



SURFACE VEHICLE STANDARD

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Superseding J176 AUG2006

(R) Fast Fill Fueling Installation for Off-Road Self-Propelled Work Machines

RATIONALE

SAE J176 required revising in order to address the recent introduction of Diesel Exhaust Fluid (DEF) and Ultra Low Sulfur Diesel (ULSD) fuel, both necessary to help meet the more stringent EPA emissions regulations.

1. SCOPE

This SAE Standard applies to off-road self-propelled work machines as categorized in SAE J1116. Fast fill fueling typically applies to self-propelled machines with a fuel capacity over 380 L, although fast fill fueling can be used on machines with smaller fuel capacity.

1.1 PURPOSE

This document specifies the proper installation, position, protection, and size of a fueling receiver, nozzle, automatic shut-off vent connections, signal line, and inlet shut-off valve. This document applies to filling diesel fuel tanks or vessels at a flow rate of 570 liters per minute or less. Filling fuel tanks at higher flow rates requires adequately larger diameter components. This specification does not apply to gasoline.

2. REFERENCES

2.1 Applicable Document

The following publications form a part of this specification to the extent specified herein. Unless otherwise indicated, the latest issue of SAE publications shall apply.

2.1.1 SAE Publication

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or 724-776-4970 (outside USA), www.sae.org.

SAE J1116 Categories of Off-Road Self-Propelled Work Machines

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http://www.sae.org/technical/standards/J176_201409**

2.2 Related Publications

The following publications are provided for information purposes only and are not a required part of this SAE Technical Report.

2.2.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or 724-776-4970 (outside USA), www.sae.org.

SAE J371 Drain, Fill, and Level Plugs for Off-Road, Self-Propelled Work Machines

SAE J476 Dryseal Pipe Threads

2.2.2 ANSI Publication

Available from American National Standards Institute, 25 West 43rd Street, New York, NY 10036-8002, Tel: 212-642-4900, www.ansi.org.

ANSI B 1.20.1 NPT Threads

3. GENERAL

3.1 Automatic Shut-off – High Pressure Systems

A pressurized fast fueling system requires internal tank pressures sufficient to achieve automatic shut-off, a nozzle connected to a fueling receiver through which fuel is conveyed to the fuel tank, and an automatic shut-off vent to provide automatic fill level control, normal venting, and emergency venting. Nozzles in pressurized systems require an internal automatic shut-off mechanism, which is pressure dependent. Shut-off of fuel into fuel tank is achieved by the nozzle shutting off due to internal fuel tank pressure. Pressurized systems are not recommended on plastic fuel tanks due to the internal tank pressures over 0.5 bar required for shut-off which can damage the fuel tank.

3.2 Automatic Shut-off – Low Pressure Systems

Low pressure systems do not require internal tank pressure to obtain automatic shut-off but require an inlet shut-off valve and signal line in addition to the components in the pressurized system. A nozzle with an automatic shut-off mechanism is not required for fuel shut-off; a dry break may be used for connection to the fuel receiver instead of an automatic shut-off nozzle. Any tank pressures created during a fast fill operation using a low pressure system are less than 0.5 bar.

4. INSTALLATION

4.1 Fuel Receiver Mounting Connection

For flow rates less than 570 liters per minute, the fuel receiver mounting connection may be 2 in NPTF, flanged or other suitable connection having a 50 mm minimum inside diameter. Where the connection is made directly to the tank, it should be located as near the bottom of the tank as practical to provide submerged filling to limit foam formation. Where mounting the fuel receiver near the bottom of the tank is impractical, a 50 mm minimum inside diameter internal extension line to the bottom of the tank may be used. The receiver should be a dry break style coupling to reduce any fuel spillage during and after refueling.

4.2 Liquid Crossover Lines

Liquid crossover lines between multiple tanks should be minimum 50 mm inside diameter. Extension fill lines between the tank and a remote fuel receiver shall have a 50 mm minimum inside diameter and shall enter the bottom of the tank so as to provide submerged filling. Remote fill lines should be run with a minimum number of bends; all bends shall have the largest possible bend radius to reduce pressure drop and not limit system performance. Total pressure build up at the fuel receiver from fuel head plus friction loss should not exceed 0.3 bar at 9 L/s.

4.3 Automatic Shut-off Vent Connection

The automatic shut-off vent connection may be 2 in NPTF, flanged or other suitable connection with the centerline vertical within 5 degrees. Where multiple tanks are used, each tank should be provided with a separate vent connection; alternatively, a minimum 25 mm inside diameter air crossover line may be used between tanks. If a crossover line is used, care should be taken to prevent kinking of the crossover line, because kinking restricts airflow from tank to tank. If an emergency overflow line is connected to the vent outlet, a minimum 25 mm inside diameter line shall be used. Care should be taken to prevent kinking of the emergency overflow line. The fuel tank shall be properly vented to ensure that the fast fill system does not shut-off prematurely due to excess internal fuel tank pressure.

4.4 5.4 Inlet Shut-off Valve Mounting Connection

The inlet shut-off valve mounting connection used in low pressure systems may be 2 in NPTF, flanged or other suitable connection. The inlet valve shall be mounted between the fuel tank and the fuel receiver. Where the connection is made directly to the tank, the connection should be located as near the bottom of the tank as practical to provide submerged filling to limit foam formation. Where mounting the fuel receiver near the bottom of the tank is impractical, a 100 mm minimum inside diameter internal extension line to the bottom of the tank may be used. If the shut-off valve is mounted remotely, a housing may be used to contain the inlet shut-off assembly. The housing should have a minimum inside diameter of 125 mm and may have multiple outlets as required to fill multiple fuel tanks simultaneously. The inlet shut-off valve assembly may be mounted inside the fuel tank and attached to the end of an inlet line mounted to the tank wall with a minimum 50 mm inside diameter. The internal option may be used where space does not allow external mounting or a vent and shut-off valve combination is incorporated into a single mounting plate.

4.5 Signal Line

The signal line used in low pressure systems is connected between the automatic shut-off vent and the inlet shut-off valve. This line should be constructed of stainless steel braided hose with a minimum 6.4 mm inside diameter. The stainless steel braided hose should have a liner that is compatible with diesel fuel. The length should be kept to a minimum. Kinking or bending of the line should be avoided. All connections of the signal line to the vent and inlet valve shall be tight to ensure proper shut-off of fuel during fast fill operations.

5. POSITION

5.1 Fuel Receiver

The fuel receiver should be accessible from ground level. The fuel receiver shall be located to allow unrestricted access by an operator with a fueling hose and nozzle. If remotely mounted, the receiver should be supported with brackets or other means to withstand the weight of the refueling nozzle and hose filled with fuel. For low pressure systems, the fuel receiver may be directly mounted to the inlet shut-off valve assembly in a remote canister or may be directly mounted to the fuel tank.

5.2 Automatic Vent Connection

The automatic vent connection shall open into the tank vapor space and shall be located at the highest point on the top of the fuel tank. The vent exhaust port should be directed away from any hot surfaces, personnel, or any surface which can block the free flow of displaced air from the fuel tank during venting. The vent should be located away from any internal spray caused from the receiver, the inlet shut-off valve assembly, or both. A guard to divert the incoming fuel spray from the fuel receiver or inlet shut-off valve can be required to keep any fuel from spraying out of the vent assembly during refueling operations. To prevent the diverter from blocking air flow from the vent, the diverter should be mounted a minimum of 10 mm away from portions of the vent within the tank. For pressurized systems, any other positive venting connections shall be closed off when using the fast fill system. In low pressure systems, a separate vacuum vent can be required and may be incorporated in the gravity fill fuel cap. In low pressure systems, the vent and automatic shut-off assembly incorporated in most vents may be separated if necessary to obtain proper fuel level shut-off height or if limited space around the fuel tank prevents the automatic fuel shut-off vent to be mounted as a single unit. If multiple tanks are vented through an air crossover hose option, the vent shall be installed to the highest tank from ground level.

5.3 Inlet Shut-off Valve Assembly

If contained in a housing and remotely mounted, the inlet shut-off valve, the inlet shut-off valve assembly used in low pressure systems should be mounted as close to the fuel tank as possible. Locate the inlet shut-off valve away from the automatic shut-off vent assembly to prevent incoming internal fuel from spraying out of the vent during high flow rate refueling. A diverter can be necessary to force the fuel flow away from the shut off vent if the vent and inlet valve are located near each other or if the tank's geometry causes fuel to spray out of the vent during fast fill refuelling. If a diverter is installed, the inside surface of the guard should be a minimum of 10 mm away from any inlet shut-off valve surfaces. Care should be taken as to avoid blocking more than 50% of the flow area of the inlet shut-off valve, because higher blockage can cause decreased performance of the fast fill system.

5.4 Signal Line

The signal line used in low pressure systems should be mounted through the inside of the fuel tank that connects the inlet shut-off valve to the vent. Internal routing of the signal line eliminates any factors which may cause damage from an external routing exposed to the environment. If the signal line is external to the fuel tank (which can be done, for example, due to internal tank features such as large baffles or other interference), the line shall be secured to the vehicle's tank or structure by using tie down clips or by other means. Bulkhead fittings may be used to run the signal lines external to the fuel tank so that connections can be made to the internal ports on the vent and inlet shut-off valve. If the signal line is run external to the fuel tank the signal line should be mounted away from any moving parts, and located closest to the internal portion of the vehicle's structure to avoid possible damage from any moving debris created during the vehicle's normal operation.

5.5 Fast Filling Nozzle

The fast filling nozzle connects directly to the refuel receiver. The nozzle shall have a safety interlock that prevents removing the nozzle from the refuel receiver while fueling. The nozzle shall provide a positive indication that the nozzle is properly connected to the refuel receiver. The nozzle shall not allow any fuel spillage upon connection to the receiver, during fueling, upon disconnection from the receiver, or during storage.

For pressurized systems, the nozzle shall have an internal, pressure-dependent shut-off mechanism that is triggered when the fuel tank reaches full capacity and shall have a pressurized tank for shut-off. The automatic shut-off mechanism shall automatically stop the flow of fuel into the tank after the tank is full or the when the nozzle is manually shut-off by the operator.

For low pressure systems, a dry break connection may be substituted for an automatic shut-off nozzle, because the inlet valve controls the flow of fuel into the tank. The dry break connection shall not allow any fuel spillage upon connection to the receiver, during fueling, upon disconnection from the receiver, or during storage. A visual or audible indicator on the dry break may be used to indicate that fluid flow has stopped into the fuel tank and the inlet shut-off valve has closed.

5.6 Protection

The fuel receiver inlet valve, signal line, and vent shall be protected from external damage or debris build up. Any guards shall not prevent removal of the receiver, inlet valve, signal line, or vent for repair of these components. The guard must not prevent the vent from properly exhausting displaced air on fast filling operations. If a hose is attached to the vent to divert exhaust vapors away from hot surfaces or personnel, the outlet end of the hose shall be located away from any areas where debris can clog the end of the hose and thereby reduce the fast fill system's performance.

5.7 Structural Considerations

For pressurized systems, the fuel tank and all ports, inlet lines from receiver to tank, air crossover line for multiple tank systems, and fluid crossover lines for multiple tank systems shall be compatible with pressures a minimum of 1.5 times the emergency venting pressure of the automatic shut-off vent or the output pressure of the fast fill fluid pump, whichever is greater. All fluid lines and connections, from the fast fill fluid pump up to and including the nozzle, shall be compatible with pressures a minimum of 1.5 times the maximum output pressure of the fast fill fluid pump.