AIRCRAFT RESCUE AND FIRE FIGHTING (ARFF) MOBILE SIMULATOR

MT. VERNON OUTLAND AIRPORT
MT. VERNON, ILLINOIS

Documentation to adhere to the requirements of FAR Part 139 and the enhancement of aviation safety.

MVN
Mt. Vernon Outland Airport

APRIL 16, 2018

AIRCRAFT RESCUE AND FIRE FIGHTING (ARFF)
MOBILE ARFF SIMULATOR

An airport in the United States, that is certificated by the Federal Aviation Administration (FAA) must comply with the requirements of Federal Aviation Regulations (FAR) Part 139.

14 CFR Part 139 requires FAA to issue airport operating certificates to airports that---

- *Serve scheduled and unscheduled air carrier aircraft with more than 30 seats;*
- *Serve scheduled air carrier operations in aircraft with more than 9 seats but less than 31 seats; and*
- *The FAA Administrator requires to have a certificate.*

Airport Operating Certificates serve to ensure safety in air transportation. To obtain a certificate, an airport must agree to certain operational and safety standards and provide for such things as firefighting and rescue equipment. These requirements vary depending on the size of the airport and the type of flights available. The regulation, however, does allow FAA to issue certain exemptions to airports that serve few passengers yearly and for which some requirements might create a financial hardship. [1]

The primary document of record that must be prepared and approved by the Airport Sponsor and reviewed and approved by the FAA is the Airport Certification Manual (ACM). Within the ACM is a chapter that addresses the requirements of FAR Part 14 Part 139.319, Aircraft Rescue and Firefighting: Operational requirements. Specifically with FAR Part 14 Part 139.319 is paragraph (i)(2)(vii) which addresses required training for emergency aircraft evacuation assistance.

The Mt. Vernon Outland Airport (KMVN) is in Mt. Vernon, Jefferson County, Illinois, at the intersection of Interstates 57 and 64 and located in a portion of the State of the Illinois referred to as Little Egypt. KMVN is a FAR Part 139 Certificated Airport and subject to the requirements referenced previously. To comply with **14 Part 139.319 (i)(2)(vii) (Emergency Aircraft Evacuation Assistance)** training requirements, KMVN created a Mobile ARFF Simulator to assist first responders in complying with FAA requirements. This portable educational classroom gives local first responders a hands-on experience in being able to extract passengers in the event of an incident. The Mobile ARFF Simulator can also be used for training of **14 Part 139.319 (i)(2)(ii) (Aircraft Familiarization)** and portions of other subjects. Advisory Circular AC 150/5210-17C "Programs for Training of ARFF Personnel", included in the Appendix, should be the foundation for any ARFF Training Curriculum. The Mobile ARFF Simulator aids in satisfying some of the Advisory Circular's training guidelines. Although the training specifications were created for 14 Part 139 airports, first responders serving airports of all sizes (non-FAR Part 139) could certainly benefit from understanding the twelve subject areas and tailoring a training curriculum to suit their department's needs. The following describes the Mobile ARFF Simulator and training options.

THE AIRCRAFT

The Mobile ARFF Simulator started its life as a Piper PA-31T, PAY1 "Cheyenne I". The PAY1 is a seven-seat cabin class twin engine turboprop. The aircraft was pressurized and routinely flew at altitudes of 18,000 – 30,000 feet. It cruised at approximately 365 knots. The maximum takeoff weight was 9,000 lbs. Turboprop aircraft such as the Piper Cheyenne PAY1-PAYIV Series and the more prevalent

[1] https://www.faa.gov/airports/airport_safety/part139_cert/what-is-part-139/

Beechcraft King Air BE90–BE-350 Series are the backbone of the entry level business transport market. Small turboprops such as these can be seen on the ramps at nearly every airport. These aircraft burn Jet A (Turbine Engine) Fuel. They do not contain an Auxiliary Power Unit (APU) in their empennage (tail). The PA-31T carried 382 gallons.

The Mobile ARFF Simulator's empennage has been removed so it can be trailered to off airport locations. The simulator's cockpit lacks all instrumentation, control yokes, throttle quadrant levers, side panels, and upper panels. These elements were removed and salvaged prior to the aircraft being pressed into ARFF training mode. Placards are placed in important areas such as the electrical master and fuel shut off switches.

For first responders to see actual aircraft construction, elements of the aircraft's interior have been removed on the right-side wall of the Mobile ARFF Simulator. Interior panels are still attached on the left side and the ceiling. Note the three Oxygen ports in the ceiling. The main Oxygen Lines feeding the ceiling ports are visible just behind the co-pilot's seat. Alert your trainees to the coding tape on the actual lines and introduce them to the Attached Standardized Coding Chart.

TRANSPORT, SET-UP, AND RETURN

The Mobile ARFF Simulator contains a tail stand on the left rear. Please deploy the tail stand, adjust the height, and lock it into place prior to boarding the aircraft. Like all aircraft, please limit the access to one occupant on the door at one time. Prior to closing the door, make sure the door cables are tucked inside the door frame. Pay special attention to the door cable on the left side. It must be to the right of the hydraulic cylinder for the door to close properly.

Feel free to pull the Emergency Exit Window. Since the aircraft is constructed for a pressurized cabin, it can only be opened from the interior. The door is a "plug type". Be sure to use this device in your training curriculum. To re-mount the window, place the bottom in first, then the top. Ensure the red handle's tabs are on the exterior of the support flange prior to moving the handle back into original

position. It takes some practice and is sort of a tight fit. Use a flashlight and your eyes on the handle upper tabs/support lock while pressing it forward.

A 120V AC electrical connector is located on the lower side of the nose (look for the OEM 24V Ground Power Connector latch). Once plugged into a source (using an extension cord), cabin outlets on the firewall and service galley are energized.

The Mobile ARFF Simulator contains a 5000 BTU air conditioner mounted in the firewall area. To operate the air conditioning system, open the nose baggage compartment door (use the fence post supplied in the cabin to keep the baggage compartment door in the open position). The air conditioning unit is controlled by a small remote magnetized to a steel cover above the throttle quadrant just aft of the firewall in the cabin. Ensure the air conditioner is plugged into the dedicated outlet inside the nose baggage compartment. **Do not operate the air conditioner without the nose compartment baggage door in the open position. If it is necessary to use and extension cord with more than twenty feet of length, make sure the cord is constructed with wire gage of 12 or larger (14 gage wire will not support the load over lengths of 25 feet or more).**

At the completion of training. Unplug devices from all outlets. And make sure all doors, door latches, and the emergency exit window are in their proper positions. Verify the air conditioner remote is affixed to the throttle quadrant cover. Ensure the tail stand is stowed in the horizontal position and locked in place prior to transport.

TRAINING RULES

Your department is encouraged to use the Mobile ARFF Simulator in as many ways as possible. This includes hands-on live training with extinguishing agents (exterior only), ingress/egress, locating aircraft systems, and **theoretical** extrication/evacuation.

However, to preserve the Mobile ARFF Simulator for future use, the following actions are **not allowed**:

ACTUAL FIRES
"LIVE" INTERIOR FIRE ATTACK TRAINING
CUTTING, SAWING, OR PUNCTURING OF THE AIRCRAFT

If AFFF and/or Dry Chemicals are utilized, please wash the Mobile ARFF Simulator upon completion of your training. The next department would appreciate receiving a clean aircraft.

TRAINING TIPS

It is recommended the following videos be viewed prior to using the Mobile ARFF Simulator:

- First Responder Safety at a Small Airplane or Helicopter Crash, Module #1, Systems and Materials (27 Min.) Hazards: https://www.faa.gov/aircraft/gen_av/first_responders/media/mod1/mod1.html
- First Responder Safety at a Small Airplane or Helicopter Crash, Module #2, Aircraft Type Familiarization and Mission Specific Hazards (7 Min.): https://www.faa.gov/aircraft/gen_av/first_responders/media/mod2/mod2.html

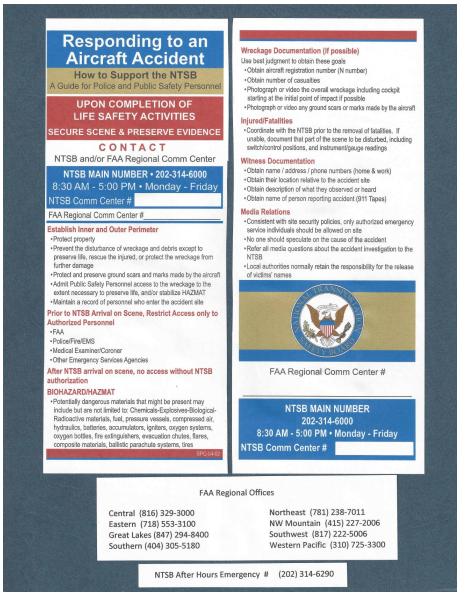
It is recommended the following videos be viewed prior to using the Mobile ARFF Simulator (cont.):

- ARFF Aircraft Familiarization Video (20 Min): https://www.youtube.com/watch?v=AHq3GTcfjdY
- ARFF Aircraft Forcible Entry (26 Min): https://www.youtube.com/watch?v=W-Xp5GIKz18
- Emergency A/C Evacuation Assistance Video (10 Min): https://www.youtube.com/watch?v=G6J8NiG4P9c

The Mobile ARFF Simulator includes a flash drive containing an ARFF "Crash Chart" Database. If your department does not have a "Crash Chart" Database, please install the database on your devices and ensure your first responders have access to it. The "Crash Chart" Database should be utilized in your Aircraft Familiarization and Emergency Aircraft Evacuation Assistance Training.

It is recommended the following video be viewed by all Command Personnel & Training Officers:

- First Responder Safety at a small Airplane or Helicopter Crash, Module #3, Command & Recovery: https://www.faa.gov/aircraft/gen_av/first_responders/media/mod3/mod3.html



The video details the notification and interaction with the FAA and NTSB after an accident. Included in the Appendix is the NTSB Pamphlet "Responding to an Aircraft Accident". Command Personnel and Training Officers should become familiar with the pamphlet's bullet points and use them in all training classes.

Below are some tips to help your department utilize the Mobile ARFF Simulator:

AIRCRAFT FAMILIARIZATION

Aircraft Familiarization – This would be a good time to compare and contrast twin engine piston and twin-engine turboprop aircraft. Piston powered aircraft burn 100LL aviation gasoline and turbine powered aircraft burn Jet A fuel. First responders should be visually able to tell the difference in engines. Piston engine nacelles and propeller blades are smaller. Another way to discern a turboprop engine is by its overall length. The propeller, engine and nacelle combination are very long. Turboprops also have very large exposed exhausts.

Some facts about fuels – ensure your trainees know the differences between 100LL Aviation Gasoline and Jet A (Turbine Engine) Fuels. 100LL Aviation Gasoline is blue in color, evaporates quickly, and for the most part is clean. Its ignition temperature, flash point (-49 degrees F), flammable limits and flame spread (800 feet per minute) are similar to automotive gasoline. Jet A is straw clear (like Coors Beer), evaporates very slowly, and is oily/greasy. Its 100 degree F flash point is much higher than 100LL Aviation Gasoline and its flame spread is lower at 100 feet per minute. Spills of both fuels over ten feet in any direction or covering an area over 50 square feet should be blanketed with foam. Trainees need to be mindful of ambient temperatures on hot summer days. Concrete and asphalt aprons could be 25 to 50 degrees F hotter making spill or incidents more dangerous for first responders.

Piston types may or may not be pressurized. All turboprops are pressurized due to the maximum performance characteristics of flying at higher altitudes.

Locate the PA-31T information on the ARFF Crash Chart Database. Ensure your first responders know where they are located and are familiar with the following on the aircraft:

- **Emergency Master Switches**
- **Fuel Shut-Off Switches**
- **Battery Quick Disconnect**
- **Oxygen System**
- **Hydraulic System**
- **Fire Protection**
- **Anti-Icing**

Note: **Reinforce that in an actual accident, nothing is moved unless there is a good reason to do so (risk of fire and/or life-saving situation). If something needs to be moved, photograph/record everything – especially instruments and fuel shut-off switch locations.**

Shutdown any necessary items prior to de-energizing the electrical system (Emergency Master Switch and/or Battery Quick Disconnect). Important features such as electrically actuated cargo doors and fire protection systems require electrical energy and must be addressed prior to de-energizing the aircraft.

Turboprops such as the PA-31T will have an Oxygen System fed by a green colored pressurized cylinder. Even if the bottle is located and first responders close the valve, responders should assume the lines are still pressurized.

Exercise extreme caution around hydraulic lines. Hydraulic lines are pressurized and some fluids can be extremely flammable. Hydraulic fluids can cause irritation to the skin and eyes.

The following topics in FAA Advisory Circular 150/5210-17C (1.3.2) "Aircraft Familiarization" (all points listed) can be covered and/or discussed using the Mobile ARFF Simulator and its corresponding "Crash Charts":

1. Identify all types of passenger and cargo aircraft operating at the airport.
2. Identify the different types of propulsion systems.
3. Locate normal entry doors, emergency exit openings, and ~~evacuation slides~~ for a given aircraft.
4. Demonstrate the opening of all doors and compartments for a given passenger or cargo aircraft.
5. Identify approximate aircrew and passenger capacities for a given aircraft.
6. Identify the type of fuel used, location of the tanks, and capacity of fuel tanks for a given aircraft.
7. Identify and locate components of the fuel, oxygen, hydraulic, electrical, fire protection, anti-icing, auxiliary power (APU), brake, wheel, and egress systems for a given aircraft.
8. ~~Identify and locate the flight data recorder and cockpit voice recorder in the event of an aircraft mishap.~~
9. ~~Identify and locate the opening and operation of doors, compartments, and hatches for a given cargo aircraft.~~
10. Identify normal and emergency shutdown procedures for aircraft engines~~ and auxiliary power units.~~
11. ~~Identify the general hazards associated with military aircraft, such as ejection seats, armament, and specialized fuels.~~

EMERGENCY AIRCRAFT EVACUATION ASSISTANCE TRAINING

Emergency Aircraft Evacuation Assistance – Think of the Mobile ARFF Simulator as a small-scale example of the aircraft shown on the ARFF Aircraft Forcible Entry and Emergency Aircraft Evacuation Assistance Videos. The Mobile ARFF Simulator has pressurized windows, window bays, and is made of the same materials as larger transport aircraft.

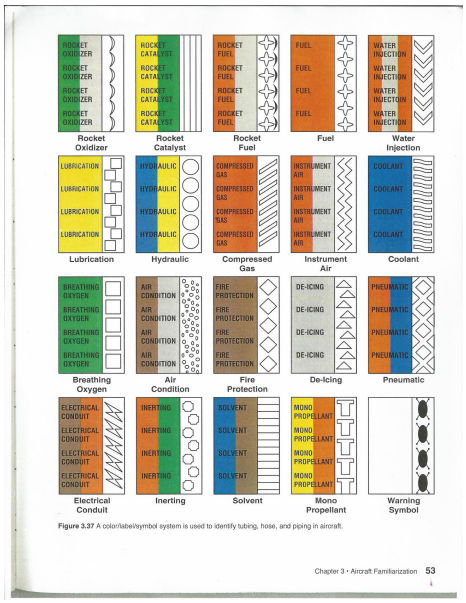
AGAIN, NO SAWING, CUTTING, AX HAMMERING, PUNCTURING, OR ANYTHING THAT COULD DAMAGE THE MOBILE ARFF SIMULATOR IS ALLOWED!

A very good way to achieve some real-world scenario training using the Mobile ARFF Simulator is to close the door and inform your trainees that the aircraft has crashed, and that the door is damaged beyond use. There are five occupants on board and all are unconscious. Ask your first responders "how do we get to them?" Remember the following:

1. The Emergency Exit is a plug type. It can't be opened from the outside and the occupants are unable to extricate themselves (unconscious).
2. The aircraft has thick windows (pressurized construction). Puncturing windows is either difficult or not possible.

3. Cutting near the door is not a good idea – the door area is the most structurally enhanced area on an aircraft.
4. Most twin engine aircraft have a service galley and/or lavatory in the aft section of the aircraft. Cutting in the service galley and/or lavatory area adds a significant amount of workload due to more structure and should be avoided.

Trainees need to identify the type of aircraft from the ARFF Crash Chart and develop an understanding where and where not to cut. If the first responder is lucky, the ARFF Crash Chart will include an area identified "Cut In Rescue" , "Emergency Rescue", or "Chop Out Area". The Piper PA-31T "Crash Chart" does not identify a cut area. Therefore, the first responder must understand the process piping and identify areas safe to cut. Stress the importance of the Standardized Coding Chart. Note the chart uses color, symbols, and labels to simplify identification of the systems.



The Oxygen System piping is visible in the Mobile ARFF Simulator in several locations. Examples of other piping systems are on display externally as well.

Once a cut area is identified, the first responder can locate the area, or "Bay", select a tool, and **imagine** cutting that "Bay".

For most small to mid-size jet and turboprop aircraft, a 14-inch diameter rotary saw is the tool of choice for extrication. Its blade diameter is sufficient to cut through outer layer skin, support structure, HVAC ducts, and interior panels (as visible on the right side of the ARFF Mobile Simulator). Category CIII Aircraft (lengths of 100' feet or more) will require a 16-inch diameter rotary saw to penetrate all structural elements.

What if the aircraft's wings are broken off and the fuselage is laying on its side or upside down? Cutting the bottom side of the fuselage is not a good idea due to large support structures and process piping. In the case of the Piper PA-31T, oxygen lines are plumbed through the top of the fuselage. **Cutting the top of the cabin is not recommended!**

The lesson learned is that first responders must be familiar with where the process piping is located so that he/she can make a safe extrication – safe for the occupants, the responder and the team. **ARFF "Crash Charts" and Aircraft Familiarization are essential!**

The following topics of Advisory Circular 150/5210-17C (1.3.7) "Emergency Aircraft Evacuation Assistance" (all points listed) can be discussed using the Mobile ARFF Simulator and its corresponding "Crash Charts":

1. Identify procedures followed during an emergency situation by crews of air carriers, cargo aircraft, and general aviation aircraft operating at the airport.
2. Identify the procedures to use to protect evacuation points.

3. Identify which opening should be used to gain entry for a given aircraft and considerations that may affect the situation.
4. Select the necessary forcible entry tool(s) and/or equipment to gain entry to a given aircraft and situation.
5. While wearing full protective clothing, demonstrate, from inside and outside the aircraft, opening normal entry doors and emergency exit points for a given aircraft.
6. Identify potential locations for cut-in entry, using reference manuals, aircraft markings, or general guidelines for a given aircraft.

7. Identify the hazards with cut-in entry.
8. Demonstrate the procedures used to assist passengers during emergency evacuation.

Note: ARFF personnel should not impede the exit of occupants and crew when trying to enter the fuselage for rescue and/or firefighting, ARFF personnel must locate and open any other available exits. Additionally, many occupants may not be able to extricate themselves, so ARFF personnel should be prepared to assist after all those who are able to exit have evacuated.

ADDITIONAL TRAINING

The following segments of Advisory Circular 150/5210-17C can be incorporated into your training with a little imagination:

1.3.3 - Rescue and Firefighting Personnel Safety:

A. Identify the hazards associated with aircraft rescue and firefighting.
B. Identify the hazards to personnel associated with aircraft and aircraft systems.

1.3.4 - Emergency Communications Systems on the Airport Including Fire Alarms:

A. Demonstrate the use of standard hand signals used to communicate with aircrew personnel (*recommend discussing local communication with your significant airport tenants and FBO Line Staff*)
B. Give an initial status report for a simulated aircraft accident.
C. Identify the local methods used to communicate with aircraft personnel (*see #8*).

1.3.6 - Applications of Extinguishing Agents:

A. Identify the preferred agent(s) to use in suppression and extinguishment for various fire scenarios (*discuss what agent to use on fuel, engine, airframe, and landing gear fire scenarios. Have first responders provide their agent preferences and why they chose a particular agent*).
B. Demonstrate agent application techniques utilizing turrets, high reach extendable turrets (if available), and hose lines in both exterior and interior fire attack scenarios. Again, no live interior firefighting!

1.3.8 - Firefighting Operations:

A. Identify the proper procedure to use when protecting and aircraft fuselage from fire exposure.
B. Identify the procedures to use to stabilize aircraft wreckage.
C. Identify interior aircraft attack procedures.
D. Demonstrate how to deploy applicable ladders to access aircraft.

1.3.9 - Adapting and Using Structural Rescue and Firefighting Equipment for Aircraft Rescue and Firefighting:

A. Use of hydraulic extrication equipment on an aircraft and how it differs from that used on motor vehicles (*aluminum and aluminum alloys cut easier than steel and do not spark like steel when cut*).

B. Use of power circular saws, reciprocating saws, and various other power tools designed for structural firefighting and the challenges their use on aircraft present (again, the most effective aircraft extrication tool is the 14" – 16" diameter rotary saw. AMKUS/Hurst Hydraulic Cutters/Spreaders work very well after puncture holes are made).
C. Use of fire axes, Halligan tool, pike poles and other hand tools designed for structural firefighting and what each would be used for.

1.3.12 - Familiarization with Firefighters' Duties under the Airport Emergency Plan:

A. Identify various types of aircraft related emergencies.
B. Identify the procedures to use to size-up a given aircraft accident/incident.

OTHER HANDS ON OPPORTUNITIES

Mt. Vernon Outland Airport owns other aircraft that are utilized for ARFF hands on training. A Cessna 402B is used for scenario based ARFF practice (engine, landing gear, wing, cabin fires, etc). For actual extrication practice, a Cessna Citation 550 Fuselage is mounted on a specially designed frame. The aircraft structure has been modified for re-use after each training exercise. If travel time is no factor, members of your department are invited to Mt. Vernon Outland Airport to use these additional tools. You will have to supply your vehicle(s) and equipment.

CONCLUSION

Enjoy your time with the Mobile ARFF Simulator. I hope it helps your department develop procedures and methods to make aviation safer at your airport and community.

If your department discovers new ways to teach with the Mobile ARFF Simulator, please pass your methods, tips, additions, deletions along so that others can benefit. Send your comments to:

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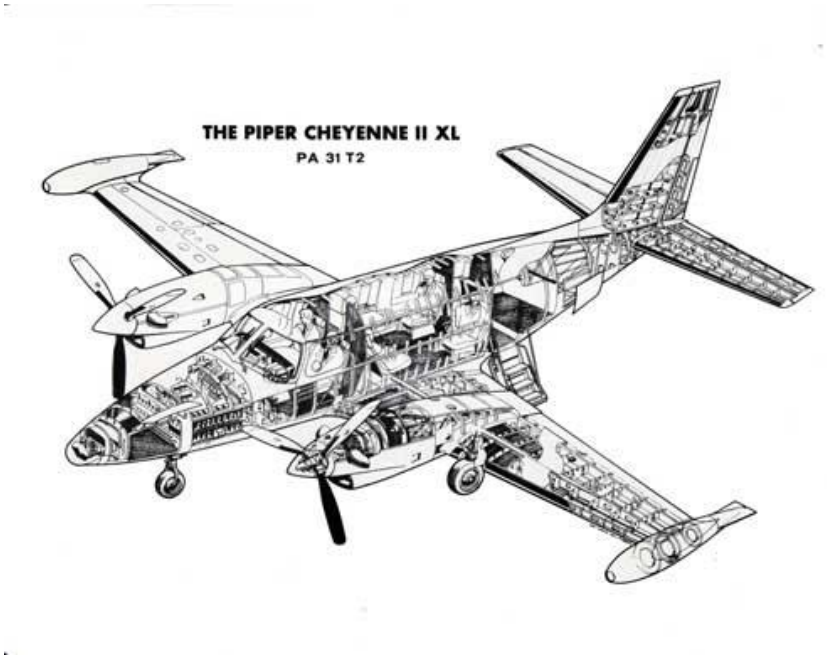
APPENDIX

Advisory Circular AC 150/5210-17C "Programs for Training of ARFF Personnel"

Standardized Aircraft Coding Chart

NTSB Pamphlet "Responding to an Aircraft Accident"



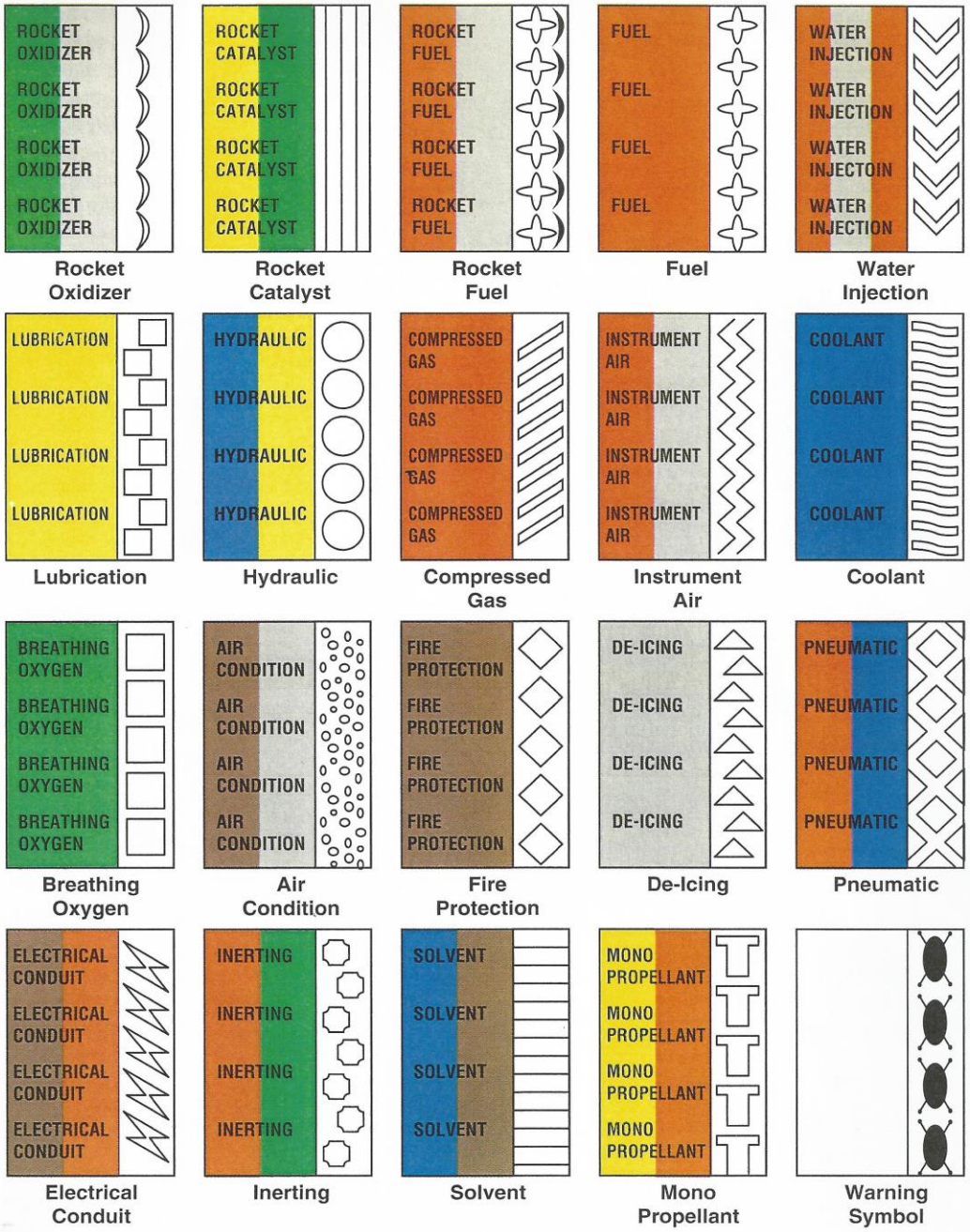


Figure 3.37 A color/label/symbol system is used to identify tubing, hose, and piping in aircraft.

Responding to an Aircraft Accident

How to Support the NTSB

A Guide for Police and Public Safety Personnel

UPON COMPLETION OF LIFE SAFETY ACTIVITIES

SECURE SCENE & PRESERVE EVIDENCE

CONTACT

NTSB and/or FAA Regional Comm Center

NTSB MAIN NUMBER • 202-314-6000

8:30 AM - 5:00 PM • Monday - Friday

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Establish Inner and Outer Perimeter

- Protect property
- Prevent the disturbance of wreckage and debris except to preserve life, rescue the injured, or protect the wreckage from further damage
- Protect and preserve ground scars and marks made by the aircraft
- Admit Public Safety Personnel access to the wreckage to the extent necessary to preserve life, and/or stabilize HAZMAT
- Maintain a record of personnel who enter the accident site

Prior to NTSB Arrival on Scene, Restrict Access only to Authorized Personnel

- FAA
- Police/Fire/EMS
- Medical Examiner/Coroner
- Other Emergency Services Agencies

After NTSB arrival on scene, no access without NTSB authorization

BIOHAZARD/HAZMAT

- Potentially dangerous materials that might be present may include but are not limited to: Chemicals-Explosives-Biological-Radioactive materials, fuel, pressure vessels, compressed air, hydraulics, batteries, accumulators, igniters, oxygen systems, oxygen bottles, fire extinguishers, evacuation chutes, flares, composite materials, ballistic parachute systems, tires

SPC-04-02

Wreckage Documentation (if possible)

Use best judgment to obtain these goals

- Obtain aircraft registration number (N number)
- Obtain number of casualties
- Photograph or video the overall wreckage including cockpit starting at the initial point of impact if possible
- Photograph or video any ground scars or marks made by the aircraft

Injured/Fatalities

- Coordinate with the NTSB prior to the removal of fatalities. If unable, document that part of the scene to be disturbed, including switch/control positions, and instrument/gauge readings

Witness Documentation

- Obtain name / address / phone numbers (home & work)
- Obtain their location relative to the accident site
- Obtain description of what they observed or heard
- Obtain name of person reporting accident (911 Tapes)

Media Relations

- Consistent with site security policies, only authorized emergency service individuals should be allowed on site
- No one should speculate on the cause of the accident
- Refer all media questions about the accident investigation to the NTSB
- Local authorities normally retain the responsibility for the release of victims' names

NATIONAL TRANSPORTATION SAFETY BOARD

FAA Regional Comm Center # _____

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