Aircraft Rescue Firefighting—Driver/Operator

Maryland Fire and Rescue Institute
University of Maryland
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The Maryland Fire and Rescue Institute of the University of Maryland is the State’s comprehensive training and education system for all emergency services.

The Institute plans, researches, develops, and delivers quality programs to enhance the ability of emergency service providers to protect life, the environment, and property.
Student Performance Objectives

• After completing this lesson, the student shall possess an understanding of the components of the training programs required for certification of an aircraft rescue firefighter driver/operator.

Overview

• Regulations Governing Training Programs
• Topics to be Covered
Regulations Governing Training Programs

- AHJ
- FAA (FAA Advisory Circular) AC-150/5210-23
- Canadian Aviation Regulations 323.14
- International Civil Aviation Organization part 1, Chapter 14

Topics to be Covered

- Vehicle familiarization
- Preventive maintenance
- Vehicle driving/operating
  - Emergency Vehicle Operations Course
  - Successful completing of driving obstacle course
  - Trial runs to all airport areas under all weather conditions
  - Fire ground operations

Topics to be Covered

- Firefighting systems operations
  - Primary agent systems
    - Foaming agents
  - Compressed-air foam systems
Topics to be Covered

• Firefighting systems operations
  – Complementary/auxiliary agent systems
    • Dry chemical
    • Clean agents
      – Halon
      – Halon replacements

Topics to be Covered

• Firefighting systems operations
  – Extinguishing agent application devices
    • Turrets
    • High Reach Extendable Turrets
    • Handlines
    • Under-truck nozzles
    • Ground sweep nozzles
    • Twinned agent systems

Student Performance Objectives

• After completing this lesson, the student shall possess an understanding of the components of the training programs required for certification of an aircraft rescue firefighter driver/operator.
Review

- Regulations Governing Training Programs
- Topics to be Covered
Student Performance Objectives

• After completing this lesson, the student shall possess an understanding of ARFF apparatus as well as the components and operation of these vehicles.

Overview

• ARFF Apparatus Requirements
• Aircraft Rescue and Firefighting Apparatus
• Apparatus Features and Options
• Apparatus Fire Suppression Equipment
• Agent Resupply Methods
• Apparatus Maintenance
ARFF Apparatus Requirements

- Levels of Protection
- Readiness and Response Requirements
- Apparatus Design
- Fire Fighting Systems Testing

Aircraft Rescue and Firefighting Apparatus

- What AARF vehicles should be equipped with

Aircraft Rescue and Firefighting Apparatus

- Areas where ARFF apparatus must be able to operate
Aircraft Rescue and Firefighting Apparatus

- Combined agent vehicles (Rapid Intervention Vehicles)

Aircraft Rescue and Firefighting Apparatus

- Structural apparatus

Aircraft Rescue and Firefighting Apparatus

- Support vehicles and equipment
Aircraft Rescue and Firefighting Apparatus

• NFPA Division of Apparatus Requirements
  – Capacity I
    • 120 to 528 gallons
  – Capacity II
    • 528 to 1585 gallons
  – Capacity III
    • 1585 gallons and above

Aircraft Rescue and Firefighting Apparatus

• FAA Division of Apparatus
  – Class 1: 120 gallons of water + 500 pounds DC
  – Class 2: 300 gallons of water + 500 pounds DC
  – Class 3: 500 gallons of water + 500 pounds DC
  – Class 4: 1500 gallons of water + 500 pounds DC
  – Class 5: 3000 to 4500 gallons of water + 500 pounds DC

Apparatus Features and Options

• Vehicle marking and lighting systems
Apparatus Features and Options

• Antilock braking system
• Central tire inflation/deflation system
• Driver’s enhanced vision system

Apparatus Features and Options

• Vehicle rear view backup camera system

Apparatus Features and Options

• Apparatus mounted video cameras
• High Mobility Suspension system (Independent Suspension)
• Monitoring and data acquisition systems
Apparatus Features and Options

• Lateral acceleration indicator system

Apparatus Fire Suppression Equipment

• Fire Pumps

Apparatus Fire Suppression Equipment

• Turrets
Apparatus Fire Suppression Equipment

• Handlines
• Auxiliary Agent delivery systems

Apparatus Fire Suppression Equipment

• Ground sweep nozzles
• Under-truck nozzles
• Elevated waterways

Apparatus Fire Suppression Equipment

• Extendable Turrets (High Reach Extendable Turrets)
  – Allow improved nozzle placement
Apparatus Fire Suppression Equipment

- Penetrating Nozzles
  - Handheld
  - HRET Mounted

Apparatus Fire Suppression Equipment

- Preferred Aircraft Penetration Points

Apparatus Fire Suppression Equipment

- Skin Penetrator Agent Applicator Tool
Agent Re-Supply Methods

- Foam:
  - Direct filling from 5-gallon containers
  - Overhead gravity filling in the fire station
  - Mechanical or hand transfer pump from
    - Drums
    - Totes
    - Foam tender

Agent Re-Supply Methods

- Personnel shall wear proper PPE when refilling agent
  - Respiratory protection
  - Eye protection
  - Head and hand protection
Apparatus Maintenance

- Apparatus should have a detailed Daily, Weekly, Monthly and Annual inspection checklist for that apparatus per manufacturer’s specification.
- Once reported, problems should be repaired by a certified ARFF vehicle mechanic in a timely manner.

Apparatus Maintenance

- A detailed record should be kept that includes the following
  - Mileage and engine hours
  - Fuel and oil levels
  - Fuel and oil consumption
  - Tire pressure, and tread depth
  - Parts information
Apparatus Maintenance

- A record of all required performance testing should be kept for the life of the vehicle
  - Annual pump tests
  - Annual Department of Transportation inspections
  - Annual Aerial Device testing

Student Performance Objectives

- After completing this lesson, the student shall possess an understanding of ARFF apparatus as well as the components and operation of these vehicles.

Review

- ARFF Apparatus Requirements
- Aircraft Rescue and Firefighting Apparatus
- Apparatus Features and Options
- Apparatus Fire Suppression Equipment
- Agent Resupply Methods
- Apparatus Maintenance
Lesson 2-1: Apparatus Inspection and Maintenance

Student Performance Objectives
• After completing this lesson, the student shall possess an understanding of the components of an ARFF vehicle and possess the knowledge of the operating instructions, safety precautions, unit capabilities, and limitations of the vehicle. The student shall possess the knowledge to complete inspection checklists and understand the operator’s manual, vehicle lubrication charts, and troubleshooting guides.

Overview
• Apparatus Inspection Procedures
• Engine Compartment Inspection
• Exhaust Emissions
• Chassis Lubrication
• Vehicle Batteries
• Post Trip Inspections
Overview

- Vehicle Cleanliness
- Foam System Inspection and Training
- Dry Chemical System Inspection and Testing
- Clean Agent Inspection and Testing
- Documentation, Reporting, and Follow-up

Apparatus Inspection Procedures

- Guidelines
  - AHJ SOP/Gs
  - Manufacturer’s recommendations
  - NFPA standards
  - Regulations for inspecting apparatus

Apparatus Inspection Procedures

- Systematic approach for minimal daily inspections
  - Review previous records
  - Check drive train fluid levels
  - Check firefighting agent levels
  - Set safety equipment for operator
Apparatus Inspection Procedures

Inspection safety
- Stop all moving components unless necessary for adjustment
- Check vehicle wheels
- Use nonflammable cleaning solvents
- Keep body parts and loose clothing away from moving parts
- Do not smoke
- Remove jewelry
- Utilize protective clothing
Apparatus Inspection Procedures

• Approaching the vehicle
  – Observe the following
    • Left and right-side orientation
    • Any readily apparent damage
    • The terrain on which the vehicle is sitting
    • Any vehicle fluid leaks

Apparatus Inspection Procedures

• Walk-around method
  – Includes
    • Operational readiness inspection
    • Pre-trip road worthiness inspection
    • Functional check

Apparatus Inspection Procedures

• Wheels and tires
  – Ensure that tires and wheels match
    • Type
    • Size
    • Weight rating
    • Maximum speed rating
Apparatus Inspection Procedures

- When inspecting wheels and tires, check for
  - Loose lug nuts
  - Wheel damage
  - Incorrect tire pressure
  - Worn tire tread
Apparatus Inspection Procedures

• When inspecting wheels and tires, check for (per DOT)
  – Tread separation
  – Cupping
  – Excessive sidewall wear
  – Cuts
  – Dry rotting
  – Cracking
  – Foreign object debris
  – Impaled objects

Engine Compartment Inspection

• Engine compartment inspection
• Interior inspection
• Brake inspection and tests
Engine Compartment Inspection

• Engine compartment inspection
  – Check
    • Fluid levels
    • Drive belt condition and tightness
    • Hose condition
    • Hydraulic line condition
    • Air intake
    • Electrical wiring
    • Vehicle air system

Engine Compartment Inspection

• Interior inspection
  – Adjusting for the on-duty driver
  – Starting the engine
  – Checking gauges for proper readings
  – Operating all running and emergency lighting
  – Miscellaneous equipment stored in cab

Engine Compartment Inspection

• Interior inspection
  – Electrical load management system
  – Manual shift transmission
  – Steering system
  – Gross vehicle weight rating
  – In-cab fire/rescue equipment
Engine Compartment Inspection

- Brake inspection and tests
  - Hydraulic braking systems
  - Anti-lock braking systems
  - Air-actuated braking systems
  - ABS brake systems
  - Brake tests
  - Automatic slack adjusters
  - Compressed air tanks

Exhaust Emissions

- Inspect for damage or missing components
- Check exhaust pipe insulation and any flexible pipe sections for damage
- Check Diesel Particulate Filters
- Check Selective Catalyst Reductant

Chassis Lubrication

- Chassis lubrication is part of the preventive maintenance program
- Follow the manufacturer’s recommendations
- Utilize the proper grade of lubricant
- The vehicle may be equipped with an automatic lubrication system
Chassis Lubrication

• Steps for proper lubrication
  – Be familiar with lubrication points
  – Press the end of the lubricant hose onto the grease fitting
  – Operate the pumping device to push lubrication into the fitting
  – Move to next lubrication point until all have been lubricated

Vehicle Batteries

• Check connections on maintenance free batteries
• Check for proper level of distilled water in older batteries
• Look for signs of cracking, leaks, and bulging
• Ensure that there are no ignition sources
Vehicle Batteries

- Consider jump-starting safety considerations
  - Make sure both vehicles utilize the same voltage system
  - Check the manufacturer’s operations manual before jump-starting any vehicle
  - Make sure cables are connected to the proper battery

Post Trip Inspections

- Follow AHJ specified procedures
- Follow similar procedures to the pre-trip inspection

Vehicle Cleanliness

- Vehicle cleanliness as it relates to longer vehicle life
  - Washing
    - Removes corrosive chemicals
    - Exposes damaged components
    - Allows components to operate properly
    - Removes gummy residues
    - Exposes fuel and fluid leakage
Vehicle Cleanliness

- Improper cleaning procedures
  - Steam cleaning or pressure washing
    - May remove proper lubrication
    - May damage hoses, wiring, and components

Vehicle Cleanliness

- Washing
  - Utilize a garden hose without a nozzle
  - Rinse loose dirt before applying soap
  - Wash the apparatus before dirt, grit, and/or corrosive chemicals can dry
  - Begin washing at the tip of the vehicle and work downward
  - Dry the apparatus

Vehicle Cleanliness

- Glass care
  - Utilize glass cleaner or warm soapy water
  - Wipe with clean damp cloth rags or paper towels
Vehicle Cleanliness

• Interior cleaning
  – Clean upholstery in accordance with manufacturer’s recommendations
  – Sweep or vacuum large, loose dirt particles
  – Use warm soapy water or commercial cleaning products to clean surfaces
  – Avoid harsh solvents

Vehicle Cleanliness

• Interior cleaning
  – Ventilate the cab or crew area while cleaning
  – Take care when using liquids around electrical system
  – Keep compartments, hinges, slide tracks, and seals clean and free of debris
  – Lubricate moving components according to the manufacture’s recommendations

Vehicle Cleanliness

• Waxing
  – Review instructions before applying products on new apparatus
  – Reference the manufacturer’s manual before applying products
  – Wait until paint finish is at least 6 months old before waxing
Vehicle Cleanliness

- Waxing
  - Wash and dry vehicle thoroughly before applying product
  - Polish out the vehicle with a soft cloth or mechanical buffer

Foam System Inspection and Training

- Foam solution refractory testing
  - Foam solution refractory testing utilizes a refractometer
  - Collect three samples from each application device

- Foam solution conductivity testing
  - Testing of synthetic based foams
  - Three methods of conductivity testing
    - Direct reading conductivity testing
    - Conductivity comparison testing
    - Conductivity calibration curve testing
Dry Chemical System Inspection and Testing

- Check nitrogen cylinder pressure
- Check dry-chemical levels and refill as needed

Clean Agent Inspection and Testing

- Check compressed gas cylinder pressure
- Inspect the condition of the handline
- Inspect the condition of turret hoses and operation

Documentation, Reporting, and Follow-up
Student Performance Objectives

• After completing this lesson, the student shall possess an understanding of the components of an ARFF vehicle and possess the knowledge of the operating instructions, safety precautions, unit capabilities, and limitations of the vehicle. The student shall possess the knowledge to complete inspection checklists and understand the operator’s manual, vehicle lubrication charts, and troubleshooting guides.

Review

• Apparatus Inspection Procedures
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• Exhaust Emissions
• Chassis Lubrication
• Vehicle Batteries
• Post Trip Inspections

Review

• Vehicle Cleanliness
• Foam System Inspection and Training
• Dry Chemical System Inspection and Testing
• Clean Agent Inspection and Testing
• Documentation, Reporting, and Follow-up
Student Performance Objectives

• After completing this lesson, the student shall possess an understanding of the principles of safe vehicle operations and shall be able to operate an ARFF apparatus within the airport environment safely and competently.

Overview

• General Information
• Braking Reaction Times
• Avoiding Rollover
• Speed and Centrifugal Force
• Skid Avoidance
• Acceleration/Deceleration
General Information

- Candidates should complete a certified EVOC course which should include:
  - Vehicle braking and reaction time
  - Vehicle rollover awareness and avoidance
  - Skid avoidance, control and recovery
  - Safe acceleration and deceleration

General Information

- Minimum skills to be performed
  - Start apparatus
  - Drive forward
  - Shift
  - Enter a roadway
  - Brake
  - Stop
  - Shut down the apparatus

Braking Reaction Times

- Total stopping distance
  - Perception distance
  - Reaction distance
  - Braking distance
- Covering the brake
Avoiding Rollover

• To prevent rollover
  – Know where the weight is
  – Know how the vehicle reacts when making a turn

Speed and Centrifugal Force

• Speed
  – As speed increases, stopping distance increases and more centrifugal force is exerted when turned

• Centrifugal force
  – As centrifugal force increases, the chance of overturning also increases
  – Driving too fast for conditions is a major cause of accidents

Skid Avoidance

[Diagram]

[Diagram description]

[Diagram notes]
Acceleration/Deceleration

• Acceleration
  — Accelerate smoothly without losing traction
  — Over-acceleration may damage vehicle and/or driveline

• Deceleration
  — Decelerate smoothly without locking up wheels and/or driveline
  — Discontinue use of driveline retarders during adverse weather conditions
  — Excessive deceleration may damage vehicle and/or driveline

• Shifting and gear patterns

Student Performance Objectives

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Student Performance Objectives

• After completing this lesson, the student shall possess an understanding of the safe vehicle operations in normal conditions within the airport environment.

Overview

• On the Airport
• Off-Airport Response
• Adverse Environmental or Driving-Surface Conditions
• Maneuvering and Positioning ARFF Vehicles on the Accident/Incident Scene
On the Airport

- Pre-designated response routes
- Taxiways
- Runways
- Ramp areas
- Service roads

On the Airport

- Aircraft parking area challenges
  - Parked aircraft
  - Taxiing aircraft
  - Fueling operations
  - Ground equipment
  - Airline personnel
  - Airline passengers (in smaller airports)

Off-Airport Response

- The ARFF D/O must be familiar with roads surrounding airport
  - Street and road layouts
  - Roadway and vehicle widths
  - Vehicle height clearances
  - Traffic patterns
  - Road and bridge weight restrictions
Adverse Environmental or Driving-Surface Conditions

- Heavy rainfall
- Blinding snow
- Dense fog
- Heavy smoke
- Darkness

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Loose or wet soil
- The D/O must be aware of the capabilities of the vehicle
- Deflating tires will improve off-road driving

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Safety Tips
Adverse Environmental or Driving-Surface Conditions

• Mud and clay soil types

Adverse Environmental or Driving-Surface Conditions

• Utilizing the transmission
  – Conditions may make it desirable to manually shift the automatic transmission
  – The lower the gear range, the greater the engine braking effect
  – When climbing a hill or going down a steep grade, shifting to a lower gear provides adequate driving power, and helps control the vehicle

Adverse Environmental or Driving-Surface Conditions

• Returning to normal driving
  – Disengage the accelerator
  – Disengage the differential locking switch
  – Stop and inspect the vehicle for damage
  – Remove mud, stones or FOD
  – Ensure all equipment is secure
Adverse Environmental or Driving-Surface Conditions

- Steep Grades
  - The vehicle’s center of gravity changes
  - The D/O should use extreme caution to avoid sudden changes in direction
  - Mud, snow, or poor surfaces present a severe safety issue

Adverse Environmental or Driving-Surface Conditions

Adverse Environmental or Driving-Surface Conditions

- Vehicle Clearance of Obstacles
  - Ground clearance
  - Ditches
  - Gullies/ravines
  - Rocky terrain
Adverse Environmental or Driving-Surface Conditions

• Limited Space for Turnaround
  – Awareness is necessary for safely turning around an ARFF vehicle
  – Practicing confined space turnaround exercises enhances the D/O’s abilities to judge the distance required and the maneuvers to complete the turnaround

Adverse Environmental or Driving-Surface Conditions

• Side Slopes
  – Avoid side-hill situations whenever possible
  – Move extremely slowly
  – Keep the wheels on the uphill side of the road when driving
  – Steer downhill in the direction of the slide if the vehicle begins to slide
  – Do not become overconfident in a side hill situation

Adverse Environmental or Driving-Surface Conditions
Adverse Environmental or Driving-Surface Conditions

Maneuvering and Positioning ARFF Vehicles on the Accident/Incident Scene

- Wreckage pattern determining factors include
  - Type of crash
  - Size of aircraft
  - Aircraft direction and speed on impact
  - Location of crash site
  - Type of terrain
  - Weather conditions
Maneuvering and Positioning ARFF Vehicles on the Accident/Incident Scene

• Driver/Operators should expect
  – Large debris
  – Victims
  – Fire
  – Hazardous materials

Maneuvering and Positioning ARFF Vehicles on the Accident/Incident Scene

• Survivors
  – Victims that are capable may move toward ARFF vehicles
  – Driver/Operators must use caution when operating turrets
  – Victims may be hard to see at night or through heavy smoke
  – ARFF personnel should protect and isolate occupant and aircraft from spill fires

Maneuvering and Positioning ARFF Vehicles on the Accident/Incident Scene

• Terrain
  – Driver/Operators should be very familiar
    • With their airport
    • With the airport’s surrounding areas
Maneuvering and Positioning ARFF Vehicles on the Accident/Incident Scene

- Terrain could make it impossible to safely set up upwind, uphill, and upstream.

Maneuvering and Positioning ARFF Vehicles on the Accident/Incident Scene

- Terrain may present the following issues:
  - Mud
  - Steep inclines
  - Lack of access roads
  - Water crossings
  - Inadequate bridges
  - Rocky/hilly areas
  - Ditches, gullies, and ravines
  - Man-made terrain features.

Student Performance Objectives

- After completing this lesson, the student shall possess an understanding of the safe vehicle operations in normal conditions within the airport environment.
Review

- On the Airport
- Off-Airport Response
- Adverse Environmental or Driving-Surface Conditions
- Maneuvering and Positioning ARFF Vehicles on the Accident/Incident Scene
Student Performance Objectives

- After completing this lesson, the student shall possess an understanding of the various extinguishing agents, their firefighting characteristics, and how to apply them effectively, and to extinguish fires.

Overview

- Agent Discharge
- Primary Agent Systems
- Compressed-Air Foam Systems
- Complimentary (Auxiliary) Agents Systems
- Agent Management
Overview

- Effects of Terrain and Wind
- Reach, Penetration, and Application
- Application Technique
- Pump-and-Roll Capability
- Agent Resupply

Agent Discharge

- Effective agent application has a definite effect on the outcome

Primary Agent Systems
Compressed-Air Foam Systems

- There are two methods of foam production
  - Pre-mixed solution of water and foam concentration
  - Proportioned foam solution drawn from water tank and foam tank

Complimentary (Auxiliary) Agents Systems

- Turret application
- Handline application

Agent Management

- Familiarize driver/operators with apparatus specifications
- Train in life-like scenarios
Effects of Terrain and Wind

• Terrain
  — Affects the approach to the scene, therefore affecting the reach of the turret
  — May expose crews and apparatus to running fuel and/or smoke
  — May keep apparatus turrets from reaching the wreckage, and requiring handlines to be stretched for agent application

Effects of Terrain and Wind

• Wind
  — Approaching upwind allows greatest discharge distance
  — Approaching perpendicular to the wind, while allowing for the wind, also works well
  — Approaching downwind, the apparatus must be closer to the fire to successfully apply agent
  — Wind breaks up streams and reduces the turret’s reach
  — Wind disperses complimentary agents and may destroy the agent’s reach

Reach, Penetration, and Application

• Knowing the vehicle’s capabilities are essential in judging the effective range
• Applying small bursts of agent will assist the driver/operator in judging the reach and effectiveness of the application
• High reach extendable turrets
  — Provide an improved reach
  — Provide the ability to attack the fire from a lower position and applies the agent closer to the base of the fire
Application Technique

• Driver/operators must develop a technique for operating the vehicle’s systems
  – Training

Application Technique

• Skills enhancement scenarios
  – Set up a course using a traffic cone with a softball on top of it
  – Push a traffic cone or milk crate

Pump and Roll Capability

• Modulating
  – Actuating the fire pump causes the accelerator to become a clutch
  – Pushing down on the “accelerator” is the same as letting out a clutch on a manual transmission
Pump and Roll Capability

• Effective modulating
  — Takes practice
  — Requires the skill of estimating the distance away from the aircraft to begin to flow and be capable of circling the aircraft without backing up while modulating
  — Comes from constant skills development

Agent Resupply

• Water
  — Sources
    • Fixed
    • Static
    • Mobile
  — Rapid resupply
  — Sustained resupply
  — Resupply point

Agent Resupply

• Foam
  — Direct filling from 5-gallon containers
  — Overhead gravity filling in the fire station
  — Mechanical or hand from transfer from drums, large storage containers, or a foam tender
Agent Resupply

• Complimentary/auxiliary agents
  — Once expended, these systems will not be available for the remainder of the incident
  — Follow manufacturer’s specifications for reservicing
  — Follow all safety precautions and utilize the proper PPE while reservicing

Student Performance Objectives

• After completing this lesson, the student shall possess an understanding of the various extinguishing agents, their firefighting characteristics, and how to apply them effectively, and to extinguish fires.

Review

• Agent Discharge
• Primary Agent Systems
• Compressed-Air Foam Systems
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• Agent Management
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