Considerations for Developing a Rapid Refueling Manual

Parachute Industry Association
Technical Standard 122

INTRODUCTION

Most skydiving operations with turbine aircraft engage in the practice of rapid refueling (refueling while the engines are running). The economic problems and the thermal stress on turbine engines as a result of frequently shutting down and starting back up again are obvious to any skydiving airplane operator.

This document was prepared from input from fire protection agencies and drop zones with active rapid refueling programs to standardize the procedures used for rapid refueling. A correctly written manual designed from the concepts presented here may help to reassure local authorities that rapid refueling can be performed safely in the proper environment.

This is not a rapid refueling manual. Refer to the accompanying Rapid Refueling Manual from Skydive City, Zephyrhills, Florida, as sample for developing a rapid refueling manual for your operation. Each operation will have different needs and considerations, so procedures will vary. Each operator must develop procedures specifically to meet the needs of that operation.

This Parachute Industry Association (PIA) Technical Standard is recognized by the PIA as an accurate description of practices accepted in the field as standard among operators who engage in rapid refueling. However, rapid refueling involves inherent risks, including but not limited to increased fire hazard and risk of personnel or equipment coming into contact with the spinning aircraft propeller. Any operator who undertakes to rapid refuel that operation's aircraft must prepare and document procedures to reduce the additional risks associated with rapid refueling and must accept full responsibility for any accident that may occur.

PIA neither recommends nor endorses the practice of rapid refueling.

PIA recognizes rapid refueling as a common skydiving industry practice that can be safely performed within a conscientiously designed, documented, and applied program. PIA accepts no liability for any accident that results from the procedures described or alluded to herein.

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REQUIREMENTS

This document refers only to fixed wing turbine powered aircraft used in skydiving operations. The following basic requirements must be met to permit rapid refueling:

- An FAA-licensed pilot or airman familiar with the ground operation of the aircraft must be at the controls during the entire fuel servicing process.

- Only designated personnel, properly trained in rapid refueling operations, shall operate the equipment.

- All jumpers shall be deboarded to a safe location prior to rapid refueling operations.

- All doors, windows and access points allowing entry to the interior of the airplane, adjacent to or in the immediate vicinity of the fuel inlet ports, shall be closed and kept closed during refueling operations. Fumes must be adequately vented from the aircraft cabin during fueling operations.

- Airplanes permitted to be fueled while an onboard engine is running shall have all sources of ignition of potential fuel spills located above or a safe distance from the fuel inlet ports. Ignition sources include but are not limited to engines, engine exhausts, APUs, and combustion type cabin heater exhausts.

TRAINING

It is the responsibility of each operator to assure that all personnel involved in rapid refueling have received proper training.

After initial training has been received, recurrency training should be conducted once every six months.

The training shall include the following subjects:

- Characteristics of jet fuel
- Fuel quality control procedures
- Operation of fuel vehicle and fuel tank
- Propeller avoidance
- Communications with the pilot
- Fuel spill procedures
- Grounding of airplane
- Personal injury response

JET FUEL CHARACTERISTICS
AND QUALITY CONTROL PROCEDURES

Most commercial operations with turbine powered aircraft use the fuel designated Jet A. Jet A is kerosene with inhibitors added to reduce corrosion and oxidation.

Another type of jet fuel is Jet A-1. It is very similar to Jet A but made for operations at very low temperatures. Jet A has a freezing point of minus 40 degrees Fahrenheit, while Jet A-1 freezes at minus 47.

One disadvantage of jet fuel is its susceptibility to contamination. Jet fuel has a greater viscosity than gasoline which allows it to hold more water and other contaminants in suspension.

The primary contaminant in fuel is entrained water, which does not readily separate out of jet fuel.

When the temperature of the fuel drops below 32 degrees Fahrenheit, the water droplets will freeze, and when combined with the kerosene, forms a substance known as gel. The gel can cause damage to fuel pumps and the engine's fuel control units.

To maintain a clean fuel environment, the fuel tank or vehicle low point and filter sumps shall be drained at least once daily. With adequate settling time, much of the free water and solid particles, if present, will normally drop to the tank bottom or system low point. Draw off sufficient quantity to ensure that the sump and the line going to that sump have been drained. The sump sample should be taken at a high flow rate to drain off all water and other contaminants that may have collected at or around each sump inside the compartment. The sump sample shall then be evaluated.

A sump sample which consists of "clear and bright" fuel is considered satisfactory. Any sump sample which is not clear and bright indicates a need for additional sumping. If after reasonable amounts of fuel have been drained the sample is still not acceptable, a supervisor shall be notified for further action.

Records of all sump draining shall be maintained and should indicate the condition of the fuel when first evaluated and the amount and nature of any contaminant found.

Turbine fuel color varies from water white to straw to amber, depending on processing or crude source. Clear and bright fuel has no floating or suspended matter. The term "clear and bright" has no relation to the natural fuel color. Brightness is a quality independent of

the sample color and refers to the lack of suspended or free water in the sample. Bright fuel tends to sparkle.

Jet fuel has a mild petroleum odor. Uncontaminated Jet A should not be irritating to the sense of smell. If the odor is unusual, irritating, or unpleasant to your sense of smell, it is an indication of possible contaminants. Unusual odors are most easily detected during routine checks where fuel is collected in an open container, particularly sump samples where water may be present. Uncharacteristic odors in the fuel can be detected by most individuals.

Because some contaminants may be noxious or toxic, e.g., ammonia or hydrogen sulfide, fuel samples must be smelled cautiously.

To avoid interference and sense saturation, fuel odor tests should be performed in an odor-free area. Repeated sniffing may temporarily dull the sense of smell.
Some of the contaminants that may be detected by odor are gasoline, ammonia, acid, stagnant water (microbiological growth), and hydrogen sulfide, which smells like rotten eggs.

PROPELLER AVOIDANCE

The spinning propeller presents without a doubt the biggest physical danger while rapid refueling is in progress.

Common sense is the key to safely being able to work around the propeller. To avoid serious injury or death these straightforward steps shall be followed:

- Keep a wheel chock under at least one of the airplane's tires during the entire refueling operation.
- Always be aware of your proximity to the spinning propeller.
- Never run.
- Stay close to the fuselage of the airplanes.
- When approaching the fuel ports, be aware of where the fuel hose is to prevent tripping on it. Also, watch for tie-downs, loose gravel, uneven pavement joints, etc.
- The hand that is not holding the nozzle should hold the hose up and away from your feet.
- Any tools should be used with extreme caution to prevent dropping or throwing on into the propeller or losing one's balance when prying or twisting with a tool.
- Rapid refueling should not be done in icy or muddy conditions.

- **CROWD CONTROL**

No one except authorized personnel shall be allowed to approach the airplane during rapid refueling procedures. This can be accomplished by fences, signs, painted lines, or a combination of the above.

The fuel truck and tank should be in a location away from the boarding area or any other location where people usually congregate, as well as away from any skydiving landing area.

COMMUNICATION

Due to the noise level around an airplane with the engines running, verbal communication between the refueler and the pilot is impractical. Most operators have developed hand signals to use instead.

Both the pilot and the refueler shall know the signals by memory so they can be used swiftly and without misunderstandings.

The following can serve as examples of useful hand signals:

- Yes, okay.

- No

- Forward, rear, right, left.
  (pointing in appropriate direction)

- Enough, stop.

- Continue, more.

SPILL AND DISPOSAL PROCEDURES:

It is the responsibility of each operator to follow federal, state, and local environmental regulations.

Spill procedures: Remove sources of heat or ignition, including internal combustion engines and power tools. Clean up spill, but do not flush to sewer or surface water. Ventilate area and avoid breathing vapors or mists. Feathering the prop increases fumes in the fueling area. Leaving the prop in power idle ventilates the area, and in many cases, would aid in blowing any spilled fuel away from the engine.

Fuel entering the air intake of a turbine engine may cause a compressor stall which can be detrimental to the engine. It is therefore important that any fuel spill is not allowed to enter the air intake.

Waste disposal: Dispose through a licensed waste disposal company.

SMOKING

- Smoking shall not be permitted within 150 feet of any aircraft, fuel vehicle, or fuel tank.

- Fueling personnel should not carry cigarette lighters, matches, or any type of sparking ignitor device on their person while fueling.

FIREFIGHTING EQUIPMENT

Fire extinguishers appropriate to size of operation shall be within easy reach of fueling personnel while refueling. The fire extinguishers shall be clearly marked with their ways of operation.

Extinguishing media: Dry chemical, foam or carbon dioxide.

Use water spray to cool exposed containers. Use a smothering technique for extinguishing fire of this material.. Do not use a forced water stream directly on petroleum fires as this will scatter the fire. Firefighters should wear self-contained breathing apparatus and full protective clothing.

Fuel vapors are heavier than air and may travel along the ground to ignition sources distant from the fuel handling point. Flowing fuel can be ignited by self-generated static electricity.

GROUNDING OF AIRPLANE

The spinning propeller, the rotating components in the engine, and the fuel running through the nozzle will all create static electricity. Static electricity is the accumulation of electrical charge by friction on an insulated body.

Enough accumulation of electric charge can cause a spark and ignite the fuel. It is therefore imperative that the aircraft is grounded to an approved grounding source during the entire refueling process, to discharge any static buildup.

The proper way to ground is fuel truck to ground, fuel truck to airplane, and airplane to ground. The hose nozzle must be kept in constant contact with the fuel inlet while fueling.

The flash point of Jet A is 120 degrees Fahrenheit , and the auto ignition temperature is 450 degrees Fahrenheit.

Flash point is defined as the lowest temperature of a fuel sample at which application of an ignition source causes the vapors above the sample to ignite under specified test conditions.

The practical application to this is that the higher the temperature, the higher the risk of the fumes igniting.

The fuel can be ignited at lower temperatures than the flash point, thus the importance of grounding the airplane.

SPECIAL PRECAUTIONS AND COMMENTS

Jet A shall be stored in tightly closed containers in a dry, cool place, away from incompatible materials or sources of ignition.

Ground and bond all transfer and storage equipment to prevent static sparks.

Do not pressurize, cut, weld, braze, solder, drill, grind, or expose empty containers to heat, flame, sparks, static electricity, or other sources of ignition. They may explode and cause injury or death.

EMERGENCY FIRST AID
PROCEDURES AND HEALTH HAZARDS

In case of a personal injury, all personnel involved in rapid refueling, including the pilot, shall know the exact location of the nearest first-aid kit and a and a telephone to be able to call 911.

Emergency first aid procedures:

Eye contact: Immediately flush with water for at least 15 minutes, including under the eyelids. Contact a physician immediately, preferably an Ophthalmologist. Speed and thoroughness in rinsing eyes are important to avoid permanent injury.

Skin contact: Remove contaminated clothing and shoes. Wash affected areas with soap and flush with large amounts of water for 15 to 20 minutes. Launder contaminated clothing before reuse. If irritation persists, get medical attention.

Inhalation: Remove to fresh air. If breathing has stopped, apply artificial respiration. Get immediate medical attention.

Ingestion: Do not induce vomiting. If spontaneous vomiting occurs, hold the victim's head lower than hips to prevent aspiration. Get immediate medical attention.

Effects of overexposure:

Acute--

Eyes: May cause moderate to sever irritation, redness, tearing or blurred vision.

Skin: Moderately irritating. May cause redness or drying of skin.
Inhalation: May cause nasal and respiratory irritation. May produce symptoms of intoxication such as headache, dizziness, nausea, weakness, fatigue, loss of coordination and consciousness or even death.

Ingestion: May cause gastrointestinal irritation, nausea, vomiting or diarrhea. Aspiration into the lungs may cause hemorrhaging, pulmonary edema progressing to chemical pneumonitis, which may be fatal.

Chronic--

Prolonged or repeated contact with the skin may cause defatting and dermatitis.

May aggravate pre-existing dermatitis. Middle distillates have cause skin cancer and kidney damage in laboratory animals.

SPECIAL PROTECTION INFORMATION

Eye protection: Remove contact lenses and wear chemical safety glasses, goggles, or face shield where contact with liquid or mist may occur.

Skin protection: Wear impervious gloves, clothing, and boots when contact with skin may occur.

Inhalation: Use approved respiratory protective equipment for cleaning large spills or entry into large tanks, vessels and other confined spaces.

Ventilation: Provide adequate general and local exhaust ventilation to prevent the formation of explosive atmospheres and to prevent oxygen deficient atmospheres, especially in confined spaces.

APPENDIX

Sources:

ASTM, Manual of Aviation Fuel Quality Control Procedures

EPA, Material Safety Data Sheet

National Fire Protection Association Code 407

ASA, FAA Flight Engineer Written Test Preparation Guide

FAA Advisory Circular AC150/5230-4

Additional References:

ATA Specification 103, “Standards for Jet Fuel Quality Control at Airports”

Gammon Technical Products “Gamgrams”

ASTM Manual