposal Methods:** Place contaminated materials in disposable containers and bury in an approved dumping area.

## REACTIVITY DATA

**Stability (Thermal, Light, etc.):** Stable.

**Incompatibility (Materials to Avoid):** May react with strong oxidizing materials.

**Hazardous Decomposition Products:** Normal combustion forms carbon dioxide and water vapor; incomplete combustion can produce carbon monoxide.

**Hazardous Polymerization:** Will not occur.

## PHYSICAL PROPERTIES

**Solubility:** Insoluble in water. Miscible with hydrocarbons.

**Appearance (Color, Odor, etc.):** Colorless to pale amber liquid.

**Boiling Range:**  $57-274^{\circ}\text{C}$

**Freezing Point:** Below  $-50^{\circ}\text{C}$  (Max.)

**Specific Gravity:** 0.75-0.80

**Vapor Pressure:** (Reid) 2.3-2.9 lbs. @  $37.8^{\circ}\text{C}$

**Vapor Density (Air = 1):** NDA

**Percent Volatile (Volume %):** NDA

**Evaporation ( = 1):** NDA

**Viscosity:** 4 cSt @  $-34.4^{\circ}\text{C}$

NDA = No Data Available

The above information is based on data of which we are aware and is believed to be correct as of the date hereof. Since the information contained herein may be applied under conditions beyond our control and with which we may be unfamiliar and since data made available subsequent to the date hereof may suggest modifications of the information, we do not assume any responsibility for the results of its use. This information is furnished upon the condition that the person receiving it shall make his own determination of the suitability of the material for his particular purpose.

# Material Information Bulletin

Turbin Fuel, Aviation JP-4

CMS 202260

## ADDITIONAL HEALTH DATA

Signs and symptoms of central nervous system depression may include one or more of the following: headache, dizziness, loss of appetite, weakness and loss of coordination. Affected persons usually experience complete recovery when removed from the exposure area. Data available for a similar material indicate that this material is not expected to be acutely toxic.

## SPECIAL PRECAUTIONS

Contains Petroleum Naphtha.

DO NOT USE OR STORE near flame, sparks or hot surfaces. USE ONLY IN WELL VENTILATED AREA. Keep container closed.

DO NOT weld, heat or drill container. Replace cap or bung. Emptied container still contains hazardous or explosive vapor or liquid.

CAUTION! Do not use pressure to empty drum or explosion may result.

# JET FUELS: JP-5

JPV

<p><b>Common Synonyms</b> Kerosene, heavy</p>	<p>Liquid</p> <p>Colorless</p> <p>Fuel oil odor</p>	<p>Floats on water.</p>	
<p>Stop discharge if possible Call fire department Avoid contact with liquid Isolate and remove discharged material Notify local health and pollution control agencies</p>			
<b>Fire</b>	<p>Combustible Extinguish with dry chemical, foam, or carbon dioxide Water may be ineffective on fire Cool exposed containers with water</p>		
<b>Exposure</b>	<p>CALL FOR MEDICAL AID</p> <p><b>LIQUID</b> Irritating to skin and eyes. Harmful if swallowed. Remove contaminated clothing and shoes. Flush affected areas with plenty of water. <b>IF IN EYES</b>, hold eyelids open and flush with plenty of water. <b>IF SWALLOWED</b> and victim is <b>CONSCIOUS</b>, have victim drink water or milk. <b>DO NOT INDUCE VOMITING</b></p>		
<b>Water Pollution</b>	<p>Dangerous to aquatic life in high concentrations. Fouling to shoreline. May be dangerous if it enters water intakes. Notify local health and wildlife officials. Notify operators of nearby water intakes.</p>		
<p><b>1. RESPONSE TO DISCHARGE</b> (See Response Methods Handbook) Mechanical containment should be removed. Chemical and physical treatment.</p>		<p><b>2. LABEL</b></p> <p>2.1 Category: None 2.5 Class: Not pertinent</p>	
<p><b>3. CHEMICAL DESIGNATIONS</b></p> <p>3.1 CG Compatibility Class: Miscellaneous Hydrocarbon Mixtures 3.2 Formula: Not pertinent 3.3 IMO/IUM Designation: 3.3/2781 3.4 DOT ID No.: 2781 3.5 CAS Registry No.: Data not available</p>		<p><b>4. OBSERVABLE CHARACTERISTICS</b></p> <p>4.1 Physical State (as shipped): Liquid 4.2 Color: Colorless to light brown 4.3 Odor: Like fuel oil</p>	
<p style="text-align: center;"><b>5. HEALTH HAZARDS</b></p> <p>5.1 Personal Protective Equipment: Protective gloves; goggles or face shield. 5.2 Symptoms Following Exposure: Vapor causes slight irritation of eyes and nose. Liquid irritates stomach; if taken into lungs, causes coughing, distress, and rapidly developing pulmonary edema. 5.3 Treatment of Exposure: <b>ASPIRATION</b>: enforce bed rest, administer oxygen, call a doctor. <b>INGESTION</b>: do NOT induce vomiting; call a doctor. <b>EYES</b>: wash with plenty of water. <b>SKIN</b>: wipe off and wash with soap and water. 5.4 Threshold Limit Value: 200 ppm 5.5 Short Term Inhalation Limit: 2500 mg/m<sup>3</sup> for 80 min. 5.6 Toxicity by Ingestion: Grade 2; LD<sub>50</sub> = 0.5 to 5 g/kg 5.7 Skin Toxicity: Data not available 5.8 Vapor (Gas) Irritant Characteristics: Vapors cause a slight stinging of the eyes or respiratory system if present in high concentrations. The effect is temporary. 5.9 Liquid or Solid Irritant Characteristics: Minimum hazard. If spilled on clothing and allowed to remain, may cause smearing and reddening of the skin. 5.10 Odor Threshold: 1 ppm 5.11 IDLH Value: Data not available</p>			

**6. FIRE HAZARDS**

6.1 Flash Point: 140°F (min.) J.C.C.  
6.2 Flammable Limits in Air: 0.6%-4.6%  
6.3 Fire Extinguishing Agents: Foam, dry chemical, or carbon dioxide  
6.4 Fire Extinguishing Agents Not to be Used: Water may be ineffective  
6.5 Special Hazards of Combustion Products: Not pertinent  
6.6 Behavior in Fire: Not pertinent  
6.7 Ignition Temperature: 475°F  
6.8 Electrical Hazard: Not pertinent  
6.9 Burning Rate: 4 mm/min.  
6.10 Adiabatic Flame Temperature: Data not available  
6.11 Stoichiometric Air to Fuel Ratio: Data not available  
6.12 Flame Temperature: Data not available

**7. CHEMICAL REACTIVITY**

7.1 Reactivity With Water: No reaction  
7.2 Reactivity With Common Materials: No reaction  
7.3 Stability During Transport: Stable  
7.4 Neutralizing Agents for Acids and Caustics: Not pertinent  
7.5 Polymerization: Not pertinent  
7.6 Inhibitor of Polymerization: Not pertinent  
7.7 Water Ratio (Reactant to Product): Data not available  
7.8 Reactivity Group: 33

**8. WATER POLLUTION**

8.1 Aquatic Toxicity: 500 ppm / 7 salmon fingerling/ethal/fresh water  
\*Time period not specified  
8.2 Waterway Toxicity: Data not available  
8.3 Biological Oxygen Demand (BOD): 53%, 5 days  
8.4 Food Chain Concentration Potential: None

**9. SHIPPING INFORMATION**

9.1 Grades of Purity: 100%  
9.2 Storage Temperature: Ambient  
9.3 Inert Atmospheric: No requirement  
9.4 Venting: Open (flame arrester)

**10. HAZARD ASSESSMENT CODE**  
(See Hazard Assessment Handbook)  
A-T-U

**11. HAZARD CLASSIFICATIONS**

11.1 Code of Federal Regulations: Combustible liquid  
11.2 NAB Hazard Rating for Bulk Water Transportation:

Category	Rating
Fire	1-2
Health	
Vapor Irritant	1
Liquid or Solid Irritant	1
Poisons	1
Water Pollution	
Human Toxicity	1
Aquatic Toxicity	1
Aesthetic Effect	3
Reactivity	
Other Chemicals	0
Water	0
Self Reaction	0

11.3 NFPA Hazard Classification:

Category	Classification
Health Hazard (Blue)	0
Flammability (Red)	2
Reactivity (Yellow)	0

**12. PHYSICAL AND CHEMICAL PROPERTIES**

12.1 Physical State at 15°C and 1 atm: Liquid  
12.2 Molecular Weight: Not pertinent  
12.3 Boiling Point at 1 atm: 349-349°F = 176-257°C = 449-507°K  
12.4 Freezing Point: <-54°F = <-48°C = <-225°K  
12.5 Critical Temperature: Not pertinent  
12.6 Critical Pressure: Not pertinent  
12.7 Specific Gravity: 0.82 at 15°C (liquid)  
12.8 Liquid Surface Tension: (est.) 25 dynes/cm = 0.025 N/m at 20°C  
12.9 Liquid Water Interfacial Tension: (est.) 50 dynes/cm = 0.05 N/m at 20°C  
12.10 Vapor (Gas) Specific Gravity: Not pertinent  
12.11 Ratio of Specific Heats of Vapor (Gas): Not pertinent  
12.12 Latent Heat of Vaporization: 140 Btu/lb = 78 cal/g = 8.3 X 10<sup>4</sup> J/kg  
12.13 Heat of Combustion: -18,540 Btu/lb = -10,300 cal/g = -43,124 X 10<sup>4</sup> J/kg  
12.14 Heat of Decomposition: Not pertinent  
12.15 Heat of Solution: Not pertinent  
12.16 Heat of Polymerization: Not pertinent  
12.17 Heat of Fusion: Data not available  
12.18 Limiting Value: Data not available  
12.19 Reid Vapor Pressure: Data not available

NOTES

JPV

## JET FUELS: JP-5

12.17 SATURATED LIQUID DENSITY		12.18 LIQUID HEAT CAPACITY		12.19 LIQUID THERMAL CONDUCTIVITY		12.20 LIQUID VISCOSITY	
Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F	Temperature (degrees F)	British thermal unit-inch per hour- square foot-F	Temperature (degrees F)	Centipoise
34	52.370	0	.444	0	.926	-35	10.600
36	52.300	10	.449	10	.924	-30	9.614
38	52.230	20	.454	20	.921	-25	8.739
40	52.160	30	.459	30	.919	-20	7.960
42	52.090	40	.464	40	.917	-15	7.286
44	52.020	50	.469	50	.915	-10	6.648
46	51.950	60	.474	60	.913	-5	6.090
48	51.880	70	.479	70	.911	0	5.592
50	51.810	80	.484	80	.909	5	5.144
52	51.740	90	.489	90	.907	10	4.740
54	51.670	100	.494	100	.905	15	4.376
56	51.600	110	.499	110	.903	20	4.046
58	51.530	120	.504	120	.901	25	3.747
60	51.460	130	.509	130	.899	30	3.476
62	51.390	140	.514	140	.897	35	3.229
64	51.330	150	.519	150	.895	40	3.004
66	51.260	160	.524	160	.893	45	2.799
68	51.190	170	.529	170	.891	50	2.612
70	51.120	180	.534	180	.889	55	2.440
72	51.050	190	.539	190	.887	60	2.282
74	50.980	200	.544	200	.885	65	2.138
76	50.910	210	.549	210	.883	70	2.005
78	50.840					75	1.883
80	50.770						
82	50.700						
84	50.630						

12.21 SOLUBILITY IN WATER		12.22 SATURATED VAPOR PRESSURE		12.23 SATURATED VAPOR DENSITY		12.24 IDEAL GAS HEAT CAPACITY	
Temperature (degrees F)	Pounds per 100 pounds of water	Temperature (degrees F)	Pounds per square inch	Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F
	I	130	.101		N		D
	N	140	.130		O		A
	S	150	.166		T		T
	O	160	.210				A
	L	170	.264		P		
	U	180	.330		E		N
	B	190	.409		R		O
	L	200	.504		T		T
	E	210	.616		I		A
		220	.750		N		V
		230	.907		E		A
		240	1.091		N		I
		250	1.306		T		L
		260	1.555				A
		270	1.843				B
		280	2.174				L
		290	2.553				E
		300	2.986				

# Material Information Bulletin

(Approved - "Essentially Similar" to Form OSHA 20, Material Safety Data Sheet)



**CHEVRON Jet Fuel A**

**CPS 216103**

**DANGER!** HARMFUL OR FATAL IF SWALLOWED  
COMBUSTIBLE  
KEEP OUT OF REACH OF CHILDREN

## TYPICAL COMPOSITION

Paraffins (incl. naphthenes)	74-88%
Aromatics:	
C <sub>8</sub> <sup>+</sup>	12-20%
Olefins	0-3%
Naphthalenes	0-3%

## EXPOSURE STANDARD

The suggested Threshold Limit Value is 200 ppm (parts of vapor per million parts of air) for a daily 8-hour exposure. There is no OSHA exposure standard.

## PHYSIOLOGICAL & HEALTH EFFECTS

May cause eye irritation.

Expected to produce no more than minor skin irritation following prolonged or frequently repeated contact.

Breathing the vapors at concentrations above the exposure standard can cause central nervous system depression. See Additional Health Data.

Not expected to be acutely toxic by ingestion.  
**Note to Physician:** Ingestion of this product or subsequent vomiting can result in aspiration of light hydrocarbon liquid which can cause pneumonitis.

## EMERGENCY & FIRST AID PROCEDURES

### Eyes

Wash eyes with fresh water for at least 15 minutes. If irritation continues, see a doctor.

### Skin

Wash thoroughly with soap and water following skin contact. Launder contaminated clothing.

### Inhalation

If there are signs or symptoms, as described in this bulletin, due to breathing this material, move the person to fresh air. If breathing has stopped, apply artificial respiration. Call a doctor immediately.

### Ingestion

If swallowed, DO NOT make person vomit. Call a doctor immediately.

of the following: headache, dizziness, loss of appetite, weakness and loss of coordination. Affected persons usually experience complete recovery when removed from the exposure area.

Data available for a similar material indicate that this material is not expected to be acutely toxic.

#### **SPECIAL PROTECTIVE INFORMATION**

**Eye Protection:** Avoid contact with eyes. Eye contact can be avoided by wearing chemical safety goggles.

**Skin Protection:** Avoid prolonged or frequently repeated skin contact with this material. Skin contact can be minimized by wearing impervious protective clothing including rubber gloves.

**Respiratory Protection:** Wear approved respiratory protection such as an organic vapor cartridge respirator or an air-supplying respirator unless ventilation equipment is adequate to keep airborne concentrations below the exposure standard.

**Ventilation:** Use adequate ventilation to keep the airborne concentrations of this material below the exposure standard.

#### **HEALTH PROTECTION**

Liquid evaporates and forms vapors (fumes) which can catch fire and burn with explosive violence. Invisible vapor spreads easily and can be set on fire by many sources such as pilot lights, welding equipment, and electrical motors and switches. Fire hazard is greater as liquid temperature rises above 85°F.

**Flash Point:** (P-M) 107-120°F

**Autoignition Temp.:** NDA

**Flammability Limits:** NDA

**Extinguishing Media:** CO<sub>2</sub>, Dry Chemical, Foam, Water Spray.

**Special Fire Fighting Procedures:** For fires involving this material, do not enter any enclosed or confined fire space without proper protective equipment, including self-contained breathing apparatus to protect against the hazardous effects of normal products of combustion or oxygen deficiency. Read the entire bulletin.

#### **SPECIAL PRECAUTIONS**

See Page 3.

areas have air pollution restrictions concerning the use of materials in work situations which may release volatile components to the atmosphere. Air pollution regulations should be studied to determine if this material is regulated in the area where it is to be used.

**Precautions if Material is Released or Spilled:** Eliminate all open flames in vicinity of spill or released vapor. Clean up spills as soon as possible, observing precautions in Special Protective Information. Absorb large spills with absorbent clay, diatomaceous earth or other suitable material. A fire or vapor hazard may exist since these cleanup materials will only absorb liquid; they will not absorb vapor.

**Waste Disposal Methods:** Place contaminated materials in disposable containers and bury in an approved dumping area.

#### **REACTIVITY DATA**

**Stability (Thermal, Light, etc.):** Stable.

**Incompatibility (Materials to Avoid):** May react with strong oxidizing materials.

**Hazardous Decomposition Products:** Normal combustion forms carbon dioxide and water vapor; incomplete combustion can produce carbon monoxide.

**Hazardous Polymerization:** Will not occur.

#### **PHYSICAL PROPERTIES**

**Solubility:** Insoluble in water; miscible with hydrocarbons.

**Appearance (Color, odor, etc.):** Pale yellow liquid.

**Boiling Range:** 150-290°C

**Freeze Point:** -40°

**Specific Gravity:** 0.784-0.811

**Vapor Pressure (mm Hg & Temp.):** NDA

**Vapor Density (Air = 1):** NDA

**Percent Volatile (Volume %):** NDA

**Evaporation (= 1):** NDA

**Viscosity:** 8 cSt @ -30°F

NDA = No Data Available

The above information is based on data of which we are aware and is believed to be correct as of the date hereof. Since the information contained herein may be applied under conditions beyond our control and with which we may be unfamiliar and since data made available subsequent to the date hereof may suggest modifications of the information, we do not assume any responsibility for the results of its use. This information is furnished upon the condition that the person receiving it shall make his own determination of the suitability of the material for his particular purpose.

# Material Information Bulletin

CHEVRON Jet Fuel A

CPS 216103

## SPECIAL PRECAUTIONS

READ AND OBSERVE ALL PRECAUTIONS ON PRODUCT LABEL

Contains Petroleum Distillate.

DO NOT USE or STORE near flame, sparks or hot surfaces. USE ONLY IN WELL VENTILATED AREA.

Keep container closed.

DO NOT weld, heat or drill container.

Replace cap or bung. Emptied container still contains hazardous or explosive vapor or liquid.

CAUTION! Do not use pressure to empty drum or explosion may result.

**WARNING!** Not for use as portable heater or appliance fuel. Toxic fumes may accumulate and cause death.

**Guide 27****POTENTIAL HAZARDS****FIRE OR EXPLOSION**

Flammable/combustible material; may be ignited by heat, sparks or flames.  
Vapors may travel to a source of ignition and flash back.  
Container may explode in heat of fire.  
Vapor explosion hazard indoors, outdoors or in sewers.  
Runoff to sewer may create fire or explosion hazard.

**HEALTH HAZARDS**

May be poisonous if inhaled or absorbed through skin.  
Vapors may cause dizziness or suffocation.  
Contact may irritate or burn skin and eyes.  
Fire may produce irritating or poisonous gases.  
Runoff from fire control or dilution water may cause pollution.

**EMERGENCY ACTION**

Keep unnecessary people away; isolate hazard area and deny entry.  
Stay upwind; keep out of low areas.  
Wear self-contained (positive pressure if available) breathing apparatus and full protective clothing.  
Isolate for 1/2 mile in all directions if tank car or truck is involved in fire.  
FOR EMERGENCY ASSISTANCE CALL CHEMTREC (800) 424-9300.  
If water pollution occurs, notify appropriate authorities.

**FIRE**

**Small Fires:** Dry chemical, CO<sub>2</sub>, water spray or foam.  
**Large Fires:** Water spray, fog or foam.  
Move container from fire area if you can do it without risk.  
Cool containers that are exposed to flames with water from the side until well after fire is out.  
For massive fire in cargo area, use unmanned hose holder or monitor nozzles; if this is impossible, withdraw from area and let fire burn.  
Withdraw immediately in case of rising sound from venting safety device or any discoloration of tank due to fire.

**SPILL OR LEAK**

Shut off ignition sources; no flares, smoking or flames in hazard area.  
Stop leak if you can do it without risk.  
Use water spray to reduce vapors.  
**Small Spills:** Take up with sand or other noncombustible absorbent material and place into containers for later disposal.  
**Large Spills:** Dike far ahead of spill for later disposal.

**FIRST AID**

Move victim to fresh air; call emergency medical care.  
If not breathing, give artificial respiration.  
If breathing is difficult, give oxygen.  
In case of contact with material, immediately flush eyes with running water for at least 15 minutes. Wash skin with soap and water.  
Remove and isolate contaminated clothing and shoes at the site.

# APPENDIX F

## **FINAL EXAMINATION and KEY**

AIRCRAFT RESCUE AND FIRE FIGHTING

FINAL EXAMINATION

AIRCRAFT RESCUE AND FIRE FIGHTING

1. VERY IMPORTANT: USE ONLY #2 PENCIL
2. Use the answer sheet provided. DO NOT write or mark on this test booklet.
3. ON ANSWER SHEET
  - fill in your name
  - subject should read AIRCRAFT RESCUE AND FIRE FIGHTING
  - fill in the date
4. Select the ONE answer that you believe to be the most correct. Mark the letter on your answer sheet that corresponds with the choice you have selected. An item will be scored wrong if more than one answer is selected.

## AIRCRAFT RESCUE AND FIRE FIGHTING

1. The Aircraft Rescue and Fire Fighting Course was designed in accordance with:
  - a. IFSTA 206
  - b. NTSB 329
  - c. NFPA 1003-1987
  - d. FAA Part 139
  
2. Familiarization of airport and surrounding areas will accomplish all EXCEPT:
  - a. Decrease response time
  - b. Become knowledgeable about all operations
  - c. Aid with additional responders
  - d. Decrease life loss and property damage
  
3. A valuable aid to utilize for the airport and surrounding area familiarization is:
  - a. Street locator
  - b. Run cards
  - c. Runway numbering map
  - d. Grid map
  
4. Runway designation numbers are taken:
  - a. Clockwise, from the face of a clock, with 12 o'clock being due north
  - b. Counterclockwise, from the face of a clock, with 12 o'clock being due north
  - c. From compass bearings
  - d. From airport grid maps
  
5. Taxiways are identified by:
  - a. White lights
  - b. Green lights
  - c. Blue lights
  - d. Amber lights

AIRCRAFT RESCUE AND FIRE FIGHTING

6. Threshold lights are identified by:
  - a. White lights
  - b. Blue lights
  - c. Amber lights
  - d. Green lights
  
7. Runway lights are identified by:
  - a. White lights
  - b. Blue lights
  - c. Amber lights
  - d. Green lights
  
8. Ways of controlling airport vehicle traffic are:
  - a. Telephone and radio communications
  - b. Tower signals and telephone
  - c. Light signals and radio communications
  - d. Ground and runway frequencies
  
9. A standard ground control frequency is:
  - a. 120.4
  - b. 121.7
  - c. 130.0
  - d. 124.0
  
10. A flashing red light from the tower means:
  - a. Stop
  - b. Return to starting point
  - c. Proceed parallel to runway
  - d. Clear active runway immediately

## AIRCRAFT RESCUE AND FIRE FIGHTING

11. Alternating red and green lights from the tower mean:
  - a. Return to starting point
  - b. Clear runway immediately
  - c. Stop
  - d. General warning, exercise extreme caution
  
12. In order to eliminate communication confusion, the International Civil Aviation Organization uses the:
  - a. Greek alphabet
  - b. European aviation alphabet
  - c. Phonetic alphabet
  - d. Universal alphabet
  
13. In the case of an actual crash situation, the tower will initiate a/an:
  - a. Alert II
  - b. Alert III
  - c. Alert I
  - d. Multi-Casualty Plan
  
14. An Alert II response would involve:
  - a. Standing by at the fire station
  - b. Standing by at taxiways adjacent to runways
  - c. Response on the runway involved
  - d. Radio surveillance only
  
15. The main purpose of an aircraft pre-fire plan is to:
  - a. Train all responding agencies
  - b. Satisfy FAA requirements
  - c. Provide basic facts about an aircraft before an incident occurs
  - d. Aid the insurance companies

## AIRCRAFT RESCUE AND FIRE FIGHTING

16. Aircraft pre-fire plans should be found in:
  - a. Airport administration
  - b. Chief's vehicle, command vehicle, station library
  - c. Training Bureau
  - d. Duty Chief's vehicle
  
17. The two main types of aircraft are:
  - a. Single engine and twin engine
  - b. Commercial and corporate
  - c. Propeller and jet driven
  - d. Fixed wing and rotary wing
  
18. The metal skin or covering on most aircraft is duralumin which begins to melt at:
  - a. 3000° F
  - b. 2000° F
  - c. 1500° F
  - d. 1200° F
  
19. Aircraft parts made of magnesium and alloys when burning will react violently when exposed to:
  - a. Air
  - b. Metal
  - c. Water
  - d. Dry chemicals
  
20. Piston engines are found primarily on:
  - a. Helicopters
  - b. Corporate aircraft
  - c. Charter aircraft
  - d. General aviation aircraft

## AIRCRAFT RESCUE AND FIRE FIGHTING

21. An engine which incorporates functions of a propeller and a jet engine is:
- Turbo-jet
  - Supercharged engine
  - Ram-jet
  - Turbo-prop
22. Air is drawn into the front of a jet engine where it is \_\_\_\_\_, mixed with fuel, ignited, and expelled to produce thrust.
- Expanded
  - Compressed
  - Heated
  - Contained
23. Because of the visibility dangers associated with propellers, approach should be made from the:
- Front only
  - Rear when at all possible
  - Side only within 15 feet
  - Front and side
24. Jet engine blast velocities are considered undesirable for personnel and equipment above:
- 30 miles per hour and 44 feet per second
  - 10 miles per hour and 30 feet per second
  - 50 miles per hour and 65 feet per second
  - 30 miles per hour and 75 feet per second
25. A safe minimum clear zone in front of jet engine intakes for fire department operations is:
- 50 feet
  - 35 feet
  - 25 feet
  - 20 yards

## AIRCRAFT RESCUE AND FIRE FIGHTING

26. When exposed to aircraft engine operations, proper health protection would include:
- Head protection
  - Ear protection
  - Eye protection
  - All of the above
27. When pre-planning for an aircraft incident, careful consideration should be given to:
- Wind velocity
  - Aircraft systems and hazards
  - Runway length
  - Aircraft weight
28. A solid red color code on aircraft piping designation signifies:
- High pressure air
  - Liquid oxygen
  - Fuel
  - Electrical
29. The color coding for hydraulic system lines is:
- Green and yellow
  - Red and brown
  - Brown and blue
  - Blue and yellow
30. The color code for aircraft electrical systems is:
- Brown and red
  - Green and yellow
  - Orange
  - Brown

## AIRCRAFT RESCUE AND FIRE FIGHTING

31. Aircraft hydraulic systems may carry pressures up to:
- 1000 psi
  - 3000 psi
  - 4000 psi
  - 1750 psi
32. Fuel tanks on aircraft are usually located in the:
- Fuselage
  - Tail empennage
  - Wings
  - Belly tanks
33. Two hazards associated with oxygen systems on aircraft are:
- Toxic vapors, smoke generation
  - Intensified burning, explosion
  - Corrosion, skin damage
  - Decomposition, oxidation
34. The danger associated with anti-icing systems is:
- Flammable alcohol
  - Toxic vapors
  - Oxidation
  - Explosive glycerine
35. With large fuel spills from and around aircraft, the following procedures should be followed:
- Monitor operations
  - Shut off electrical power and evacuate the aircraft
  - Notify the Coast Guard
  - Call the tower

AIRCRAFT RESCUE AND FIRE FIGHTING

36. A large fuel spill would be classified as:
- a. Under 10 feet in any direction
  - b. Over 60 square feet
  - c. Over 10 feet in any direction, over 50 square feet of a continuous nature
  - d. Under 50 square feet
37. An ignition source which is often overlooked is:
- a. Sonar
  - b. Radar
  - c. Lightning
  - d. Hot engines
38. Protective clothing should be inspected:
- a. Annually
  - b. Semi-annually
  - c. Daily and after use
  - d. As needed
39. Long sleeve clothing should be worn beneath protective clothing to avoid:
- a. Hypothermia
  - b. Skin rash
  - c. Steam burns
  - d. Heat stroke
40. When fighting aircraft fires, self-contained breathing apparatus is to be donned when:
- a. Directed by the officer in charge
  - b. Depending on wind conditions
  - c. Toxic atmospheres exist
  - d. Extinguishing wheel fires only

## AIRCRAFT RESCUE AND FIRE FIGHTING

41. When fighting aircraft fires involving explosives, a minimum withdrawal distance for fire fighters is:
- 1200 feet
  - 2000 feet
  - 2500 feet
  - 3000 feet
42. When fighting an aircraft fire which involves conventional weapons, position fire fighting vehicles at:
- The nose of the aircraft
  - A 45 degree angle to the fuselage
  - The tail of the aircraft
  - An upwind position
43. In accidents involving nuclear weapons, fire fighters may be subjected to:
- Detonation
  - Gamma fallout
  - Alpha contamination
  - Beta rays
44. Airport fire fighters should learn to recognize radioactive symbols as outlined in:
- NFPA Fire Code No. 406
  - U.S. Title 14 Code of Federal Regulations 103
  - FAA Part 139
  - NTSB 329
45. Only when the canopy cannot be opened by primary and secondary systems should it be:
- Cut open
  - Jettisoned
  - Removed
  - Disassembled

## AIRCRAFT RESCUE AND FIRE FIGHTING

46. The safest method of safetying an ejection seat is:
- Pinning the seat
  - Removing the arming handles
  - Cutting the gas (initiator) line
  - Have the pilot safety the seat
47. Only after all normal entrance and exit doors and hatches have been tried for egress should:
- Slides be deployed
  - Emergency cut-in be initiated
  - Cargo compartments be opened
  - Aircraft be dismantled
48. Various dry chemical extinguishing agents:
- Are compatible with each other and can be mixed in portable extinguishers
  - Are non-corrosive
  - Will prevent reflash of fuels after extinguishment
  - Are treated to be water repellent and free flowing
49. Using an aspirating foam nozzle compared to a non-aspirating foam nozzle:
- Does not expand the finished foam as much
  - Increases burnback resistance of finished foam
  - Creates finished foam which lasts longer
  - Answers b and c are both correct
50. Carbon dioxide (CO<sub>2</sub>) as an extinguishing agent:
- Leaves a messy residue after use
  - May crack hot metal
  - Works primarily by removing the fuel side of the fire triangle
  - Eliminates danger of flashback

## AIRCRAFT RESCUE AND FIRE FIGHTING

51. Aircraft fuel vapors:
- Are lighter than air
  - Will not migrate downwind of a fuel spill
  - Can be ignited by hot aircraft engine parts up to twenty (20) minutes after shutdown
  - Are water soluble and water miscible
52. The key word(s) to describe proper foam application techniques is/are:
- Submerge
  - Gently
  - Plunge
  - Wide fog
53. The kerosene grade aircraft fuel used by commercial and some military jets is:
- Jet A
  - Jet B
  - JP-4
  - AVGAS
54. The flash point of AVGAS and Jet B aircraft fuels:
- Is well below ambient temperatures found in California
  - Is well above ambient temperatures found in California
  - Are identical to their autoignition temperatures
  - Are only a problem in a mist form after an aircraft crash
55. Which of the following agents extinguishes aircraft fuel fires and prevents reflash for a period of time?
- Halon 1211
  - Carbon dioxide (CO<sub>2</sub>)
  - Aqueous film forming foam (AFFF)
  - Purple K dry chemical

## AIRCRAFT RESCUE AND FIRE FIGHTING

56. Which of the following extinguishing agents works primarily by interrupting the combustion chain reaction?
- Carbon dioxide (CO<sub>2</sub>)
  - Halon 1211
  - Purple K dry chemical
  - Answers b and c are both correct
57. Different types of foam concentrates:
- Can be mixed together prior to proportioning and during storage
  - Must be proportioned separately, but can be applied simultaneously on burning fuel
  - Have almost identical characteristics and properties
  - Have similar 25% drain times
58. Foam concentrates, foam pre-mix solutions, and foam proportioning equipment:
- Have indefinite shelf life
  - Should be tested a minimum of once a year (annually)
  - Are not expensive to purchase
  - Require very little training to use
59. All of the following are advantages of aqueous film forming foam EXCEPT:
- Its foam solution will not break down or drain out
  - Quick knockdown
  - Its foam blanket reheals itself when disrupted by foot traffic or hose lines
  - Has a long shelf life compared to other foams
60. Foam solution is the proper combination of:
- Water and foam concentrate
  - Foam concentrate and air
  - Aqueous film forming foam (AFFF) and purple K
  - Flouorocarbon surfactants and protein polymers

## AIRCRAFT RESCUE AND FIRE FIGHTING

61. When connecting bonding cables during fueling operations:
- Connect to an unpainted metal point on aircraft
  - All necessary bonding cables should be connected prior to start of fueling
  - Use bonding wire of adequate size and construction
  - All of the above are correct statements
62. Which of the following is most important at a large aircraft fuel fire:
- Ambient temperature
  - Water supply
  - Ground composition
  - Ignition sources
63. Airport fire prevention activities involve:
- Monitoring aircraft maintenance and service activities for fire hazards
  - Observing fueling operations for proper procedures
  - Checking portable extinguishers for proper placement and charge
  - All of the above are correct answers
64. The usual method of discharge for twin agent extinguishing systems is:
- High pressure helium
  - A two stage pump
  - Compressed air or nitrogen
  - A balanced pressure proportioner
65. Guidelines for aircraft fire fighting apparatus are found in:
- FAA Regulations
  - NFPA pamphlets
  - U.S. Air Force fire fighting manuals
  - Both a and b are correct answers

## AIRCRAFT RESCUE AND FIRE FIGHTING

66. Airport index ratings for required quantities of extinguishing agents are based on the:
- Amount of fuel carried on aircraft using the airport
  - Length of aircraft using the airport
  - Number of passengers using the airport
  - Distance from airport fire station to the farthest runway
67. A minimum of one fire fighting vehicle must be able to reach and discharge agent at the midpoint of the farthest runway within how many minutes?
- 1
  - 2
  - 3
  - 4
68. What is the minimum number of fire fighting vehicles needed to satisfy Index D and E requirements?
- 1
  - 2
  - 3
  - 4
69. To satisfy extinguishing agent requirements on airport fire fighting vehicles, one pound of Halon 1211 is equivalent to how many pounds of dry chemical?
- 1
  - 3
  - 8
  - 16
70. The eight basic elements of aircraft fire fighting, in priority order are:
- Response, Size Up/Approach, Positioning, Control, Rescue, Attack, Extinguishment, Overhaul
  - Response, Size Up/Approach, Positioning, Attack, Control, Rescue, Extinguishment, Overhaul
  - Response, Size Up/Approach, Attack, Positioning, Control, Rescue, Extinguishment, Overhaul
  - Response, Size Up/Approach, Positioning, Control, Rescue, Attack, Overhaul, Extinguishment

## AIRCRAFT RESCUE AND FIRE FIGHTING

71. The primary objective of aircraft fire fighting is:
- Extinguishment
  - Rescue
  - Positioning
  - Exposures
72. The last resort to gaining access in aircraft is:
- Hatches and doors
  - Cargo compartments
  - Cutting in procedures
  - Pilot's windows
73. A good way of providing additional means of egress is to:
- Provide additional foam blanketing
  - Cut the fuselage
  - Ladder the wings and pilot's windows
  - Provide additional rescue crews
74. The correct hand signal for "ready for operations" (everything OK) is:
- Thumbs up
  - Thumbs down
  - Arm across chest
  - Inverted V-signal over head
75. Because of the noise involved with air crash fire fighting, the most effective means of communications between crews is:
- Runners
  - Radios
  - Hand signals
  - All of the above

AIRCRAFT RESCUE AND FIRE FIGHTING

76. The correct hand signal for "cease operations" is:
- a. Hands over head in an inverted V-pattern
  - b. One hand pointing to a location
  - c. One arm extended, thumb up
  - d. One arm extended, thumb down
77. The correct hand signal for a fog (dispersed) discharge pattern is:
- a. Hands over head in an inverted V-pattern
  - b. One arm across the chest
  - c. One arm extended, thumb down
  - d. None of the above are correct
78. The correct hand signal for a straight stream application is:
- a. One hand across the chest
  - b. Hands over head in an inverted V-pattern
  - c. One hand extended and the other hand pointing to desired location
  - d. One arm extended, thumb up
79. The correct hand signal for a bumper turret operation is:
- a. Hands over the head
  - b. One hand pointing to a location
  - c. One hand across the chest
  - d. None of the above are correct
80. The best method of extinguishing engine fires is by using:
- a. Foam
  - b. Water
  - c. Dry chemical
  - d. Halon 1211

## AIRCRAFT RESCUE AND FIRE FIGHTING

81. Because wheel fires involve combustibile metals, fire fighters should:
- Use large amounts of water
  - Use AFFF
  - Wear breathing apparatus
  - Allow the fire to burn out
82. Because aircraft wheel rims have fusible plugs which can explode at 400° F, fire fighters fighting a wheel fire should:
- Evacuate the area
  - Approach from front and rear only
  - Approach from sides only
  - Use mass foam application
83. A good wind indicator when responding to an aircraft incident is:
- Weather report
  - Tower wind vane
  - Wind sock
  - Observation
84. Positioning at the accident may be difficult because of:
- Water supplies
  - Exposures
  - Wreckage and victims
  - Airport traffic
85. Rescue corridors are established with mass application of agent from turret nozzles and maintained with:
- Mutual aid
  - Handlines
  - Portable extinguishers
  - Ladders

## AIRCRAFT RESCUE AND FIRE FIGHTING

86. Handlines are important because they ensure:
- Rescue crew protection
  - Additional fuselage protection
  - Fuel spill coverage
  - All of the above
87. In aircraft incidents, complete extinguishment of all fire may not be attempted until:
- The pilot is rescued
  - Additional crews arrive
  - Rescue is complete
  - The incident commander directs it
88. Overhaul operations begin at the:
- Tail
  - Wing
  - Engines
  - Nose
89. During overhaul, avoid disturbing the wreckage when possible:
- To avoid more damage
  - To preserve investigation evidence
  - To avoid injury
  - For insurance purposes
90. Body removal should be done:
- With body bags
  - Under medical supervision
  - With stretchers
  - By triage teams

## AIRCRAFT RESCUE AND FIRE FIGHTING

91. Because aircraft accidents attract large crowds of spectators, it is important that the:
- News media be contacted
  - Incident be isolated
  - Tower controls the area
  - Military be notified
92. A appropriate method of identifying authorized personnel at the scene is with:
- I.D. cards
  - Drivers license
  - Vests and arm bands
  - Airport pass
93. All of the following are good practices for news media personnel at a crash scene EXCEPT:
- Provide vests
  - Schedule briefings
  - Escort into crash site
  - Provide constant access
94. The two agencies who are notified to investigate an aircraft incident are:
- FBI, FEMA
  - FAA, NTSB
  - USAF, NASA
  - CIA, DOT
95. Fire fighters have the authority to remove which of the following from crashed aircraft?
- Mail
  - Armaments
  - Flight recorder
  - Emergency locating transmitter

## AIRCRAFT RESCUE AND FIRE FIGHTING

96. The fire department is in command of an aircraft crash scene until?
- Relieved by law enforcement officers
  - The FAA arrives at the scene
  - Fire officials determine the emergency is over
  - The NTSB takes command
97. Bodies are photographed in original positions for:
- Legal and investigative evidence
  - Fire department records
  - Release to relatives
  - Training of airport fire fighters
98. A quick and efficient means of establishing a temporary morgue is by using:
- Ice skating rinks
  - Frozen food storage lockers
  - Refrigerated trucks
  - High school gymnasiums
99. Because of the brutal nature of aircraft crashes, fire fighters must recognize the symptoms of:
- Nausea
  - Headaches
  - Critical incident stress disorder
  - Fatigue
100. The most effective method of recognizing and dealing with Post Traumatic Stress Disorder is to:
- Monitor personnel at scene
  - Provide frequent rest periods and fresh personnel
  - Provide professional counseling at scene
  - All of the above are true statements

AIRCRAFT RESCUE AND FIRE FIGHTING

JULY 1988

Key

<u>ANSWER</u>	<u>ANSWER</u>
1. ( C )	26. ( D )
2. ( B )	27. ( B )
3. ( D )	28. ( C )
4. ( C )	29. ( D )
5. ( C )	30. ( A )
6. ( D )	31. ( B )
7. ( A )	32. ( C )
8. ( C )	33. ( B )
9. ( B )	34. ( A )
10. ( D )	35. ( B )
11. ( D )	36. ( C )
12. ( C )	37. ( B )
13. ( B )	38. ( C )
14. ( B )	39. ( C )
15. ( C )	40. ( C )
16. ( B )	41. ( A )
17. ( D )	42. ( B )
18. ( D )	43. ( C )
19. ( C )	44. ( B )
20. ( D )	45. ( B )
21. ( D )	46. ( C )
22. ( B )	47. ( B )
23. ( B )	48. ( D )
24. ( A )	49. ( D )
25. ( C )	50. ( B )

AIRCRAFT RESCUE AND FIRE FIGHTING  
JULY 1988  
Key

<u>ANSWER</u>	<u>ANSWER</u>
51. ( C )	76. ( C )
52. ( B )	77. ( A )
53. ( A )	78. ( C )
54. ( B )	79. ( C )
55. ( C )	80. ( D )
56. ( D )	81. ( C )
57. ( B )	82. ( B )
58. ( B )	83. ( C )
59. ( A )	84. ( C )
60. ( A )	85. ( B )
61. ( D )	86. ( D )
62. ( B )	87. ( C )
63. ( D )	88. ( D )
64. ( C )	89. ( B )
65. ( D )	90. ( B )
66. ( B )	91. ( B )
67. ( C )	92. ( C )
68. ( C )	93. ( D )
69. ( A )	94. ( B )
70. ( B )	95. ( A )
71. ( B )	96. ( C )
72. ( C )	97. ( A )
73. ( C )	98. ( C )
74. ( A )	99. ( C )
75. ( C )	100. ( D )

