

Generator Fuel System Installation Guide: Complete Diesel, Natural Gas, and Propane System Design and Installation Manual

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Introduction

The fuel system is the lifeblood of any generator installation. Without a properly designed, installed, and maintained fuel system, even the most expensive and well-engineered generator is nothing more than an elaborate paperweight. Fuel system design encompasses fuel storage, delivery, filtration, pressure regulation, leak detection, and emergency shutdown—all of which must comply with stringent codes and standards to prevent fires, explosions, and environmental contamination.

This comprehensive guide covers fuel system installation for all common generator fuels: diesel (ultra-low sulfur diesel, ULSD), natural gas, propane (liquefied petroleum gas, LPG), and bi-fuel (diesel + natural gas). We address aboveground and underground storage tanks, day tanks, fuel polishing systems, gas pressure regulation, and seismic restraints. Whether you are installing a 500-gallon day tank for a 100 kW standby generator or a 10,000-gallon underground storage tank for a 2000 kW mission-critical power plant, this guide provides the methodology and procedures you need.

Fuel system installation is not merely plumbing. It requires understanding of fluid mechanics (pressure drop, flow velocity), material compatibility (metals, elastomers), environmental regulations (spill prevention, leak detection), and fire safety (separation distances, fire-resistant piping). A fuel system failure can lead to generator failure during an outage (empty tank, contaminated fuel, gas leak), fire or explosion (fuel leak, ignition source), environmental damage (underground tank leak, spill), and regulatory violations (EPA, DOT, local fire marshal).

This guide is written for mechanical contractors, fuel system installers, facility managers, and engineers who need to design or oversee generator fuel system installations. We cover NFPA 30 (Flammable and Combustible Liquids Code), NFPA 37 (Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines), NFPA 54 (National Fuel Gas Code), NFPA 58 (Liquefied Petroleum Gas Code), and EPA regulations (40 CFR Part 112 - SPCC Rule).

Compatible Generator Brands and Fuel System Requirements

Brand	Fuel Type	Consumption Rate (gal/hr per kW)	Tank Size Recommendation	Fuel Filter Specification
Caterpillar (Diesel)	Diesel (ULSD)	0.06-0.08 gal/kW-hr	24-72 hours run time	10 micron (primary), 2 micron (secondary)
Cummins (Diesel/Natural Gas)	Diesel or Natural Gas	0.07 gal/kW-hr (diesel)	24-48 hours (diesel), gas line	10 micron (diesel), none (gas)
Kohler (Diesel/Gas/Propane)	All	0.06-0.09 gal/kW-hr (diesel)	24-72 hours	10 micron (diesel), 1/2" NPT (gas)
MTU (Diesel)	Diesel	0.05-0.07 gal/kW-hr	48-72 hours	2 micron (high-pressure common rail)
Generac (Natural Gas/Propane)	Gas or Propane	N/A (gas)	250-500 gallon (propane)	None (gas), 10 micron (propane vapor)
Perkins (Diesel)	Diesel	0.06-0.08 gal/kW-hr	24-48 hours	10 micron (standard), 2 micron (Tier 4)

Technical Specifications and Design Criteria

Design Parameter	Diesel System	Natural Gas System	Propane (LPG) System
Fuel Pressure at Generator	N/A (gravity or lift pump)	3.5-14 inches WC (residential), 5-10 inches WC (commercial)	10-14 inches WC (vapor), 100-200 PSI (liquid)
Pipe Material	Black iron, CSST, Copper (tube)	Black iron, CSST, PE (underground)	Black iron, CSST, Copper
Pipe Sizing Criteria	≤ 5 ft/sec (suction), ≤ 10 ft/sec (discharge)	≤ 20 ft/sec (low pressure), ≤ 40 ft/sec (high pressure)	≤ 10 ft/sec (vapor), ≤ 5 ft/sec (liquid)
Filtration	10 micron (primary), 2 micron (secondary)	None (may have strainer at regulator)	10 micron (vapor), none (liquid with valve)
Tank Material	Steel (UL-142), Fiberglass (UL-1768)	N/A (utility supplied)	Steel (ASME), Composite (DOT)
Tank Capacity (Minimum)	24 hours run time (NFPA 110 Level 1)	N/A (verify utility pressure)	250 gallons (whole house)
Leak Detection	Electronic (double-wall tank), Manual (monthly)	Gas detector (methane), Soap test (connections)	Gas detector (propane), Soap test
Seismic Restraints	Tank anchorage, Pipe bracing (ASCE 7)	Pipe bracing (ASCE 7)	Tank anchorage, Pipe bracing
Venting	Tank vent (conservation vent), Fill vent	N/A	Tank vent (vapor), Relief valve (100% capacity)
Codes and Standards	NFPA 30, NFPA 110, UL-142	NFPA 54, NFPA 37	NFPA 58, NFPA 30, DOT

Step-by-Step Fuel System Installation

Phase 1: Diesel Fuel System Design and Installation

Step 1: Diesel Storage Tank Sizing and Selection

Diesel storage tank capacity is typically sized for 24-72 hours of continuous operation at full load.

1. Tank Sizing Calculation:

- Fuel consumption = Generator kW × Hours run × Consumption rate (gal/kW-hr)
- Example: 500 kW generator, 48 hours run, 0.07 gal/kW-hr:
- Tank capacity = 500 × 48 × 0.07 = 1,680 gallons
- Select standard tank size: 2,000 gallons (allows for 20% spare, compensates for unusable fuel)

2. Tank Type Selection:

- Aboveground Storage Tank (AST): Easier to install, inspect, and maintain. Required for capacities < 1,000 gallons in most jurisdictions. Must comply with NFPA 30 and UL-142.
- Underground Storage Tank (UST): Required for large capacities (> 1,000 gallons) or where space is limited. Must comply with EPA 40 CFR Part 280, UL-58 (steel) or UL-1768 (fiberglass).

- Day Tank: Small tank (50-500 gallons) located near generator, fed by main storage tank. Provides stable fuel pressure, allows fuel polishing. Required for generators > 500 kW or long piping runs.

3. Tank Configuration:

- Single-wall: Less expensive, but requires secondary containment (concrete berm, double-wall piping)
- Double-wall: More expensive, but provides built-in secondary containment (leak detection between walls)
- Rectangular vs. Cylindrical: Rectangular (AST) easier to install in tight spaces, cylindrical (UST) better for burial (uniform stress distribution)

Step 2: Diesel Tank Installation

1. Aboveground Tank Installation:

- Install on concrete pad (4-6 inches thick, 110% containment capacity)
- Anchor tank (per ASCE 7 seismic requirements, if applicable)
- Install spill containment (concrete berm or steel dike) around tank
- Provide adequate separation from buildings (NFPA 30 Table 22.4.1.2):
 - ≤ 1,000 gallons: 5 feet from property line, 10 feet from building
 - > 1,000 gallons: 10 feet from property line, 25 feet from building
- Install tank vent (conservation vent, 2" NPT minimum)
- Install fill connection (with dry break coupler, anti-siphon valve)
- Install suction connection (with shutoff valve, flexible connector)
- Install level gauge (dial or electronic, with high/low alarms)
- Paint tank (if outdoors, use UV-resistant paint)

2. Underground Tank Installation:

- Excavate to depth per manufacturer (allow 12-18 inches for sand bedding)
- Place 6 inches of sand bedding (protect tank bottom)
- Lower tank into excavation (use proper rigging, slings)
- Backfill with sand (6 inches over tank, then native soil)
- Install cathodic protection (for steel tanks, prevent corrosion)
- Install tank vent pipe (extend to grade, terminate with rain cap)
- Install fill and suction pipes (with double-wall piping or jacketed pipe)
- Perform vacuum test on double-wall (verify integrity before backfilling)
- Install leak detection system (electronic monitoring, monthly manual test)

Step 3: Diesel Fuel Line Installation

Fuel lines must deliver clean, air-free fuel to the generator at adequate pressure.

1. Suction Line (Tank to Generator):

- Use black iron pipe or seamless copper tube (Type L or K)
- Size for velocity ≤ 5 ft/sec (prevent cavitation at lift pump)
- Install with constant slope toward tank (no low spots, prevent air accumulation)
- Install flexible connector at tank and generator (allow for settlement, vibration)

- Install shutoff valve at tank (accessible, labeled, lockable)
- Install strainer (100 mesh) at tank connection (prevent debris entry)
- Install vacuum gauge at generator (monitor filter condition, suction lift)

2. Discharge Line (Generator to Tank Return):

- Size for velocity ≤ 10 ft/sec
- Route with slight slope toward tank (drain back to tank when generator off)
- Install check valve at generator (prevent siphoning)
- Install needle valve (adjust return flow, maintain fuel pressure at injector pump)

3. Day Tank Piping (if applicable):

- Feed line from main tank to day tank (with transfer pump, float switch)
- Fill line (with overflow prevention, high level alarm)
- Suction line from day tank to generator (short run, ≤ 10 feet)
- Return line from generator to day tank (with temperature control, if day tank heated)

4. Pipe Pressure Testing:

- Pressure test suction and discharge lines to 10 PSI (hold for 30 minutes, no drop)
- Use air pressure (not hydraulic, easier to detect leaks)
- Soap test all connections (look for bubbles)

Step 4: Diesel Fuel Filtration and Polishing

Diesel fuel degrades over time (algae growth, water contamination, oxidation). Filtration and polishing maintain fuel quality.

1. Primary Filtration (Tank to Generator):

- Install 10 micron filter (spin-on or pleated) in suction line
- Locate filter close to generator (accessible for service)
- Provide bypass valve (allow fuel flow if filter clogs)
- Provide water separator (coalescing filter, removes free water)

2. Secondary Filtration (Generator Mounted):

- Most generators have secondary filter (2-5 micron) on engine
- Follow manufacturer recommendation (some Tier 4 engines require 2 micron absolute)

3. Fuel Polishing System (Optional, for Critical Installations):

- Continuous or periodic fuel circulation through polishing cart (filter, water separator, pump)
- Polishing rate: 10-20% of tank volume per day
- Install in bypass loop (does not interrupt generator fuel supply)
- Test fuel quality quarterly (ASTM D975, check for water, sediment, microbes)

Phase 2: Natural Gas System Design and Installation

Step 5: Natural Gas Pressure and Capacity Verification

Natural gas generators require adequate gas pressure and volume from the utility.

1. Gas Pressure Requirements:

- Residential generators (7-24 kW): 3.5-7 inches WC (water column)
- Commercial generators (25-500 kW): 5-10 inches WC
- Industrial generators (500+ kW): 10-14 inches WC
- Verify available pressure from utility (call before designing system)

2. Gas Volume Requirements:

- Gas consumption = Generator kW × Heat rate (BTU/kW-hr) ÷ Gas heating value (BTU/ft³)
- Example: 500 kW generator, heat rate 7,500 BTU/kW-hr, gas heating value 1,000 BTU/ft³:
- Gas volume = 500 × 7,500 ÷ 1,000 = 3,750 ft³/hr = 62.5 CFM
- Verify utility can supply this volume at design pressure (may require larger service line)

3. Pressure Regulator Sizing:

- If line pressure exceeds generator requirement, install pressure regulator
- Regulator capacity = 2× generator gas consumption (allow for surge, future expansion)
- Regulator type:
 - Single-stage: Line pressure ≤ 2 PSI, reduce to inches WC
 - Two-stage: Line pressure > 2 PSI, first stage reduces to 10-15 PSI, second stage reduces to inches WC

Step 6: Natural Gas Piping Installation

1. Pipe Material Selection:

- Aboveground: Black iron pipe (threaded or welded), CSST (corrugated stainless steel tubing)
- Underground: Polyethylene (PE) pipe (ASTM D2513), with steel risers at ends
- Transition: Dielectric union (prevent galvanic corrosion between dissimilar metals)

2. Pipe Sizing:

- Use NFPA 54 (National Fuel Gas Code) pipe sizing tables
- Size for pressure drop ≤ 0.5 inch WC (typical design criteria)
- Gas velocity ≤ 20 ft/sec (low pressure), ≤ 40 ft/sec (high pressure)
- Example: 100 feet run, 3,750 ft³/hr gas, 7 inches WC pressure, 0.5 inch WC drop:
- Required pipe size = 1.5" black iron (per NFPA 54 Table A.3.4.2)

3. Pipe Installation:

- Install with minimum 1:50 slope toward drip leg (condensate drainage)
- Install drip leg (sediment trap) at generator inlet (18" minimum vertical drop)
- Install manual shutoff valve (accessible, labeled, lockable)
- Install flexible connector (stainless steel, 3× diameter length) at generator
- Support pipe every 10 feet (hangers, not strap)
- Bond and ground metal piping (prevent static electricity ignition)

4. Pressure Testing:

- Low pressure systems (< 14 inches WC): Test to 20 inches WC (hold for 60 minutes, no drop)
- High pressure systems (> 14 inches WC): Test to 1.5× operating pressure (hold for 60 minutes, no drop)

- Use manometer or pressure gauge (calibrated, appropriate range)
- Soap test all connections (look for bubbles)

Phase 3: Propane (LPG) System Design and Installation

Step 7: Propane Tank Sizing and Installation

Propane is stored as a liquid under pressure (100-200 PSI) and vaporizes to gas when released to atmospheric pressure.

1. Tank Sizing:

- Propane consumption = Generator kW × Hours run × Consumption rate (gal/hr)
- Consumption rate: 0.5-1.0 gallons/hr per 10 kW (depends on load factor)
- Example: 50 kW generator, 48 hours run, 0.75 gal/hr per 10 kW:
- Tank capacity = $50 \div 10 \times 0.75 \times 48 = 180$ gallons
- Select standard tank size: 250 gallons (allows for 20% spare, 80% fill limit)

2. Tank Type:

- Aboveground: ASME steel tank (vertical or horizontal), required for residential
- Underground: ASME steel tank (with cathodic protection), allowed for commercial/industrial

3. Tank Installation:

- Install on concrete pad (4-6 inches thick, anchored)
- Provide separation from buildings (NFPA 58 Table 6.3.1):
- ≤ 500 gallons: 10 feet from building, 10 feet from ignition source
- > 500 gallons: 25 feet from building, 25 feet from ignition source
- Install tank vent (vapor return, relief valve)
- Install liquid withdrawal valve (for vapor withdrawal systems, most common)
- Install service valve (with excess flow valve, thermal relief valve)
- Paint tank (white or reflective color, reduce heat absorption)
- Install fence around tank (prevent vehicle impact, unauthorized access)

Step 8: Propane Piping and Regulator Installation

Propane systems require two-stage pressure regulation (tank pressure to generator pressure).

1. First Stage Regulator (Tank to 10 PSI):

- Installed at tank (or within 10 feet of tank)
- Reduces tank pressure (100-200 PSI) to 10 PSI (intermediate pressure)
- Capacity = $2 \times$ generator propane consumption

2. Second Stage Regulator (10 PSI to Inches WC):

- Installed within 10 feet of generator
- Reduces 10 PSI to generator requirement (typically 11 inches WC for vapor withdrawal)
- Capacity = generator propane consumption

3. Piping Installation:

- Use black iron pipe or CSST (propane is heavier than air, use threaded joints, dope with pipe dope + Teflon tape)
- Install with minimum 1:50 slope toward tank (drain liquid propane if condensed)
- Install sediment trap at generator inlet
- Install manual shutoff valve (accessible, labeled)
- Install flexible connector (stainless steel) at generator
- Support pipe every 10 feet

4. Pressure Testing:

- Test to 20 PSI (hold for 60 minutes, no drop)
- Use propane gas detector (sniffer) to check for leaks (more sensitive than soap test)
- Verify regulator lockup pressure (should be $\leq 2\times$ generator requirement, prevent overpressure)

Phase 4: Fuel System Controls and Safety Devices

Step 9: Fuel System Instrumentation and Controls

1. Tank Level Monitoring:

- Dial gauge: Mechanical float, readable at tank (inexpensive, requires manual check)
- Electronic sensor: Ultrasonic or capacitive, transmits to generator control panel (allows remote monitoring, low fuel alarm)
- Alarm setpoints: Low level (25% remaining, alert for refuel), Critical low (10% remaining, automatic shutdown if not overridden)

2. Fuel Temperature Monitoring (Diesel):

- Install temperature sensor in day tank or main tank
- Setpoint: Maintain 40-70°F (prevent gelling in cold weather, prevent bacterial growth in warm weather)
- Control: Tank heater (immersion or jacket), with thermostat

3. Leak Detection:

- Double-wall tank: Monitor interstice (between walls) for fuel (electronic sensor, alarms if fuel present)
- Piping: Double-wall piping with leak detection (similar to tank)
- Single-wall tank/piping: Periodic manual inspection (look for stains, odors), install fuel vapor detector in generator room

Step 10: Emergency Shutdown and Safety Devices

1. Automatic Shutdown on Fuel Leak:

- Fuel leak detected (vapor detector alarm) → Close fuel shutoff valve, shutdown generator
- Wiring: Normally closed contacts (valve closes on power loss, fail-safe)

2. Overspeed/Overcrank Protection:

- If generator overspeeds or fails to start (overcrank), shutdown and lockout fuel supply

3. Fire Shutdown:

- Fire alarm activates → Close fuel shutoff valve, shutdown generator

4. Seismic Shutdown (if in seismic zone):

- Earthquake sensed (seismic switch) → Close fuel shutoff valve, shutdown generator

Phase 5: Commissioning and Testing

Step 11: Fuel System Pre-Start Checks

1. Diesel System:

- Verify tank level ($\geq 50\%$ for commissioning)
- Verify fuel quality (clear, no water, no sediment)
- Verify all valves open (except emergency shutdown valve, which should be closed until ready to start)
- Purge air from fuel lines (use lift pump or primer pump)
- Verify no leaks (visual inspection, pressure test)

2. Natural Gas System:

- Verify gas pressure at generator (within specification)
- Verify no gas leaks (soap test, gas detector)
- Verify regulator operation (inlet and outlet pressure)
- Verify shutoff valve operational

3. Propane System:

- Verify tank level ($\geq 50\%$)
- Verify no propane leaks (propane detector, soap test)
- Verify regulator operation (first and second stage)
- Verify vapor withdrawal (not liquid, unless designed for liquid withdrawal)

Step 12: Fuel System Functional Testing

1. Diesel System:

- Start generator, verify oil pressure builds
- Verify fuel supply pressure (at injector pump, per manufacturer)
- Verify return fuel flow (warm to touch, indicates flow)
- Run at various loads (25%, 50%, 75%, 100%), verify stable operation
- Check for fuel leaks (generator running, high fuel pressure)

2. Natural Gas System:

- Start generator, verify gas pressure at inlet (should be steady, no drop > 0.5 inch WC)
- Verify gas consumption (check utility meter, compare to calculated)
- Run at various loads, verify stable operation (no surge, no misfire)

3. Propane System:

- Start generator, verify regulator lockup (should maintain pressure with generator off, then drop slightly when running)
- Verify vaporization rate (if tank is cold, vaporization may be inadequate, causing pressure drop)
- Run at various loads, verify stable operation

Step 13: Fuel System Documentation and Training

1. As-Built Drawings:

- Update drawings to reflect field changes (pipe routing, valve locations)
- Provide isometric drawing of fuel system (all components, elevations)
- Provide tank data plate information (capacity, manufacturer, serial number)

2. Operation and Maintenance Manual:

- Provide fuel system O&M; manual (tank, pumps, filters, regulators)
- Provide maintenance schedule:
 - Weekly: Check tank level, inspect for leaks
 - Monthly: Check fuel quality (water, sediment), test leak detection system
 - Quarterly: Change fuel filters, test fuel polish system
 - Annually: Tank inspection (internal, if required by code), hydrostatic test of piping

3. Training:

- Train facility staff on:
 - Fuel system operation (normal, emergency shutdown)
 - Leak detection and response (what to do if smell gas/fuel)
 - Refueling procedure (who to call, how to verify delivery)
 - Emergency contacts (fuel supplier, fire department, service provider)

Download PDF Section

The complete Generator Fuel System Installation Guide PDF is available for free download. This comprehensive manual includes all fuel system design calculations, tank sizing spreadsheets, piping diagrams, and commissioning checklists.

File Details:

- Format: PDF (Portable Document Format)
- Size: 22.3 MB
- Pages: 156 pages
- Language: English
- Compatibility: Windows, macOS, Linux, iOS, Android

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What's Included in the PDF:

1. Fuel system design flowchart
2. Diesel tank sizing spreadsheet (Excel)
3. Natural gas pipe sizing calculator (NFPA 54)
4. Propane regulator sizing guide
5. Fuel filtration selection chart

6. Fuel system commissioning checklist
7. Leak detection system design guide
8. Seismic restraint design examples (ASCE 7)
9. Fuel system maintenance log templates
10. Emergency shutdown system wiring diagrams

Frequently Asked Questions (FAQs)

1. How much diesel fuel storage do I need for my generator?

NFPA 110 (Emergency and Standby Power Systems) requires fuel storage for:

- Level 1 (Critical): 72 hours minimum (hospitals, fire pumps, emergency lighting)
- Level 2 (Legally Required): 24 hours minimum (elevators, HVAC for occupied buildings)
- Optional (Standby): As determined by owner (typically 24-48 hours)

Calculate tank size: Generator kW × Hours run × Consumption rate (0.06-0.09 gal/kW-hr for diesel). Add 20% margin (allow for unusable fuel, spare capacity). Select standard tank size (nearest larger to calculated capacity).

2. Can I use flexible propane hose to connect the generator?

Yes, but only if:

1. Hose is listed for propane service (UL 569, CSA 6.27)
2. Hose is installed with excess length (not stretched tight)
3. Hose is protected from physical damage (not routed through walls, not subject to traffic)
4. Hose length is ≤ 6 feet (typical, check local code)
5. Hose is accessible for inspection (not buried, not concealed)

For permanent installations, black iron pipe or CSST is preferred (more durable, less prone to leak).

3. What is the difference between vapor withdrawal and liquid withdrawal for propane?

Vapor withdrawal: Propane vapor (gas) is drawn from the top of the tank (where propane vapor accumulates). This is the most common method for generators ≤ 500 kW. Advantage: No liquid propane entering regulator (which can cause freeze-up). Disadvantage: Vaporization rate limited by tank surface area and ambient temperature (in cold weather, vaporization may be inadequate for large generators).

Liquid withdrawal: Liquid propane is drawn from the bottom of the tank, then vaporized in an external vaporizer (electric or gas-fired). This is used for large generators (> 500 kW) or in cold climates where vaporization rate is inadequate. Advantage: Unlimited vaporization rate (vaporizer capacity, not tank surface area, limits flow). Disadvantage: More expensive (vaporizer required), more complex (additional equipment to maintain).

4. How often should I polish (clean) diesel fuel?

Fuel polishing frequency depends on fuel quality, tank conditions, and generator usage:

- Quarterly: If fuel is used frequently (generator runs > 500 hours/year), or if tank is old (condensation, rust)
- Annually: If fuel is stored long-term (generator is standby, runs < 100 hours/year)
- Immediately: If fuel test shows water > 200 ppm, sediment > 0.05% volume, or microbial growth (dark color, foul odor)

Fuel polishing involves circulating fuel through a filtration cart (water separator, particulate filter) and can be done without interrupting generator service (install in bypass loop).

5. What causes diesel fuel to gel in cold weather?

Diesel fuel contains paraffin wax, which crystallizes (gels) at low temperatures (cloud point: 15-40°F, depending on fuel blend). Gelled fuel clogs filters, prevents engine starting.

Prevention:

1. Use winter blend diesel (cloud point \leq -20°F, available in cold climates)
2. Add anti-gel additive (lowers cloud point by 10-20°F)
3. Install tank heater (immersion or jacket, maintains fuel temperature > 40°F)
4. Install fuel line heater (heat fuel before filter, prevent filter clogging)
5. Store generator in heated space (if possible)

6. Can I install a diesel tank in a basement?

In most jurisdictions, no. NFPA 30 and International Fire Code (IFC) prohibit diesel tanks > 60 gallons in basements of occupied buildings. Small day tanks (\leq 60 gallons) may be allowed if:

1. Tank is double-wall
2. Tank is in a dedicated fuel room (2-hour fire-rated walls, self-closing fire door)
3. Tank has spill containment (110% capacity)
4. Tank is automatically shut off on fuel leak or fire alarm

For basement installations, use aboveground tank outdoors, with fuel piped to generator (day tank in basement fed by outdoor tank).

7. How do I detect a diesel fuel leak in an underground tank?

Underground storage tank (UST) leaks are detected by:

1. Electronic monitoring: Sensors in interstice (between double walls) detect fuel (alarm if fuel present)
2. Manual tank gauging: Measure tank level at beginning and end of week (if level drops > 0.5% of tank capacity, suspect leak)
3. Statistical inventory reconciliation (SIR): Compare fuel deliveries, dispensing, and tank levels (computer algorithm detects discrepancies indicative of leak)
4. Groundwater monitoring: Monitor groundwater monitoring wells around tank (if hydrocarbons present, tank is leaking)

EPA requires USTs to have leak detection system (40 CFR Part 280).

8. What is a day tank, and do I need one?

A day tank is a small fuel tank (50-500 gallons) located near the generator, fed by the main storage tank. Benefits:

1. Stable fuel pressure: Day tank is elevated (gravity feed) or has dedicated supply pump (consistent pressure, not affected by main tank fuel level or long piping runs)
2. Fuel polishing: Day tank can be equipped with recirculation loop (fuel polished while generator is off)
3. Fuel temperature control: Day tank can be heated (cold climates) or cooled (hot climates)
4. Reduced suction lift: Day tank close to generator (minimize suction lift, prevent cavitation)

Day tanks are recommended for generators > 500 kW, long piping runs (> 50 feet), or critical installations (hospitals, data centers). For small generators (< 100 kW) with short piping runs, a day tank is not necessary.

9. How do I size a natural gas regulator for a generator?

Regulator sizing steps:

1. Calculate gas consumption (CFM) = Generator kW × Heat rate (BTU/kW-hr) ÷ Gas heating value (BTU/ft³)
2. Determine inlet pressure (from utility) and outlet pressure (generator requirement)
3. Select regulator with capacity ≥ 2× calculated gas consumption (allow for surge, future expansion)
4. Verify regulator capacity at actual pressure drop (check manufacturer's capacity curve)
5. Select regulator type:
 - Single-stage: If inlet pressure ≤ 2 PSI, use single-stage regulator (reduces to inches WC)
 - Two-stage: If inlet pressure > 2 PSI, use two-stage regulation (first stage to 10 PSI, second stage to inches WC)

Example: 500 kW generator, gas consumption 62.5 CFM, inlet pressure 5 PSI, outlet pressure 7 inches WC. Select two-stage regulator, first stage capacity 125 CFM (2× 62.5), second stage capacity 125 CFM.

10. What is the purpose of a sediment trap (drip leg) on gas piping?

A sediment trap (drip leg) is a vertical pipe section (18" minimum) installed at the generator inlet (and at changes in direction, if horizontal run > 20 feet). Purpose:

1. Collect debris: Pipe scale, rust, threads, Teflon tape (prevent from entering generator gas valve, causing malfunction)
2. Collect condensate: Moisture in gas condenses in pipe (especially in underground runs), collects in drip leg (prevent from entering generator, causing freeze-up or corrosion)

Maintain drip leg: Shut off gas, remove cap, blow out debris/condensate, reinstall cap, leak test.

11. Can I use the same propane tank for generator and domestic heating?

Yes, but:

1. Tank must be sized for combined load (generator + heating)
2. Install separate regulators for generator and heating (different pressure requirements)
3. Install check valves (prevent backflow between systems)
4. Install separate shutoff valves (able to isolate generator without affecting heating)

5. Verify propane supplier can deliver adequate volume (large generators + heating peak demand may exceed tank vaporization rate)

For large generators (> 100 kW), separate propane tank is recommended (dedicated fuel supply, not affected by domestic demand).

12. What causes a propane regulator to freeze?

Propane regulator freeze-up occurs when liquid propane enters the regulator (instead of vapor). Liquid propane expands to vapor in the regulator, which absorbs heat (adiabatic expansion), causing the regulator to freeze (ice on regulator body, propane flow stops).

Causes:

1. Liquid withdrawal: Tank piped for liquid withdrawal (instead of vapor), or tank tilted (liquid drawn into vapor withdrawal pipe)
2. Overfilled tank: Tank filled > 80% (liquid propane expands to fill vapor space, especially in hot weather)
3. Cold weather: Tank surface area inadequate for vaporization (large draw from small tank in cold weather)

Prevention: Use vapor withdrawal (not liquid), do not overfill tank (> 80%), install regulator heater (electric or heat tape) in cold climates.

13. How do I bond and ground a diesel fuel system?

Bonding and grounding prevents static electricity ignition (spark from static discharge). Requirements:

1. Bond all metal components: Tank, pipes, generator frame, building ground (connect with 6 AWG copper wire, or equivalent)
2. Ground the tank: Connect tank to building ground electrode (ground rod, ufer ground) with 6 AWG copper wire
3. Use dielectric unions: If connecting dissimilar metals (steel pipe to copper pipe), use dielectric union (prevent galvanic corrosion)
4. Verify continuity: Test resistance between tank and building ground (< 1 ohm, per NFPA 78)

Note: Diesel fuel is not flammable (flash point > 100°F),

14. What is an SPCC plan, and do I need one?

SPCC (Spill Prevention, Control, and Countermeasure) plan is required by EPA (40 CFR Part 112) for facilities that store > 1,320 gallons of aggregate aboveground oil (diesel fuel) capacity, or > 42,000 gallons underground.

SPCC plan must include:

1. Facility diagram (show tank locations, drainage paths)
2. Spill prevention measures (secondary containment, overflow prevention)
3. Spill response procedures (who to call, what to do)
4. Employee training (annual spill response training)
5. Plan certification (by Professional Engineer, if > 10,000 gallons aggregate capacity)

File SPCC plan with EPA (if required), and provide to local fire department.

15. How do I dispose of old diesel fuel?

Old diesel fuel (stale, contaminated with water/sediment) must be disposed of as hazardous waste (EPA 40 CFR Part 262). Do NOT pour down drain, on ground, or in trash.

Disposal options:

1. Fuel polishing: If fuel is mildly contaminated (water < 500 ppm, sediment < 0.1%), polish and reuse
2. Recycle: Send to fuel recycler (filters, restores fuel quality)
3. Hazardous waste disposal: If fuel is severely contaminated (water > 1000 ppm, microbial growth), dispose as hazardous waste (call licensed hazardous waste disposal contractor)

Document disposal (manifest, receipt) for environmental compliance.

Related Downloads

Ensure complete fuel system integration with these additional resources:

1. [\[Generator Installation Guide PDF\]\(\)](#) - Comprehensive installation manual covering all aspects of generator setup, including fuel system integration.
2. [\[Generator Foundation Design Guide PDF\]\(\)](#) - Foundation design manual, including tank foundation requirements and seismic restraints for fuel tanks.
3. [\[Generator Room Ventilation Design PDF\]\(\)](#) - Ventilation design guide, including ventilation requirements for fuel vapor (diesel, propane) and gas leak detection.
4. [\[Generator Electrical Installation Guide PDF\]\(\)](#) - Electrical integration guide, including wiring for fuel system controls, alarms, and automatic shutdown.
5. [\[Generator Exhaust System Installation PDF\]\(\)](#) - Exhaust system design, including separation distance from fuel tank (prevent radiant heat ignition).
6. [\[Generator Cooling System Installation PDF\]\(\)](#) - Cooling system design, including fuel cooler (if generator has fuel cooler for hot climates).
7. [\[ATS Installation Guide PDF\]\(\)](#) - Automatic transfer switch installation, including fuel system interlocks (ATS transfer signal can trigger fuel system startup).
8. [\[Containerized Generator Installation PDF\]\(\)](#) - Containerized generator installation, including integrated fuel tank installation (day tank in container).
9. [\[Soundproof Enclosure Installation Guide PDF\]\(\)](#) - Acoustic enclosure installation, including fuel line penetrations (maintain sound rating, fire rating).
10. [\[Generator Commissioning Checklist PDF\]\(\)](#) - Commissioning checklist that includes fuel system functional testing and leak detection verification.
11. [\[NFPA 30 Compliance Checklist PDF\]\(\)](#) - Checklist for verifying diesel fuel system compliance with NFPA 30 (Flammable and Combustible Liquids Code).

12. [NFPA 54 Gas Pipe Sizing Spreadsheet]() - Excel spreadsheet for sizing natural gas pipes per NFPA 54, including pressure drop calculations.
13. [Propane Regulator Sizing Guide PDF]() - Guide to selecting appropriate propane regulators for generator applications, including capacity curves.
14. [Fuel Polishing System Design Guide PDF]() - Design guide for fuel polishing systems, including pump sizing, filter selection, and integration with day tank.
15. [SPCC Plan Template (Word)]() - Template for developing an SPCC (Spill Prevention, Control, and Countermeasure) plan for facilities with diesel storage tanks.

Conclusion

Generator fuel system installation is a complex, highly regulated discipline that directly impacts generator reliability, safety, and environmental compliance. A properly designed and installed fuel system provides clean, adequate fuel to the generator under all operating conditions, while preventing leaks, fires, and environmental contamination. This guide has provided you with the methodology, procedures, and practical examples needed to install fuel systems for diesel, natural gas, and propane generators of all sizes.

Remember that fuel system installation is not a DIY project. It requires knowledge of codes and standards (NFPA 30, 37, 54, 58), fluid mechanics, material compatibility, and safety practices. Always engage qualified fuel system installers (licensed plumbers, pipefitters) and have the installation permitted and inspected by the local Authority Having Jurisdiction (AHJ). The cost of professional installation is insignificant compared to the risks of improper installation: fire, explosion, environmental damage, regulatory fines, and generator failure during an outage.

Key takeaways from this guide:

1. Size fuel storage adequately. NFPA 110 requires 24-72 hours run time for emergency systems. Calculate based on actual consumption, not rules of thumb.
2. Prevent leaks. Use double-wall tanks, properly installed piping, leak detection systems. Test all connections (pressure test, soap test).
3. Provide adequate filtration. Diesel fuel degrades over time. Install primary and secondary filters, and consider a fuel polishing system.
4. Verify gas pressure and volume. For natural gas and propane, verify utility can supply adequate pressure and volume before purchasing generator.
5. Install safety devices. Emergency shutdown, seismic shutdown, fire shutdown, leak detection. Fuel systems are hazardous; design for fail-safe operation.
6. Maintain the system. Regular maintenance (tank level checks, fuel quality tests, filter changes, leak inspections) is essential for reliable operation.

By following the procedures outlined in this guide and adhering to applicable codes and standards, you can install a generator fuel system that provides decades of safe, reliable service. Invest the time and effort in proper design and installation—your generator will reward you with uninterrupted power when you need it most.

Document Information:

- Title: Generator Fuel System Installation Guide
- Version: 2.0

- Last Updated: June 2026
- Total Word Count: 3,945 words
- Category: Installation Guides
- Skill Level: Intermediate to Advanced (Mechanical, Plumbing, Gas Fitting)
- Estimated Reading Time: 28 minutes
- Next Review Date: December 2026

Disclaimer: This guide is for informational purposes only. Generator fuel system installation must be performed by licensed professionals and permitted through the local Authority Having Jurisdiction. Always consult applicable codes and standards, manufacturer instructions, and qualified engineers before proceeding with fuel system installation. The authors assume no liability for damages resulting from the use of this information.

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