

How to Design a Generator DEF Urea System

Diesel Exhaust Fluid (DEF) is a critical component now of generator systems, because it is required to meet emissions regulations. DEF problems can require that generators shut-down rather than operate outside emissions limits.

DEF Systems have become common for Diesel Truck fuel facilities. But Generator Systems are much different primarily because of the volume of static inventory needed. So storage and temperature of storage is important

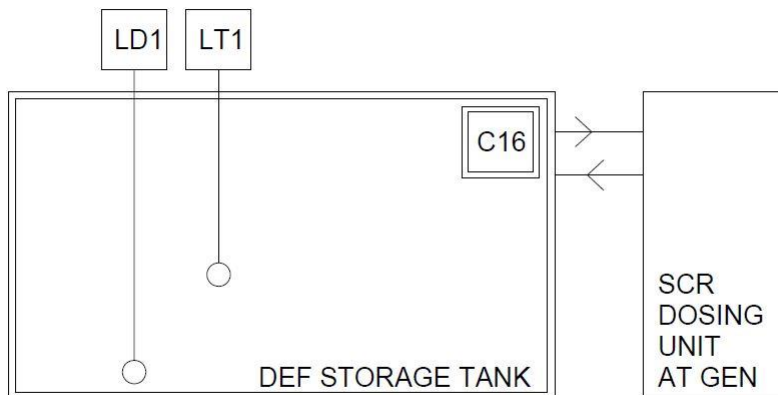
This guide starts with a simple storage system. Each subsequent step results in a functional system, so you can just stop after the step that fulfills your requirements.



Things to Know about DEF

1. **What is DEF.** Diesel Exhaust Fluid (DEF) is a mixture of Urea in De-ionized water in a 32.5 % concentration. It is used as a consumable fluid in diesel engine emissions control using Selective Catalytic Reduction (SCR).
2. **How Much DEF do I Need.** A good rule of thumb for generators is that DEF consumption will be about 10% of diesel consumption. Tanks can be sized at 10% of the fuel storage requirements. Pump and pipe systems for replenishment can be sized as well for about 10% of the diesel systems.
3. **DEF is Corrosive – Design with Stainless.** It's the de-ionized water that makes it corrosive. Pumps, valves, tanks, piping, and sensors should all be stainless steel construction. Plastics and fiberglass may be suitable for some applications as well.
4. **DEF Freezes at 12F (-11C) and De-Grades at 85F (30C).** DEF can be stored inside within heated space and cubic tanks can help you save space. Outside it should be in insulated tanks and piping with heaters. In warmer climates consider a DEF chiller system to assure quality and save money on replacement

1. The Basics

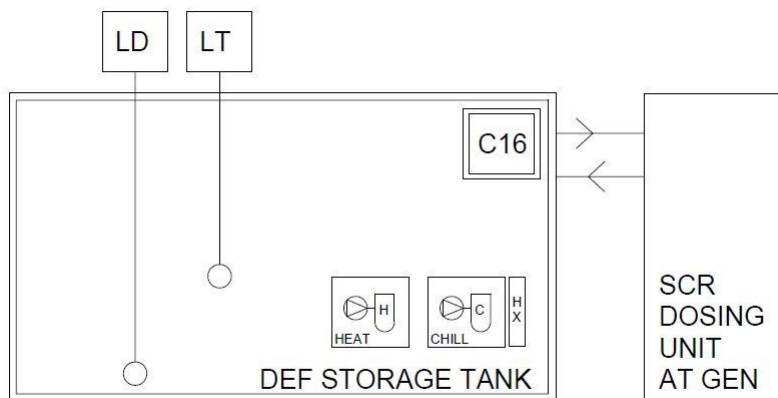


The basic system starts with a storage tank, typically 25 to 2500 GAL (100- 10000 L). Cubic stainless steel tanks are best, however HDPE cylindrical tanks are also used. A tank inside a building may be single wall and uninsulated. Secondary containment and insulation should be considered for outside storage or where temperature control inside is outside the recommended storage temperatures.

Simple monitoring is a tank low level sensor, tank level transmitter, and a leak sensor for double wall tanks.

The Generator SCR unit typically suctions DEF from the tank and recirculates the fluid through the unit returning to the storage tank. CAT Systems with a Buffer Tank require a low pressure DEF supply as described in Step 5 below.

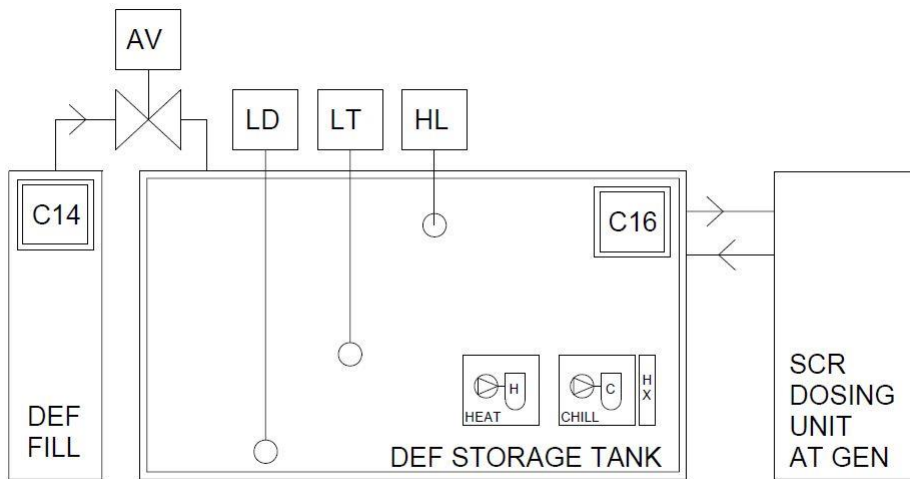
2. Add Temperature Control



DEF Stored outside or inside without full temperature control will need systems to maintain the fluid between 12 – 85 F (-11 to 30C). Plug heaters are a simple solution for heat systems only, and external pad heaters are used on plastic tanks. Consider circulation type heaters, with stainless for wetted components, where DEF is circulated through piping systems.

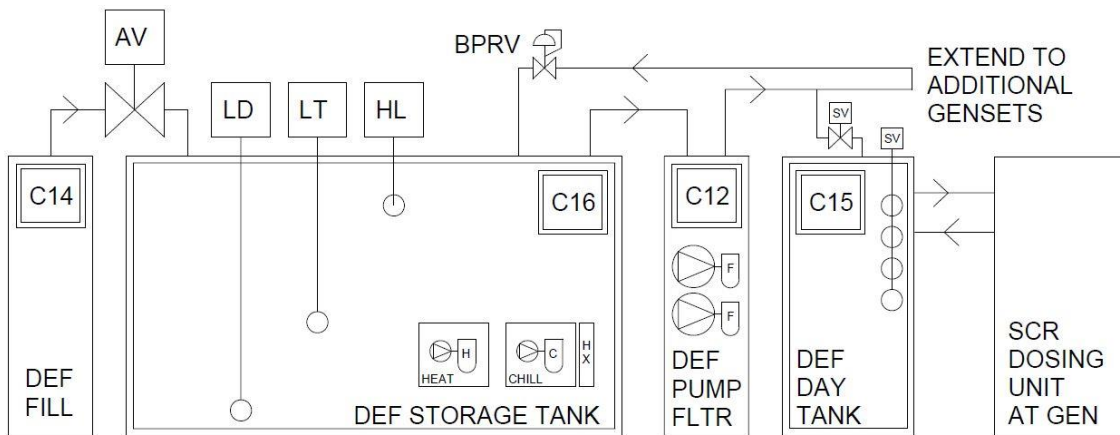
DEF recommended storage is 85F (30 C) on the high side to maintain a shelf life of 1 year. Degradation can accelerate above that point. Insulated tanks should be specified. A circulation type chilling system should also be considered for maintaining systems in spec.

3. Add a Remote Fill System



Remote fill systems are added to allow for DEF delivery from pump equipped trucks. Fill stations should be stainless steel construction with volume indication and audible / visual high alarms. An actuated ball valve can be used for additional overflow protection. Fill station components should be stainless steel construction. Typically pipe sizes are 1.5 to 2.0 IN (38 to 50).

4. Add a Duplex Pump and Day Tank

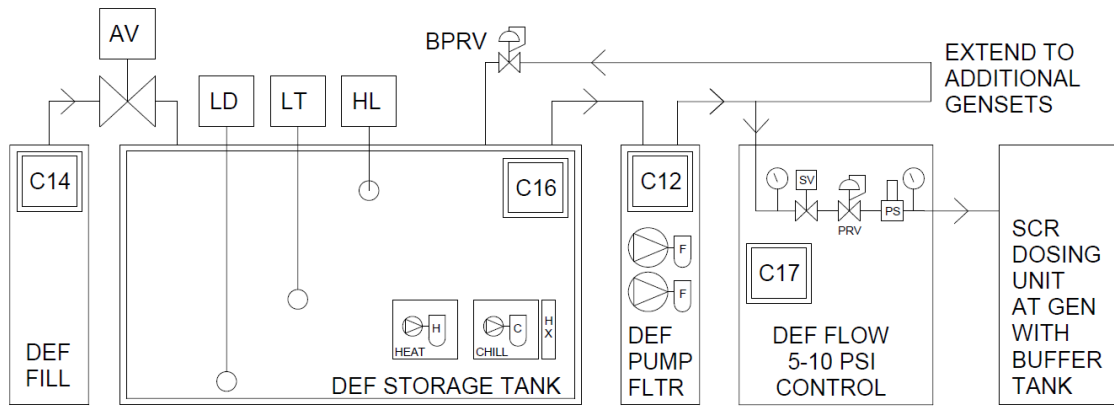


Add a day tank where multiple generators are supplied or are remote from the storage tank. A low flow, usually 5-15 GPM (20 to 60 LPM) stainless steel body pump is used. The pumps should operate as a duplex system with lead – lag operation.

The day tank will have an integral level switch, level control panel, and inlet solenoid valve for automatic refill. A low level signal should integrate to the generator controls.

The pumps may operate continuously and auto-switch every week. Or the pumps may operate continuously only when the generators are running. If intermittent use, the pumps should activate once per week to cycle DEF through the piping system. Some systems require DEF circulation through piping in low temperature conditions.

5. Create a Low Pressure Feed to Caterpillar SCR Buffer Tanks











Caterpillar SCR systems may have an integral buffer tank that requires a low pressure 5-10 PSI inlet feed. The low pressure can be achieved by a flow scheme shown above. The system is setup to circulate DEF continuously or at least whenever the generators are running. The circulation loop operates at a 10-25 PSI pressure range to assure adequate flow to the point of use.

The DEF Flow Control Unit is operated by sensing a pressure drop in the feed, meaning that the CAT buffer tank inlet valve is open and requesting refill. Then the Flow Control Solenoid Valve is energized to open and allows flow through the pressure reducing valve to the buffer tank inlet.

When the buffer tank is satisfied, the pressure rise will close the inlet solenoid valve, isolating the buffer tank inlet from the higher pressure of the circulation loop.

6. Reference Legend

 AV	ACTUATED VALVE
 O-I	OPERATOR INTERFACE
 HL	HIGH STOP SENSOR
 LD	LEAK SENSOR
 LT	LEVEL XMTR
 PC	PUMP CONTROLLER
 SV	SOLENOID VALVE
	DEF TRANSFER PUMP