

Recommended Practices for the Design and Maintenance of Fluid Distribution Systems at Vehicle Maintenance Facilities

Recommended Practices for the Design and Maintenance of Fluid Distribution Systems at Vehicle Maintenance Facilities

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- 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 and Maintenance of Fluid Distribution Systems at Vehicle Maintenance Facilities* have been prepared as an industry service by the Petroleum Equipment Institute. The text represents the consensus views of the PEI Vehicle Maintenance Fluids Equipment Committee, comprised of the following members:

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1. INTRODUCTION

1.1 Origin. The Petroleum Equipment Institute (PEI) has produced this document as an industry service. The recommended practices described herein represent a synthesis of industry procedures and manufacturer recommendations relating to centralized fluid distribution systems typically installed at vehicle maintenance facilities. These practices are the consensus recommendations of the PEI Vehicle Maintenance Fluids Equipment Committee. This Committee is made up of representatives from equipment manufacturers and contracting companies specializing in the design, service and installation of lubrication equipment. In addition, the Committee has had the benefit of reasoned comments submitted by parties interested in vehicle maintenance facilities.

1.2 Background. Well-designed and properly constructed centralized vehicle fluid distribution systems are commonly found at vehicle repair and fleet maintenance facilities. Although they are technically sophisticated, there is little published literature on the design of these systems. Because most of the fluids involved do not pose substantial fire or health hazards, there are few regulations regarding these systems. The absence of both industry guidance and regulatory standards has led to the installation of many such systems by people who are unfamiliar with the high air and fluid pressures present in these systems and the flow characteristics of lubrication fluids. Many factors make this uninformed approach to fluid distribution system design undesirable:

- Poorly designed systems may be inconvenient or inefficient to use and may require frequent servicing, repair or replacement.
- The high pressures used to convey viscous fluids can be dangerous.
- A lack of understanding of the relationships between fluid viscosity, pump pressure, and tubing length and diameter can result in the installation of distribution systems that have insufficient flow rates and inadequate performance.
- Improperly designed systems may create safety hazards posed by components operating at pressures well beyond their rated pressures.

The design of these fluid distribution systems is further complicated by the properties of the fluids themselves. Viscous fluid distribution systems must be properly designed in order to move these fluids efficiently through the distribution system. Proper design includes the use of

specialized fittings, pumps and materials that can safely produce and contain the pressures required to move these fluids.

To perform effectively and efficiently, properly designed distribution and pumping systems must be able to safely and conveniently deliver ample flow rates at multiple distribution points. In addition, the rising cost of the products stored and distributed through these systems has placed increased emphasis on accurate inventory systems to track the usage of these fluids.

1.3 Purpose. The purpose of this document is to provide a concise summary of the design considerations and general guidelines for the proper installation of centralized fluid distribution systems for various types of vehicle-related fluids. This information has been assembled from published and unpublished sources provided by equipment manufacturers and experienced installers. The intent is to provide recommended practices to facility designers and installers that:

- promote construction of systems that operate safely and reliably;
- promote trouble-free performance of fluid distribution equipment; and
- provide the required flow rates over a broad range of end-user applications.

This document is NOT intended to:

- endorse or recommend particular materials, equipment, suppliers or manufacturers; or
- discourage the development and implementation of new procedures, equipment or devices.

1.4 Scope. These recommended practices apply to stationary, centralized fluid distribution systems for vehicle-related new and used fluids, such as:

- motor oil;
- gear oil;
- transmission fluid;
- hydraulic fluid;
- grease;
- antifreeze;
- windshield washer fluid.

The equipment covered includes supply containers (e.g., tanks, totes, drums, kegs, pails), piping and tubing, pumps, compressors, hoses, reels, control handles, and other equipment typically used to construct these systems.

These recommended practices do NOT apply to:

- mobile (e.g., truck-mounted) fluid distribution systems for vehicle fluids;
- fluid distribution systems used in food service or food preparation operations;
- storage and distribution systems for motor vehicle fuels.

1.5 Sources. The procedures outlined in this document constitute a synthesis of requirements and recommendations published by equipment manufacturers. In instances where disparities or omissions existed in the available reference material, the PEI Vehicle Maintenance Fluids Equipment Committee has provided its own consensus recommendations based on practical experience in the installation and operation of centralized fluid distribution systems.

1.6 Use of Other PEI Recommended Practices. There are many other aspects of liquid storage systems that are not described in this document. Refer to the

following PEI documents for additional recommended practices and procedures related to fluid storage systems:

- 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/RP600, *Recommended Practices for Overfill Prevention for Shop-Fabricated Aboveground Tanks*.

1.7 Importance of Competent Installers. In addition to proper system design and operation, the use of skilled, professional installers with experience in fluid distribution systems is an important factor in ensuring a safe, efficient fluid distribution system that will operate for extended periods with minimal maintenance. The use of installers who have the experience and integrity to insist on doing the job correctly provides the greatest assurance that a fluid distribution system will operate smoothly and efficiently.

2. DEFINITIONS

When used in this document, the terms listed below have the following meanings:

2.1 Air Drop. A branch of a compressed air distribution system that connects an air-operated piece of equipment to an air header. A typical air drop consists of a length of piping or tubing leading from an air header, a water drip leg, and a short length of tubing that includes a shutoff valve, a filter, a regulator and a lubricator. (See Figure 4-1.)

2.2 Air Fuse. See “Pump Overrun Control.”

2.3 Air Header. In a compressed air distribution system, the main trunk line that carries the compressed air from the compressor to the various areas where air-operated equipment is located. An air drop connects the air header to the air-operated equipment.

2.4 Air Side. The portion of a centralized vehicle fluid distribution system that handles compressed air. This typically includes an air compressor, an air-powered motor, and the piping and ancillary equipment used to connect the compressor to the air motor.

2.5 Authority Having Jurisdiction (AHJ). An organization, office or individual responsible for enforcing the requirements of a code or standard, or for approving equipment, materials, installations or procedures.

2.6 Backpressure. When a fluid pump pushes a fluid into a distribution network, frictional forces resist the flow and appear to push back against the fluid exiting the pump outlet. The frictional forces originate from the viscosity of the fluid and the movement of the fluid against the walls of the piping, tubing and other components of the fluid distribution system. The pump output pressure must be greater than the backpressure of the fluid in the distribution network in order for the fluid to flow.

2.7 Bleed Type Shutoff Valve. A shutoff valve that includes a mechanism to relieve the pressure downstream of the valve to atmospheric pressure when the valve handle is in the closed position so that equipment can be safely serviced. (Also known as a “Safety Bleed Shutoff Valve.”)

2.8 Bulkhead Fitting. A threaded fitting installed in a side wall of a container or tank. Bulkhead fittings are typically installed near the bottom of a tank and are often used to manifold tanks together or to provide a water drainage point.

2.9 Bung. A device used to seal an opening in a container. Typically, the bung is threaded and is screwed into place to seal the opening.

2.10 Bung Adaptor. A fitting that can be screwed into a bunghole. The bung adaptor allows a stick type of reciprocating pump or suction tube to be installed directly into a container of fluid.

2.11 Bunghole. The threaded opening created when a bung is removed.

2.12 Cavitation. When fluid travels through a tube or hose, or is drawn into a fluid pump inlet by a vacuum, a void is created in the fluid if the negative pressure (vacuum) exerted by the pump exceeds the vapor pressure of the fluid. The fluid then “boils” in the tube, hose or pump and the effectiveness of the pump in moving the fluid is seriously reduced. Cavitation is typically produced when a pump is cycling too fast, or the tube or hose diameter is too small.

2.13 Check Valve. A valve installed in the fluid piping between a storage vessel and a dispense point that allows the fluid to flow in only one direction. The flow of the liquid in the piping opens the valve, and when the fluid flow stops or reverses, the valve closes.

2.14 Classified Liquid. A liquid included in a system of labeling liquids that pose fire hazards according to their flash point and, in some cases, boiling point. (See Figure 2-1.)

2.15 Control Handle. A device installed at the dispense point of a fluid distribution system that regulates the flow of fluid from the system. A control handle typically includes a valve that can be fully or partially opened in order to control the flow rate of the fluid being dispensed. A control handle may also incorporate a metering device to measure the amount of fluid dispensed.

2.16 Cubic Foot per Minute (CFM). The volume of air flowing past a given point in one minute. (See also “Standard CFM.”)

2.17 Diaphragm Pump. An air-operated device that uses a flexible membrane to move liquids. Air pressure on one side of the membrane forces the fluid trapped in a chamber on the other side of the membrane through an outlet in the fluid chamber. A pair of check valves at the inlet and outlet of the fluid chamber control the direction of fluid flow. (See Figure 3-2.)

2.18 Dispense Point. A general term for any location where product is delivered from a fluid distribution system. A dispense point can be an oil bar, a hose reel or a hose with a control nozzle.

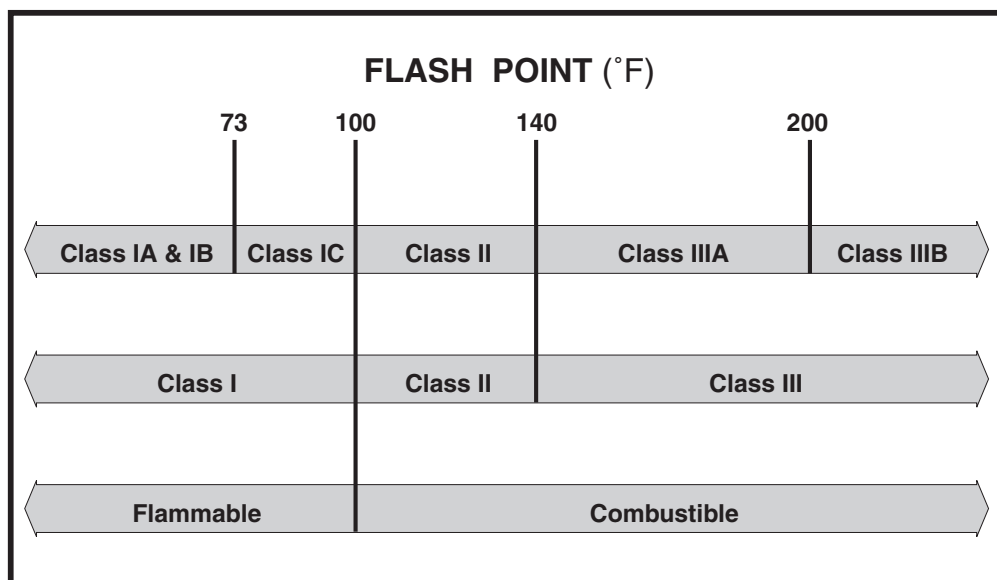


FIGURE 2-1. Graphic representation of the relationships among classified liquids. Most hazard classes are based solely on the flash point of the liquid. Class IA and IB are based on flash point and boiling point. Class IA liquids have a boiling point below 100°F, Class IB liquids have a boiling point at or above 100°F.

2.19 Double-Tapped Bushing. A donut-shaped fitting that is threaded both on its outside edge and the inside opening. The threads on the inside opening are cut from both sides of the fitting. This permits two lengths of pipe to screw into the center opening of the double-tapped bushing—one from each side of the fitting. A double-tapped bushing is typically threaded into a bung hole, with a suction tube screwed into one side and piping leading to the inlet of a fluid pump on the other side of the bushing.

2.20 Drip Leg. A vertical length of piping or tubing that is designed to capture any water droplets that may be traveling inside compressed air distribution piping or tubing. An automatic or manually operated drain valve is installed at the lowest point of a drip leg to allow the removal of the water that has accumulated. A drip leg typically forms the lowest point of an air drop, but may also be installed in an air header. (See Figure 4-1.)

2.21 Drum. A cylindrical container for transporting and storing lubrication oils and greases. A typical drum can contain 55 gallons of lubrication oil or about 400 pounds of grease.

2.22 Drum Cover. A steel disc with a rim that is designed to sit on top of a standard open-head, 55-gallon drum. The drum cover includes an opening and a clamp mechanism that allows the body of a stick pump to be inserted and held in a fixed position inside the drum.

2.23 Duty Cycle. The percentage of time that a piece of equipment is designed to operate. For example, a

pump designed to operate for 30 minutes out of every hour has a 50% duty cycle.

2.24 Elevator. A device used to remove a stick pump from a drum and transfer the pump to another drum. The elevator typically consists of a stand, a support post, a method of attachment to the air motor of the pump, and a manual or air-operated lift mechanism to raise the stick pump out of the drum.

2.25 Emergency Vent. A large-capacity vent that provides for vapor release in the event a tank is exposed to a fire.

2.26 Flash Point. The minimum temperature at which a liquid produces sufficient vapors to form an ignitable mixture with air.

2.27 Flexible Tubing. Tubing that can be bent into smooth curves without collapsing or kinking.

2.28 Fluid. The product dispensed from a distribution system. A substance that has no fixed form and takes the shape of its container.

2.29 Fluid Side. The portion of a centralized vehicle fluid distribution system that handles fluid. This typically includes a pump and the piping and ancillary equipment used to connect the product pump outlet to the tip of the dispense point.

2.30 Follower Plate. A steel disc installed inside an open-head drum that helps keep viscous fluids flowing to the pump inlet. The disc rests on the top surface of the product in the drum. The disc typically includes a seal on its outer rim that wipes product from the inside surface of the drum as the product level in the drum decreases. The disc also includes a hole in the middle of the disc through which the pump is inserted. (See Figure 5-2.)

2.31 Free-Flow Pumping Rate. The delivery rate of fluid at the outlet of a product pump when there is no backpressure present. The free-flow pumping rate is typically stated in gallons per minute (gpm). Also known as “Free Flow.”

2.32 Hose. A flexible, hollow cylinder that can be used to convey compressed air or liquids under pressure. Hose is measured by its inside diameter.

2.33 Hose Reel. A device that winds a hose around a spool. Various methods can be used to wind the hose on the spool, including a spring, a hand crank or a motor. In fluid distribution systems, hose reels are used to provide the end user with a convenient means of accessing and storing a lengthy hose that connects the control handle to the rigid piping that dispenses a specific fluid.

2.34 Hydraulic Hammer. A sudden, temporary increase in pressure inside a fluid distribution system. Hydraulic hammer is typically produced when flow through a fluid distribution network is suddenly stopped by the rapid closing of a dispense handle.

2.35 Inductor Plate. A steel disc attached to the bottom of a grease pump. Like a follower plate, the inductor plate helps move product in a drum toward the inlet of the pump, and includes a seal that wipes the inside surface of the drum as the product level decreases. While a follower plate slides down the body of the pump, the inductor plate is fixed to the bottom end of the pump so that the weight of the pump helps push the inductor plate down onto the product, reducing cavitation by forcing the product toward the pump inlet. (See Figure 5-2.)

2.36 Isolation Valve. See “Shutoff Valve.”

2.37 Keg. A small barrel with a capacity of about 16 gallons of lube oil or about 120 pounds of grease.

2.38 Liquid Side. See “Fluid Side.”

2.39 Lockout Shutoff Valve. A shutoff valve designed so that it can be secured in the closed position.

2.40 Lower End. The fluid pumping portion of a stick pump.

2.41 Manifolded. A piping arrangement wherein two or more tanks containing the same product are piped together so that product can flow freely between the tanks. The fluid levels in tanks that are manifolded should be equal.

2.42 Maximum Operating Level. The fluid level in a tank or container that should not be exceeded during normal filling procedures. The maximum operating level is below the activation point of any overflow prevention device.

2.43 Non-Pourable Fluid. A viscous substance that cannot be efficiently transferred from one container to another by gravity alone (e.g., grease).

2.44 Oil Bar. A centrally located dispensing point for one or more vehicle maintenance related fluids.

2.45 Open-Head Container. A drum, keg or pail of product of which the top is completely removed in order to access the product.

2.46 Pail. A cylindrical container with a capacity of about 5 gallons of lube oil or about 35 pounds of grease.

2.47 Positive Displacement Pump. A device that causes a fluid to move by trapping a fixed amount of fluid in a chamber and then applying pressure to force the fluid out of the chamber through a discharge outlet. Check valves at the inlet and outlet of the fluid chamber control the direction of fluid flow. Diaphragm and stick pumps are positive displacement pumps. (See Figures 3-1 and 3-2.)

2.48 Pourable Fluid. A substance with a relatively low viscosity that can be efficiently transferred from one container to another by gravity (e.g., windshield washer fluid, engine lubrication oil).

2.49 Pressure Drop. The loss of pressure that occurs when a fluid moves through a fluid-distribution system. This pressure loss is the result of friction against the walls of the pipe or tube; friction within the fluid itself; and friction produced by fluid flow through various system components, such as elbows, hose reels and control handles.

2.50 Pressure Relief Valve. A normally closed valve in a fluid distribution system that opens automatically whenever the pressure in the system exceeds the set point of the pressure relief valve. The set point of the pressure relief valve should be below the maximum rated operating pressure of the fluid distribution system.

2.51 Pulser. A component of a fluid meter that generates a brief electrical or magnetic signal (a “pulse”) each time a fixed amount of fluid passes through the meter. By keeping track of the pulses generated during a dispensing event, the volume of fluid dispensed can be calculated.

2.52 Pump Cycle. A term used to describe the motion of the moving parts in a positive displacement pump. One complete pump cycle is the path taken by the moving components from a starting point back to the starting point. For a stick type of pump, the pump cycle consists of an upstroke, wherein fluid on the upper side of the pump piston is pushed out of the pump into the distribution system and fluid on the lower side of the piston is drawn into the body of the pump, and a downstroke, wherein fluid passes from the lower to the upper side of the piston. One complete upstroke and downstroke of the pump is required to complete one pump cycle. (See Figure 3-1.)

2.53 Pump Cycles per Minute (CPM). A term used to describe the speed at which a pump operates. Pump CPM refers to the number of pump cycles completed in a time period of one minute.

2.54 Pump Overrun Control. A device that automatically shuts off the air supply to a pump if excess air consumption is detected. Also known as an “Air Fuse” or “Runaway Valve.”

2.55 Pump Ratio. The ratio of the area of the air piston to the area of the fluid piston in an air-powered pump. The pump ratio determines the multiplication factor between the air input pressure of the air motor and the fluid output pressure of the pump. For example, if the air input pressure is 100 psi, a pump ratio of 2:1 will yield a fluid output pressure of 200 psi. For a pump ratio of 3:1, the same input pressure of 100 psi will yield a fluid output pressure of 300 psi.

2.56 Pump Runaway. A condition wherein a fluid pump operates with no fluid entering the fluid inlet or very little backpressure at the fluid outlet. The lack of fluid or backpressure causes the pump to cycle very rapidly, and can damage the fluid pump or air motor. Pump runaway typically occurs because the fluid container that supplies the pump has emptied or because some component in the fluid distribution system has ruptured.

2.57 Pump Output Volume. The volume of fluid flowing through the outlet of a pump during the completion of one pump cycle.

2.58 Quarter-Turn Ball Valve. A shutoff valve operated by a handle that rotates 90 degrees to move the valve between the open and the closed position.

2.59 Reciprocating Compressor. A compressor is a device that mechanically forces a volume of air at ambient atmospheric pressure into a smaller volume, thus increasing its pressure. A reciprocating compressor uses a piston moving inside a closely fitting cylinder, with appropriate inlet and outlet valves at the top of the cylinder, as the mechanism for compressing the air.

2.60 Remote Fill. A method of filling a tank in which the connection between the transport vehicle’s delivery hose and the facility piping is located away from the tank.

2.61 Shutoff Valve. A device for interrupting the flow of air or fluid in a piping or tubing network. Shutoff valves allow portions of an air or fluid distribution network to be conveniently isolated from the rest of the system for maintenance, repair or other purposes. Also known as an “Isolation Valve.”

2.62 Single-Stage Compressor. A compressor that achieves the design output pressure using a single compression step. Output pressures for single-stage compressors are typically in the range of 25 to 135 psig. (Compare “Two-Stage Compressor.”)

2.63 Stall. A condition in an air-operated fluid pump wherein the fluid backpressure downstream of the pump equals the pressure of the fluid at the output of the pump. Because there is no pressure difference, the pump stops and there is no movement of fluid into or out of the pump.

2.64 Standard CFM. A flow of air converted to a standard set of reference conditions, usually 14.7 pounds per square inch absolute, 68°F and 0% relative humidity.

2.65 Stick Pump. A positive displacement pump, usually powered by an air motor, consisting of a hollow tube with a moveable piston inside. Check valves control the flow of fluid as the piston moves up and down inside the tube to pump the fluid. (See Figure 3-1. See also “Pump Cycle.”)

2.66 Suction Stub. See “Suction Tube.”

2.67 Suction Tube. A length of pipe that extends downward from the inlet of a pump or the top of a container of fluid to within a few inches of the bottom of the container. Fluid is drawn from the container through the suction tube by a pump. Also known as a “Suction Stub.”

2.68 Thermal Expansion. An increase in the volume of a fluid due to an increase in the temperature of the fluid. When thermal expansion occurs inside of a fluid distribution system that is closed at both ends, increases in pressure will occur.

2.69 Thixotropic. A property of certain fluids wherein the viscosity decreases as shear stress is applied. Certain types of grease are thixotropic. These greases are very viscous when at rest, but they flow much more readily when they are pumped through a relatively small diameter tube.

2.70 Tight-Head Container. A drum, keg or pail of product where the top of the container is left in place while product is dispensed. Product is accessed through a bung hole in the lid of the container.

2.71 Tube or Tubing. A hollow cylinder that can be used to convey compressed air or liquids under pressure. Tubing is specified by its outer diameter. Lengths of tubing are joined by fittings that are designed to mate with the outside surface of the tube.

2.72 Two-Stage Compressor. A compressor that achieves the design output pressure using two compression

sion steps. The compressed air output from the first stage of the compressor is directed to the intake of the second stage of the compressor, where the air is further compressed. Output pressures for two-stage compressors are typically in the range of 125 to 175 psig. (Compare “Single-Stage Compressor.”)

2.73 UL 142 Tank. A welded steel tank designed to store flammable and combustible liquids constructed according to Underwriters Laboratories (UL) Standard 142 entitled, *Steel Aboveground Tanks for Flammable and Combustible Liquids*. A UL 142 tank is intended for noncorrosive, stable liquids that have a specific gravity not exceeding that of water. Class IIIB liquids, such as lubrication oils, and vehicle fluids, such as antifreeze,

that are noncorrosive, stable and have a specific gravity not exceeding that of water, can be stored in UL 142 tanks.

2.74 Ullage. The volume of the empty space above the product level in a tank or container.

2.75 Upper End. The air motor portion of a stick pump.

2.76 Viscosity. A measure of the resistance to flow of a fluid at a given temperature. For example, water has low viscosity; lube oil has medium viscosity; and grease has a high viscosity. As the temperature of a fluid decreases, the viscosity of the fluid will generally increase.

3. LUBRICANT DISTRIBUTION SYSTEM COMPONENTS

3.1 General. The purpose of this chapter is to describe specific features and important characteristics of the various components that are included in a typical centralized fluid distribution system for vehicle fluids. A solid understanding of these components is required in order to properly design these systems.

3.2 Containers. Containers for the various fluids used in vehicle maintenance vary widely in size, construction and installation requirements.

3.2.1 Pails, Kegs and Drums. Pails, kegs and drums are used where the quantity of fluid to be stored is relatively small. These types of containers are usually cylinders made of metal or rigid plastic. They are typically delivered full of product by the manufacturer or distributor of the fluid directly to the end user.

3.2.2 Intermediate Bulk Containers (IBC). Larger quantities of fluids can be stored in IBCs, often called totes. Totes are typically rectangular in shape, can be made of plastic or metallic materials, and are designed to be portable. Some totes are designed to be stacked so that limited storage space can be used more efficiently. Totes can be brought to a site full of product or filled on site. They can be fitted with spigots so that product can be dispensed by gravity or with pumps for remote dispensing. Because totes are designed to be transportable, they are classed as mobile storage devices. They are not constructed to the same standards as stationary tanks.

3.2.3 Tanks. Storage of larger volumes of fluids is typically accomplished using aboveground or belowground storage tanks. These tanks are generally purchased from an equipment distributor and are filled by bulk deliveries of product after the tank is installed.

Tanks storing fluids at vehicle maintenance facilities are unique in that they contain Class IIIB liquids. Class IIIB liquids typically found at vehicle maintenance facilities include:

- antifreeze;
- brake, transmission and power steering fluids;
- motor oils;

- crankcase drainings;
- gear lubricants;
- chassis, white and lithium moly greases.

Many fire and environmental regulations applicable to the storage of Class I, II and IIIA liquids are not applicable to the storage of Class IIIB liquids. For example, fire codes generally do not limit the location of tanks storing Class IIIB liquids within buildings, allowing them to be installed at grade, belowground or aboveground, as long as the tank is double-walled or an alternate form of secondary containment (e.g., a dike) is provided. Fire codes also provide for minimal separation distances between adjacent tanks and between tanks storing Class IIIB liquids and property lines. Consult with the authority having jurisdiction (AHJ) to determine whether there are any limits on the volume of Class IIIB liquids that may be stored.

Tanks storing Class IIIB liquids should be constructed according to a recognized standard. These standards include:

- UL 58 and UL 1746 for underground steel tanks;
- UL 1316 for underground fiberglass tanks;
- UL 142 for aboveground steel tanks;
- ULC/ORD-C142.14-03 for aboveground non-metallic bulk containers.

State codes, environmental authorities or local fire departments may require permits for aboveground or belowground tank installation, and may have specific requirements for the type of storage tank that must be used. Consult with the AHJ to determine all of the applicable regulatory requirements before specifying a tank or proceeding with the tank installation.

Common Name	Typical Capacity (gal.)	Typical Capacity (lb.)
Pail	5	35
Keg	16	120
Drum	55	400
IBC or Tote	119 to 793	
Tank	100+	

TABLE 3-1. Common names and typical capacities of various containers routinely used to store lubricants and vehicle fluids. Quantities of pourable fluids are usually given in gallons, while non-pourable fluids are given in pounds.

3.3 Gauging Equipment. Gauging equipment may range from a simple stick to sophisticated ultrasonic gauges with remote digital readouts that allow the product in a tank to be monitored conveniently from almost any location. Selection of gauging equipment should be based on the accuracy required, convenience and the nature of the product in which the gauge operates. Most gauging equipment is intended for use with pourable liquids.

3.3.1 Gauge Sticks. Gauge sticks work with any liquid and in most any situation where the top of the tank is accessible and there is adequate room above the tank to conveniently insert a stick long enough to reach the bottom. Stairs, ladders or other secure means of accessing the top of aboveground tanks may be required to allow the person using the stick to safely and conveniently gauge the tank.

3.3.2 Mechanical Gauges. Mechanical, float-based gauges may be used on tanks storing pourable fluids. Verify the compatibility of gauge components with the fluid stored, especially for corrosive liquids, such as windshield washer fluid.

3.3.3 Electronic Gauges. Electronic gauges that utilize probes to measure liquid volume provide the most accurate inventory measurements. These gauges are typically used when accurate product inventory measurements must be made. Check manufacturer specifications for the type of fluids with which these gauges can be used. Follow manufacturer installation instructions.

3.4 Overfill Prevention. Aboveground tanks storing Class IIIB liquids are not required to have overfill prevention devices. Tanks utilizing remote fills should have an overfill prevention device. Verify that the overfill prevention equipment installed is compatible with the product delivery procedures used and the product stored. Provide a convenient means for determining the volume of product present in the tank before the delivery. Provide a permanent, readily visible label, plate or sign in the immediate vicinity of the fill pipe that indicates the maximum operating level of the tank.

Underground tanks receiving bulk deliveries from tank vehicles should be equipped with overfill prevention equipment.

Used fluids are typically transferred from small mobile containers to larger storage tanks using a pump. Install a high level alarm in the receiving tank and an automatic transfer pump shutoff mechanism to prevent overfilling of the used oil storage tank.

NOTE: For additional information concerning overfill prevention for underground tanks, refer to PEI/RP100, *Recommended Practices for Installation of Underground Liquid Storage Systems*. For additional information concerning overfill prevention for aboveground tanks, including used oil tanks, refer to PEI/RP600, *Recommended Practices for Overfill Prevention for Shop-Fabricated Aboveground Tanks*.

3.5 Pumps. Fluid dispensing pumps at vehicle maintenance facilities should operate reliably and effectively. In order to properly distribute fluid products throughout a distribution system, fluid dispensing pumps must be able to produce and hold pressures from one hundred to several thousand pounds per square inch. They must be able to handle fluids with viscosities ranging from that of water to greases that have a consistency similar to peanut butter.

Air-operated, positive displacement pumps are ideally suited for the distribution of fluids at vehicle maintenance facilities. They operate reliably with minimal maintenance. Air-operated pumps can produce the wide range of output pressures required to move fluids having widely differing viscosities from a single compressed air source by simply selecting the appropriate pump ratio.

The most advantageous characteristic of air-operated pumps is that they can easily maintain the required pressure in the distribution piping, stalling indefinitely when all the dispense points are closed without damaging the pump or requiring a sophisticated control mechanism. Because the pressure in the distribution system is constantly maintained, product is dispensed immediately whenever a control handle in the system is opened. The air motor then responds by pumping more fluid into the distribution piping. When all control handles are closed, backpressure increases and the air motor stalls harmlessly. When electric, hydraulic or other types of motors are used, the system design must include pressure relief valves, fluid return lines or other design features to compensate for the inability of these types of motors to simply stall against backpressure.

The most common type of air-operated pump used in fluid distribution systems is the displacement pump, commonly called a “stick” pump. (See Figure 3-1.) Stick pumps consist of two basic components: an air motor (often called the “air side” or “upper end” of the pump) and a fluid pump (often called the “fluid side” or “lower end”). The air motor is a simple reciprocating piston moved by compressed air. A valve arrangement alter-

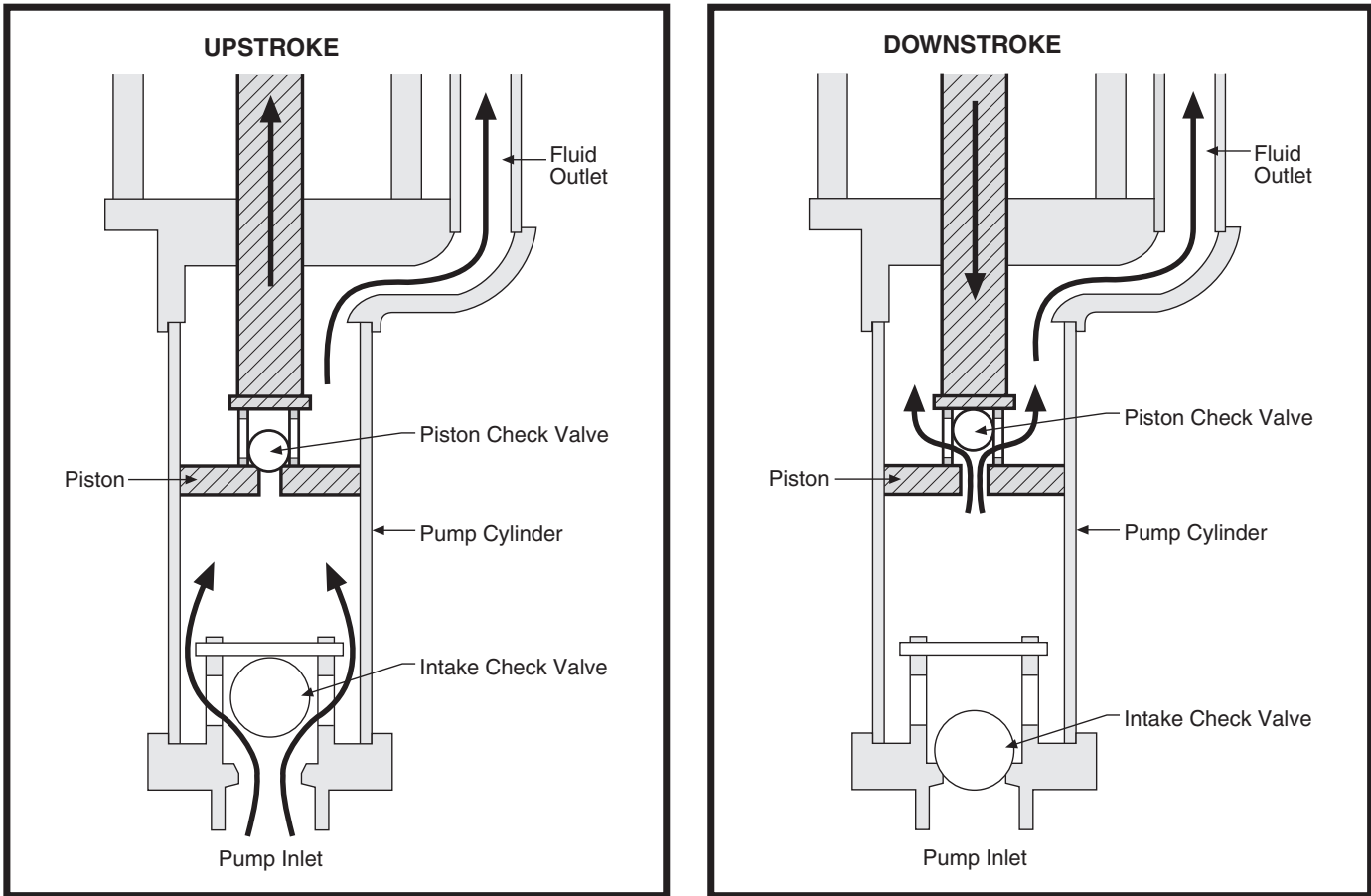


FIGURE 3-1. Operation of a stick pump. During the upstroke, fluid is drawn into the pump cylinder through the intake check valve by the upward movement of the piston. Fluid above the piston is pushed out of the pump through the fluid outlet because the piston check valve is closed. During the downstroke, the intake check valve closes and fluid is pushed upward through the piston check valve by the downward movement of the piston. Because the volume of the pump cylinder above the piston is less than the volume of the pump cylinder below the piston, some fluid also flows out of the pump through the fluid outlet during the downstroke.

nates the air pressure from one side of the piston to the other to force the piston up and down. The piston in the air motor is connected by a rod to another piston in the fluid pump. Movement of the air motor piston drives the piston in the fluid pump up and down. The motion of the fluid pump piston draws fluid in from a source container; pumps the fluid out into the fluid distribution system during the upstroke; and recharges the pump cylinder with fluid during the downstroke. Check valves in the fluid pump control the flow of the fluid inside the pump.

The ratio of the area of the air motor piston to the area of the fluid pump piston determines the output pressure of the pump. By varying the ratio of the area of the air motor piston to the fluid pump piston, a wide range of pump output pressures can be obtained using a single compressed air source. For example, if the air motor piston has an area of four square inches and the fluid pump piston has an area of two square inches, the output fluid

pressure will be twice the input air pressure (a 2:1 ratio). Pump ratios range from 1:1 through 75:1.

For moving larger volumes of low-viscosity fluids, diaphragm pumps are typically selected. (See Figure 3-2.) In a diaphragm pump, the air pushes against a flexible diaphragm rather than a solid piston. The fluid to be moved is in a chamber on the other side of the diaphragm. Diaphragm pumps typically contain two diaphragms connected by a rod and mounted opposite of one another, so that the power stroke that pushes the fluid out of one diaphragm is the intake stroke that fills the fluid chamber of the other diaphragm. The role of the two diaphragms is reversed when incoming air pressure is applied to the diaphragm on the opposite side of the pump. Diaphragm pumps typically have a 1:1 ratio.

3.6 Piping and Tubing. Piping and tubing are different and must not be confused. Both have appropriate uses in vehicle fluid distribution systems.