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of Transportation

Federal Aviation
Administration

Advisory Circular

Subject: ARFF Vehicle and High Reach
Extendable Turret (HRET) Operation,
Training and Qualifications

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Change:

1. PURPOSE. This advisory circular (AC) contains the Federal Aviation Administration's (FAA) standards, and recommendations for the training of airport firefighting and rescue personnel in the proper operation and tactical use of ARFF vehicles and ARFF Vehicles equipped with HRETs. This guidance includes the development of department Standard Operating Guidelines (SOGs) and the development of department proficiency evaluation standards. This AC incorporates detailed information concerning operational requirements, and applicability of Title 14 Code of Federal Regulations (CFR) Part 139.317, Aircraft Rescue and Firefighting: Equipment and Agents, AC 150/5220-10, Guide Specification for Aircraft Rescue and Firefighting Vehicles, and National Fire Protection Association (NFPA) Standards 405, Recurring Proficiency of Airport Fire Fighters (2010 Edition), 414, Aircraft Rescue and Firefighting Vehicles (2007 Edition), and 1003, Airport Fire Fighter Professional Qualifications (2010 Edition). Certain information in the Advisory Circular is complemented by the FAA ARFF Training DVD in the HRET and Cargo Aircraft Sections.

2. SCOPE. This AC addresses the following:

- a. An overview of technological advances in ARFF.
- b. Provisions for a systematic approach of determining vehicle requirements.
- c. Tactical applications and capabilities of HRETs.
- d. Firefighting strategies involving employment of HRETs.
- e. Training, qualification and recurrent training guidance for ARFF trainers and ARFF firefighters relative to ARFF vehicles and mounted equipment.
- f. Proficiency exercises for qualification of ARFF vehicle operators and HRET operators.
- g. Guidance on the use of penetrating nozzles.
- h. Guidance on aircraft construction as it relates to the use of penetrating nozzles.
- i. Tactical guidance for ARFF firefighters when deploying penetrating nozzles on passenger and cargo aircraft.
- j. Guidance on aircraft stability as it relates to the use of penetrating nozzles.

3. BIBLIOGRAPHY. References and web links provided in the bibliography.

4. APPLICATION. The Federal Aviation Administration (FAA) recommends the guidance and specifications in this Advisory Circular be used by ARFF personnel. In general, use of this AC is not mandatory. However, use of this AC is mandatory for all projects funded with federal grant monies through the Airport Improvement Program (AIP) and with revenue from the Passenger Facility Charges (PFC) Program. See Grant Assistance No. 34, Policies, Standards, and Specifications, and PFC Assurances No.9, Standards and Specifications. The training and qualification guidance provided may be adopted or amended by the airport based on their specific circumstances, but the ARFF program must meet the intent of the guidance provided herein.

5. METRIC UNITS. To promote an orderly transition to metric units, this AC contains both English and metric dimensions, where applicable. The metric conversions may not be exact metric equivalents and, until there is an official changeover to the metric system, the English dimensions will govern.

6. EFFECTIVE DATE. This is a new advisory circular with an effective date of September 30, 2010.

7. COMMENTS OR SUGGESTIONS for improvements to this AC should be sent to:

Manager, Airport Safety and Standards
Federal Aviation Administration
ATTN: AAS-300
800 Independence Avenue, S.W.
Washington D.C. 20591

8. COPIES OF THIS AC. The Office of Airport Safety and Standards is in the process of making ACs available to the public through the Internet. These ACs may be found through the FAA ARFF Web Page: http://www.faa.gov/airports/airport_safety/aircraft_rescue_fire_fighting/ which is linked to the FAA home page (www.faa.gov). A printed copy of this AC and other ACs can be ordered from:

U.S. Department of Transportation
Subsequent Distribution Office
Ardmore East Business Center
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CHAPTER 1. INTRODUCTION

1.1 General

National Fire Protection Association (NFPA) Standard 414, Aircraft Rescue and Fire Fighting Vehicles, defines a High Reach Extendable Turret (HRET) or Extendable Turret as: “a device, permanently mounted with a power-operated boom or booms, designed to supply a large-capacity, mobile, elevated water stream or other fire extinguishing agents, or both”.

1.2 Purpose

a. HRETs provide significant tactical Aircraft Rescue and Fire Fighting (ARFF) capabilities. The skill sets required to best deploy these capabilities are only realized through structured hands-on training and continuous practice. This training first requires mastering the operation of ARFF vehicles and then HRET's.

b. This Advisory Circular (AC) describes the functions, capabilities and benefits of HRETs. It also outlines the standards for training and qualification of ARFF vehicle and HRET operators. This document also serves as a reference providing specific data that will be helpful in making specific strategic decisions relative to piercing aircraft involved in fire.

1.3 Overview of HRET Technology

HRETs provide ARFF firefighters with a number of tactical advantages when involved in ARFF operations. Testing conducted by the FAA compared a P-19 roof turret with an HRET involving pooled fuel test fires (refer to DOT/FAA/AR-05/53 – High Reach Extendable Turrets with Skin Penetrator Nozzle, Final Report November 2005). The HRET in its optimum attack mode, the down-in-front configuration, was compared to the P-19 roof-mounted turret agent delivery system. Both vehicles were tested under the same conditions. The HRET in the down-in-front attack mode extinguished the burn area an average of 53% faster than the P-19 roof-mounted turret. Both vehicles used a frontal attack method on the large-scale burn area. The HRET in the down-in-front position was able to extinguish the burn area by oscillating the HRET from right to left without repositioning the vehicle. The P-19, however, had to make slight vehicle adjustments to the right and left of the burn area in order for its roof-mounted turret to reach the sides of the large-scale aircraft mockup.

a. The HRET and skin-penetrating nozzle evaluated at the fire test facility outperformed the standard roof-mounted turret and hand line. In all aspects of the evaluation, the data gathered from simulated real fire aircraft crashes involving the HRET with skin-penetrating nozzle demonstrated the ability to extinguish fire faster, increase the accuracy of firefighting agent application by positioning the HRET close to the source of the fires, and using less firefighting agent on several fires. Other fire extinguishment performance advantages included the extendable reach of the HRETs nozzle, increase in firefighting agent throw range because of its extendibility, and its ability to reposition the HRET in all directions without moving the airport firefighting vehicle.

b. The HRET with skin-penetrating nozzle, when used on the full-scale fire field test using a training aircraft, showed the ability to control and contain the fire from spreading beyond the tail section, reduce high cabin temperatures from over 1500°F (815°C) to approximately 250°F (121°C), provide rapid smoke ventilation, and the ability to extinguish fire. The injection of fine mist water spray showed immediate results providing a fire-block and lowering cabin temperatures. The ability to ventilate using

the skin-penetrating nozzle is a less manpower-intensive and time-consuming process compared to using traditional ventilation fans. The cabin conditions after discharging the fine mist water spray allowed fire fighters to enter the aircraft.

c. The extendable turret places the nozzle well forward and below the operator, thus eliminating foam overspray and providing a clearer view of the effectiveness of agent application. The ability to position the nozzle nearer to, or in alignment with the target allows more precise aiming, reduces disruption from wind and helps to conserve agent.

d. When the nozzle is positioned at the seat of the fire, it allows extinguishment of ground based fires more effectively as agent is applied directly on the burning surface. This eliminates the “raindrop” application, a situation that generally results in wasted agent, as the heated smoke plume and wind carry it away. In addition, the nozzle can be placed near an elevated engine or wing fuel tank fire to cut off running fuel fires.

e. The extendable turret with precision nozzle placement can be more effective with rates in the 250 to 500 gallon per minute (946 to 1892 Liters per minute) range, whereas conventional primary turrets flowing 750 to 1000 gallons per minute (2839 to 3785 Liters per minute) exhaust the supply of agent much more rapidly. This technology allows the operator to extinguish the fire with short bursts of agent with more precision, as opposed to mass application.

f. The operator has the ability to switch agent application rates between high flow and low flow. This allows the operator to select the amount of agent needed to do the job most effectively. In large fires, a high flow rate is the most effective way to overcome the intense heat and quickly control the fire. In other situations, where less flow can be effective, a low flow rate helps to conserve agent for reapplication to maintain the integrity of the foam blanket.

g. HRETs increase ability and safety in getting agent to a high mounted engine as well as with 3 dimensional running fuel fires. The ability to quickly position the nozzle in the most effective attack position, increases effectiveness of the stream, reduces agent consumption and provides a safe vantage point for the firefighter.

h. HRETs are very effective in fighting fires on aircraft undercarriage. The tool allows precise positioning of the nozzle without putting the firefighter in harm’s way.

i. All of the benefits of an HRET that have been verified through extensive testing and during actual events can only be realized if the tool is in the hands of skilled, qualified operators.

1.4 Options and Considerations

HRETs must meet the requirements of NFPA 414 and AC 150/5220-10, Guide Specification for Aircraft Rescue and Fire Fighting Vehicles.

a. ARFF vehicles equipped with HRETs are eligible for funding under the Airport Improvement Program (AIP). Consideration for funding will be limited to one of these devices at each ARFF Station at Airports at Index B and above. If funded by the FAA, the HRET must include a skin penetrating nozzle. The penetrating nozzle must be movable to allow for proper alignment of the penetrator to the aircraft fuselage for piercing operations.

b. Complementary agent can be provided through individual hose reels or through combined agent systems, which combine one or more complementary agent lines with a water/foam line.

c. In addition to the complementary agent hose reels, options are available on HRETs which can provide discharge of the selected complementary agents at the tip of the boom, or through the piercing tip.

d. Forward-looking Infrared (FLIR) Cameras are now standard equipment on any ARFF vehicle purchased with AIP funds. FLIR Cameras provide a number of capabilities and properly locating the best mounting position for the camera and the monitor on the vehicle helps ARFF fire fighters get the greatest advantage from the FLIR.

e. The selection and installation of the FLIR and the FLIR monitor should be in compliance with AC 150/5210-19, Drivers Enhanced Vision Systems.

f. Night vision capability will improve visual awareness in smoky, foggy, or dark environments by sensing thermal radiation instead of visible light. FLIR Cameras were first installed on ARFF Vehicles because of the value they provide during low visibility response. Response on the airfield during periods of fog, darkness or inclement weather reduces visibility for drivers, and adds to response times. The view provided by the FLIR camera during low visibility response is enhanced by the thermal signature of fixed targets and landmarks as well as moving people, vehicles and aircraft.

g. In addition to its' benefits during low visibility response, FLIR cameras provide a number of tactical benefits. FLIRs provide excellent visual indicators during initial assessment for hot spots or overheated aircraft components as well as to measure effectiveness of firefighting efforts or other tactical operations.

h. ARFF vehicles equipped with HRETs and DEVs may be eligible for two (2) FLIR cameras. The FLIR associated with Driver Enhanced Vision Systems (DEVs) should be mounted with remote controlled pan and tilt capabilities. It should be sufficiently tight so that the picture is clear and stable. Line of sight should be aligned with that of the driver. The mounting should not compromise operation of the HRET in any manner. The mounting of the FLIR should be accomplished in such a way that the FLIR is still able to view the aircraft during piercing operations

i. Roof vision panels in the cab are very helpful during HRET operation, but should be equipped with tint or other accommodation to ensure that monitors, controls and indicators in the cab are not washed out by bright sunlight.

j. Remote color video cameras provide a number of capabilities helpful during ARFF tactical operations and, if connected to a digital recorder, provide a record of the incident for training and incident documentation.

k. FAA AC 150/5220-10, Guide Specification for Aircraft Rescue and Fire Fighting Vehicles, fully describes all eligible equipment and options for ARFF Vehicles.

CHAPTER 2. SAFETY

2.1 Overhead Hazards

One hazard when operating a HRET is the possibility of contact with overhead energized power lines. Although power lines typically run underground at airports, operators must be aware of any overhead hazards which may be present in and around structures. Most fire department Standard Operating Guidelines (SOGs) require operators of man-rated and non man-rated aerial apparatus to maintain at least a 10-foot (3.048 M) separation from overhead electrical hazards. Operators should be constantly aware of overhead hazards, remembering:

- Electricity from high-energy lines has the ability to arc several feet to an HRET.
- Water conducts electricity.
- Metal conducts electricity.

2.2 Object Free Zone

Airports have a number of rules and restrictions designed to maintain safety. One of those restrictions is directly related to operating a boom within an obstruction free zone for a runway. Airports are required to develop procedures to comply with Title 14, Chapter 1, Part 77, Objects Affecting Navigable Airspace. These procedures are developed primarily to restrict cranes and derricks from being raised in areas that might interfere with safety of flight. Operating the HRET boom may be subject to the same restrictions and requirements placed upon construction cranes working in and around the airport. This issue is primarily raised to increase awareness during vehicle inspection run-ups and training events. Areas used for HRET training must conform to applicable airport design standards stated in AC 150/5300-13, including the airspace obstruction clearance criteria contained therein. There may be requirements for notifications and strobe warning lights to be attached to your HRET. These procedures should be coordinated through airport operations and the control tower.

CHAPTER 3. TRAINING

3.1 General Training Background

Training is critical in every area of fire fighting, but even more so when operating ARFF vehicles and utilizing roof turrets and HRETs. Developing proficiency in controlling of HRETs and roof turrets is a skill that must be developed and maintained or it will be lost without use. There are a number of tools available in the industry, but “time on the joy stick” is the best way to maintain the skill sets developed.

a. ARFF departments should have an internal training program which is used to initially qualify an operator, as well as continuation training to maintain and re-qualify. A predetermined method of demonstrating proficiency in qualification and requalification training should be in place for each vehicle in the ARFF fleet. Requalification should be required at least annually, but may be required more frequently based on the ARFF Departments procedures for vehicle staffing assignments. (See References in Appendix D.)

b. If the HRET can normally be operated from more than one position, qualified operators should train in both positions and meet the performance qualifications established by the department. Each seat offers different views of the controls, the HRET, and the aircraft or training mock up. Operating joy sticks and controls from both positions requires practice with both hands. A trained individual who is not simultaneously operating the vehicle will be more efficient than one who is multitasking

c. Each ARFF department should have an established standard for qualifications of a training officer. The person conducting the training must be qualified to instruct and have the knowledge and experience necessary. The training officer must possess proficiency in the subject matter and skills sets being taught. Students need to have confidence in the instructor’s ability to provide the training necessary for them to develop required proficiencies. It is difficult to develop highly trained and skilled ARFF Firefighters without using highly trained and skilled instructors.

d. All training should start with vehicle familiarization and the use of a lesson plan that identifies the course outline, learning objectives, critical performance items, goals and methods of evaluating proficiency. Successful completion of training should be used as a prerequisite for a formal certification process used to “qualify” vehicle driver / operators. Qualified operators will have demonstrated proficiency in the knowledge and skills required to drive and or operate the vehicle and mounted equipment. Each qualified operator should be re-qualified as per the ARFF departments training program at an interval not to exceed every 12 consecutive calendar months after demonstration of knowledge and skills required for proficiency in the operation of the vehicle and its mounted components including HRETs.

e. A separate lesson plan is required for each vehicle or each type of ARFF vehicle. An ARFF vehicle equipped with an HRET requires a more detailed lesson plan than one without an HRET. At a minimum, the lesson plan should include: vehicle specifications, height and weight restrictions, agent, capacities, flow rates, mounted component complement, stored equipment inventory, daily - weekly – monthly inspection procedures, maintenance procedures, operating procedures, hazards, restrictions and related department SOGs.

f. Vehicles with HRETs have a higher Center of Gravity (CG), and an increased gross vehicle weight than identical vehicles without the HRET. Lesson plans should identify this difference and discuss the specific operational effects in driving, cornering, approaching side slopes or grades and

stopping. Furthermore, this additional weight and height may require additional driving restrictions to avoid areas having height and weight restrictions.

g. All lesson plans should be considered a draft document. Each class, and each use at an incident will produce additional knowledge and lessons learned which may be of added value, resulting in changes to lesson plans. Firefighters should be encouraged to submit topics, lessons learned and experiences for consideration in updating lesson plans.

h. PowerPoint presentations and videos are very effective methods of delivering classroom training. Training in the use of HRETs is not limited to how to operate the HRET and its accessories, but must include Department Standard Operating Guidelines (SOGs) on Tactics and Strategies and aircraft construction.

i. There are some training tools available that allow virtual training utilizing the HRETs. Full size cab mock ups with airport specific driver training models can be customized where a student can virtually drive the new vehicle around their airport, respond to an aircraft accident, fight a fire and even penetrate the aircraft using the HRET and penetrating nozzle. Other technology available makes use of virtual training from a desktop PC that utilizes joysticks and controls identical to those in the ARFF vehicle to develop good technique before attempting a penetration on a fuselage or trainer. These trainers are fundable under the Airport Improvement Program (AIP).

j. The ability to pierce material that forms an aircraft is an essential element in the development of operator proficiency in the use of HRETs with skin penetrating nozzles. Donated aircraft fuselages acquired for simulated training is the best tool for piercing training. Commercially available skin penetrating training mockups with replaceable skin panels are excellent training aids for developing piercing skill proficiency. They may be fundable under AIP.

3.2 Proficiency

Proficiency with HRET operations is only developed through hands-on-training and practical experience. HRET operators need to develop a good sense of the range of the boom and the turret in various patterns using high and low flow rates, become proficient in aiming streams and have a complete understanding of the capabilities and limitations of the device. Training exercises, as well as demonstrations of proficiencies, need to include all of the capabilities of the vehicle and HRET. This would include driving, and primary turret operation with the HRET in the stowed position and with the HRET in various pre-deployment, attack and various other positions, while stationary and in pump and roll modes. It should also include approach considerations, set up, stand-off distances and piercing operations in various positions, pumping through the penetrating nozzle, simulated or actual discharge of complementary agent through HRET, and the use of mounted components, including cameras and lights.

ARFF Department procedures describing the methods used for the evaluation of the proficiencies required to qualify ARFF vehicle operators and HRET operators should be detailed in the ARFF Department Standard Operating Guidelines (SOG) on training. Records of the initial training and proficiency testing / evaluation for each operator shall be maintained with the ARFF Training records. The training SOG will indicate who can qualify a firefighter as an operator for assignment to a position.

3.3 Recurrent Training

Satisfactory completion of a training program and proficiency evaluation / testing procedures qualifies an operator for assignment to a vehicle. Daily operation of a vehicle and its components helps to maintain familiarity with the controls and some of the skill sets. The skills that are not routinely practiced will

diminish with time. The qualification to operate a vehicle and/or HRET should not remain in force longer than the skills required to remain proficient (never more than 1 year). ARFF department training SOGs should indicate the period of time during which the operator remains qualified before requiring recurrent training and proficiency testing / evaluation. Records of the recurrent training and proficiency testing / evaluation for each operator shall be maintained in the ARFF training records.

3.4 Airline Partnerships in Safety

It is advisable to always call for an airline representative that can serve as an aircraft Subject Matter Expert (SME) to a Command Staff. The representative can provide a great deal of expertise, as well as the resources of the airline and their contractors to support emergency management. As the representative may have been involved in previously conducted training evolutions and emergency planning activities, cooperation and communications during emergency management may be enhanced.

CHAPTER 4. TACTICAL CONSIDERATIONS

4.1 HRET-Mounted Turret Operations

The HRET has the ability to lower the nozzle to or below ground level. A low approach with the HRET provides the operator a clear view of the nozzle and the intended target. The operator can see the effectiveness and application of the extinguishing agent or complementary agent. The attack angle permits agent application under the wings and under the fuselage if the aircraft is still up on its landing gear. This attack mode is very effective in fighting pooled fuel fires or providing a foam blanket over a spill. When the nozzle is positioned at the base of the fire, it allows extinguishment of ground based fires more effectively, as agent is applied directly on the burning surface. This eliminates the “raindrop” application, a situation that generally results in wasted agent, as the heated smoke plume or thermal column dissipates the effectiveness, and the wind carries it away. Avoid the use of straight streams, particularly if there are people in range of the turret. Pressure from turrets are very dangerous to personnel. Straight streams at the wrong angle also causes “plunging” which disrupts the existing foam blanket and fuel

a. The HRET has the ability to elevate the boom above most aircraft. This allows the operator the ability to position the HRET appropriately for fires in high mounted engines, APUs or through an open door.

b. Firefighting operations are enhanced with the use of complementary firefighting agents when they are capable of being discharged at the tip of the HRET piercing or high flow nozzles. This configuration allows for precision placement in areas difficult to access from the ground, reduces the effect of wind drift of agent, and increases efficiency of the agent discharged.

c. A FLIR camera is an essential tool in evaluating fire conditions and the primary tool used to determine optimum piercing locations. If only one FLIR camera is installed on the ARFF Vehicle, it must be mounted in a position that allows the camera to monitor the piercing operation. For ARFF vehicles with HRETs that have a second FLIR camera, it should be mounted near the tip of the boom. In this location FLIR and color cameras serve as remote optics for investigation or evaluation of conditions. The cameras can be directed to look at an aircraft component not accessible from the ground or through a door or window so as to be capable of safely performing visual inspections or evaluations of the aircraft without leaving the cab. Recordings made of these operations may be helpful in follow up investigations and training.

4.2 Size up / Set-up

Each piece of ARFF apparatus has certain capabilities and a specific role at each type of incident. Positioning of the ARFF apparatus will be different for each response, based on the resources available.

a. Each vehicle responding should be positioned based on all of the factors identified above. The anticipated needs of the incident will contribute to the decisions regarding positioning. For example, if it is anticipated that personnel will need to enter the aircraft and there are stairs in position at the L-1 door, the vehicle carrying the personnel who would be expected to enter would position near the L-1 door. ARFF vehicles equipped with an HRET should initially be positioned in the location which best anticipates the needs, in the event it will become necessary to use the HRET. If the report is for a problem with a high mounted engine, the apparatus should be positioned in a location that ideally puts the

boom in a position to reach the high mounted engine from the upwind side, without blocking passenger egress or other possible access.

b. For a pooled fuel fire burning under an aircraft, the HRET offers a tremendous tactical advantage. If the ARFF vehicle equipped with an HRET is positioned upwind, at the nose or the tail, a low attack position with the boom allows the placement of agent beneath the wings and fuselage. Using the available rotation of the boom up to 30 degrees to the left and right allows the operator to position the boom to one side of the fuselage, applying foam to that side of the aircraft, and then reposition the boom to the other side. The entire pooled fire can be covered without repositioning the vehicle.

c. When responding to an aircraft with a fire on board, there are a number of immediate needs and concerns. The deployment of the tools, the establishment of a Unified Command Post, and the positioning of ARFF assets are all critical first steps in the management of this emergency. After all occupants are safely off the aircraft, an interior fire on board is among the highest priorities in the risk assessment. The Incident Action Plan (IAP) should be developed drawing upon the combined knowledge of all of the stakeholders serving as resources at the Unified Command Post. Information collected and shared in the Unified Command Post specific to the aircraft, the cargo carried, existing conditions, available resources, and technology, contribute to educated collaborative decisions guiding the actions taken to manage the incident.

4.3 Benefits of Combined Technologies

One of the most valuable tools used in evaluating fire conditions on board and aircraft is the Forward Looking Infra-Red (FLIR) camera. The heat created by a fire on board the aircraft will present as a bright spot or “bloom” on the FLIR display. This bloom will identify the location and relative intensity of the fire, and will be visible by using the FLIR camera.

a. The FLIR camera provides the advantage of monitoring the effectiveness of any action taken. If the FLIR Camera indicates that the firefighting efforts are not having the desired effect, [meaning the “bloom” is not reducing in size in spite of the agent application,] re-evaluation is necessary. It is likely the agent is not reaching the fire. If the bloom is not growing in size or intensity and / or is diminishing in size or intensity, it is an indication that the action taken is having the desired effect upon the fire.

b. Use of the FLIR camera on an aircraft will identify all visible heat signatures. Training will aid in the understanding of normal heat signatures. As an assessment tool, a thermal scan of a closed compartment adds valuable data to the risk analysis performed prior to decisions to open doors or to pierce spaces.

c. Spotlights mounted near the tip of the HRET provide illumination for piercing operations, and may also be used to illuminate a target being examined using remote optics. The lights can be directed in a door or from above to contribute to illumination of the scene. From the door position, the boom-mounted lights can provide interior illumination and help mark the door location. HRET mounted cameras can be used to monitor interior conditions.

4.4 Complementary Agents

ARFF Vehicles equipped with HRETs may be equipped with complementary agent systems, such as dry chemical, Halon 1211 or Halotron 1. Complementary agent can be provided through individual hose reels or through combined agent systems, which combine one or more complementary agent lines with a water/foam line. These combined use hose reels provide the firefighter with a number of firefighting

options that can be used individually or in combined discharge. Foam/dry-chemical/clean agent simultaneous delivery systems must be designed and installed to comply with the requirements of AC 150/5220-10, Guide Specifications for ARFF Vehicles.

a. In addition to the complementary agent hose reels, options are available on HRETs which can provide discharge of the selected complementary agents at the tip of the boom, or through the piercing tip.

CHAPTER 5. FIREFIGHTING STRATEGIES

Since no two aircraft fires are alike, the best strategy is to develop objectives in the order of their priority. For each of the objectives, multiple strategies may exist. The best strategy for the situation is determined through risk analysis, based on specific conditions present and resources available.

The tactical considerations that follow are provided to assist ARFF Fire Fighters and Commanders in decision making during an aircraft fire. No two situations are alike and no single tactic can be depended upon. ARFF responders need to combine knowledge of aircraft construction, fire loads, and fire behavior with available assets, a risk analysis, resource management and common sense to affect the best possible outcome for the event. Airline representatives can provide a great deal of knowledge as well as resources and should be included in the Unified Command Post.

a. The first and most important objective is the protection and preservation of life. In a cargo aircraft, there will typically be fewer people on board than on the same type aircraft flown in passenger service. Ensuring and maintaining a safe rescue path, assisting with evacuation, or the rescue of occupants from the aircraft is the first priority.

b. The second objective may be accomplished in response to the first. If there is pooled fuel or a spill fire, it must be controlled and extinguished in order to provide a clear safe path for evacuation. The spill area needs to be covered and maintained with a foam blanket. The HRET boom is very effective in accomplishing these tasks. A low approach with the HRET provides the operator with a clear view of the nozzle and the target. The vehicle operator can observe the effectiveness of the application of water and foam. The attack angle permits agent application under the wings and under the fuselage if the aircraft is still up on its landing gear. Using a low attack sweeping mode of the boom on low flow provides an effective method of maintaining the foam blanket, reducing the risk of plunging, until hand lines can be established.

c. This attack mode is very effective in fighting pooled spill fires and/or providing a foam blanket over the spill area. When the nozzle is positioned at the seat of the fire, it allows extinguishment of ground based fires more effectively, as agent is applied directly on the burning surface. This eliminates the “raindrop” application, a situation that generally results in wasted agent, as the heated smoke plume or thermal column dissipates the effectiveness and the wind carries it away. As long as there is fuel on the ground, there is a hazard of ignition. Protection over the area through manning vehicles or hand lines as necessary for the size of the spill area must be maintained. Activities that will break the seal of the foam blanket should be restricted. Using a hand line, foam should be reapplied, as needed, to maintain the integrity of the foam blanket.

d. If the aircraft is intact with an interior cargo fire that has not breached, an effective first step may be to secure the openings of the aircraft to restrict the introduction of air. Deep seated cargo fires may smolder for a long time before the fire is of sufficient intensity to breach the container or the fuselage. This tactic may be applicable if a direct attack is not immediately possible.

e. In evaluating fire conditions onboard an aircraft, the FLIR camera is a valuable tool. The heat created by the fire on-board will present as a bright spot or “bloom” on the FLIR display. This bloom will identify the location and relative intensity of the fire, and will be visible through the fuselage using the FLIR camera. After locating the fire on board with the FLIR camera, a sense of the fire size, location and intensity can be determined.

f. This evaluation will help to make appropriate tactical decisions. In some circumstances, a direct fire attack initially may not be prudent or appropriate. If the fire is contained on the aircraft, there is no life hazard on board, and the fuselage is not showing signs that burn-through is imminent, closing up the aircraft, rather than trying to gain entry, may starve the fire of oxygen. In addition, flowing water to the fuselage roof in the area over the interior fire may cool the metal and could delay burn through. If water supply has not been established, the use of water carried in ARFF vehicle tanks for this exercise may not be advisable. In some situations, the combined effect of reducing available oxygen to the fire and cooling the fuselage may cause a reduction in the intensity of the fire, which will be visible through the FLIR. This tactic may not provide total extinguishment, but could potentially slow down the fire, providing time to those departments that need to assemble necessary resources, and expertise, and populate a Unified Command Post. As all of these resources are assembled and a new assessment of conditions and effects of actions are reviewed a new strategy and Incident Action Plan (IAP) can be employed.

g. In certain FAA testing, penetration and discharge through the top of the fuselage, has provided an entry point for agent. This location provides a discharge pattern and effect similar to a sprinkler head in a structure, but with greater flow and larger pattern. On many aircraft, a penetrating nozzle extension may be necessary to clear the roof liner. Bear in mind that the weight of the boom and the down force of the hydraulics build up on the piercing tip during roof top penetration. On some HRETs, as the piercing tip overcomes the resistance and breaks through, there will be a sudden downward shift of the boom. Use caution, as this could cause damage to the nozzle or boom. Check with HRET OEM's for restrictions.

h. Some HRET manufacturers prefer for the piercing to be accomplished with the piercing tip in line with the boom. The power of the hydraulics and the in line configuration provides the optimum piercing ability. These booms will penetrate on angles, but with some HRET's the increase in angle, may increase the likelihood that the piercing tip will slide or skip across the curve of the fuselage. On booms equipped with a clutch, you may see a slip of the clutch which will cause the HRET head to move out of alignment with the boom. This does not permanently damage the device, but will require clutch realignment in order to continue. HRET OEM's should be consulted for more information and clutch realignment procedures. Most piercing training models suggest piercing the fuselage on an angle that is perpendicular to the fuselage. To be most effective, the piercing tip should be as close to "parallel with the ground" as possible. If the penetrating nozzle is angled too far down, the piercing tip can end up below the seat backs. If the penetrating nozzle is angled too far up, the piercing tip can end up in the overhead luggage compartment. When piercing higher up on the fuselage, particularly on double deck aircraft such as B-747s and A-380s, the area of the fuselage should be approached with the piercing tip on the steeper angle of the fuselage curve. If the piercing angle is based on the angle of the fuselage, the piercing tip may be closer to the seat height than is desirable. Therefore, a compromise may need to be made between an ideal piercing angle to penetrate the aircraft skin and the necessity to keep the penetrating nozzle parallel with the ground.

i. Terrain is a consideration for vehicle positioning and operation. The site should be as level as possible, but if not, the safest positioning would be heading up or down the grade. If the grade is side to side, the vehicle should be positioned so that all the work is done on the low side. HRET manufacturers should be consulted for operating limitations.

5.1 Engine Fires / APU Fires

HRETs are a very effective tool in dealing with engine and APU fires. They allow the provision of agent to a specific remote location without putting firefighters at risk. For high mounted engines and APUs,

HRETs enable access without positioning and climbing ladders or work platforms. They are rapidly deployable and can provide optics, lighting, water/foam and complementary agent to these areas.

a. Auxiliary Power Units (APUs) are actually supplementary engines that are being used to provide electricity to the aircraft when it is not plugged into a power source on the ground, or Ground Power Unit (GPU).

b. Engine fires may include the accessory section located around the outside core of the engine. Directing a stream of agent into the air inlet of the engine will not extinguish this type of fire.

c. The safest method of extinguishing an engine fire is to operate the engine or APU shutdown system from the cockpit or externally mounted fire protection panel.

d. Large-frame aircraft have easily identifiable engine and APU fire shutoff handles in the cockpit. Many also have external APU fire protection panels. The department's aircraft familiarization training should include the specific location and operation of these controls. They are often located on either the nose landing gear, in the main wheel well, on the belly, or in the tail. In addition to arming the extinguishing agent bottles, these systems may simultaneously shut off the engine fuel, hydraulic system, electrical, and pneumatic connections. For the safety of the firefighters, the engine should be shut down and the fuel, electrical, hydraulic, and pneumatic supply removed whenever firefighters are working around the engine, particularly if involved in firefighting.

e. If attempts to extinguish the fire in an engine or APU using the aircraft's controls and systems fail, it may be necessary to open engine cowlings or access panels. Extreme caution is necessary as the opening of these panels may release hot or burning fluids. Some engines have fire extinguishing access points or knock in panels which can provide access to discharge agent directly into the engine.

f. The agent of choice for this operation is a clean agent such as Halon 1211 or Halotron I. If clean agents are not available, AFFF can be applied. Dry chemical can also be used, but will cause collateral damage through contamination of the engine. This is only an issue if, in fact, the engine is salvageable after the fire. The first priority is to control and extinguish the fire, preventing the involvement of components outside of the engine, and creating a threat to human life. Minimizing collateral damage through agent choice should always be a consideration, but not at the possibility of additional risks and losses.

5.2 Tail Pipe Fires

Tail pipe fires occur when too much fuel is fed to the engine during engine start. The high temperatures in the tail pipe cause the fuel and vapors to ignite. Tail pipe fires should not be confused with engine fires. Usually the pilots will shut down the fuel supply to the engine and spool it up. This maneuver will cause the burning fuel to blow out of the engine, and the engine can be restarted normally. This maneuver may cause the fuel to burn for a moment on the ramp.

Typically, tail pipe fires will require little or no intervention by the fire department other than communications and monitoring. Putting an HRET in low attack position is an excellent way to provide protection on the ramp if burning fuel is discharged from the engine during a tail pipe fire.

5.3 Piercing Considerations

In FAA tests, it was demonstrated that boom mounted penetration nozzles provided a rapid interior suppression system. With the application of water into the interior of an aircraft, it provided rapid

cooling, immediate fire knockdown, rapid temperature reduction and ventilation of toxic gasses, thus extending survivable conditions throughout the aircraft. Also it provided rapid intervention which allowed other equipment and personnel to commence rescue operations in a less harmful environment.

Penetration placement and depth is the key to success in getting agent into the area of the burning freight. Most penetrating nozzles range from 22 to 34 inches (0.055 to 0.863 M) in length, from the piercing tip to the visual stop point. That visual stop point should be mounted on the tip so as to provide the maximum penetrating depth without causing damage to other mounted components. There are extension tubes that can be added to some piercing tips. These tubes can be added in the field with the use of two (2) strap wrenches, or, if not available, channel-lock pliers. The addition of the extension will provide an additional 12 inches (0.304 M) in length. Consult HRET manufacturer to see if extension tips are available and what limitations their addition may impose. Depth of penetration required also varies with the contents of the cargo containers. If, for example, the container is full of cardboard boxes with lightweight contents, it is likely that the force of the spray will disrupt the contents of the can sufficiently to begin saturating the contents of the can. In a different scenario, the cargo in the can could be a more tightly packed, high density product. If, for example, the piercing tip were to penetrate a bundle of leather jackets, or a container full of printed matter, the stream from the nozzle would be substantially suppressed. In these cases, with a deep smoldering fire, penetration into the container may yield little effectiveness. Because we are not always sure exactly where and what is burning, introduction of agent into the cargo bay above and around the container may be effective in reducing the heat and may reach the area involved in fire.

Penetration through the top of the fuselage is another good attack location in terms of effectiveness. This location provides a rain down effect similar to a sprinkler head in a structure, but with greater flow and larger pattern. On many aircraft, a penetrating nozzle extension may be required to clear the roof liner. Consideration must be given to the reality that the weight of the boom and the down force of the hydraulics build up on the piercing tip during roof top penetration. On some HRETs, as the piercing tip overcomes the resistance and breaks through, there will be a sudden downward shift of the boom. Caution should be used, as this could cause damage to the nozzle or boom.

Once the decision has been made to pierce an aircraft, the proper positioning and effective monitoring of the amount of agent being applied becomes critical. The penetrating nozzle discharges at a rate of at least 250 gallons per minute (GPM) (946 LPM) into the aircraft fuselage in a spray which covers approximately 40 feet (12.92 M). If using a penetrating nozzle with a 250 GPM (946 LPM) flow rate, the truck can pump for 12 minutes from a 3000 gallon (11356 L) ARFF vehicle, and 6 minutes for a 1500 Gallon (5678 L) truck.

The introduction of water into an aircraft has a significant effect on the aircraft weight and balance. A gallon of water weighs 8.34 lbs (3.79 kg). A single piercing application introducing a minimum of 250 gallons of water per minute (946 LPM) will introduce over 2000 pounds (909 kg) in the first minute. That is a great deal of weight and, depending on the size and type of the aircraft and where the weight settles, it will not take long before the weight has an effect on balance of the aircraft. In the case of water, it may be prudent to create a drain to remove the water from the aircraft. This is another decision that an airline representative, preferably a licensed mechanic who has knowledge of the airframe, can facilitate. If an aircraft tail has tipped due to the weight of water being introduced with people working underneath, or while an HRET piercing tip is penetrating the fuselage, it may be very dangerous to all personnel in and around the scene.

Depending on how fast water is added to the fuselage, consideration should be given to create a drain hole above the floor line. The floor line can usually be distinguished by four to six rows of rivets running longitudinally following the cusp line (a distinct line where the upper lobe meets the lower lobe). The

portion of the floor line in the area of the wing has much heavier reinforcement, and is not the best location for making a drain hole. The piercing tip on an HRET would be the easiest way to make this hole to drain the water and minimize the effects of the weight on the aircraft's overall weight and balance.

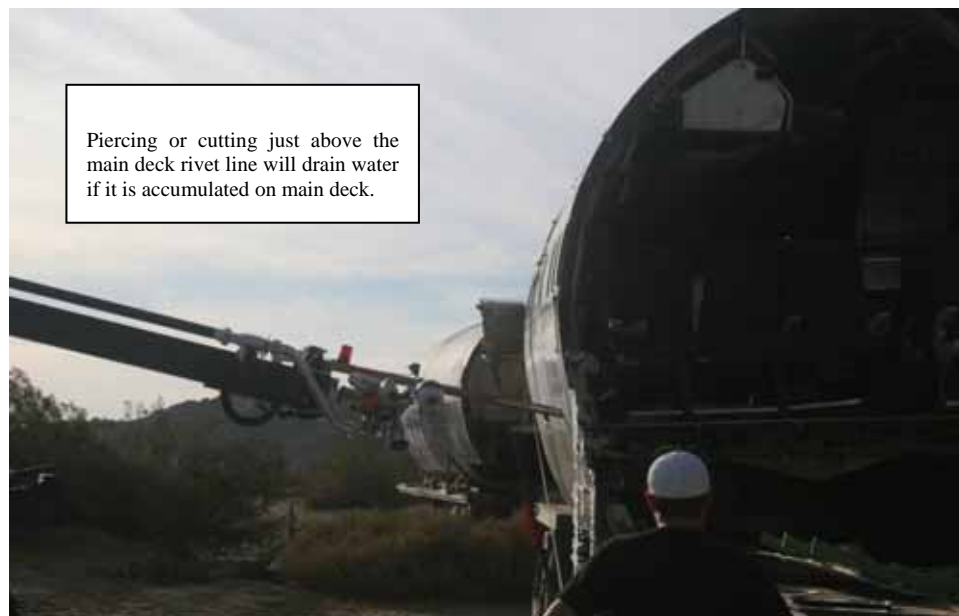


Figure 5-1. FAA Piercing tests for pooled water relief.

On other aircraft, or perhaps as an additional step, a hole cut or pierced into the aircraft bilge in the low point of the underside of the fuselage might provide a relief for the weight of the water, and eliminate the large collection of water in this area. If planning to cut a hole in the fuselage to drain the water, and assumed a square cut using some sort of powered circular saw, there are some things of which to be mindful. Airplanes are constructed of stringers running longitudinally and frames running circumferentially with the outer skin attached to each. The open area between the stringers and frames is commonly referred to as a bay. The bay is identifiable by the area with no fasteners and is typically 18-20 inches (0.46 to 0.51 M) long, and 8-10 inches (0.203 to 0.254 M) wide. Cutting a hole in a bay will be much faster, since no frame or stringer need be cut (with the added benefit of ease of repair later on). The cut should be made just off the bottom centerline closer to the main gear wheel well. Caution should be used in getting too close to the wheel well, because the structure gets stouter as you move toward it. The rivet lines should help identify the areas to avoid.

The same effect could be accomplished by using an HRET and making multiple piercings in the same area. It may be more difficult because of the difficulty in seeing the area under the aircraft, and the limitation of some devices to pierce on that angle.

The cut or piercing will actually be passing through an inner and an outer skin, but the distance is within the capabilities of most rescue saws. A saw with a 16-inch (0.406) blade is the most effective for all phases of aircraft forcible entry.



Figure 5-2. With the lower deck floor removed, the bilge bays can be more clearly seen. Water from firefighting will accumulate in the bilge.

5.4 Stand-Off Distances and Piercing Height

In order to pierce an aircraft at the required height and the optimal position, the ARFF Vehicle must be positioned within the operating range of the HRET being used. Each model HRET has different range and ability. Contact the HRET manufacturer for specific stand-off distances for each attack position. For training purposes, 3 attack position heights are determined. These heights are based on a large frame aircraft with 3 decks such as a B-747 or A-380. The lower cargo deck, main deck and upper deck are the 3 examples used. The approximate piercing heights for these decks are as follows:

Lower Cargo Deck	13' 6" (4.11 M)
First Level Passenger or Cargo Deck	23' 0" (7.01 M)
Second Level Deck	31' 0" (9.44 M)

Each HRET, based on its length and type of piercing mechanism, needs to be within the safe operational range of the device. Positioning the vehicle too near or too far from the piercing target places the tool and the operator at a disadvantage. Ideal placement provides optimum visibility for the operator and puts the HRET within its designed operational range. Department SOGs on piercing should provide specific parameters, based on the HRET in service at the airport. It should also provide the height of any pre-programmed attack positions.

The standoff distance is the closest that an ARFF vehicle with an HRET should get to an aircraft. It is based on the height of the boom and the desired piercing location. Being able to maximize standoff distances is important to maintaining the broadest viewing angles of the incident while remaining clear of emergency slides, debris or potential fire or hazards beneath the aircraft.

Initially, the vehicle should be stopped when the front bumper is 15 to 25 feet (4.57 to 7.62 M) from the fuselage. This distance should provide the HRET the ability to pierce at each of the standard attack heights. Vehicles with longer booms may need to stop further back. If the aircraft is off the pavement or not sitting on all of its gear, adjustments to heights and standoff distances will be required. The manufacturers of HRET equipment may have more specific guidance on recommended standoff positions.

Measurements for this guidance was taken from the penetrator tip with the inner boom at full extension and penetrating nozzle fully deployed and level. Specific guidance for each HRET should be obtained from the manufacturer. In general, longer booms can be further away from the aircraft at every level of piercing.

5.5 Cargo Aircraft Fires

Certain unique aspects of cargo aircraft operations put their crews and ARFF personnel at a clear disadvantage. Cargo freighters often fly fully loaded. Fully loaded freighters provide little or no access to an onboard fire, and they usually carry much more flammable material than passenger flights. Dangerous goods, another name for hazardous materials that are not permitted on passenger flights, are also carried in cargo aircraft.

Cargo is moved in unit load devices, or ULDs, which are often pallets or containers, also known as cans. A single aircraft loads can consist of cans, pallets, or other types of ULDs. The freight is arranged to make best use of the available space and accommodate requirements of weight and balance. For firefighters, this means that even if access can be quickly gained to the cargo deck, there is little or no space to gain access to the burning cargo. The amount of space or access available to firefighters varies, depending upon the type of aircraft, the location of the fire, and the specific load configuration.

Cargo aircraft may have fewer exits, and there are no requirements for fire suppression systems in the cargo bays. Some carriers have developed fire detection and suppression systems which may be installed in certain aircraft. One such system includes mounted hardware in the cargo bay, which includes detection devices and overhead penetrating nozzles. These penetrating nozzles are designed to penetrate the ULD and discharge agent. Technology is being pursued for another system, which consists of detection and suppression hardware and agent installed inside the ULD, rather than mounting in the aircraft. This system is designed to provide protection for the freight in the ULD throughout its entire journey, not just while onboard the aircraft. Cargo carriers at an airport should be consulted in order to become familiar with these systems. Cargo aircraft may or may not have emergency exit slides. There may or may not be people and sometimes livestock aft of the cockpit bulkhead.

The number of occupants on board is generally less than on passenger aircraft, but other unique characteristics may actually increase the level of difficulty. Some cargo carriers may included the number of occupants in a manifest included in the Notice to Captain (NOTOC), while others do not, necessitating a call to the carrier's Global Operation Center to get that count. When possible, the flight crew should be consulted for the number of Souls on Board (SOB).

Penetrating nozzles on HRETs offer the ability to discharge agent into the aircraft where cargo is burning:

- Without putting fire fighters in harm's way.
- Without introducing excessive amounts of oxygen.
- Without the delays encountered opening cargo doors, and removing cargo to gain access to the area involved in fire.

Understanding freight loading and cargo positions used in the different type of aircraft at an airport is an essential element in developing good response procedures enhancing piercing tactics. Working with the cargo carriers conducting operations at an airport is essential in developing an understanding of the policies and practices of the individual carriers. Each carrier has specific procedures regulating the type and quantity of goods they will ship and store. Training visits during freight loading periods, usually at

night, will help firefighters understand the methods used for loading and unloading cargo aircraft. These same tools and techniques may be necessary during or after a cargo fire or incident.

Developing procedures with cargo carriers to get expert help, and armed with freight and crew manifests at the Unified Command Post, development of the Incident Action Plan will be facilitated. These resources will continue to play a valuable role throughout the incident.

5.5.1 Cargo Aircraft Piercing

There are a number of considerations when determining the best location to pierce a cargo aircraft. As a general rule of thumb, the 10:00 o'clock and the 2:00 o'clock positions are normally good starting points for fires on the main cargo deck. This will help in controlling fires on the main deck level of cargo aircraft. Ultimately, it may be necessary to reposition the HRET and make a second or third penetration until an effective fire attack occurs. For fires in the belly (lower) bay, piercing positions of 4:00 and 8:00 are good "rule of thumb" positions. Cargo aircraft familiarization training is critical to the understanding the requirements to fight a fire on board a cargo aircraft. These recommended piercing positions generally are the point of the fuselage that a cargo ULD is closest to the fuselage, and most accessible for piercing.

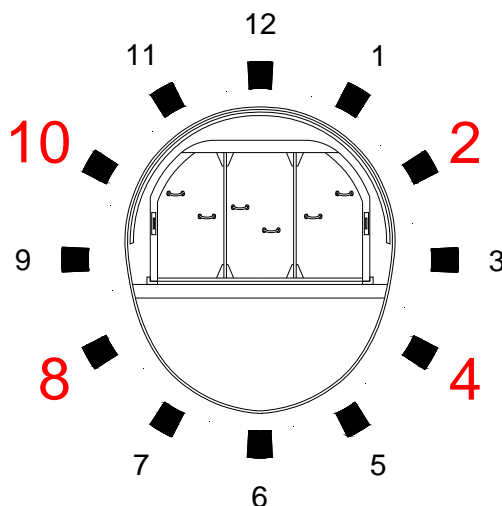


Figure 5-3. The hands of a clock as positioned from the front of the fuselage can be used to identify “rule of thumb” piercing locations. Main deck positions of 10:00 O’Clock and 2:00 O’Clock and belly bay positions of 8:00 O’Clock and 4:00 O’Clock are those positions with the greatest opportunity to pierce a cargo container.

Understanding the distances between the outside of the fuselage and the outside of the cargo containers on each type aircraft will help in the development of the Incident Action Plans. It will also provide an immediate understanding of the capabilities and limitations of equipment to reach the potential fire location.

Most narrow body cargo aircraft are loaded in such a way that there is about 12 inches (0.304 M) between the outside of the fuselage and the outside wall of the cargo container. The space above those containers is small, as well, and depending on the specific configuration could be as small as 6 inches (0.152 M). The advantage of a narrow body is that, in most cases, one can reach inside the cargo container with the piercing tip and introduce agent. The disadvantage is that the space above the containers is minimal, and discharging in this area restricts the effectiveness of the water spray pattern, reducing its range, cooling and overall effectiveness.

Wide body aircraft vary in size and configuration. Typically, there are greater distances between the fuselage and the cargo containers. This distance can be as much as 46 inches on the main cargo deck. So although these distances mean that one may not be successful in penetrating the containers, the open space allows a better use of spray pattern to interrupt the thermal column, and reduce temperatures.

Boeing and McDonnell Douglas wide body aircraft typically have from 30 to 34 inches between the outside of the fuselage and the outside of the cargo container. Often the distances change further aft on the aircraft. Although the majority of the main deck is typically loaded with two containers across, as the aircraft tapers, the loading goes to a single container loaded in the center. This causes a greater distance in the aft positions from the outside of the fuselage to the wall of the center loaded container. In this area, the distances range from 39 to 53 inches.

Airbus cargo aircraft are loaded offset to center. This means that there is up to 46 inches on the left side and only 17 inches on the right. Belly cargo holds offer additional challenges. First, there is a separate access door from the main deck. The fuselage interior wall is squared off with an interior bulkhead which squares off the cargo hold and creates a void. This provides a separate compartment that either could be involved in fire, or creates additional obstacles in accessing a fire in the belly hold. On an A-300 for example, the distance from the outside of the fuselage in the area of the belly hold, to the inner bulkhead is 43 inches. On a Boeing 747, it is as much as 57 ½ inches.

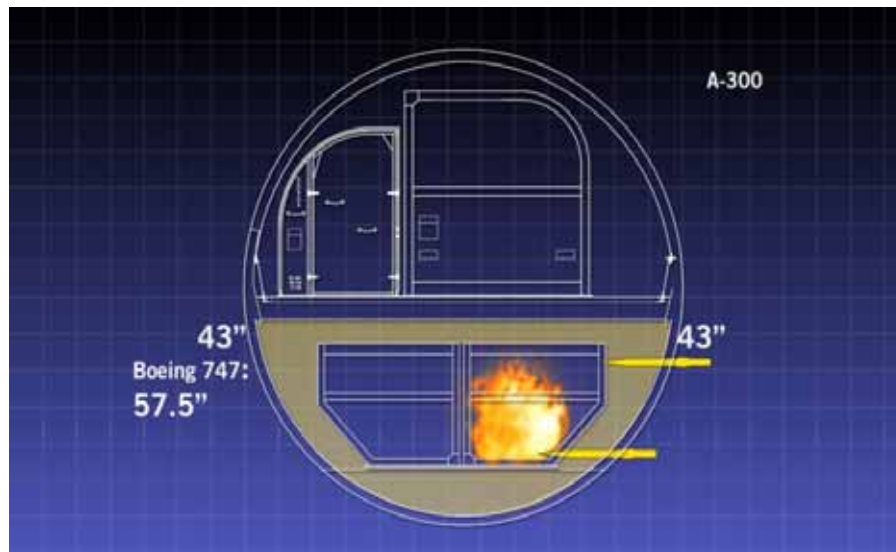


Figure 5-4. Piercing Depths - Examples

ARFF Departments need to partner with cargo carriers to develop an understanding of type of aircraft, and loading configurations for the aircraft conducting service to their airports. All of the specific information needed to develop effective firefighting strategies should be collected, disseminated and updated so that all ARFF personnel understand their role in an emergency involving cargo aircraft.

5.5.2 Fires in Cargo Containers

The type of fire, the fire load, the container location, the container construction, and the location of the fire all contribute to the effectiveness of the firefighting strategy deployed. The more information gathered regarding the specifics, the more effective strategies can be developed. By developing a better understanding of the conditions, and watching the effects or lack of effects of the strategies employed, an effective next step can be launched.

If a smoldering fire is inside a cargo container, you either need to smother the fire by excluding air, or extinguish it through the introduction of agent inside the container or compartment. If unable to achieve either of those prior to the fire breaching the container or compartment, the fire will extend.

The level of difficulty of course is increased by the fact that one cannot see specifically where the fire is in the aircraft. The evaluation is made from outside the aircraft, looking for effects of the fire, such as paint blistering and metal distortion. The FLIR camera will give an indication as to the location and size of the fire. After firefighting efforts have been launched, it will provide us with some indication of the effectiveness of those efforts. If agent is being discharged and the heat bloom continues to grow, it is obvious that agent application is ineffective. This is the point where familiarization with the load configuration is beneficial, recognizing situations such as penetrating between the cans, or penetrating too high. An educated re-evaluation, perhaps assisted by the cargo airline representative on scene, may help determine the next logical place to penetrate.

The specific type of container and the construction of that container will also have an effect on how the fire behaves. It is not likely that the construction of the involved container will be known, but understanding the different characteristics will help predict various behaviors of the fire.

a. Containers with Lexan sides failed fairly quickly in fire testing and allowed the fire to spread from container to container through the side walls. If the fire is located near one of the Lexan sides, this will occur very quickly.

b. Cargo containers that have vinyl curtain type doors see failure of the door within 57-60 seconds.

c. Cargo containers come in various different sizes, ranging from 79 inches to 96 inches in height. The clearance above the containers ranges from 6 inches to several feet. The greater the size of the container, the more difficult it is to reach the far side of the container with agent from outside the aircraft.

d. The size of the space above the container in the cargo bay is a consideration, as well. A very small space above the container, such as in many narrow body aircraft configurations, may be difficult to locate from the outside. Once the piercing tip is in the fuselage, the discharge pattern of the piercing tip is reduced when confined in a small space. A reduction in the full pattern may reduce its effectiveness on the fire.

e. Smaller cargo aircraft may be floor loaded. The freight may not be in a cargo container or ULD, but perhaps separated into sections of the aircraft by nets or bulkheads which are installed to keep the load from shifting. This is typical on many of the feeder aircraft used by the major cargo carriers.

f. Another ULD is called a cargo position or pallet. The pallet is a flat metal pan with accommodations for tie down nets. The freight is loaded onto the pallet, covered with polyethylene sheets and secured with nets. Some airlines have begun using a protective bag to be wrapped around the pallet of freight. The bag is designed to contain a fire within the freight, proving time for the aircraft to get on the ground.

There are many sizes, types of construction and characteristics of ULDs. The effect of firefighting attempts through the HRET will vary, depending upon the type ULD, the area of penetration and the ability to reach the fire with agent. Having an understanding of the types of ULDs carried on aircraft at the airport will help in the development of an appropriate firefighting strategy.

The walls of the aircraft cargo hold have fiberglass type liners, called gill liners or econo-liners which can be difficult to pierce. They often stretch, particularly when heated. If the liner stretches as the piercing tip contacts it after penetrating the fuselage, the agent can be trapped between the liner and the fuselage wall. In this situation, the liner acts like a shower curtain protecting the fire from the agent. If the liner is stretching, it will stop when it comes in contact with the cargo container. At that point the piercing tip will easily pass through the liner.

Some aircraft are fitted with fiberglass batting as a thermal barrier. This is essentially a plastic bag full of wool. The batting is not substantial in any way, but this could cause interference or entanglement to the piercing tip, perhaps blocking an effective spray pattern.

Although one cannot see exactly what is being penetrated, the FLIR camera is a valuable tool to identify fire location and to measure the effectiveness of the firefighting efforts. Trial and error using different penetration depths and piercing locations will ultimately attain the most effective method.

If the fire is located in a load of freight being carried on a cargo pallet covered with polyethylene and cargo netting, access may be easier. It is likely that if the fire has grown to the intensity required to see the “bloom” with FLIR cameras, then it has broken through the poly and a well positioned penetration above the cargo position with a 40 foot diameter spray pattern from the penetrating nozzle will have an excellent chance of interrupting the rising thermal column and suppressing the fire.

5.5.3 Passenger Aircraft Piercing

Piercing operations can also be conducted on passenger aircraft. The passenger aircraft should be penetrated 10-12 inches above the cabin windows, as this location will be above the seat backs, but below overhead luggage bins. The rivet pattern will indicate where the aircraft structural members are located.

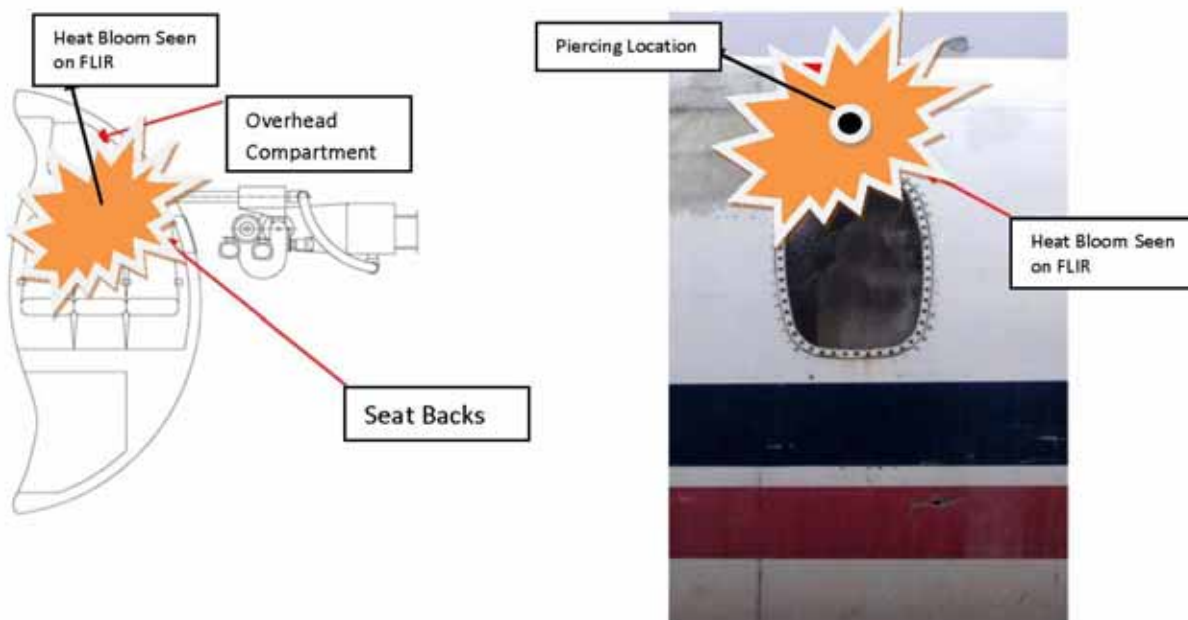


Figure 5-5. The piercing location is between the top of the seats and the overhead compartment in the center of the heat bloom seen through the FLIR. This piercing location is typically above head height, (HRET not to scale) but also in an area of extremely high temperatures.

Piercing into the overhead storage bins will reduce the effectiveness of the spray pattern. In tests conducted by the FAA, piercing into the overhead compartment still provided the introduction of agent into the aircraft cabin; however the amount and effectiveness was significantly reduced. The storage compartment door was opened or partially opened either by the force of the stream or by contents being pushed against the door by the piercing tip.

The piercing tip can be used very effectively in the removal of aircraft cabin windows. Positioning the piercing tip and slowly extending the tip and pushing the window will cause the window mounting clips to break and force the window to drop into the aircraft cabin. Although the windows can be penetrated rather easily on most aircraft, the seats will block 25% to 50% of the effective fog spray.

Examples using the HRET used to remove aircraft windows are provided in the FAA ARFF Training video in the HRET module.

ARFF Firefighters may be reluctant in theory to pierce passenger aircraft as they are concerned with injuring a passenger with the piercing tip. Tactical guidance on the penetrating aircraft identifies piercing locations based on heat blooms as seen on FLIR cameras. If piercing into a significant heat bloom, it would be considered that the piercing area is not a survivable environment. Passengers in this area have either moved away from the fire or may have already perished.

5.5.4 HRET Interior Operations

The HRET can be positioned at the door of an aircraft for interior fire fighting. On certain doors, HRETs can be positioned inside the aircraft. This provides the opportunity to use the HRET mounted lighting, optics and turret for evaluation of interior conditions. The positioning of the HRET at or inside the door can be used, in some cases, as a water supply for a hand line used for interior fire fighting. A wye or gated wye should be used so that the discharge can be manually controlled as appropriate for the attack line being supplied.

In a potentially compromising scenario, it is possible to use the master stream at the end of the boom to discharge agent into the aircraft fuselage while the HRET is positioned inside the doorway. This is not a recommended standard attack method, as it could cause damage to the boom. It is however a method of getting agent on an interior fire when all other methods have been exhausted.

When flow is initiated through the HRET boom, the nozzle reaction will cause movement of the boom. If the boom is not allowed to move, the energy created by the flow builds up in the boom structure. This effect is called boom loading. The design of HRETs allows for the movement of the boom in response to nozzle reaction, but does not factor any particular allowance for boom loading.

If the boom is placed in the door opening and the nozzle is rotated 90 degrees, the boom will react to the nozzle pressure and move in the opposite direction. That movement can be anywhere from 12 to 36 inches or more, depending on the HRET, the length of boom extension, the nozzle, the pressure and the flow rate. That movement will cause the boom to strike the door frame of the aircraft. If positioned to the opposite side of the door frame from the direction of flow, the boom travel will be minimized, reducing the impact; however the boom will “load” from the energy of the nozzle reaction. Either of these events may cause damage to the HRET.

If this method is used, manufacturer’s recommended procedures should be followed. The HRET manufacturers may have specific guidance on the best case scenario for the HRET in service at any given airport. The following factors should be considered:

1. Use “low flow” settings. This creates less nozzle reaction force and boom loading. High flow rates can cause interior damage to lose wall coverings and luggage compartments that can then create flying debris. High flow is also dangerous to passengers that may be trapped inside.
2. Use a fog or narrow fog pattern. This creates less nozzle reaction force and boom loading. Fog patterns will cool the interior faster and reduce ancillary damage.
3. Potential injury could occur to any occupants if struck by high flow rates and straight stream discharge of the master stream nozzle.
4. Shift of aircraft or tail tip while the boom is in the aircraft door could cause damage and injury to ARFF vehicles and personnel.
5. When the boom is placed inside a doorway or over-wing exit, that opening is no longer available for exit by passengers or access by firefighters.

5.5.5 Manual Piercing

A properly trained crew with hand held penetrating nozzles, given a safe working platform and proper protection, can deliver many of the same firefighting tactics and strategies described for HRETs. A variety of hand held penetrating nozzles are available. Understanding the limitations and capabilities of each, and maintaining proficiency in their use, allows firefighters to draw upon an arsenal of tools to satisfy the needs of the incident.

Penetrating nozzles are available in a variety of lengths and configuration. Longer penetrating nozzles may actually allow access to areas at a greater distance than HRET piercing tips. Hand held penetrating nozzles flow less agent than HRETs and require firefighters to be working directly alongside the aircraft. Firefighters must remain aware of the limitations of the handheld penetrating nozzle based on a flow rate of 95 to 125 GPM (359.61 to 473.18 LPM) as compared to 250 GPM (946 LPM) from a HRET.

5.6 Aircraft Stabilization

The airline representative may be able to provide equipment that is helpful in stabilizing the overall aircraft during emergency operations. Some cargo aircraft are configured to accommodate a tail stand or mooring post. A mooring post can be attached to a reinforced assembly near the tail section and may help prevent tail tip. This is an accommodation that is only available through the airline. Improper installation of the mooring post or attempted installation on an aircraft not specifically configured for one will not aid in stabilizing the aircraft, but instead will likely cause additional damage to the aircraft. Some cargo carriers have specific tie downs on their ramp designed to secure the nose to the ramp. If this accommodation is available at the location of your emergency, airline representatives can make the attachments and help prevent tail tips. Some cargo carriers have specially equipped dollies equipped with heavy counter balance weights. This tool is nicknamed a “Pet Rock” in ramp jargon. This system is used to hold the nose of the aircraft on the ramp, and serves as another tool to prevent tail tip. There are times, when additional equipment may be needed to stabilize an aircraft. Many different tools, materials and pieces of equipment can be used to stabilize the aircraft. A variety of tools including cribbing, airbags, jacks, rams and heavy timber can be used to stabilize the aircraft preventing rolling, sliding, shifting, twisting, or collapse. These resources may require assistance from airlines, Fixed Based Operators (FBOs), or mutual aid departments.

Shiny metal (chrome) on struts is a reference point that should be monitored; 1-4 inches (0.025 to 0.102 M) of a shiny metal on a large frame aircraft strut is normal. This amount will vary, depending on

the type of aircraft and its load. Tracking any changes in the amount of shiny metal on the strut is a good way to monitor shifts in the aircraft load and balance.

Actions that will prevent the aircraft from tail tipping or cause gear that has been compromised in the event from collapsing under the extra weight of firefighting water may be prudent or necessary.

A risk analysis should be conducted to determine if additional stabilization can be provided, or if the condition of the aircraft is providing an opportunity for the water to drain. Cracks or damage to the fuselage or open doors may already be creating an opportunity for water to drain. If the action of cracking open a door does not affect the tactics of fire attack being employed, i.e., ventilation or restricting oxygen supply to the fire, in some circumstances it could provide an escape for water and reduce the opportunity for tail tipping. Additional methods for draining water through piercing or cutting are discussed in Section 5.3.

APPENDIX A. SAMPLE HRET JOB PERFORMANCE REQUIREMENT QUALIFICATION DOCUMENT (LESSON PLAN)

SAMPLE

This guidance is intended to serve as a sample that can be used to help develop an ARFF Department's vehicle operator training SOG, Lesson Plan, Operator Certification System, and/or Proficiency Evaluation. If used, it will need to be refined to harmonize with existing Manufacturer's Operating Procedures, Department policies, procedures and SOGs. It has been developed through the sharing of existing procedures in place at a number of ARFF Departments operating at FAA Certificated Airports. The forms, lesson plans and suggested proficiency exercises are provided as examples. They may be replaced or modified by the department, but the intent of the examples must be satisfied in the department's methods.

GENERAL

This Job Performance Requirement (JPR) Qualification Guidance has been developed to serve as a training lesson plan for qualification / certification of proficiency for operators of ARFF vehicles equipped with High Reach Extendable Turrets. This document identifies the job performance requirements for the specific certification in a format that allows a candidate to be trained and evaluated during the training sessions. To achieve certification, the applicant must successfully complete all task and JPRs in this Qualification Guidance document. Once a candidate has completed the process, it serves as a record of the training, evaluation and proficiency demonstration.

Before a JPR certification can be issued, successful performance of all sections must be observed and recorded by a qualified and approved evaluator.

These JPR serve as general guidelines. As such, they are not intended to replace specific sequences of apparatus or equipment operation that may be outlined by manufacturers of the apparatus or the HRET. Training shall follow department standard operating guidelines, which are harmonized with this training. If there is a question about the safe operating requirements and limitations of the specific apparatus or mounted equipment, the manufacturer's operation manual should be referenced. When a conflict with department procedures and manufacturer's procedures occur, manufacturer's procedures will take precedence. Trainers / evaluators should have available manufacturer specifications and department standard operational guidelines.

Qualification

Satisfactory completion of this training program and proficiency evaluation / testing procedures qualifies an operator for assignment to a vehicle. Daily operation of a vehicle and its components helps to maintain familiarity with the controls and some of the skill sets. The skills that are not routinely practiced will diminish with time. The qualification is needed to operate a vehicle and/or HRET. This JPR Qualification is valid for One (1) year from the date of final sign off of the JPR Qualification. Records of the recurrent training and proficiency testing / evaluation for each operator shall be maintained in the ARFF training records.

Proficiency

Proficiency with ARFF vehicle operations and especially HRET operations is only developed through hands-on-training and practical experience. ARFF Vehicle and HRET operators need to develop a good sense of the range of the boom and the turret in various patterns using high and low flow rates, aim and capabilities and limitations of the device. Training exercises, as well as demonstrations of proficiencies, need to include all of the capabilities of the vehicle and HRET. This JPR Qualification Program includes examples of Proficiency events which demonstrate the ability of the Operator to safely and efficiently operate the equipment. Satisfactory completion of the Proficiency events is required for vehicle operator Qualification.

Recurrent Training

Driver / Operator Qualification issued as a result of satisfactory completion of this training program and proficiency evaluation / testing procedures qualifies an operator for assignment to a vehicle. Daily operation of a vehicle and its components helps to maintain familiarity with the controls and some of the skill sets. The skills that are not routinely practiced will diminish with time. The qualification to operate a vehicle and/or HRET does not remain in force longer than the skills required to remain proficient. Operator Qualification must be accomplished prior to the expiration date of the previously issued Qualification. Re-entry into the JPR Qualification program can also be required if the operator is found to be deficient in any required skill set. This determination can be made by the Training Officer, Company Officer, Shift Commander or the Fire Chief. Records of the recurrent training and proficiency testing / evaluation for each operator shall be maintained in the ARFF training records, and are subject to review by the Airport Safety Certification Inspector (ASCI).

Instructions:

Trainers

1. Must be qualified and authorized in compliance with the department's standards establishing minimum qualification for trainers, must be certified on the apparatus and it's mounted components, and possess a current driver's license (of the proper class, with appropriate endorsements to satisfy local requirements) before conducting any training.
2. The applicant must fill in answers to all required questions on the JPR Qualification document to the satisfaction of the Trainer in writing. Questions requiring a verbal explanation or demonstration must be done to the satisfaction of the Trainer.
3. Ensure that all information, dates and hours are recorded accurately in this JPR Qualification document.
4. When complete, must provide copy of JPR Qualification to Applicant. Must file original in applicant's FAA Training Record, which is subject to review by ASCI.

Applicants

1. Must have a current SIDA Badge, applicable drivers license (of the proper class with appropriate endorsements to satisfy local requirements), as well as unrestricted AOA Driver's License in their possession.
2. Must complete driver's license information on the certification page(s).
3. When all JPR Qualification tasks have been documented, must obtain required signatures and save a copy for personal records.

In this space provide Departments minimum requirement for Drivers License Class and endorsements as per local requirements.

TRAINING DIVISION USE ONLY	
Training and Safety Officer Signature:	_____
Driver Training Officer Signature:	_____

Fill In Apparatus Manufacturer and Model for this JPR Qualification

QUALIFICATION

THE SECTION BELOW MUST BE COMPLETED IN ITS ENTIRETY BEFORE AN APPARATUS
QUALIFICATION WILL BE ISSUED.

Apparatus Type or Vehicle Designation : _____		@ Sta. _____	
Name (Print): _____		Employee or Badge Number _____	
Rank: _____	Station: _____	Division: _____	Shift: _____
CDL or License #: _____	Exp: _____	Physical: _____	Exp: _____
Class: _____	Endorsements: _____	Restriction(s): _____	
<p>This applicant has satisfactorily completed a (minimum) (12) twelve hour training course in the operation of this vehicle, demonstrating the requisite knowledge and skills to effectively and safely operate this classification of apparatus. Training time may be reduced to the (6) six hours HRET Qualification if applicant is previously certified on the same make and model apparatus without a HRET. For Qualification, all documentation in the JPR Qualification Document pertaining to this apparatus must be completed.</p>			
<p>Total training hours required is dependent upon student's skill level and NOT the minimum hourly requirement.</p>			
Dates of Training:		From: _____	To: _____
		Month Day Year	Month Day Year
Applicant's Signature: _____			

* Trained by: _____ Trainer Signature: _____
Print Name and Rank

* Supervisor: _____ Supervisor Signature: _____
Print Name and Rank

* *Chief Officer:* _____ *Shift Commander or*
Print Name and Rank *Chief of Dept. Signature:* _____

* Your signature certifies that the above person has completed the Qualification program detailed in this booklet. This individual has completed the minimum number of training hours and demonstrated a driving ability that is consistent with all department standards and procedures.

TRAINING DIVISION USE ONLY

Training and Safety Officer Signature: _____
Driver Training Officer Signature: _____

TRAINING RECORD – FILL IN APPARATUS MAKE & MODEL

TRAINING RECORD - FILL IN WITH FACTS AND FIGURES						MODEL
DATE	TIME	HRS	APP. #	TASK	STA. #	SUPERVISOR NAME
	FROM:					PRINT:
	TO:					SIGN:

DATE	TIME	HRS	APP. #	TASK	STA. #	SUPERVISOR NAME
	FROM: TO:					PRINT:
						SIGN:

DATE	TIME	HRS	APP. #	TASK	STA. #	SUPERVISOR NAME
	FROM: TO:					PRINT:
						SIGN:

DATE	TIME	HRS	APP. #	TASK	STA. #	SUPERVISOR NAME
	FROM:					PRINT:
	TO:					SIGN:

DATE	TIME	HRS	APP. #	TASK	STA. #	SUPERVISOR NAME
	FROM:					PRINT:
	TO:					SIGN:

DATE	TIME	HRS	APP. #	TASK	STA. #	SUPERVISOR NAME
	FROM:					PRINT:
	TO:					SIGN:

DATE	TIME	HRS	APP. #	TASK	STA. #	SUPERVISOR NAME
	FROM:					PRINT:
	TO:					SIGN:

DATE	TIME	HRS	APP. #	TASK	STA. #	SUPERVISOR NAME
	FROM:					PRINT:
	TO:					SIGN:

DATE	TIME	HRS	APP. #	TASK	STA. #	SUPERVISOR NAME
	FROM:					PRINT:
	TO:					SIGN:

DATE	TIME	HRS	APP. #	TASK	STA. #	SUPERVISOR NAME
	FROM:					PRINT:
	TO:					SIGN:
	TOTAL HOURS					PRINT:
						SIGN:

Apparatus Type or Vehicle Designation : _____ @ Sta. _____		
Name (Print): _____		Employee or Badge Number _____
Rank: _____	Station: _____	Division: _____ Shift: _____
CDL or License #: _____	Exp: _____	Physical: _____ Exp: _____
Class: _____	Endorsements: _____	Restriction(s): _____
AOA Unrestricted Drivers License Expiration Date: _____		
This applicant has satisfactorily completed a minimum (6) six hour training course in the operation of the HRET, demonstrating the requisite knowledge and skills to effectively and safely operate this classification of equipment.		
Training hours are limited to (2) two hours training time, per shift maximum. Total training hours required depends on student's skill level and NOT the minimum hourly requirement.		
Dates of Training: From: _____ To: _____ <div style="display: flex; justify-content: space-around; width: 100%;"> Month Day Year Month Day Year </div>		
Applicant's Signature: _____		

* *Chief Officer:* _____ *Shift Commander or*
Chief of Dept. Signature: _____
Print Name and Rank

TRAINING DIVISION USE ONLY

Training and Safety Officer Signature: _____

Driver Training Officer Signature: _____

TRAINING RECORD – HRET OPERATOR

TRAINING RECORD - MEET OPERATOR						
DATE	TIME	HRS	APP. #	TASK	STA. #	SUPERVISOR NAME
	FROM: TO:					PRINT:
						SIGN:
DATE	TIME	HRS	APP. #	TASK	STA. #	SUPERVISOR NAME
	FROM: TO:					PRINT:
						SIGN:
DATE	TIME	HRS	APP. #	TASK	STA. #	SUPERVISOR NAME
	FROM: TO:					PRINT:
						SIGN:
DATE	TIME	HRS	APP. #	TASK	STA. #	SUPERVISOR NAME
	FROM: TO:					PRINT:
						SIGN:
DATE	TIME	HRS	APP. #	TASK	STA. #	SUPERVISOR NAME
	FROM: TO:					PRINT:
						SIGN:
DATE	TIME	HRS	APP. #	TASK	STA. #	SUPERVISOR NAME
	FROM: TO:					PRINT:
						SIGN:
DATE	TIME	HRS	APP. #	TASK	STA. #	SUPERVISOR NAME
	FROM: TO:					PRINT:
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DATE	TIME	HRS	APP. #	TASK	STA. #	SUPERVISOR NAME
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DATE	TIME	HRS	APP. #	TASK	STA. #	SUPERVISOR NAME
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DATE	TIME	HRS	APP. #	TASK	STA. #	SUPERVISOR NAME
	FROM: TO:					PRINT:
						SIGN:
DATE	TIME	HRS	APP. #	TASK	STA. #	SUPERVISOR NAME
	FROM: TO: TOTAL HOURS					PRINT:
						SIGN:
						PRINT:
						SIGN:

I. INSTRUCTIONS

- A. The evaluator will check off each box after successful completion of the performance requirements by the trainee.
- B. Sections with three boxes are to be initialed after each evolution is completed successfully.
* **Driving skills can be demonstrated during normal driving**
- C. **Trainer should add any appropriate comments after initialing boxes.**

EXAMPLE:

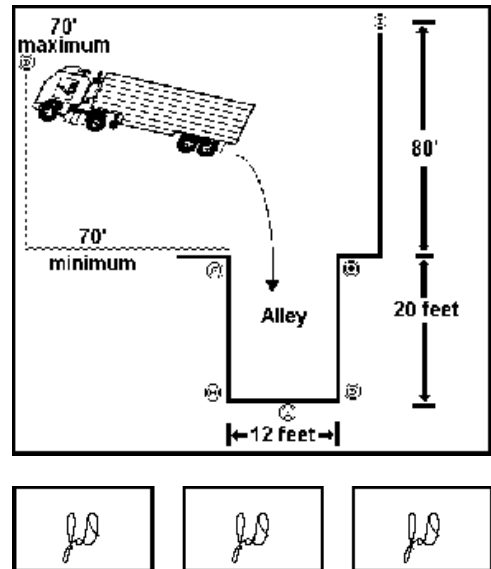
1. ***Alley Dock (Backing into station)**

Dock the vehicle from a 90° angle, in one movement, without touching any cones or stanchions, staying within all boundary lines and stopping within one (1) foot (.304 M) of the dock or stop line.

Pulling forward will result in a penalty.

Comments:

- D. Trainee must complete (6) six hours minimum of driving to include vehicle operation driving on the A.O.A. (Aircraft Operations Area) following all airport driving and security policies / procedures, and utilizing proper radio communication skills. Driving to include:



Add or delete categories as appropriate.

- | | |
|-------------------------------------------------------------|------------------------------------|
| 1. Normal street / traffic conditions | 6. Off airport response or driving |
| 2. Multiple turns and lane changes | 7. |
| 3. Underpass / low clearance areas | 8. |
| 4. Overpass / Weight Restrictions | 9. |
| 5. Off road and Unimproved surface operation of the vehicle | |

NOTE: Driving requirement(s) may be adjusted or eliminated if not in the available operation area.

- E. Trainee must complete (4) four hours minimum training of pumping operations, hydraulics, foam systems, complementary agent systems, mounted equipment, and tools carried. Trainee must demonstrate the requisite knowledge and skills to successfully and effectively perform all operational tasks.
- F. Trainee must complete (2) two hours minimum using all apparatus forms, performing apparatus “check out”, discrepancy reporting, maintenance, and auxiliary equipment operation and maintenance

- G. If the apparatus is equipped with a HRET, hands on training shall not be conducted until the Department's training SOG requirements for classroom and computer based training (if available) have been satisfied.
- H. Trainee must complete (6) six hours minimum of hands on HRET operation, demonstrating the requisite knowledge and skills to successfully and effectively perform all operational tasks.
- I. Resources:
 - 1. Manufacturer's Maintenance and Operating manuals.
 - 2. Fire Department Policies and Procedures and SOGs
 - 3. State Department of Motor Vehicles Driving Handbooks
 - 4. Aircraft Rescue and Fire Fighting IFSTA
 - 5. NFPA 402 Guide for Aircraft Rescue and Fire- Fighting Operations
 - 6. NFPA 403 Standard for Aircraft Rescue and Fire-Fighting Services at Airports
 - 7. NFPA 414 Standard for Aircraft Rescue and Fire-Fighting Vehicles
 - 8. FAA Advisory Circular 150-5220-10 Guide Specification for Aircraft Rescue Fire Fighting Vehicles
 - 9. FAA Advisory Circular 150-5210-7, ARFF Communications
 - 10. FAA Advisory Circular 150-5210-17, Programs for Training of Aircraft Rescue and Fire Fighting Personnel
 - 11. Certalert #0809 Guidance on High Reach Extendable Turrets (HRETs)
 - 12. Certalert 9602 High Reach ARFF Equipment
 - 13. DOT/FAA/AR-05/53 High-Reach Extendable Turrets with Skin Penetrating Nozzle

All FAA documents are available for free download at:

http://www.faa.gov/airports/airport_safety/aircraft_rescue_fire_fighting/

DEMONSTRATE AND DISCUSS KNOWLEDGE OF THE FOLLOWING:

II. APPARATUS DESCRIPTION

A. Manufacturer _____

B. Apparatus Type _____

C. GVWR _____

D. Engine Manufacturer _____

E. Engine Type / Horsepower _____

F. Transmission Type _____

G. Suspension Type _____

H. All Wheel Drive _____

I. ABS Braking Operation _____

J. Rear Wheel Steer (if equipped) _____

K. Central Tire Inflation (if equipped) _____

L. Rear Wheel Steer (if equipped) _____

M. Crew Seating Capacity _____

N. Pumps _____

 1) Water _____

 a) _____ Type, # of stages _____ GPM @ _____ PSI @ _____ RPM

 b) _____ Structural Panel Operation (if equipped) _____

 c) _____ Stationary pumping operation _____

 d) _____ Pump and Roll Operation _____

 2) Foam _____

 a) _____ Type of Automatic Proportioning System _____

 b) _____ Percentage (3% or 6%) _____

 c) _____ Manual Proportioning Operation (if equipped) _____

O. Water Reservoir Gallons _____

 a) Fill pressure not to exceed PSI: _____

 b) Tank Inlet Size / type connection / location / quantity: _____

 c) Hose and adaptors carried: _____

P. Foam Tank _____

 1) _____ Gallons (Liters) _____

 2) _____ % _____ Type foam _____

Q. Complementary Agent

- 1) Type _____
- 2) Quantity _____
- 3) Operation _____
- 4) Daily Check _____
- 5) Re-Service _____

R. Turrets and Nozzles

1) HRET Boom Nozzles

a) Twin or single agent

1. _____ GPM @ _____ PSI (water / foam)
2. Complementary Agent: _____ Type _____ Flow rate _____

b) Piercing tip

1. _____ GPM @ _____ PSI (water / foam)
2. Complementary Agent: _____ Type _____ Flow rate _____
3. Usable Length of Piercing Tip _____
4. Use of Extensions (if applicable) _____

2) Bumper Turret

- a) _____ GPM @ _____ @ _____ RPM water/foam only
- b) Patterns _____
- c) Range _____
- d) Complementary Agent _____
- e) Auto Oscillate, Low Attack or other features _____

3) Under truck nozzles

- a) Qty _____
- b) _____ GPM @ _____ psi water / foam only

4) Windshield deluge system water only _____

S. Hand lines

- 1) Hose Reel _____ ft. Twin or single agent
 - a) _____ GPM water / foam
 - b) _____ lbs. per sec. Dry Chemical
 - c) _____ lbs. per second Halogenated Agent
- 2) Hand Lines _____ ft 1 3/4" _____ PSI @ _____ GPM, Nozzle Type
- 3) Auxiliary equipment: *List Carried Equipment and identify storage location*
 - a) *PROVIDE EQUIPMENT LIST BY COMPARTMENT*

T. Intakes # and sizes _____

U. Outlets # and sizes	_____	
V. Supply Hose Size	_____	Length _____
W. Generator (if equipped)	_____	
1) Type	_____	KW, Powered by a _____
_____	Volt output with (Example: 2 / 500 watt front floods, 2 / 1000 watt side floods), and electrical outlets, (Type Plug, location).	

III. APPARATUS SPECIFICATIONS

A. Height (clearance)	_____	Width _____	Turning Radius _____
B. Length	_____		
C. Tire pressure	Front _____	Rear _____	Tandem _____
D. Weight Loaded	_____		
E. Weight Empty	_____		

IV. PRELIMINARY TO DRIVING

- A. Demonstrate understanding of apparatus communication systems
 - 1) Department radio policies and procedures
 - a) Fire radios _____
 - b) ATC Radios _____
 - c) Portable radios _____
 - 2) Public Address system and siren _____
 - 3) Interior communication system _____
- B. Understanding of FAA hand and light signals
 - 1) Hand signals
 - a) Evacuation
 - b) Stop
 - c) Emergency contained
 - 2) Light signals
 - a) Steady Green - clear to cross or proceed
 - b) Steady Red - **STOP**
 - c) Flashing Red - **CLEAR OFF** runway or taxiway
 - d) Flashing White - return to starting position
 - e) Alternating Red / Green - use extreme caution
- C. Knowledge of aircraft firefighting tactics and procedures. *(Department SOGs)*
- D. Location, maintenance and use of all auxiliary equipment

E. Daily Check Out Procedures *Refer to Department Check-out Procedures.***V. DRIVING APPARATUS**

- A. Checks that crew is seated and seat belts fastened, mirrors adjusted.
- B. Foot on brake.
- C. Begin movement in (2 - 5) (or drive gear as recommended by manufacturer).
- D. Release parking brake.
- E. Accelerating
 - 1) Light accelerator pressure to begin movement
 - 2) Ease off accelerator as desired speed is reached
 - 3) Avoids full throttle acceleration from a stop
 - 4) Consistent, smooth and controlled movements
- F. Braking
 - 1) Anticipates stops, let off accelerator in anticipation of braking.
 - 2) Allows engine to act as a brake (down shift if necessary)
 - 3) Use secondary braking system if equipped.
 - 4) Brakes into turn - Accelerates out of turn
 - 5) Leaves room to go around stopped vehicles
 - 6) Consistent, smooth and controlled
- G. Operates vehicle with awareness of chassis length, height and weight.
 - 1) Considers vehicle length when changing lanes
 - 2) Slows sufficiently at bumps and dips in operating surfaces to prevent boom lash in cradle
 - 3) Chooses correct lane for driving conditions
- H. Follows all Fire Department Policies, Procedures, and State and Local driving laws.
- I. Turning
 - 1) Plans and adjusts for extended turning radius of vehicle
 - 2) Uses mirrors consistently during driving and maneuvering for positioning in turns and to monitor for possible hazards
 - 3) Proper hand position on steering wheel
 - 4) Does Not let wheel slip through hands
 - 5) Uses turn signal appropriately
 - 6) Starts and complete turn in proper lane.
 - 7) Observe and monitor Lateral G Indicator (if equipped). Modify driving habits based on alerts or alarms indicating turns are too aggressive and compromising safety.

VI. DRIVING CAUTIONS

- A. Turn HRET Master Switch “OFF” when entering station. NEVER turn on inside station
- B. Make sure HRET is properly bedded before moving vehicle
- C. Understand height and weight restrictions
 - 1) High center of gravity six feet above ground
 - 2) Mass of water in motion (25,000 + lbs.) (based on Qty x 8.34 Lbs)
 - 3) Partially empty water / foam tanks increase vehicle instability due to sloshing of fluid
 - 4) Increased braking time due to heavy weight
- D. No sharp turns at speed
 - 1) Understand reaction of suspension when turning or hitting dips such as ramp storm drains
 - 2) Do not brake while turning except at very low speeds under 10 mph
 - 3) Take turns slowly. Do not attempt to estimate your speed, check the speedometer before making the turn
 - 4) Remember mass in motion will continue to move in the same direction
 - 5) When responding to emergencies, accelerate fast while straight, but brake hard and downshift before going into a turn or curve
- E. Do not drive with the boom extended except in fire fighting operations
- F. Do not exceed 5 MPH when turning with boom not bedded
- G. Stand by in High Idle
 - 1) Do not shut down in High Idle
 - 2) Do not idle engine for long periods of time (10 minutes or more) as damage to turbo and injectors may occur. (See Engine Manufacturers recommendations) If idling for long periods is required by operations increase RPMs to a minimum of 900 to 1100 RPM (shift to high idle operation)
 - 3)
- H. Do not use differential lock up on hard surfaces. Check manufacturer requirements.
 - 1) Turns may cause damage to axles
 - 2) Use only in soft terrain or mud.

VII. BACKING

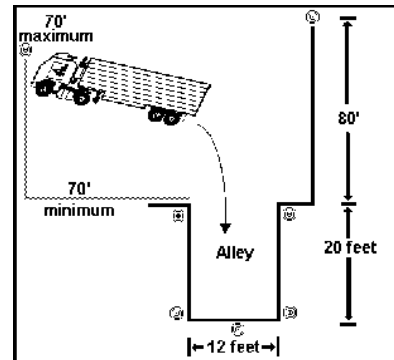
- A. When and how to back
- B. Use of emergency lights and rear vision camera if equipped.
- C. Utilization of crew
 - 1) Use personnel to back apparatus at all times (Department Procedure)
 - 2) Stop immediately if personnel backing are lost from sight
 - 3) Maintain slow speeds while backing

VIII. DRIVING SKILLS

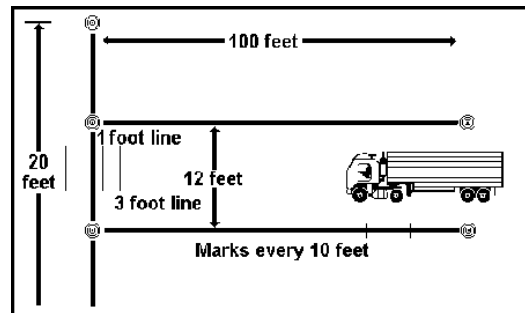
A. Demonstrates the following driving skills / maneuvers:

*** Driving skills can be demonstrated during normal driving**

- 1) **Alley Dock** (Backing into station). Dock the vehicle from a 90° angle, in one movement, without touching any cones or stanchions, staying within all boundary lines and stopping within one (1) foot of the dock or stop line. Pulling forward will result in a penalty.

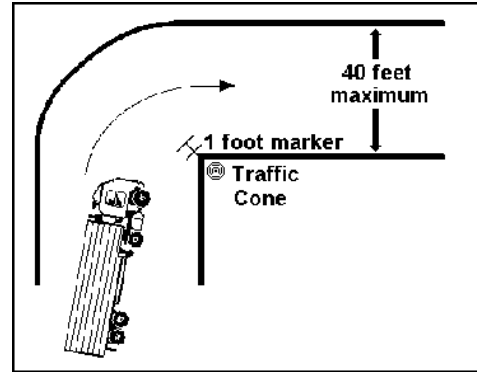
Comments:

- 2) *** Forward Stop (Limit Line)**
Drive down a 12 foot wide lane and stop when the driver estimates the bumper is even with the stop line. Driver is allowed to make **one** stop only, to be within one (1) foot of the stop line. This event helps to illustrate awareness of the forward position of the vehicle, critical in holding short of Runway Hold Bars.

Comments:

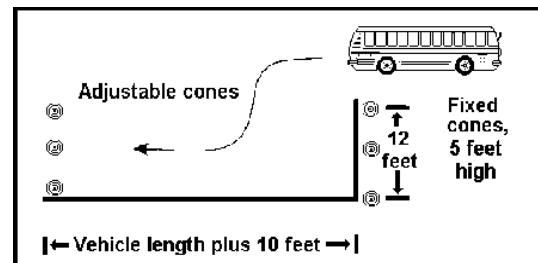
- 3) * **Measured Right Turn**
Make a right turn around a corner, with the back axles of the vehicle within one (1) foot of the designated cone, **without** striking it.

Comments:



- 4) * **Parallel Parking**
Park in a designated area without striking any cones or boundary lines. This exercise is not designed to prepare for parallel parking an ARFF vehicle, but rather to develop control, and mirror use.

Comments:



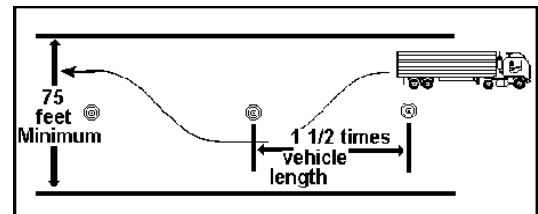
- 5) **Serpentine .**
Maneuver vehicle forward around 3 cones in a serpentine without knocking down cones

Maneuver vehicle in reverse around 3 cones in a serpentine without knocking down cones

Maneuver vehicle forward around 3 cones during pump and roll in a serpentine without knocking down cones

Maneuver vehicle in reverse around 3 cones during pump and roll in a serpentine without knocking down cones

Comments:

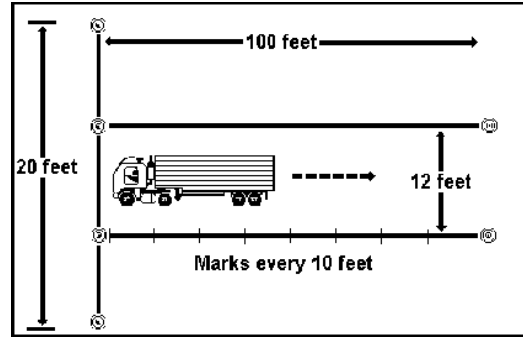


6) **Straight Line Backing**

Drive in reverse between the 12 foot wide lane without going outside the cones or boundary lines

Normal driving while backing.

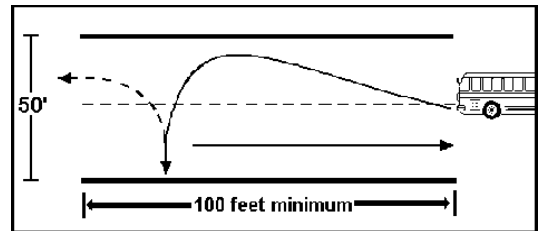
Pump and roll while backing.



Comments:

7) * **Three-point U-turn**

Driver turns the vehicle 180 degrees, staying inside the cones or boundary lines. There is no limitation on the number of maneuvers used to accomplish this task.



Comments:

IX. APPARATUS AUXILIARY AND SAFETY SYSTEMS

A. Antilock Braking System (ABS)

- 1) ABS operation
- 2) ABS prevents wheel
- 3) Wheels effected
- 4) Brake pedal pressure during emergency stops
- 5) ABS warning light remains lit until
- 6) Report malfunction if warning light stays on (color)
- 7) ABS brake system operational technique

a) **Emergency Braking Operation**

- Depress the brake pedal hard to the floorboard
- Stay on the brake pedal, do not let up. Releasing the pedal resets the ABS computer, Increasing the stopping distance.
- Steer around the hazard(s). The vehicle will handle well with ABS system working.

B. Automatic Traction Control (ATC) (Review Manufacturers Operating Instructions)

- 1) Theory of operation
- 2) What ATC does when wheel spin develops.
- 3) Locate control switch. Label indicates
- 4) Normal control switch position
- 5) Explain why the indicator might display.
- 6) Explain what to do if the indicator remains illuminated

X. SHIFTING APPARATUS WITH AUTOMATIC TRANSMISSIONS

(Review Manufacturer's Operating Instructions)

In General:

- A. Maintain engine speed in power range (1600 - 2100 RPM)
WARNING - DO NOT LUG OR OVER SPEED ENGINE
- B. Select proper gear for road and weather conditions
- C. Bring vehicle to a complete stop before shifting from Neutral to Drive gear or Reverse gear.
- D. Does not descend a hill in a gear higher than required to ascend.

XI. OFF ROAD OPERATIONS

(Review Manufacturer's Operating Instructions)

CAUTION: Use all wheel drive OFF ROAD ONLY!

Do not use differential lock up on hard surfaces

Turns may damage axles USE ONLY IN SOFT SAND OR MUD

- A. Remember the Gross Vehicle Weight Rating (GVWR) of this apparatus is #

- B. Operation on unimproved or semi - improved surfaces (other than fully engineered surfaces)

MUST be done with extreme care as structural stability of surface and underlying soil is unknown

- 1) Soil or surfaces other than runways, taxiways, streets or highways have unknown load bearing capability

- C. Carefully inspect apparatus for damage after operation on an unimproved or semi-improved surface
- D. Select differential lock position
 - 1) Lock differential on hard surface just prior to moving off road
 - 2) Shifting differential lock must only be done at very slow speeds. Check apparatus operator's manual for specific restrictions.
 - 3) Wheels must be straight before shifting to lock
- E. Operate only in 1st. gear
 - 1) Top speed 5 MPH maximum (typical). *Check Operator's Manual*

XII. SECURING APPARATUS FROM DRIVING

(Review Manufacturer's Operating Instructions)

In General:

- A. Transmission in neutral
- B. Parking brake set
- C. Check engine temperature (normal temp
 - 1) For high temp idle at _____ to _____ RPM, until normal temperature achieved
 - 2) Do not idle engine for long periods of time (5 minutes or more) as damage to turbo and injectors may occur
 - 3) If idling for long periods is required by operations, increase RPM to a minimum of 900 to 1100 RPM (Activate High Idle)
- D. Idle engine to cool turbo (3-5 minutes) at _____ RPM
- E. Control switches off ignition and Masters _____
- F. Chock wheels if not in station (*As per Dept. procedure*)
- G. Attached exhaust capture system
- H. Post trip vehicle inspection
 - 1) Air and fluid leaks
 - 2) Apparatus damage
 - 3) Equipment missing or damaged
 - 4) Resupply apparatus
 - 5) Clean apparatus

XIII. PUMPING OPERATIONS

(Review Manufacturer's Operating Instructions)

In General:

- A. Do not engage pump above 1500 RPM! Engine speed
- B. Understand cab mounted firefighting systems control switches
 - 1) Location and operating sequence
 - 2) Do not shift agent selector switch directly between water and foam , pause at neutral first to prevent system damage Engine speed will increase to 2100 RPM immediately or when discharges opened
- C. Understand pump and roll operation
 - 1) Hand lines shut down and will not operate when transmission in any drive gear
- D. Sets parking brake and places transmission in neutral prior to pumping in fixed position

- E. Relief valve or Pressure Governor operation. (Review Manufacturer's Operating Instructions)

NOTE: *If ARFF vehicle is equipped with a pressure relief valve, it may need to be left at a high pressure setting to allow for rated flow and capacity of turrets operated from the cab. Follow manufacturers' instructions and insert appropriate operating instructions here.*

- 1) Automatic pressure control set at _____ psi

- F. Turret operation (roof and bumper turret)

- 1) Direction _____
 - 2) Distance _____
 - 3) Pattern selection _____
 - 4) Flow switch _____
 - 5) Manual operation _____

- G. Window deluge system operation

- H. Under truck nozzle operation

- I. Hand line Operations

- 1) Water foam hose reel operation
 - a) Location / Compartment
 - b) Activation Method
 - c) Length / Size
 - d) Nozzle
 - e) _____ GPM @ _____ PSI
 - f) Flushing Procedures
 - g) Blow down procedures

2) Combined Agent hose reel operations

- a) Location / Compartment
- b) Activation Method
- c) Length / Size
- d) Capacity of complementary agent
- e) Nozzle
- f) _____ GPM water @ _____ PSI
- g) _____ PPM @ _____ (Type Agent)
- h) Flushing Procedures
- i) Blow down procedures
- j) Complementary Agent System Re-Service Procedures

3) Pre-Connected Hand Lines

- a) Location
- b) Activation Method
- c) Length / Size
- d) Nozzle
- e) _____ GPM @ _____ PSI

4) 2 ½ inch Discharges

- a) Procedures for supplying foam water solution to 2 ½" hose lines.
- b) Procedures for using 2 ½" or larger discharge as Nurse Line or Supply line to other apparatus.

J. Shut down pumping operations

- 1) Turn off pump with water / foam switch first
- 2) Close discharge last to prevent water hammer
- 3) Purge foam from all systems at completion of incident
- 4) Purge dry chemical and expellant from all systems at completion of incident
- 5) Rewind hose reels and reapply hand brake(s)

K. Flushing system and blow down procedures

- 1) Switch located on dash
- 2) Individual switches on water hose reel
- 3) Follow manufacturer's instructions exactly

L. Re-Service (Water / Foam). *Refer to Department SOG on Re-Service*

- 1) Tanks can be filled in any order
- 2) Fill foam tank to capacity
 - a) Fill first if possible to allow bubbles from fill operation to settle, then top off. Bottom filling through 1 ½" foam reservoir bottom drain / fill connection will minimize sudsing.
- 3) Fill water tank to capacity

XIV. PUMPING OPERATIONS OFF TANK

(Review Manufacturers Operating Instructions)

In General:

- A. Select water or foam with agent switch
- B. Select High or Low Flow (if using turrets)
- C. Ensure turret is aimed properly.
- D. Open Discharge Valve(s)

XV. PUMPING OPERATIONS FROM A HYDRANT, RELAY OR TANKER

- A. Select agent with selector switch and perform immediate task(s) as required
- B. Secure Supply Line and connect
- C. Checks Number and Type lines deployed
- D. Check Intake / Hydrant Pressure

NOTE: *ARFF vehicles that may enter into foam operation work off the tank only. Supply lines must be connected to Nurse Line or Tank Fill inlets. ARFF vehicles equipped with structural panels will accept a pressure source through pump inlet for water only operation.*

- E. Intake pressure on Tank Fill or Nurse line inlets must not exceed 80 PSI maximum
- F. Open Discharge Valve(s)

XVI. CONSIDERATIONS WHEN PUMPING

- A. Do not idle in pump gear for long periods of time
- B. Closely monitor agent levels to assure adequate water supply to protect personnel
- C. Monitor Pump Temperature to avoid over heating
- D. Monitor Engine Temperature, especially during long term pumping operations.
- E. Emergency Cooling Procedures
- F. Ensure Fire Fighting Safety as the highest priority

XVII. HRET OPERATION

FAA Advisory Circular 150-5210-23 provides detailed information on HRETs. Fire Department SOGs specific to Department operated equipment, the airports aircraft fleet mix and available resources should be incorporated into this portion of the lesson. At a minimum, the following subjects shall be included.

The Lesson plan for the HRET must be developed based on the specific model HRET in use and applicable to the airports aircraft fleet mix, Department SOGs, staffing and assets available. The following outline is provided for guidance. Specific information needs to be provided for each field to suit the airports equipment and application.

A. Equipment Needed:

- 1) ARFF Unit with High Reach Extendable Turret
- 2) ARFF Vehicle Operator's Manual
- 3) HRET Operator's Manual
- 4) Department SOG for ARFF Vehicle with HRET Operation

B. Facility Needed:

- 1) Training ground sufficient to accommodate size and weight of HRET Vehicle with HRET
- 2) Piercing mockup / trainer
- 3) Area located far enough from AOA to allow raising of HRET without interfering with Title 14, Chapter 1, Part 77, Objects Affecting Navigable Airspace
 - Enhancements
 - Wind Sock
 - Water Supply
 - Video Recording Capability

C. HRET Specifications

- 1) HRET Operating Systems
 - a) Electronic Controls
 - Auto- Functions
 - Joysticks
 - Gages / Indicators
 - b) Hydraulic System
 - Reservoir Location, checks, capacity, type fluid
 - Operating pressures / hazards
 - c) Back up Systems
 - Manual Controls
 - Operator must be familiar with operations of the HRET in the event of a failure
 - HRET Size, Capacity and Configuration:

- d) HRET maximum height is _____ (allow for the height of the vehicle as well)
- e) Bedded position allows for turret to be extended _____
- Low Angle Height _____
 - Midrange Height _____
 - Maximum Height _____
 - Nozzle Flow Rates _____
- f) Turret Nozzle= 1000/500 GPM- Variable Fog/Straight Nozzle _____
- g) Penetrating nozzle= 250 GPM- 40' radius spray _____
- h) Bumper Turret (if equipped) _____

D. HRET Controls and Operations

- 1) Piercing Mode - when the intention to pierce has been determined, the piercing mode must be selected.
- 2) HRET operation
 - a) Boom raising and lowering
 - b) Boom extension
 - c) Boom rotation—scrub area
 - d) Bedding the boom
 - e) Flowing Agent while in the bedded position.
- 3) Operator must develop proficiency in HRET movement. Smooth movements without going past desired position and minimizing of boom movement after Stop are goals for Operator training.
- 4) Operators must understand the minimum and maximum extension distances provided by each boom manufacturer. The distances are used in developing Stand – Off positions, or distance to stop the vehicle from the fuselage, depending on anticipated piercing height.
- 5) Operator must be fully aware of HRET Manufacturer's cautions regarding extending the HRET while the vehicle is moving.
- 6) Overhead obstructions:
 - a) Overhead Electrical Hazards
 - b) Low Clearances
 - c) Title 14, Chapter 1, Part 77, Objects Affecting Navigable Airspace
- 7) Waterway Operations
 - a) High flow vs. Low flow
 - b) Low angle vs. upper level angle
 - c) Using HRET as a stand pipe
 - d) Environmental Considerations

- 8) Setting up on aircraft / Positioning
 - a) Wind
 - b) Terrain
 - c) Access (i.e.) hard pavement, debris field, obstructions
 - d) Evacuation Route
 - e) Positioning apparatus based on apparatus capabilities and anticipated needs
- 9) Window Removal
 - a) Position piercing tip against passenger aircraft window, slowly advance piercing tip. Mounting clips will fail and window will fall into aircraft.
 - b) Position piercing tip against cargo aircraft window blank, slowly advance piercing tip. Mounting clips will fail. Interior gill liner may prevent window from falling into cargo bay.
- 10) Operating HRET inside aircraft door
 - a) Positioning HRET inside aircraft door allows use of HRET mounted lighting and cameras.
 - b) Discharging Nozzle with HRET inside door opening causes movement of the boom due to nozzle reaction.
 - c) Positioning the HRET boom against door opening before discharging causes boom loading.
 - d) Boom loading and / or striking the aircraft door frame can damage the HRET. Check with HRET Manufacturer for specific guidance and limitations.
- 11) Piercing Operations
 - a) Prior to conducting any actual piercing operations, operators must complete classroom training, and Computer Based Training (if available).
 - Classroom Training
 - Aircraft Construction / Piercing Locations
 - Evaluating Heat Signatures to determine piercing locations
 - Evaluating aircraft condition to determine fire intensity / location
 - Aircraft load and balance / effect of firefighting efforts
 - De-watering aircraft
 - Passenger Aircraft – piercing strategies
 - Cargo Aircraft – piercing strategies
 - Cargo aircraft load configurations / distance to pierce
 - Interior fire attack methods / piercing
 - Direct attack – into cargo ULDs
 - Indirect Attack – into cargo bay
 - Monitoring effect of interior fire attack / piercing
 - Piercing approach / Set up
 - Stand off positions

- Piercing attack angles
 - b) Virtual Training
 - Make use of available Computer Based Training
 - c) Hands on Training
 - Inspection / review of HRET components
 - Review of check out procedures
 - Review of Department SOG on ARFF Vehicle and HRET
 - Cab control familiarization / operation (static)
 - Cab control familiarization / operational (actual)
 - Piercing demonstration on piercing mock up (trainer)
 - Piercing training / practice session
- 12) Practical Training Exercises
- a) Turret Training Exercises
 - Developing “second nature” operating skills in the operation of joysticks and controls for turrets requires initial and recurring practice. Each set of controls may have an individual feel that must be mastered by operators. When operators have a comfort level with the controls, certain practical training exercises serve as a tool to gauge the effectiveness of the operator’s skill set.
 - “T-Ball” Skill development for understanding range and aim of turrets. IFSTA Aircraft Rescue and Firefighting describes placing the softball on the traffic cone, and begin making attacks on the softball, attempting to knock it off the cone without knocking over the cone. This exercise can be timed for competitions among operators. It is effective with all type of turrets on High and Low foam from rolling or stationary positions.
 - “Touch and Go” piercing set up exercise. Requires an area with a tall chain link fence. Colored tape or ribbon is used to identify targets at various attack heights reflecting the fleet mix of the airport. The target is simply a circle of tape or ribbon spun through the chain links in various colors. The trainer notifies the operator to approach, set up and pierce the “Red” target which may be positioned for a low, high or mid range attack. The operator must select the correct stand - off position, and establish the correct piercing angle. The operator is instructed to touch the fence in the center of the designated color target and discharge through the piercing tip. The event can be timed from a predetermined approach line.

APPENDIX B. PROFICIENCY EVALUATIONS

Following are examples of Proficiency events that can be adopted or scaled to the specific requirements of the airport.

- **HIGH REACH EXTENDABLE TURRET (HRET) SAMPLE PROFICIENCY EXERCISES**
(Evaluation for the HRET operator position)

INSTRUCTIONS

- 1) The evaluation is to be filled out by the evaluator.
- 2) Boxes will be filled in with a P for “proficient” or an N for “needs work”.
- 3) All exercises need to be accomplished to the satisfaction of the evaluator.

EXERCISE/EVALUATION #1

Event:

PASSENGER AIRCRAFT, GROUND FIRE UNDER WING.

Objectives:

- ☐ Protect escape paths without impeding passenger evacuation.
- ☐ Create adequate foam blanket, fuselage protection.

Assign side of aircraft to complete tasks. Event can be staged using training aircraft, pavement markings or cones and delineators. SOG should include layout of event so that it is consistently repeated.



- *Simulate evacuation in progress from all exits sides.*
- *Foam coverage on the involved wing/engine without pushing fuel under aircraft.*
- *HRET and nozzle placement to adequately cover fuel and protect fuselage without interrupting evacuation. Low angle.*
- *Maintain a means of egress.*
- *Control fires to allow egress and access for firefighters.*

Critical Performance Considerations:

- ☐ Wind, Topography
- ☐ Pool fire disruption
- ☐ Adequate aeration of foam, correct nozzle setting, external structural aeration.
- ☐ Proper HRET deployment
- ☐ Visibility driver/HRET operator
- ☐ Correct distance from objective
- ☐ Pattern adjustment for correct coverage and reach
- ☐ Discharge initiation in time
- ☐ Coverage of area
- ☐ Communication between operators
- ☐ Agent conservation / depletion

Member: _____ Print Name and Rank	Signature: _____ Date: _____
Proficiency Evaluator: _____ Print Name and Rank	Signature: _____

EXERCISE/EVALUATION #2**Event:****PASSENGER AIRCRAFT, LARGE POOL FIRE UNDER WING IMPINGING REAR FUSELAGE.**

Event should be scaled to representative aircraft of the airport Index. Identify area of sufficient size to simulate aircraft size typical to your airport. Mark area with indicators on fence, pavement or grass area. Further identify escape areas for that aircraft.

Objectives:

Using HRET, in low attack mode:

- ☐ Protect escape route without impeding passenger evacuation.
- ☐ Create adequate foam blanket.
- ☐ Protect fuselage, maintain integrity of foam blanket.

NOTE: HRET operation can be followed with bumper turret.

**Critical Performance Considerations:**

- ☐ Wind, Topography
- ☐ Cut off fire from escape route (primary objective protect escape route)
- ☐ Pool fire disruption, horizontal low angle attack, foam application method
- ☐ Proper HRET deployment
- ☐ Discharge initiation in time
- ☐ Visibility driver/HRET operator
- ☐ Correct distance from objective
- ☐ Fuselage cooling and foam application method
- ☐ Pattern adjustment for correct coverage and reach
- ☐ Coverage of area
- ☐ Communication between operators
- ☐ Under truck nozzles, bumper turret, deluge consideration

Member: _____ <div style="text-align: center;">Print Name and Rank</div>	Signature: _____ <div style="text-align: center;">Date:</div>
Proficiency Evaluator: _____ <div style="text-align: center;">Print Name and Rank</div>	Signature: _____

EXERCISE/EVALUATION #3

Event:

MASS AGENT APPLICATION USING HRET. UNDERSTANDING OF TACTICAL CONSIDERATIONS. AGENT CALCULATIONS.

Objectives:

Understand application methods:

- ☐ TCA/PCA formulas and principals.
- ☐ Event should be scaled to representative aircraft of the airport Index.

Identify area of sufficient size to simulate:

- ☐ Theoretical Critical Area for aircraft size typical to your airport.
- ☐ Mark area with indicators on fence, pavement or grass area.
- ☐ Further identify escape areas for that aircraft, begin mass application beginning with HRET.
- ☐ Operator must satisfy each critical performance consideration.

NOTE: Event can be accomplished with 1 vehicle or multiple vehicles dependent upon airports capabilities and the quantity of agent required for the size of the aircraft.

Pre-Requisite: Familiarization and training with NFPA 403 and the Theoretical Critical Area (TCA) calculations methods.

Reference Info:

TCA Formula:
$$\frac{TCA = L \times (100 + w) \text{ where } L > 65 \text{ feet}}{TCA = L \times (40 + w) \text{ where } L < 65 \text{ feet}}$$

EXAMPLE

Boeing 757 - Length 155 Ft - External Width 13 feet

TCA for aircraft > 65 feet = Length x (100 + Width)

TCA for 757 = 155 x (100 + 13)

155 x 113 = 17,515 sq feet

Application Rate - .13 GPM per square foot = 2277 gallons water for foam production, (Q1) per minute of control time.

Critical Performance Considerations:

- ☐ Start initial discharge soon enough
- ☐ Proper coverage of objective and pool fire
- ☐ Fuselage/Blast Fence primary objective, acquire targets
- ☐ Low angle discharge no aeration of fuel on ground
- ☐ Pattern manipulation for coverage
- ☐ Boom movement for coverage
- ☐ Bumper usage
- ☐ Visibility with boom turret pattern
- ☐ Judicious use of agent, full coverage
- ☐ Under trucks when in foam blanket
- ☐ Communication between operators
- ☐ Targets acquired
- ☐ Complementary Agent / combined agent consideration, i.e., how used

Tactical Discussion Points**THREE DIMENSIONAL FIRE AND AGENTS USED FOR SUPPRESSION.**

Three dimensional, cascading fire, large fire ball, combined agent nozzle use for initial knock down. Injection of Dry Chemical in stream allows for extended reach of Dry Chemical material deeper into the fire.

Dry Chemical extinguisher effective on 3D fires.

When to charge system, why, how?

Discharge, How, Why, How long will system discharge?

APPLICATION CONSIDERATIONS

Proper techniques used for foam application and proper technique for scenario.

Bank Down Method

Foam stream hits fuselage, engine, or object to aerate.

Low Angle Attack

Foam stream discharged horizontal to ground 3 – 6 feet off surface of fuel to disrupt vapors emitting off fuel and allow foam to settle on surface of flammable liquid.

Roll On Method

Effective on pooled liquid fuel (ignited or un-ignited) on the open ground. Direct the stream on the front edge of the liquid pool. Continue foam application, foam rolls across the surface until covering entire area extinguishing the fire or sealing to surface.

Member: _____ <div style="text-align: center;">Print Name and Rank</div>	Signature: _____ <div style="text-align: center;">Date:</div>
Proficiency Evaluator: _____ <div style="text-align: center;">Print Name and Rank</div>	Signature: _____

EXERCISE/EVALUATION #4

Event:

PASSENGER AIRCRAFT WITH INTERIOR FIRE

(Aircraft with smoke, heat source pool fire set in training fuselage)

Need to improve post crash interior fire survivability through better cabin interior fire suppression techniques.

Objective:

- ☐ Create a survivable atmosphere or extend the period of survivable atmosphere inside an aircraft with an exterior pool fire.

Firefighting efforts should be concentrated on:

Critical Performance Considerations:

- ☐ Establish or maintain a means of egress
- ☐ Control fires to allow egress and access for firefighters
- ☐ Stabilize aircraft, chock and pin gear
- ☐ Stair Truck considerations: Access
- ☐ Pierce fuselage
 - ☐ Penetrator tip horizontal
 - ☐ Deploy HRET on final slow speed approach to aircraft
 - ☐ Stop at proper stand-off position for piercing level anticipated
 - ☐ Determination of correct location to place penetrator
 - Thermal imaging camera
 - Passenger escape route
 - Physical identifiers
 - ☐ Communication between driver and turret operator (if more than 1 in cab)
 - ☐ Penetrator target options and decision
 - Window
 - 10-12" above window
 - Door Opening
 - Other
 - ☐ Discharge rate, quantity, and frequency
 - ☐ Foreign objects and obstructions to impede arrival direction
 - ☐ Closed Doors slide deploy - firefighter entry.
 - ☐ Calculate approximate flow based on discharge rate and time. Calculate weight added to aircraft. Discuss additional weight affect on balance and stability of aircraft. Identify areas to monitor, methods of releasing water.

Member: _____ Print Name and Rank	Signature: _____ Date:
Proficiency Evaluator: _____ Print Name and Rank	Signature: _____

EXERCISE/EVALUATION #5**Event:****CARGO AIRCRAFT WITH REPORTED CARGO FIRE***(aircraft interior with smoke, heat source set in training fuselage)***Objective:**

- ☐ Operate FLIRs to identify heat source location.

Conditions Upon Arrival:

- Aircraft intact, L-1 door and cockpit windows open, on landing gear, smoke showing from open doors and windows
- No fire showing, no distortion of metal
- Significant heat bloom visible on FLIR camera in the rear 1/3 of the aircraft

Assessment:

- No direct access to burning cargo
- Crew has evacuated and reports all accounted for
- No obvious damage to airframe
- Aircraft is fully on pavement and appears level and stable

Incident Action Plan:

- IC orders crew to secure open doors and windows, attempt to recover NOTOC, and provide assessment from L-1 open door position
- IC orders exterior water stream to top of fuselage above heat bloom to cool metal
- Aircraft gear is chocked and pinned.
- Closing the aircraft has reduced available oxygen to the fire and has given Command the opportunity to populate his Command Post.
- IC orders piercing of aircraft at the 2 o'clock position in the center of the heat bloom.

Critical Performance Considerations:

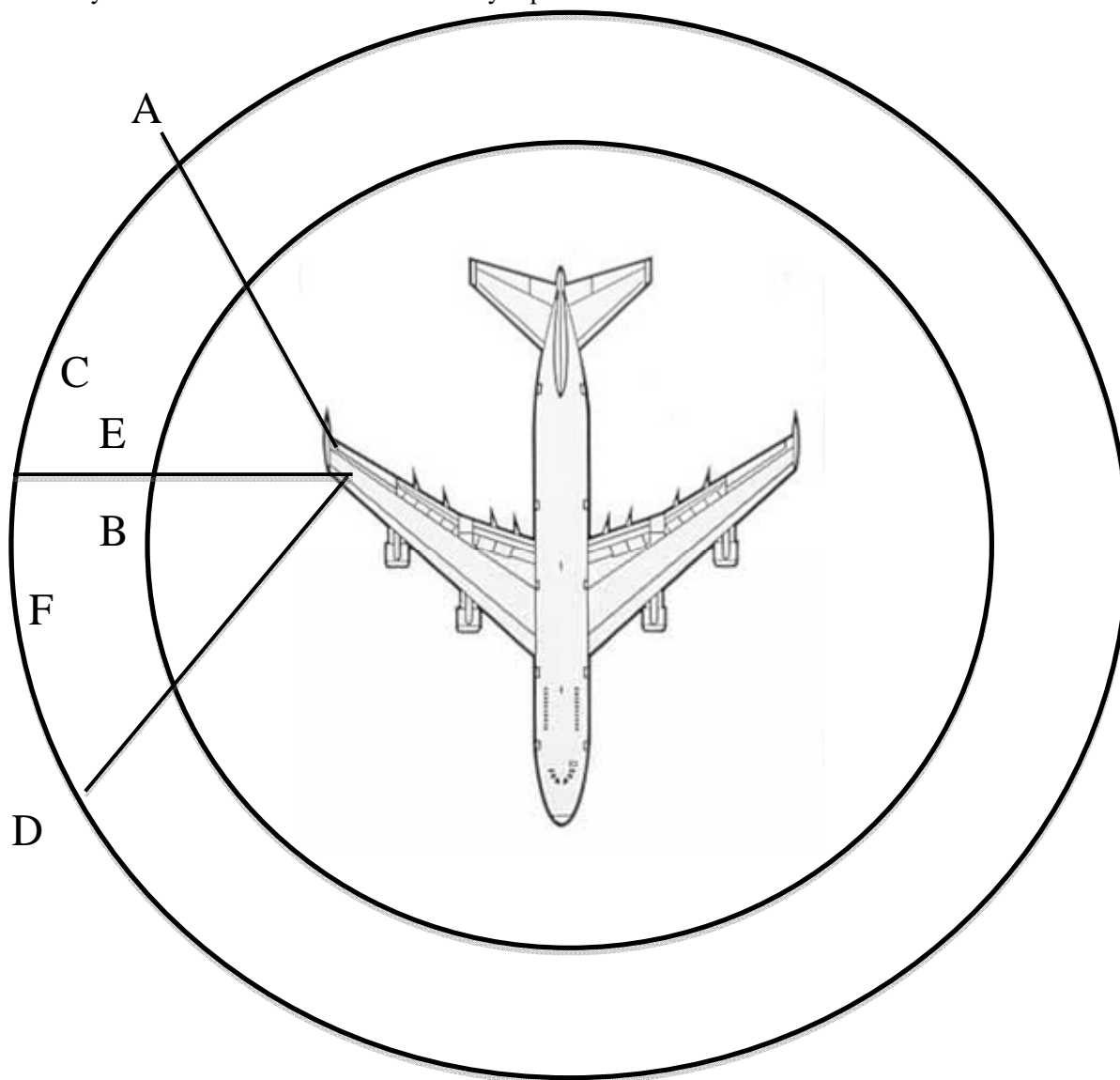
- ☐ Penetrator tip horizontal to the ground
- ☐ Deploy HRET during final approach to aircraft.
- ☐ Determine location of heat source on aircraft. Approach aircraft heat bloom seen on FLIR at 90 degrees.
- ☐ Determine proper location of target, cargo aircraft 10 or 2 o'clock
- ☐ Window outlines present, 8"-10" above window to attempt piercing into cargo container, 18-20 above window rain down,
- ☐ Announce heat source location on Fire Department Frequency and acknowledge additional reports from other apparatus if available.
- ☐ Coordinate with ARFF Command.

- ☐ Position apparatus, correct stand-off distance and location and height of piercing target.
- ☐ Penetrate Aircraft or piercing mockup, discharge agent.
- ☐ Calculate approximate flow based on discharge rate and time. Calculate weight added to aircraft. Discuss additional weight affect on balance and stability of aircraft. Identify areas to monitor, methods of releasing water.

Member: _____ Print Name and Rank	Signature: _____ Date:
Proficiency Evaluator: _____ Print Name and Rank	Signature: _____

EXERCISE/EVALUATION #6**Event:****TARGET, BOOM AND NOZZLE MANIPULATION WITH APPARATUS MOVEMENT ON DESIGNED COURSE**

Event can be staged using training aircraft, pavement markings or cones and delineators. The target must be mounted or substantial enough to stay in place during continued discharge from turrets. SOG should include layout of event so that it is consistently repeated.



Use of bumper turret (if applicable)

Objectives:

Target, HRET and nozzle manipulation with apparatus movement:

- ☐ From the bedded position
- ☐ High angle attack from distance
- ☐ Low angle attack when in range
- ☐ Maintain safe control of vehicle and discharge during simultaneous operations.
- ☐ Maintain streams on targets during movement

Course to follow while turret stream continues to hit target:

Event A - Start dispersal at A mark, Move apparatus to B mark; Backup apparatus to C mark.

Event B - Start dispersal at D mark, Move apparatus to E mark; Backup apparatus to F mark.

Critical Performance Considerations:

- ☐ Proper approach route, angle and speed
- ☐ Good judgment for range of turrets in various positions and patterns
- ☐ Control during repositioning, forward and reverse
- ☐ Minimize waste of agent
- ☐ Minimize wasted movements

Member: _____ Print Name and Rank	Signature: _____ Date: _____
Proficiency Evaluator: _____ Print Name and Rank	Signature: _____

APPENDIX C. ACRONYMS

AC	Advisory Circular
AIP	Airport Improvement Program
APU	Auxiliary Power Unit
ARFF	Aircraft Rescue and Firefighting
CertAlert	Certification Alert
CFR	Code of Federal Regulations
CG	Center of Gravity
DOT	Department of Transportation
FAA	Federal Aviation Administration
FBO	Fixed Base Operator
FLIR	Forward Looking Infrared
GPM	Gallons per Minute
GPU	Ground Power Unit
HRET	High Reach Extendable Turret
IAP	Incident Action Plan
IFSTA	International Fire Service Training Association
NFPA	National Fire Protection Association
SME	Subject Matter Expert
SOG	Standard Operating Guidelines
SOP	Standard Operating Procedures

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APPENDIX D. BIBLIOGRAPHY

The following standards and references are listed below for additional background and requirements information purpose:

FAA Documents http://www.faa.gov/airports/airport_safety/aircraft_rescue_fire_fighting/

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http://www.faa.gov/airports/airport_safety/certalerts/media/cert9602.pdf

CertAlert 08-07, Guidance on the High Reach Extendable Turret (July 2008)
http://www.faa.gov/airports/airport_safety/certalerts/media/cert0807.pdf

Title 14, Code of Federal Regulations (CFR) Chapter I, Part 77, Objects Affecting Navigable Airspace

Title 14 CFR Chapter I – FAA, DOT, Part 139, Certification and Operations: Land Airports Serving Certain Air Carriers

Title 14, CFR Part 139.317, Aircraft Rescue and Firefighting: Equipment and Agents

AC 150/5220-10, Guide Specification for Aircraft Rescue and Fire Fighting Vehicles

AC 150/5210-19, Drivers Enhanced Vision Systems

National Fire Protection Association <http://www.NFPA.org>

NFPA 402, Guide for Aircraft Rescue and Firefighting Operations

NFPA 405, Recurring Proficiency of Airport Fire Fighters

NFPA 414, Aircraft Rescue and Firefighting Vehicles

NFPA 1003, Airport Fire Fighter Professional Qualifications

International Fire Service Training Association, (IFSTA)

IFSTA, Aircraft Rescue and Firefighting, Fifth Edition

Technical Reports

Report Number DOT/FAA/AR-TN06/13, Evaluation of Quad-Agent Small Firefighting Systems
<http://www.airporttech.tc.faa.gov/safety/downloads/>

DOT/FAA/AR-05/53, High Reach Extendable Turrets with Skin Penetrating Nozzles
<http://www.airporttech.tc.faa.gov/safety/elevated.asp>

National Transportation Safety Board (NTSB) Recommendation A-07-100

Commercial Manufacturer Publications

- Crash Rescue Equipment Services, Snozzle® 501 Operators Manual
- Rosenbauer Stinger Operators Manual
- UPS ARFF Training DVD
- FedEx ARFF Training DVD

REFERENCES

139.203 Contents of Airport Certification Manual (b) 9, A description of personnel training, as required under § 139.303

139.303 (c)(5)(e)(1)

139.319 (h)(1)(ii)

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