

Recommended Practices for the Design, Installation, Service, Repair and Maintenance of Aviation Fueling Systems

Inside Front Cover
This page is intentionally blank.

Recommended Practices for the Design, Installation, Service, Repair and Maintenance of Aviation Fueling Systems

Other Reference Publications Available From PEI

Order Online at www.pei.org/shopping

- PEI/RP100, *Recommended Practices for Installation of Underground Liquid Storage Systems*
- PEI/RP200, *Recommended Practices for Installation of Aboveground Storage Systems for Motor Vehicle Fueling*
- PEI/RP300, *Recommended Practices for Installation and Testing of Vapor Recovery Systems at Vehicle Fueling Sites*
- PEI/RP400, *Recommended Procedure for Testing Electrical Continuity of Fuel Dispensing Hanging Hardware*
- PEI/RP500, *Recommended Practices for Inspection and Maintenance of Motor Fuel Dispensing Equipment*
- PEI/RP600, *Recommended Practices for Overfill Prevention for Shop-Fabricated Aboveground Tanks*
- PEI/RP700, *Recommended Practices for the Design and Maintenance of Fluid Distribution Systems at Vehicle Maintenance Facilities*
- PEI/RP800, *Recommended Practices for Installation of Bulk Storage Plants*
- PEI/RP900, *Recommended Practices for the Inspection and Maintenance of UST Systems*
- PEI/RP1000, *Recommended Practices for the Installation of Marina Fueling Systems*
- PEI/RP1100, *Recommended Practices for the Storage and Dispensing of Diesel Exhaust Fluid (DEF)*
- PEI/RP1200, *Recommended Practices for the Testing and Verification of Spill, Overfill, Leak Detection and Secondary Containment Equipment at UST Facilities*
- PEI/RP1400, *Recommended Practices for the Design and Installation of Fueling Systems for Emergency Generators, Stationary Diesel Engines and Oil Burner Systems*
- PEI/RP1500, *Recommended Practices for the Design, Installation, Operation and Maintenance of Compressed Natural Gas Vehicle Fueling Facilities*
- PEI/RP1600, *Recommended Practices for the Design, Construction, Installation, Operation and Maintenance of Liquefied Natural Gas/Liquefied Compressed Natural Gas Vehicle Fueling Facilities*
- PEI/RP1700, *Recommended Practices for the Closure of Underground Storage Tank and Shop-Fabricated Aboveground Storage Tank Systems*

FOREWORD

These *Recommended Practices for the Design, Installation, Service, Repair and Maintenance of Aviation Fueling Systems* have been prepared as an industry service by the Petroleum Equipment Institute (PEI). The text represents the consensus views of the PEI Aviation Fueling Committee, comprised of the following members:

Jim O'Day, Chairman

O'Day Equipment LLC
Fargo, North Dakota

Michael J. Brunmeier

Petro-Chemical Systems Inc.
Fond Du Lac, Wisconsin

Roy Creley

Lakes Region Environmental Contractors
Belmont, New Hampshire

Penelope Ellis

FuelMaster Syn-Tech Systems
Tallahassee, Florida

Arthur H. Hoffmann

A. H. Hoffmann LLC
Ocean, New Jersey

Charles B. Hubbard

Oil Equipment Sales & Service Co. Inc.
Chesapeake, Virginia

Gordon Johnson

Millennium Systems International LLC
Westminster, Maryland

John B. Lindner

Epic Aviation LLC
Salem, Oregon

Scott Milsted

Mascott Equipment Company Inc.
Portland, Oregon

Thomas M. Riddle

AMEC Foster Wheeler
Kennesaw, Georgia

Steve Thickstun

Advanced Fuel Systems Inc.
Columbus, Ohio

Andrew Thompson

Facet
Tulsa, Oklahoma

Previously serving as consultant to the committee was Don Gilson, Gilson Environmental, 33 Heather Ave., San Francisco, CA 94118.

The PEI Aviation Fueling Committee acknowledges the contributions to past editions of this document by the following people: Robert Becker, Mark Cowie, Ron McDowell and Brian Wiegert.

All questions and other communications relating to this document should be sent only to PEI Headquarters, addressed to the attention of the PEI Aviation Fueling Committee.

Petroleum Equipment Institute

P.O. Box 2380

Tulsa, OK 74101-2380

(918) 494-9696

Fax: (918) 491-9895

E-mail: info@pei.org

www.pei.org

© 2020 Petroleum Equipment Institute

DISCLAIMER

Every effort has been made by the PEI Aviation Fueling Committee to ensure the accuracy and reliability of the information contained in this document. However, the Committee, its consultant and the Petroleum Equipment Institute make no representation, warranty or guarantee in connection with the publication of these recommended practices. PEI hereby expressly disclaims any liability or responsibility for loss or damage resulting from the use of these recommended practices; for the violation of any federal, state or municipal regulation with which these practices may be in conflict; or for the infringement of any patent resulting from their use.

CONTENTS

Foreword.....	iii
----------------------	------------

SECTIONS

1. Introduction.....	1
1.1 Origin	1
1.2 Background	1
1.3 Purpose.....	1
1.4 Scope	1
1.5 Sources	1
1.6 Regulations and Codes.....	1
1.7 Importance of Competent Installers and Technicians	1
1.8 Importance of Competent Operators.....	2
2. Definitions	3
2.1 Air Eliminator	3
2.2 American Society of Mechanical Engineers (ASME).....	3
2.3 Apron.....	3
2.4 Authority Having Jurisdiction (AHJ).....	3
2.5 Automatic Air Eliminator (AAE).....	3
2.6 Avgas	3
2.7 Aviation Fuel	3
2.8 Block Valve	3
2.9 Bollard.....	3
2.10 Bond	3
2.11 Check Valve.....	3
2.12 Coalescer Element.....	3
2.13 Compartmented Tank	3
2.14 Complete Internal Lining	3
2.15 Control Valve.....	3
2.16 Direct-to-Aircraft.....	3
2.17 Entrained	3
2.18 Federal Aviation Administration (FAA).....	3
2.19 Filter/Separator.....	3
2.20 Fixed Base Operator (FBO)	3
2.21 Fuel Ramp	3
2.22 Fuel System Icing Inhibitor (FSII).....	3
2.23 Holiday-Free.....	3
2.24 International Code Council (ICC).....	3
2.25 International Fire Code (IFC)	3
2.26 Internal Pipe Scrubbing.....	3
2.27 Joint Inspection Group (JIG).....	3
2.28 Manual Drain.....	3
2.29 Media.....	4
2.30 National Fire Protection Association (NFPA).....	4
2.31 National Type Evaluation Program (NTEP)	4
2.32 Occupational Safety and Health Administration (OSHA)	4
2.33 Passivation.....	4
2.34 Point-of-Sale System (POS).....	4
2.35 Pressure-Relief Valve	4
2.36 Pressure/Vacuum Vent (P/V Vent).....	4
2.37 Psi	4
2.38 Psig	4

2.39	Refueler	4
2.40	Self-Service Fueling	4
2.41	Separator Element	4
2.42	Slug Valve	4
2.43	Spider	4
2.44	Sump	4
2.45	Sumping	4
2.46	Surfactant	4
2.47	Thief Pump	4
2.48	Transition Sump	4
2.49	UV Shield	4
2.50	Water Defense System	4
2.51	Water Slug Valve	4
3.	Aircraft Fuel Storage Facilities	5
3.1	General	5
3.2	Site Planning	5
3.2.1	Traffic Flow	5
3.2.2	Electronic Equipment	5
3.2.3	Security	5
3.2.4	Piping	5
3.2.5	Emergency Planning	6
3.2.6	Signage	6
3.2.6.1	Posted Signs	6
3.2.7	Self-Service Fueling Operations	6
3.3	Aviation Fuel Storage Tanks	6
3.3.1	General	6
3.3.2	Testing Procedures	7
3.3.3	Product Segregation	7
3.3.4	Tank Slope/Pitching	7
3.3.5	Tank Exterior Coating	7
3.4	Tank Accessories	7
3.4.1	Floating Suction	7
3.4.2	Tank Vents	7
3.4.3	External Ladders and Stairways	7
3.4.4	Tank Low-Point Sumping	7
3.4.5	Reclaim Tanks	8
3.4.6	Color Codes	8
4.	Piping and Fittings	9
4.1	General	9
4.1.1	Segregation of Products	9
4.2	Piping Materials	9
4.3	Pipe Sizing	9
4.4	Aboveground Piping	9
4.4.1	General	9
4.4.2	Thermal Relief	9
4.5	Valves	9
4.6	Transition Sumps	9
5.	Pumps	10
5.1	General	10
5.2	Overpressurization	10
5.3	Pump Installation	10
5.4	Anchoring	10
5.5	Pump Location	10

6.	Filtration	11
6.1	Filter/Separators	11
6.2	Filter Monitors.....	12
6.3	Differential Pressure.....	12
6.4	Flow Rate	13
6.5	Sumping	13
6.6	Static Electricity	13
6.7	Heaters	14
6.8	Air Eliminators	14
6.8.1	General	14
6.8.2	Air Eliminator Check Valve.....	14
6.8.3	Manual Air Release Valve.....	14
6.8.4	Filter Sump Drain	14
6.9	Pressure-Relief Valve	15
6.10	Water Defense	15
6.10.1	General	15
6.10.2	Float-Operated Systems	15
6.10.3	Electronic Probe-Operated Systems	15
6.10.4	Slug Valves.....	15
6.11	Sample Port Connections	15
6.12	Maintenance	15
6.12.1	Sump Draining	16
6.12.2	Differential Pressure	16
6.12.3	Element Replacement	16
6.12.4	Water Defense System Testing	17
6.13	Service.....	17
6.13.1	Element Inspection and Change Out	17
6.13.2	Start-Up Procedure.....	17
7.	Dispensing Equipment.....	18
7.1	General	18
7.2	Nozzles	18
7.3	Hoses	18
7.4	Reels	18
7.5	Static Cables.....	18
7.6	Deadman Controls.....	18
7.7	Secondary Refueler High-Level Shutoff.....	18
7.8	Meters.....	18
7.8.1	Air Eliminators.....	19
7.9	Maintenance	19
7.9.1	Checking Fuel Quality	19
7.9.2	Inspecting Fueling Hose	19
7.10	Fueling Hose Installation	19
8.	Self-Service Fueling	20
8.1	Background	20
8.2	Location.....	20
8.3	Electrical Requirements	20
8.4	Operating Instructions	20
8.5	Site Preparation	20
8.5.1	Equipment Foundation.....	20
8.5.2	Hose Reels.....	20
8.5.3	Static Bonding Cables.....	20
8.5.4	Fire Protection.....	20
8.5.5	Equipment Protection.....	20
8.6	Meters and Meter Displays	20
8.7	Automated Payment	20

9. Electrical.....	21
9.1 General	21
9.2 Electrical Codes.....	21
9.3 Emergency Shutoff.....	21
9.4 Intrinsically Safe	21
9.5 Grounding and Bonding.....	21
10. Installation and Pre-Operational Testing.....	22
10.1 General	22
11. Emergency Preparedness	23
11.1 General	23
11.2 Seasonal Factors or Weather Emergencies	23
11.3 Spill Prevention, Control and Countermeasure (SPCC) Plans	23
12. Documentation, Training, Inspection and Maintenance	24
12.1 General	24
12.2 Documentation	24
12.2.1 Retained Files.....	24
12.2.2 Inspections and Tests	24
12.3 Training	24
12.4 Maintenance	25
12.4.1 Tank Water Removal.....	25
12.4.2 Pump Maintenance.....	25
12.4.2.1 Service	25
12.4.2.2 Repair	25

APPENDICES

Appendix A: Reduced Flow Rate Differential Pressure Readings	26
Appendix B: Filter Elements.....	27
Appendix C: Publication Reference	28

1. INTRODUCTION

1.1 Origin. The Petroleum Equipment Institute (PEI) has produced this document as an industry service. It has been prepared in response to requests from fixed base operators, equipment manufacturers, and service and repair contractors for a single authoritative source of information.

The recommended practices described herein represent a synthesis of industry procedures and manufacturer recommendations relating to the design, installation, service, repair and maintenance of aviation fueling systems. These practices are the consensus recommendations of the PEI Aviation Fueling Committee. The Committee is made up of representatives from equipment manufacturers and contracting companies specializing in the design, installation and service of aviation fueling systems. In addition, the Committee has had the benefit of reasoned comments submitted by parties interested in such fueling systems.

In instances where there were differences or omissions in material available from existing sources, the PEI Aviation Fueling Committee has included its own consensus recommendations based on the practical experience of Committee members.

1.2 Background. Over the years, fueling systems at general aviation airports have grown in sophistication, as have the aircraft that they refuel, but safe fueling and maintaining fuel quality remain the highest priority for aviation fuel providers. Aviation fueling facilities are the primary providers of services to general aviation aircraft and are generally located at or adjacent to airports. They traditionally offer aircraft fueling (line service) of aviation gasoline and jet turbine fuel.

For a modern fueling system to operate successfully and safely, numerous components from a variety of manufacturers must be properly installed, inspected and maintained. The proper installation of fueling systems requires special knowledge and skills to ensure continued safe and efficient operation.

1.3 Purpose. The purpose of this document is to provide concise recommended practices for the design, installation, service, repair and maintenance of fueling systems at aviation fueling facilities. The intent is to provide recommendations that will:

- promote the proper design, construction and safe operation of fueling systems;
- minimize the possibility of fueling system failure;

- avoid practices that will unnecessarily increase installation costs; and
- minimize environmental impacts and hazards.

This document is not intended to:

- endorse or recommend particular suppliers or manufacturers; or
- discourage the development of new and improved designs, equipment or procedures.

1.4 Scope. The recommended practices in this publication are limited to those relating to design, installation, service, repair and maintenance of aircraft fueling systems located at aviation fueling facilities. They do not cover the design or operation of hydrant systems or ground equipment fueling systems for fuel distribution.

1.5 Sources. The practices outlined in this document constitute a synthesis of requirements and recommendations published by equipment manufacturers, petroleum marketers and regulatory agencies. References are listed in Appendix C. When disparities or omissions existed in the available reference material, the PEI Aviation Fueling Committee included its own consensus recommendations based on practical experience.

1.6 Regulations and Codes. Aviation fueling systems discussed in these recommended practices are usually regulated by federal, state or local agencies. While the general requirements of the regulations are similar, specific requirements may vary among jurisdictions. The PEI Aviation Fueling Committee has not attempted to describe or interpret specific regulations in this document. When there are differences between applicable regulations and the recommendations in the publication, the more stringent requirements should be followed.

Aviation fueling system owners and operators need to verify that their facilities meet all applicable regulatory requirements. At some locations, equipment may require the approval of fire, environmental or other authorities having jurisdiction (AHJs), or listing by a nationally recognized testing laboratory. AHJs also may require technicians to meet specific qualifications prior to working on equipment at aviation fueling facilities.

1.7 Importance of Competent Installers and Technicians. In addition to proper aviation fuel system design and operation, the use of skilled, professional service technicians with experience in aviation fueling systems is an important factor in ensuring that fueling operations run safely and effectively throughout their working lives. The use of installers who have the experience and integrity

to insist on doing the job correctly provides the greatest assurance that components and systems will operate as designed and intended.

1.8 Importance of Competent Operators. Knowledgeable and conscientious facility operators are key to the reliable and safe operation of aviation fueling facilities. Personnel responsible for the fueling systems should be instructed on how to safely operate these systems and properly respond to emergency situations. Refer to Chapter 12 for further guidance concerning the training of facility personnel.

2. DEFINITIONS

2.1 Air Eliminator. A device that provides a vent to allow the escape of trapped air during the filling of a vessel. When the vessel is completely filled with fuel, the air eliminator automatically closes.

2.2 American Society of Mechanical Engineers (ASME). A professional society that provides safety codes and standards.

2.3 Apron. A hard-surfaced area at an airfield used for maneuvering and parking aircraft.

2.4 Authority Having Jurisdiction (AHJ). An organization, individual or office responsible for regulating and/or approving equipment, installations or procedures.

2.5 Automatic Air Eliminator (AAE). A valve located at the highest point on a device that opens and vents air to the atmosphere. The valve closes when the air has been purged.

2.6 Avgas. Aviation gasoline. Avgas is a Class IB flammable liquid.

2.7 Aviation Fuel. Avgas, Jet A, Jet A-1, Jet B, JP8 and other hydrocarbon-based or synthetic fuels for use in aircraft.

2.8 Block Valve. Any type of valve that is used to close off flow through a pipe. Types of block valves include gate valves, ball valves, butterfly valves and plug valves.

2.9 Bollard. A heavy, protective post installed to prevent vehicles or aircraft from coming in contact with structures and fuel transfer equipment.

2.10 Bond. An electrical connection between two or more conductive objects such that they are at the same electrical potential but not necessarily at the same potential as the earth.

2.11 Check Valve. A valve installed in fluid piping that allows flow in only one direction.

2.12 Coalescer Element. An element located in a filter vessel that is designed to remove solid contaminants, break the emulsion of water in the product into droplets, and enlarge these droplets so that they will drop out of the product.

2.13 Compartmented Tank. A storage tank containing two or more compartments, each typically separated by two bulkheads.

2.14 Complete Internal Lining. A coating applied to all internal surfaces of a tank, vessel or pipeline.

2.15 Control Valve. A valve that controls fuel flow by opening and closing in response to a signal from a sensor.

2.16 Direct-to-Aircraft. A type of fueling in which aircraft are fueled with a dispensing nozzle delivering fuel from a stationary storage tank.

2.17 Entrained. Water or solids suspended in fuel.

2.18 Federal Aviation Administration (FAA). The national civil aviation authority of the United States and part of the United States Department of Transportation.

2.19 Filter/Separator. A vessel containing elements that separate particulate matter and water from aviation fuel.

2.20 Fixed Base Operator (FBO). A provider of support services to general aviation owners/operators at a public-use airport located either on or adjacent to airport leasehold property.

2.21 Fuel Ramp. A pull-off or staging area where aircraft fueling is conducted.

2.22 Fuel System Icing Inhibitor (FSII). An aircraft fuel icing inhibitor/additive. The chemical name for FSII is diethylene glycol monomethyl ether (DiEGME).

2.23 Holiday-Free. A description of a coating on a surface that has no flaws, such as pinholes or areas of uneven application.

2.24 International Code Council (ICC). A non-governmental organization that allows governmental jurisdictions and other stakeholders to work together to create model consensus codes.

2.25 International Fire Code (IFC). A fire code developed by the International Code Council that sets minimum standards to safeguard life and property from fire and explosion.

2.26 Internal Pipe Scrubbing. The cleaning action of a fuel flowing through a pipe.

2.27 Joint Inspection Group (JIG). An international group specifying aviation fuel standards.

2.28 Manual Drain. A normally closed valve at the bottom of a filter vessel. During normal operation, the valve is briefly opened manually to remove any accumulated water and to sample the fuel in the sump. The valve can be opened to completely drain the vessel when changing elements.