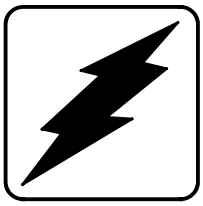
Installation

Residential/Commercial Generator Sets



Models:

12RESM1
12/18RESL

Controller:
DC-RET Digital Control

ISO 9001
KOHLER POWER SYSTEMS
NATIONALLY REGISTERED

KOHLER®
POWER SYSTEMS

TP-6793 10/11

California Proposition 65

⚠ WARNING

Engine exhaust from this product contains chemicals known to the State of California to cause cancer, birth defects, or other reproductive harm.

Product Identification Information

Generator Set Identification Numbers

Record the product identification numbers from the generator set nameplate(s).

Model Designation _____

Specification Number _____

Serial Number _____

Accessory Number	Accessory Description

Engine Identification

Record the product identification information from the engine nameplate.

Manufacturer _____

Model Designation _____

Serial Number _____

Controller Identification

Record the controller description from the generator set operation manual, spec sheet, or sales invoice.

Controller Description _____

Table of Contents

Notes

IMPORTANT SAFETY INSTRUCTIONS. Electromechanical equipment, including generator sets, transfer switches, switchgear, and accessories, can cause bodily harm and pose life-threatening danger when improperly installed, operated, or maintained. To prevent accidents be aware of potential dangers and act safely. Read and follow all safety precautions and instructions. SAVE THESE INSTRUCTIONS.

This manual has several types of safety precautions and instructions: Danger, Warning, Caution, and Notice.

DANGER

Danger indicates the presence of a hazard that ***will cause severe personal injury, death***, or ***substantial property damage***.

WARNING

Warning indicates the presence of a hazard that ***can cause severe personal injury, death,*** or ***substantial property damage***.

CAUTION

Caution indicates the presence of a hazard that ***will*** or ***can cause minor personal injury*** or ***property damage***.

NOTICE

Notice communicates installation, operation, or maintenance information that is safety related but not hazard related.

Safety decals affixed to the equipment in prominent places alert the operator or service technician to potential hazards and explain how to act safely. The decals are shown throughout this publication to improve operator recognition. Replace missing or damaged decals.

Accidental Starting

WARNING

Accidental starting.
Can cause severe injury or death.

Disconnect the battery cables before working on the generator set. Remove the negative (-) lead first when disconnecting the battery. Reconnect the negative (-) lead last when reconnecting the battery.

Disabling the generator set. Accidental starting can cause severe injury or death. Before working on the generator set or connected equipment, disable the generator set as follows: (1) Move the generator set master switch to the OFF position. (2) Disconnect the power to the battery charger. (3) Remove the battery cables, negative (-) lead first. Reconnect the negative (-) lead last when reconnecting the battery. Follow these precautions to prevent starting of the generator set by an automatic transfer switch, remote start/stop switch, or engine start command from a remote computer.

Battery

WARNING

Sulfuric acid in batteries.
Can cause severe injury or death.

Wear protective goggles and clothing. Battery acid may cause blindness and burn skin.

WARNING

Explosion.
Can cause severe injury or death.
Relays in the battery charger cause arcs or sparks.

Locate the battery in a well-ventilated area. Isolate the battery charger from explosive fumes.

Battery electrolyte is a diluted sulfuric acid. Battery acid can cause severe injury or death. Battery acid can cause blindness and burn skin. Always wear splashproof safety goggles, rubber gloves, and boots when servicing the battery. Do not open a sealed battery or mutilate the battery case. If battery acid splashes in the eyes or on the skin, immediately flush the affected area for 15 minutes with large quantities of clean water. Seek immediate medical aid in the case of eye contact. Never add acid to a battery after placing the battery in service, as this may result in hazardous spattering of battery acid.

Battery acid cleanup. Battery acid can cause severe injury or death. Battery acid is electrically conductive and corrosive. Add 500 g (1 lb.) of bicarbonate of soda (baking soda) to a container with 4 L (1 gal.) of water and mix the neutralizing solution. Pour the neutralizing solution on the spilled battery acid and continue to add the neutralizing solution to the spilled battery acid until all evidence of a chemical reaction (foaming) has ceased. Flush the resulting liquid with water and dry the area.

Battery gases. Explosion can cause severe injury or death. Battery gases can cause an explosion. Do not smoke or permit flames or sparks to occur near a battery at any time, particularly when it is charging. Do not dispose of a battery in a fire. To prevent burns and sparks that could cause an explosion, avoid touching the battery terminals with tools or other metal objects. Remove all jewelry before servicing the equipment. Discharge static electricity from your body before touching batteries by first touching a grounded metal surface away from the battery. To avoid sparks, do not disturb the battery charger connections while the battery is charging. Always turn the battery charger off before disconnecting the battery connections. Ventilate the compartments containing batteries to prevent accumulation of explosive gases.

Battery short circuits. Explosion can cause severe injury or death. Short circuits can cause bodily injury and/or equipment damage. Disconnect the battery before generator set installation or maintenance. Remove all jewelry before servicing the equipment. Use tools with insulated handles. Remove the negative (-) lead first when disconnecting the battery. Reconnect the negative (-) lead last when reconnecting the battery. Never connect the negative (-) battery cable to the positive (+) connection terminal of the starter solenoid. Do not test the battery condition by shorting the terminals together.

Engine Backfire/Flash Fire

⚠ WARNING

Fire.
Can cause severe injury or death.

Do not smoke or permit flames or sparks near fuels or the fuel system.

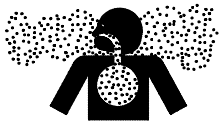
Servicing the air cleaner. A sudden backfire can cause severe injury or death. Do not operate the generator set with the air cleaner removed.

Servicing the fuel system. A flash fire can cause severe injury or death. Do not smoke or permit flames or sparks near the carburetor, fuel line, fuel filter, fuel pump, or other potential sources of spilled fuels or fuel vapors. Catch fuels in an approved container when removing the fuel line or carburetor.

Combustible materials. A fire can cause severe injury or death. Generator set engine fuels and fuel vapors are flammable and explosive. Handle these materials carefully to minimize the risk of fire or explosion. Equip the compartment or nearby area with a fully charged fire extinguisher. Select a fire extinguisher rated ABC or BC for electrical fires or as recommended by the local fire code or an authorized agency. Train all personnel on fire extinguisher operation and fire prevention procedures.

Exhaust System

⚠ WARNING



Carbon monoxide.
Can cause severe nausea, fainting, or death.

The exhaust system must be leakproof and routinely inspected.

Generator set operation. Carbon monoxide can cause severe nausea, fainting, or death. Carbon monoxide is an odorless, colorless, tasteless, nonirritating gas that can cause death if inhaled for even a short time. Avoid breathing exhaust fumes when working on or near the generator set. Never operate the generator set inside a building. Never operate the generator set where exhaust gas could seep inside or be drawn into a potentially occupied building through windows, air intake vents, or other openings.

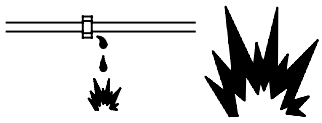
Carbon monoxide symptoms. Carbon monoxide can cause severe nausea, fainting, or death. Carbon monoxide is a poisonous gas present in exhaust gases. Carbon monoxide is an odorless, colorless, tasteless, nonirritating gas that can cause death if inhaled for even a short time. Carbon monoxide poisoning symptoms include but are not limited to the following:

- Light-headedness, dizziness
- Physical fatigue, weakness in joints and muscles
- Sleepiness, mental fatigue, inability to concentrate or speak clearly, blurred vision
- Stomachache, vomiting, nausea

If experiencing any of these symptoms and carbon monoxide poisoning is possible, seek fresh air immediately and remain active. Do not sit, lie down, or fall asleep. Alert others to the possibility of carbon monoxide poisoning. Seek medical attention if the condition of affected persons does not improve within minutes of breathing fresh air.

Fuel System

⚠ WARNING



Explosive fuel vapors.
Can cause severe injury or death.

Use extreme care when handling, storing, and using fuels.

Gas fuel leaks. Explosive fuel vapors can cause severe injury or death. Fuel leakage can cause an explosion. Check the LP vapor gas or natural gas fuel system for leakage by using a soap and water solution with the fuel system test pressurized to 6-8 ounces per square inch (10-14 inches water column). Do not use a soap solution containing either ammonia or chlorine because both prevent bubble formation. A successful test depends on the ability of the solution to bubble.

Hazardous Noise

⚠ CAUTION

Hazardous noise.
Can cause hearing loss.

Never operate the generator set without a muffler or with a faulty exhaust system.

Engine noise. Hazardous noise can cause hearing loss. Generator sets not equipped with sound enclosures can produce noise levels greater than 105 dBA. Prolonged exposure to noise levels greater than 85 dBA can cause permanent hearing loss. Wear hearing protection when near an operating generator set.

Hazardous Voltage/ Moving Parts

⚠ WARNING

Hazardous voltage. Moving parts.
Can cause severe injury or death.

Operate the generator set only when all guards and electrical enclosures are in place.

⚠ WARNING

Hazardous voltage.
Backfeed to the utility system can cause property damage, severe injury, or death.

If the generator set is used for standby power, install an automatic transfer switch to prevent inadvertent interconnection of standby and normal sources of supply.

⚠ CAUTION

Welding the generator set.
Can cause severe electrical equipment damage.

Never weld components of the generator set without first disconnecting the battery, controller wiring harness, and engine electronic control module (ECM).

Grounding electrical equipment. Hazardous voltage can cause severe injury or death. Electrocution is possible whenever electricity is present. Ensure you comply with all applicable codes and standards. Electrically ground the generator set, transfer switch, and related equipment and electrical circuits. Turn off the main circuit breakers of all power sources before servicing the equipment. Never contact electrical leads or appliances when standing in water or on wet ground because these conditions increase the risk of electrocution.

Welding on the generator set. Can cause severe electrical equipment damage. Before welding on the generator set perform the following steps: (1) Remove the battery cables, negative (–) lead first. (2) Disconnect all engine electronic control module (ECM) connectors. (3) Disconnect all generator set controller and voltage regulator circuit board connectors. (4) Disconnect the engine battery-charging alternator connections. (5) Attach the weld ground connection close to the weld location.

Connecting the battery and the battery charger. Hazardous voltage can cause severe injury or death. Reconnect the battery correctly, positive to positive and negative to negative, to avoid electrical shock and damage to the battery charger and battery(ies). Have a qualified electrician install the battery(ies).

Short circuits. Hazardous voltage/current can cause severe injury or death. Short circuits can cause bodily injury and/or equipment damage**.** Do not contact electrical connections with tools or jewelry while making adjustments or repairs. Remove all jewelry before servicing the equipment.

Electrical backfeed to the utility. Hazardous backfeed voltage can cause severe injury or death. Install a transfer switch in standby power installations to prevent the connection of standby and other sources of power. Electrical backfeed into a utility electrical system can cause severe injury or death to utility personnel working on power lines.

⚠ WARNING

Airborne particles.
Can cause severe injury or blindness.

Wear protective goggles and clothing when using power tools, hand tools, or compressed air.

Heavy Equipment

⚠ WARNING

Unbalanced weight.
Improper lifting can cause severe injury or death and equipment damage.

Do not use lifting eyes.
Lift the generator set using lifting bars inserted through the lifting holes on the skid.

Hot Parts

⚠ WARNING

Hot engine and exhaust system. Can cause severe injury or death.

Do not work on the generator set until it cools.

Servicing the exhaust system. Hot parts can cause severe injury or death. Do not touch hot engine parts. The engine and exhaust system components become extremely hot during operation.

Servicing the engine heater. Hot parts can cause minor personal injury or property damage. Install the heater before connecting it to power. Operating the heater before installation can cause burns and component damage. Disconnect power to the heater and allow it to cool before servicing the heater or nearby parts.

Notice

NOTICE

Canadian installations only. For standby service connect the output of the generator set to a suitably rated transfer switch in accordance with Canadian Electrical Code, Part 1.

This manual provides installation instructions for Model 12RESL/12RESM1 and 18RESL residential/ commercial generator sets equipped with the Kohler® DC-RET Digital Control. Refer to TP-6517, Operation Manual, for generator set operation and maintenance instructions.

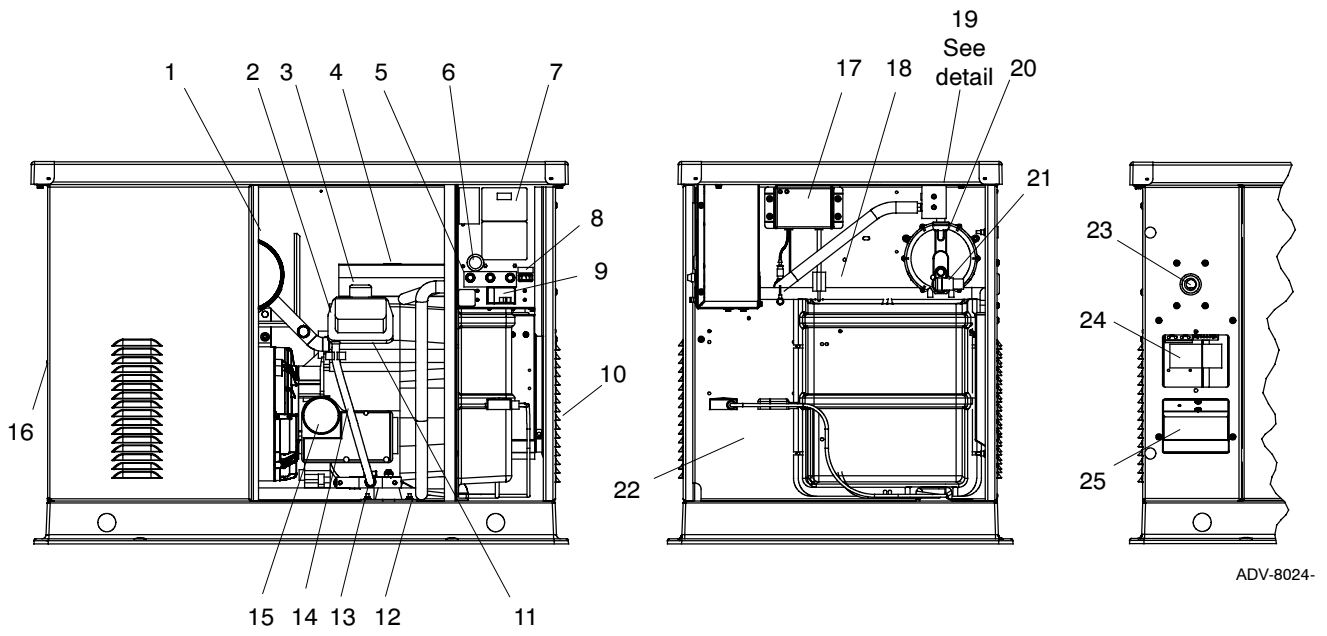
The generator set is approved for use in stationary applications in locations served by a reliable utility power source.

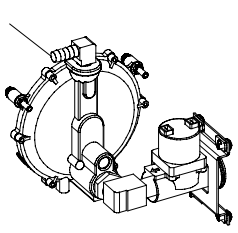
Have an authorized distributor/dealer install the generator set outdoors according to the instructions in this manual. The generator set installation must comply with the National Electrical Code (NEC) and local code requirements. Do not install this generator set indoors.

Information in this publication represents data available at the time of print. Kohler Co. reserves the right to change this publication and the products represented without notice and without any obligation or liability whatsoever.

Read this manual and carefully follow all procedures and safety precautions to ensure proper equipment operation and to avoid bodily injury. Read and follow the Safety Precautions and Instructions section at the beginning of this manual.

See Figure 1 or Figure 2 for generator set component locations.

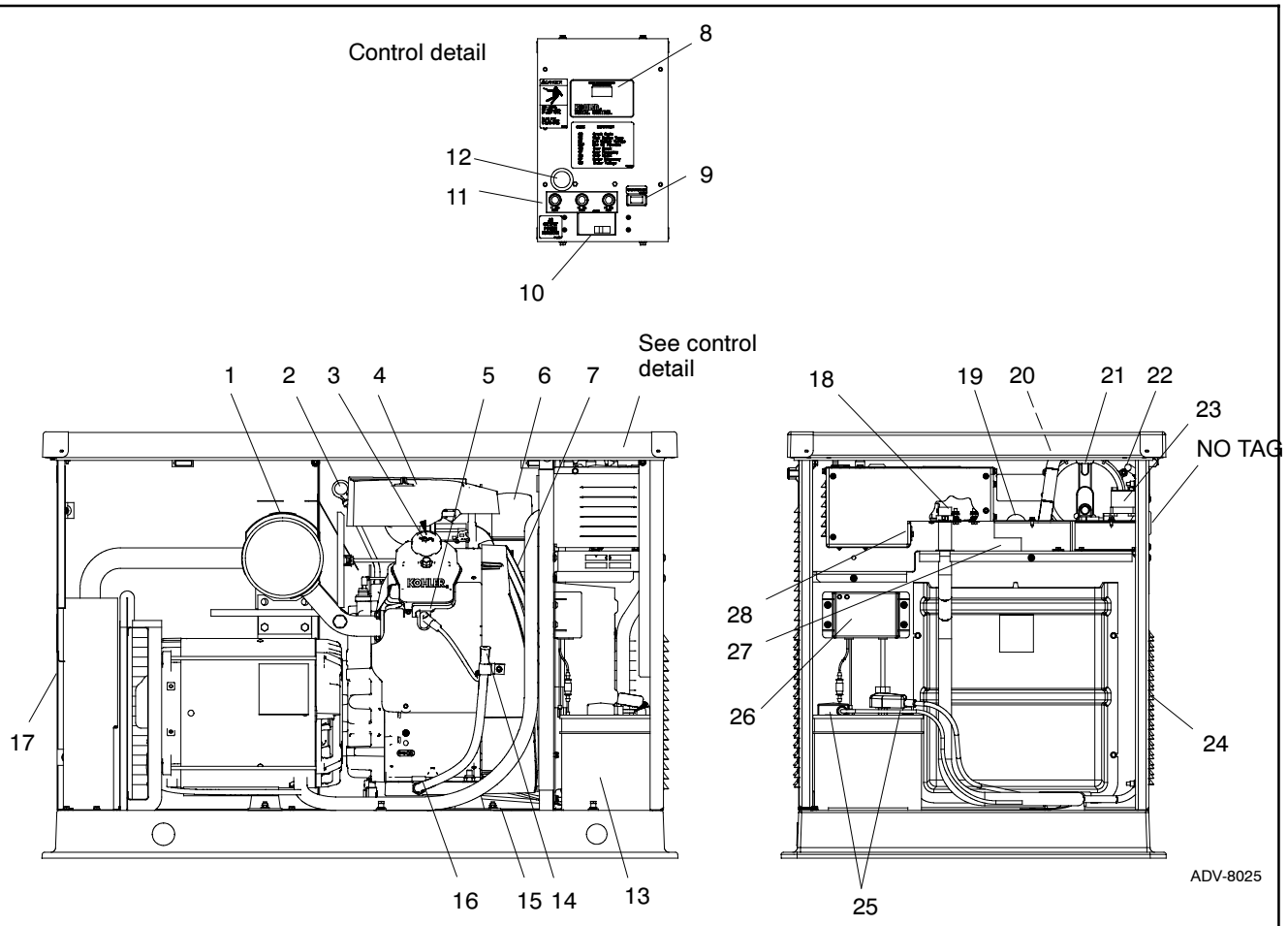




Fuel system detail

1. Muffler
2. Oil check
3. Oil fill
4. Air cleaner
5. Fuses
6. RS-232 connector (for application program updates)
7. Controller user interface
8. Generator set master switch (RUN-OFF/RESET-AUTO)
9. Load circuit breaker
10. Air intake
11. Spark plug locations (both sides)
12. Nameplate location (on base)
13. Oil drain valve
14. Oil drain hose
15. Oil filter
16. Exhaust
17. Battery charger
18. DSAI lead location
19. LP fuel orifice location
20. Gas regulator assembly
21. Fuel solenoid valve
22. Engine starting battery location (battery purchased separately)
23. Fuel inlet
24. Field-connection terminal block location
25. Electrical entry area

Figure 1 Generator Set Component Locations, Model 12RESL/12RESM1



1. Muffler
2. Oil check
3. Oil fill
4. Air cleaner
5. Spark plug locations (both sides)
6. Oil filter
7. Oil cooler location
8. DC-RET Digital Control display
9. Generator set master switch (RUN-OFF/RESET-AUTO)
10. Line circuit breaker
11. Fuses
12. RS-232 connector (for application program updates)
13. Engine starting battery location (battery purchased separately)
14. Oil drain hose
15. Nameplate location (on base)
16. Oil drain valve
17. Exhaust outlet
18. Equipment ground
19. Carburetor heater access opening
20. LP fuel orifice location (inside hose fitting)
21. Gas regulator assembly
22. DSAI leads
23. Fuel inlet
24. Air intake
25. Battery cables
26. Battery charger
27. Field-connection terminal block location
28. 120 VAC receptacles for battery charger and optional carburetor heater

Figure 2 Generator Set Component Locations, Model 18RESL

For professional advice on generator set power requirements and conscientious service, please contact your nearest Kohler distributor or dealer.

- Consult the Yellow Pages under the heading Generators—Electric.
- Visit the Kohler Power Systems website at KohlerPower.com.
- Look at the labels and stickers on your Kohler product or review the appropriate literature or documents included with the product.
- Call toll free in the US and Canada 1-800-544-2444.
- Outside the US and Canada, call the nearest regional office.

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East China Regional Office, Shanghai
Phone: (86) 21 6288 0500
Fax: (86) 21 6288 0550

India, Bangladesh, Sri Lanka
India Regional Office
Bangalore, India
Phone: (91) 80 3366208
(91) 80 3366231
Fax: (91) 80 3315972

Japan, Korea
North Asia Regional Office
Tokyo, Japan
Phone: (813) 3440-4515
Fax: (813) 3440-2727

Notes

1.1 General

Have an authorized distributor/dealer install the generator set outdoors according to the instructions in this manual. The generator set installation must comply with the National Electrical Code (NEC) and local code requirements. Do not install this generator set indoors.

Use the generator set and transfer switch dimension drawings and wiring diagrams for installation. See Section 2 for the generator set dimension drawings and wiring diagrams.

1.2 Lifting

⚠ WARNING

Unbalanced weight.
Improper lifting can cause severe injury or death and equipment damage.

Do not use lifting eyes.
Lift the generator set using lifting bars inserted through the lifting holes on the skid.

Approximate generator set weights are shown in Figure 1-1. Use lifting bars inserted through the holes in the skid to lift the unit. See the dimension drawings in Section 2 for lifting hole locations.

Model	Weight, kg (lb.)
12RESL/12RESM1	186 (410)
18RESL	227 (500)

Figure 1-1 Approximate Weights

1.3 Generator Set Inspection

Complete a thorough inspection of the generator set. Check for the following:

1. Inspect the generator set for loose or damaged parts or wires. Repair or tighten any loose parts before installation.

2. Check the engine oil. Fill, if necessary, with the recommended viscosity and grade of oil. Use synthetic oil, API (American Petroleum Institute) Service Class SG or higher. See TP-6517, Operation Manual, for additional information.

1.4 Location and Mounting

See the dimension drawings in Section 2 for the generator set dimensions and fuel and electric inlet locations. The dimensions are shown in millimeters, with inches in brackets.

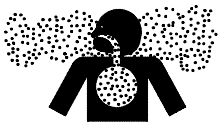
Install the generator set outdoors. Provide the minimum clearance around the generator set shown in the clearance drawings in Section 2. Locate the generator set so that the hot exhaust does not blow on plants or other combustible materials. Do not install the generator set where exhaust gas could accumulate and seep inside or be drawn into a potentially occupied building.

The generator set is shipped on a plastic mounting pad. Prepare a flat, level mounting area covered with a weed barrier and gravel or a concrete pad as shown in the generator set clearance drawing. Set the plastic mounting pad directly on the gravel or concrete. Do not install the mounting pad directly on grass.

See the dimension drawings in Section 2 for special mounting instructions for high wind (150 MPH) areas.

1.4.1 Exhaust Requirements

⚠ WARNING



Carbon monoxide.
Can cause severe nausea, fainting, or death.

The exhaust system must be leakproof and routinely inspected.

Generator set operation. Carbon monoxide can cause severe nausea, fainting, or death. Carbon monoxide is an odorless, colorless, tasteless, nonirritating gas that can cause death if inhaled for even a short time. Avoid breathing exhaust fumes when working on or near the generator set. Never operate the generator set inside a building. Never operate the generator set where exhaust gas could seep inside or be drawn into a potentially occupied building through windows, air intake vents, or other openings.

The exhaust system is complete for generator sets installed outdoors. Do not install this generator set indoors.

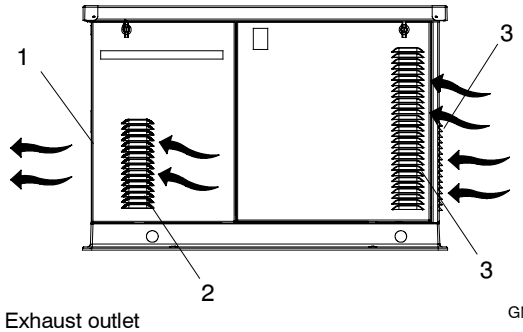
Figure 1-2 gives the exhaust flow and temperature at rated load. The engine exhaust mixes with the generator set cooling air at the exhaust end of the enclosure. Mount the generator set so that the hot exhaust does not blow on plants or other combustible materials. Maintain the clearances shown in the dimension drawing in Section 2.

Exhaust System	60 Hz
Exhaust flow at rated kW, m^3/min. (cfm)	
12RESL/12RESM1	3.8 (135)
18RESL	5.3 (187)
Exhaust gas temperature exiting the enclosure at rated kW, °C (°F)	216 (420)

Figure 1-2 Exhaust Flow and Temperature

1.4.2 Air Requirements

The generator set requires correct air flow for cooling and combustion. The inlet and outlet openings in the sound enclosure provide the cooling and combustion air. Figure 1-3 shows the locations of the cooling air intake and exhaust vents. Inspect the air inlet and outlet openings inside and outside the housing to ensure that the air flow is not blocked.



1. Exhaust outlet
2. Alternator air intake (both sides)
3. Engine air intake

Figure 1-3 Cooling Air Intake and Exhaust

Model	Hz	Air Requirements, m^3/min. (cfm) Cooling Air	Combustion Air	Total Inlet Air
12RESL	60	26.9 (950)	1.1 (39.2)	28.0 (990)
	50	22.4 (790)	0.9 (32.6)	23.4 (826)
18RESL	60	28.0 (989)	1.62 (57.3)	29.6 (1045)
	50	22.6 (798)	1.42 (50.1)	24.0 (848)

Figure 1-4 Air Requirements

1.5 Power Supply

Power must be supplied from a source that is GFCI protected to the generator set location for the battery charger and the optional carburetor heater. See Section 1.8. Connect power from a circuit on the essential loads panel to the 120-VAC receptacles. The circuit must be backed up by the generator set. Figure 1-5 lists the power requirements for the battery charger and accessories.

Equipment	Power Requirement, Max. Watts	Amps	Volts
Battery charger	192	1.6	120
Carburetor heater:			
12RESL	38	0.32	
18RESL	40	0.34	
Battery heater	110	0.92	

Figure 1-5 Power Requirements

1.6 Fuel Requirements

The generator set operates using natural gas or LP vapor fuel. The generator set is EPA-certified for both natural gas and LP vapor fuels.

The fuel system installation must comply with the NEC and local codes.

1.6.1 Fuel Supply

Because of variable climates and geographical considerations, contact the local fuel supplier for fuel system planning and installation. Figure 1-6 lists the recommended fuel ratings and other fuel supply information for natural gas and LP vapor fuels.

Verify that the output pressure from the primary gas utility (or LP tank) pressure regulator is within the range shown in Figure 1-6 and that the utility gas meter flow rate is sufficient to supply the generator set at rated load plus all other gas-consuming appliances. See Figure 1-7 or Figure 1-8 for fuel consumption. Contact the fuel supplier for flow rate information or a gas meter upgrade, if necessary.

Fuel types	Natural Gas	LP Vapor
Fuel supply inlet	1/2 NPT	1/2 NPT
Fuel supply pressure, kPa (in. H_2O):		
12RESL	1.3–2.7 (5-11)	1.7–2.7 (7-11)
18RESL	1.7–2.7 (7-11)	1.7–2.7 (7-11)
Fuel flow rate, Btu/hr.:		
12RESL	193000	203000
18RESL	242000	280000
Nominal Fuel Rating, Btu/ft^3	1000	2500

Figure 1-6 Fuel Supply

12RESL	Fuel Consumption, m^3/hr. (cfh)	
% Rated Load	Natural Gas	LP Vapor
100%	5.4 (193)	2.3 (81)
75%	4.7 (163)	2.1 (75)
50%	3.5 (124)	1.8 (60)
25%	2.6 (93)	1.2 (45)
LP vapor conversion factors: 8.58 ft.^{3} = 1 lb. 0.535 m^3 = 1 kg 36.39 ft.^{3} = 1 gal. Nominal fuel rating: Natural gas: 37 MJ/m^3 (1000 Btu/ft.^{3}) LP vapor: 93 MJ/m^3 (2500 Btu/ft.^{3})		

Figure 1-7 Fuel Consumption, 12RESL Models

18RESL	Fuel Consumption, m^3/hr. (cfh)	
% Rated Load	Natural Gas	LP Vapor
100%	6.9 (242)	3.2 (112)
75%	5.8 (204)	2.7 (96)
50%	4.4 (155)	2.1 (74)
25%	3.4 (120)	1.6 (57)
LP vapor conversion factors: 8.58 ft.^{3} = 1 lb. 0.535 m^3 = 1 kg 36.39 ft.^{3} = 1 gal. Nominal fuel rating: Natural gas: 37 MJ/m^3 (1000 Btu/ft.^{3}) LP vapor: 93 MJ/m^3 (2500 Btu/ft.^{3})		

Figure 1-8 Fuel Consumption, 18RESL Models

1.6.2 Fuel Pipe Size

Ensure that the fuel supply pipe size and length meet the specifications in Figure 1-9 or Figure 1-10. Measure the pipe length from the primary gas pressure regulator to the pipe connection on the generator set fuel inlet. Add 2.4 m (8 ft.) to the measured length for each 90 degree elbow. Compare the total pipe length with the chart in Figure 1-9 or Figure 1-10 to find the required pipe size.

Contact the local LP provider for LP installation information.

Minimum Gas Pipe Size Recommendation, in. NPT		
Pipe Length, m (ft.)	12RESL/12RESM1	
	Natural Gas (193,000 Btu/hr.)	LP Vapor (203,000 Btu/hr.)
8 m (25 ft.)	3/4	3/4
15 m (50 ft.)	1	3/4
30 m (100 ft.)	1	1
46 m (150 ft.)	1 1/4	1
61 m (200 ft.)	1 1/4	1

Figure 1-9 Fuel Pipe Size, 12RESL/12RESM1

Minimum Gas Pipe Size Recommendation, in. NPT		
Pipe Length, m (ft.)	18RESL	
	Natural Gas (242,000 Btu/hr.)	LP Vapor (280,000 Btu/hr.)
8 m (25 ft.)	1	3/4
15 m (50 ft.)	1	1
30 m (100 ft.)	1 1/4	1
46 m (150 ft.)	1 1/4	1 1/4
61 m (200 ft.)	1 1/4	1 1/4

Figure 1-10 Fuel Pipe Size, 18RESL

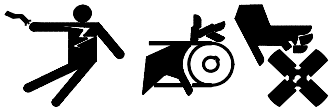
1.6.3 Fuel Inlet Connection

See the dimension drawings in Section 2 (or Figure 1-15 and Figure 1-16) for the location of the fuel inlet connection. Use flexible sections to prevent fuel line breakage caused by vibration. Hold the fuel solenoid valve with a wrench when tightening the fuel connections. Protect all fuel lines from machinery or equipment contact, adverse weather conditions, and environmental damage.

1.7 Fuel Conversion

The multi-fuel system allows conversion from natural gas to LP vapor (or vice-versa) in the field while maintaining emissions-standard compliance. A trained technician or authorized distributor/dealer can convert the fuel system.

⚠ WARNING

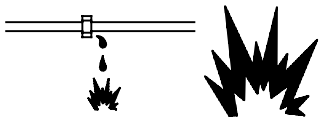


Accidental starting.
Can cause severe injury or death.

Disconnect the battery cables before working on the generator set. Remove the negative (-) lead first when disconnecting the battery. Reconnect the negative (-) lead last when reconnecting the battery.

Disabling the generator set. Accidental starting can cause severe injury or death. Before working on the generator set or connected equipment, disable the generator set as follows: (1) Move the generator set master switch to the OFF position. (2) Disconnect the power to the battery charger. (3) Remove the battery cables, negative (-) lead first. Reconnect the negative (-) lead last when reconnecting the battery. Follow these precautions to prevent starting of the generator set by an automatic transfer switch, remote start/stop switch, or engine start command from a remote computer.

⚠ WARNING



Explosive fuel vapors.
Can cause severe injury or death.

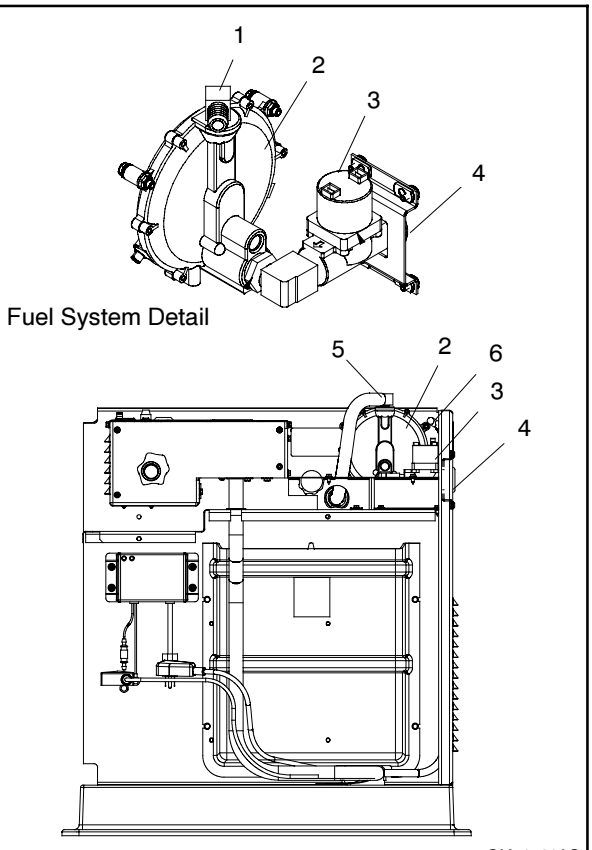
Use extreme care when handling, storing, and using fuels.

For LP vapor fuel, an orifice is used in the fuel line. The unit is typically shipped set up for natural gas, with the loose LP orifice tied near the fuel line. To convert to LP vapor, install the orifice and disconnect the spark advance leads as described in the following procedure. See Figure 1-11 for the fuel system component locations.

To convert from LP vapor to natural gas, remove the fuel orifice and connect the DSAI leads together.

Procedure to Convert from NG to LP

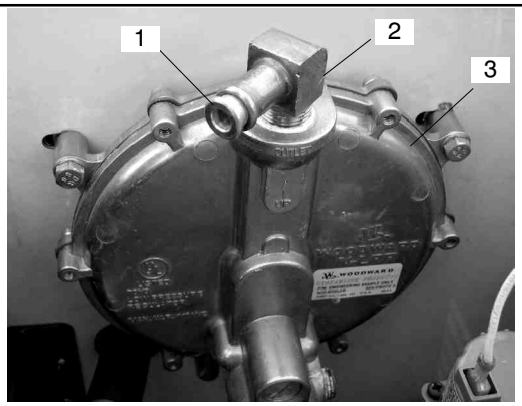
1. Place the generator set master switch in the OFF position.
2. Disconnect the power to the battery charger.
3. Disconnect the generator set engine starting battery, negative (-) lead first.
4. Turn off the fuel supply.
5. Remove the hose clamp and fuel hose from the hose fitting. See Figure 1-11.



1. Hose fitting (LP orifice fits inside; see Figure 1-12)
2. Regulator
3. Fuel valve
4. Fuel inlet, 1/2 in. NPT female
5. Fuel hose with clamp
6. DSAI connector location (see Figure 1-14)

Figure 1-11 Fuel System Components, Air Inlet Side, 18RESL Shown

6. Place the orifice into the hose fitting. See Figure 1-12.



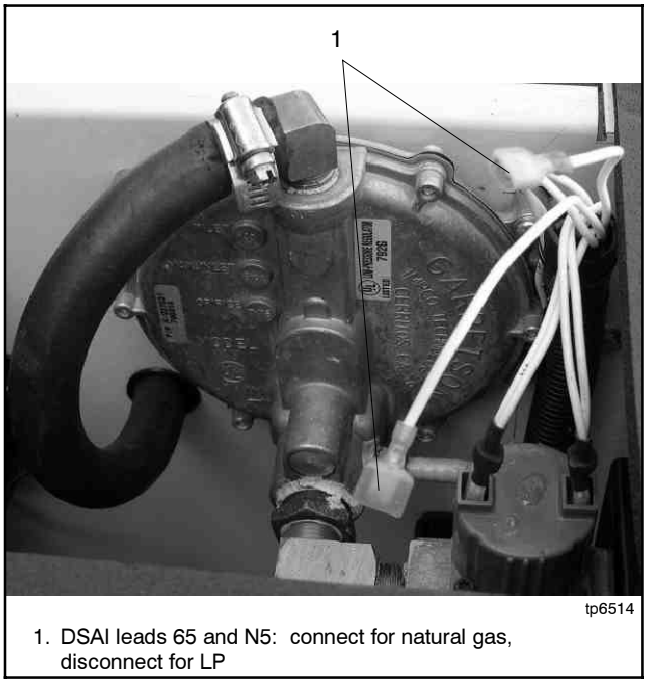
1. LP orifice 2. Hose fitting 3. Regulator

Figure 1-12 LP Fuel Orifice Installation

7. Slide the hose onto the hose fitting and secure it with the clamp.
8. Disconnect the digital spark-advance module (DSAI) leads for LP. (Connect the leads for natural gas.) See Figure 1-13 and Figure 1-14.

Fuel	DSAI Leads
Natural Gas	Connect
LP	Disconnect

Figure 1-13 DSAI Connection



1. DSAI leads 65 and N5: connect for natural gas, disconnect for LP

Figure 1-14 Digital Spark Advance (DSAI) Leads (located in generator set air intake area)

9. Connect and turn on the new fuel supply.

10. Check that the generator set master switch is in the OFF position.

11. Reconnect the generator set engine starting battery leads, negative (–) lead last.

12. Reconnect power to the battery charger.

13. Start the generator set by moving the generator set master switch to the RUN position.

14. Check for leaks using a gas leak detector.

15. Move the generator set master switch to the OFF/ RESET position to shut down the generator set.

1.8 Electrical Connections

⚠ WARNING

Hazardous voltage.
Backfeed to the utility system can cause property damage, severe injury, or death.

If the generator set is used for standby power, install an automatic transfer switch to prevent inadvertent interconnection of standby and normal sources of supply.

Grounding electrical equipment. Hazardous voltage can cause severe injury or death. Electrocution is possible whenever electricity is present. Ensure you comply with all applicable codes and standards. Electrically ground the generator set, transfer switch, and related equipment and electrical circuits. Turn off the main circuit breakers of all power sources before servicing the equipment. Never contact electrical leads or appliances when standing in water or on wet ground because these conditions increase the risk of electrocution.

Electrical backfeed to the utility. Hazardous backfeed voltage can cause severe injury or death. Install a transfer switch in standby power installations to prevent the connection of standby and other sources of power. Electrical backfeed into a utility electrical system can cause severe injury or death to utility personnel working on power lines.

NOTICE

Canadian installations only. For standby service connect the output of the generator set to a suitably rated transfer switch in accordance with Canadian Electrical Code, Part 1.

Have an authorized distributor/dealer or a licensed electrician make the following electrical connections. Verify that the electrical installation complies with the National Electrical Code (NEC) and all applicable local codes. Ground the generator set according to applicable codes.

1.8.1 Field Connections

The generator set is equipped with a field-connection terminal block located in the air inlet area near the junction box. Leads have been factory-installed from the junction box to the terminal block for easier field wiring. Refer to the decal near the terminal block for connections. Also see the wiring diagrams in Section 2.

Refer to the decal below the terminal block and the transfer switch specifications for the acceptable cable sizes. Route leads through flexible conduit. Use separate conduit for AC wiring and low-voltage engine start leads. Ensure that the leads and conduit do not interfere with the operation of the generator set or obstruct the service areas.

The electrical installation must comply with the National Electrical Code (NEC) and all applicable local codes.

Connection Procedure

1. 12RESL: Remove the cover from the electrical connection access area. See Figure 1-15.

2. Drill holes for conduit fittings as described for each model below:

   a. 12RESL: See Figure 1-15 for the electrical inlet location. Remove the cover from the electrical inlet area. Drill holes in the cover for the conduit fittings and replace the cover. Use separate conduit for AC wiring and low-voltage engine start leads. Feed the cables through the openings.

   b. 18RESL: See Figure 1-16 for the recommended electrical inlet location. Drill holes for the conduit fittings. Use separate conduit for AC wiring and low-voltage engine start leads. Feed the cables through the openings.

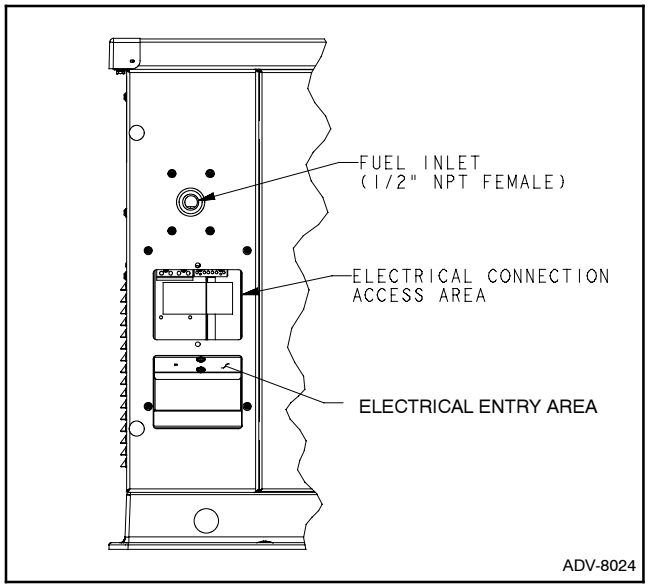


Figure 1-15 12RESL/12RESM1 Electrical Connection Area

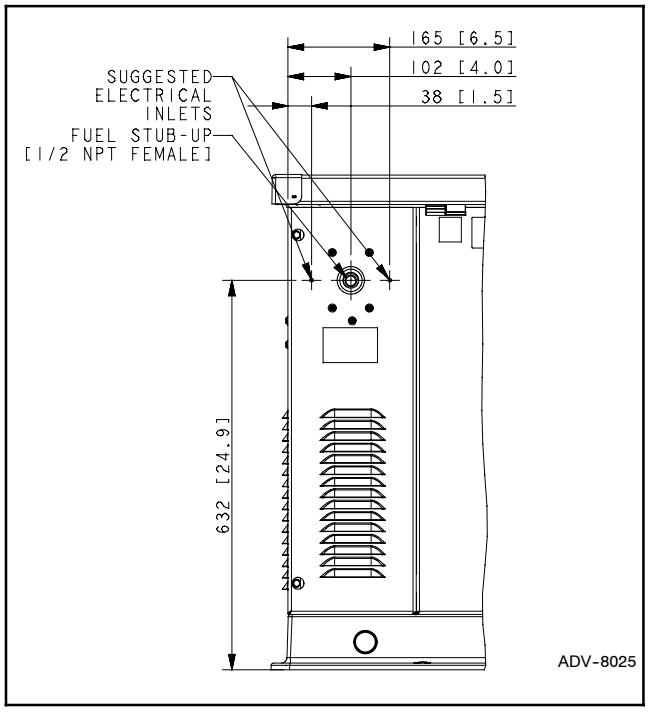


Figure 1-16 18RESL Electrical Inlets

3. See Figure 1-17. Connect the leads from the transfer switch emergency source lugs to the L1 and L2 connections on the generator set terminal block.

4. Connect the neutral (L0) and ground (GRD) leads from the ATS and the main panel to the corresponding connection points on the terminal block. See Section 1.8.3, Grounding.

5. Connect 120 VAC utility power to the terminals marked Utility Power. Power to this circuit must be backed-up by the generator set. See Section 1.5 for more information about the utility power requirement.

6. Connect the engine start leads from the automatic transfer switch or remote start switch to terminals 3 and 4 on the terminal block.

7. 12RESL/12RESM1: Replace the cover over the electrical connection access area. See Figure 1-15.

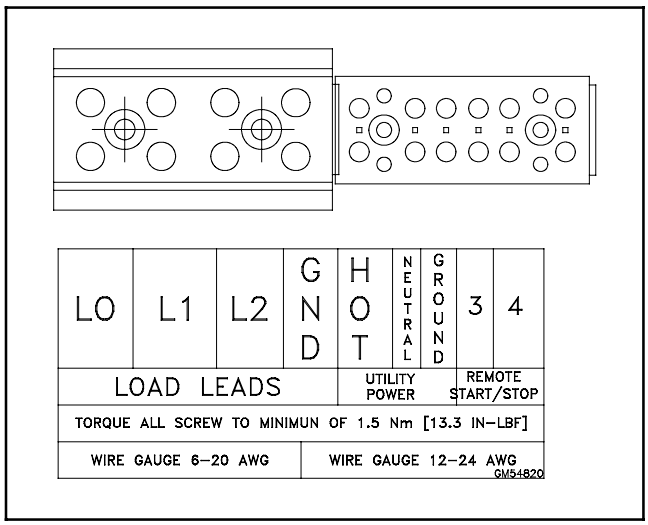


Figure 1-17 Field-Connection Terminal Block

1.8.2 Remote Start Connection

Connect engine start leads from terminals 3 and 4 to the automatic transfer switch's engine start terminals or to an optional remote start/stop switch. Route the engine start leads through separate conduit from the AC power and load leads.

1.8.3 Grounding

Ground the generator set. The grounding method must comply with NEC and local codes. Connect the grounding strap to the generator set ground lug, terminal GND inside the controller compartment.

Generator sets are shipped with the generator neutral bonded (connected) to the generator ground in the junction box. The requirement for having a bonded (grounded) or ungrounded neutral is determined by the type of installation. At installation, the neutral can be grounded at the generator set or lifted from the ground stud and isolated if the installation requires an ungrounded neutral connection at the generator. The generator set will operate properly with the neutral either bonded to ground or isolated from ground at the generator.

Various regulations and site configurations including the National Electrical Code (NEC), local codes, and the type of transfer switch used in the application determine the grounding of the neutral at the generator. NEC Section 250 is one example that has a very good explanation of the neutral grounding requirements for generators.

1.8.4 Battery Charger Power

A 6-amp battery charger is factory-installed in the battery compartment to keep the starting battery fully charged. The battery charger's DC leads are factory-connected.

Plug the battery charger's power cord into the receptacle on the bottom of the controller junction box. See Section 1.5, Power Supply. Refer to the generator set Operation Manual for battery charger operation information.

1.9 Battery

⚠ WARNING

Sulfuric acid in batteries.
Can cause severe injury or death.

Wear protective goggles and clothing. Battery acid may cause blindness and burn skin.

⚠ WARNING

Explosion.
Can cause severe injury or death.
Relays in the battery charger cause arcs or sparks.

Locate the battery in a well-ventilated area. Isolate the battery charger from explosive fumes.

Battery electrolyte is a diluted sulfuric acid. Battery acid can cause severe injury or death. Battery acid can cause blindness and burn skin. Always wear splashproof safety goggles, rubber gloves, and boots when servicing the battery. Do not open a sealed battery or mutilate the battery case. If battery acid splashes in the eyes or on the skin, immediately flush the affected area for 15 minutes with large quantities of clean water. Seek immediate medical aid in the case of eye contact. Never add acid to a battery after placing the battery in service, as this may result in hazardous spattering of battery acid.

Battery acid cleanup. Battery acid can cause severe injury or death. Battery acid is electrically conductive and corrosive. Add 500 g (1 lb.) of bicarbonate of soda (baking soda) to a container with 4 L (1 gal.) of water and mix the neutralizing solution. Pour the neutralizing solution on the spilled battery acid and continue to add the neutralizing solution to the spilled battery acid until all evidence of a chemical reaction (foaming) has ceased. Flush the resulting liquid with water and dry the area.

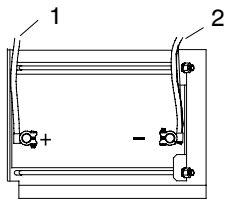
Battery gases. Explosion can cause severe injury or death. Battery gases can cause an explosion. Do not smoke or permit flames or sparks to occur near a battery at any time, particularly when it is charging. Do not dispose of a battery in a fire. To prevent burns and sparks that could cause an explosion, avoid touching the battery terminals with tools or other metal objects. Remove all jewelry before servicing the equipment. Discharge static electricity from your body before touching batteries by first touching a grounded metal surface away from the battery. To avoid sparks, do not disturb the battery charger connections while the battery is charging. Always turn the battery charger off before disconnecting the battery connections. Ventilate the compartments containing batteries to prevent accumulation of explosive gases.

Battery short circuits. Explosion can cause severe injury or death. Short circuits can cause bodily injury and/or equipment damage. Disconnect the battery before generator set installation or maintenance. Remove all jewelry before servicing the equipment. Use tools with insulated handles. Remove the negative (-) lead first when disconnecting the battery. Reconnect the negative (-) lead last when reconnecting the battery. Never connect the negative (-) battery cable to the positive (+) connection terminal of the starter solenoid. Do not test the battery condition by shorting the terminals together.

Connecting the battery and the battery charger. Hazardous voltage can cause severe injury or death. Reconnect the battery correctly, positive to positive and negative to negative, to avoid electrical shock and damage to the battery charger and battery(ies). Have a qualified electrician install the battery(ies).

Use a 12-volt battery with a minimum rating of 500 cold cranking amps at 0°F. The generator set uses a negative ground with a 12-volt engine electrical system. See Figure 1-18 for battery connections. Make sure that the battery is correctly connected and the terminals are tight.

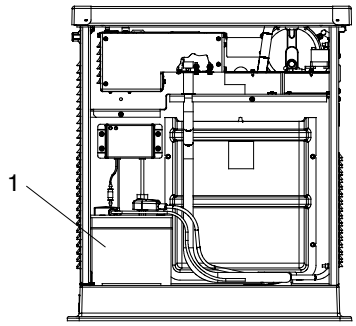
Note: The generator set will not start and circuit board damage may occur if the battery is connected in reverse.



1. To positive (+) terminal on starter solenoid.
2. To ground (-) terminal on or near starter motor.

Figure 1-18 12-Volt Engine Electrical System Single Starter Motor Typical Battery Connection

Figure 1-19 shows the location of the engine starting battery. Standard battery cables provide easy connection to the battery. Use the following procedure to install and connect the battery.



1. Engine starting battery location

Figure 1-19 Battery Location, Air Intake End (typical)

Battery Installation Procedure

1. Ensure that the starting battery is fully charged before placing the battery in service.
2. Clean the battery posts and/or adapters if necessary.
3. Install the battery post adapters, if needed.
4. Place the battery in the housing.
5. Verify that the controller master switch is in the OFF position.
6. Connect the positive (+) lead to the engine starting battery.
7. Connect the negative (–) lead to the engine starting battery.

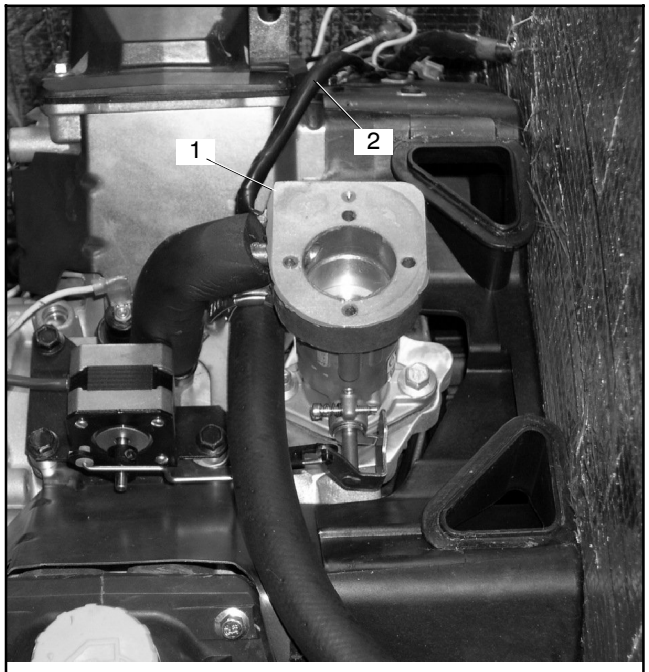
Refer to the generator set Operation Manual and the battery manufacturer's instructions for battery maintenance instructions.

1.10 Carburetor Heater (optional)

Have accessories installed by an authorized distributor/ dealer or a licensed electrician. Follow the installation instructions provided with each kit. Use separate conduit for AC and DC leads to reduce the possibility of electrical interference. Verify that the leads and conduit do not interfere with the operation of the generator set or obstruct the service areas. Verify that the electrical installation complies with the National Electrical Code (NEC) and all applicable local codes. See the wiring diagrams in Section 2 for more information regarding generator set electrical connections.

An optional carburetor heater is recommended for improved cold starting in locations where the ambient temperature drops below 0°C (32°F). The carburetor heater prevents condensation and carburetor icing. The heater turns on when the temperature at the thermostat falls below approximately 4°C (40°F) and turns off when the temperature rises above approximately 16°C (60°F). See Figure 1-20 through Figure 1-23.

The heater thermostat is installed in the cord. Figure 1-23 shows the location of the thermostat on the power cord.



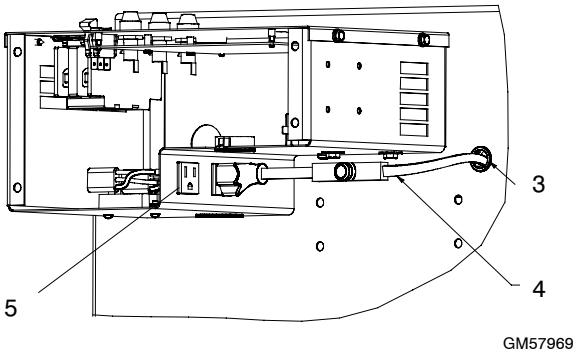
1. Carburetor heater (air cleaner removed to show heater)
2. Carburetor heater power cord

Figure 1-20 Carburetor Heater Location, 12RESL

The heater requires a continuous source of 120 VAC power. The heater power cord and thermostat are located in the generator set housing air intake area/ battery compartment. See Figure 1-19 and Figure 1-21. Plug the carburetor heater into an outlet that supplies continuous 120 VAC power.

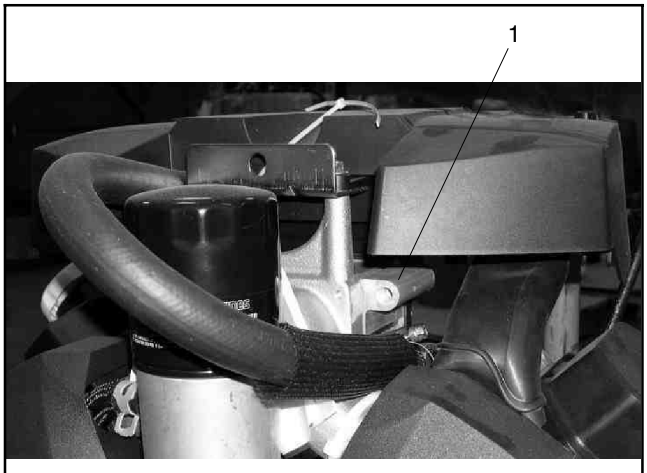
Note: Do not place the heater thermostat inside the generator set engine compartment. The thermostat must be exposed to the ambient air. Thermostat will shut off power to the heater when ambient temperature reaches approximately 16°C (60°F).

Figure 1-22 shows the location of the carburetor heater on the 18RESL generator set engine for reference. (The engine has been removed from the generator set in this photo for a clear view.)



1. Thermostat
2. Heater
3. Bulkhead opening for carburetor heater access
4. Carburetor heater cord with thermostat
5. 120 VAC receptacles for carburetor heater and battery charger

Figure 1-21 Carburetor Heater, 18RESL



1. Carburetor heater location

Figure 1-22 Carburetor Heater Location, 18RESL

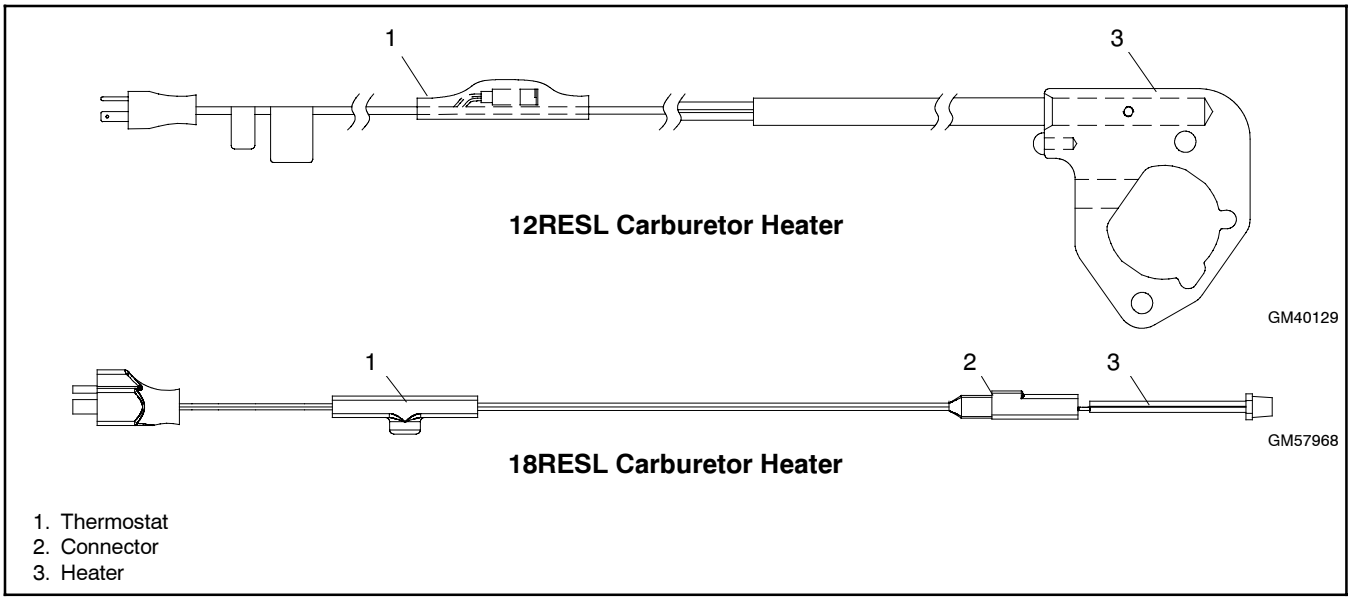


Figure 1-23 Carburetor Heaters

1.11 Prestart Installation Check

Review the entire installation section. Inspect all wiring and connections to verify that the generator set is ready for operation. Check all items in the following Prestart Checklist.

Prestart Checklist

Air Cleaner. Check that a clean air cleaner element is installed to prevent unfiltered air from entering the engine. See the generator set Operation Manual for instructions.

Air Inlets. Check for clean and unobstructed air inlets.

Battery. Check for tight battery connections. Consult the battery manufacturer's instructions regarding battery care and maintenance.

Exhaust System. Check for exhaust leaks and blockages. Check the muffler condition.

- Inspect the exhaust system components for cracks, leaks, and corrosion. Check for tight exhaust system connections.
- Check for corroded or broken metal parts and replace them as needed.
- Check that the exhaust outlet is unobstructed.

Oil Level. Maintain the oil level at or near, not over, the full mark on the dipstick.

Operating Area. Check for obstructions that could block the flow of cooling air. Keep the air intake area clean. Do not leave rags, tools, or debris on or near the generator set.

1.12 Startup Notification

Complete the startup and installation checklists supplied with the startup notification form. Complete and sign the startup notification form and return copies to Kohler Co. and the distributor/dealer as instructed on the form.

Standby systems not registered within 60 days of startup are automatically registered using the manufacturer's ship date as the startup date.

Notes

Section 2 Dimension Drawings and Wiring Diagrams

Refer to the dimension drawings and wiring diagrams for your model during generator set installation. Figure 2-1 lists the drawing numbers and locations.

Dimension Drawing Description	Drawing Number	Page
12RESL/12RESM1	ADV-8024	
Mounting and Dimensions	Sheet 1	26
Clearance	Sheet 2	27
High Wind Mounting	Sheet 3	28
18RESL	ADV-8025	
Mounting and Dimensions	Sheet 1	29
Clearance	Sheet 2	30
Wiring Diagram Description	**Drawing Number**	**Page**
12RESL/12RESM1		
Schematic Diagram	ADV-7325	31
Point-to-Point Wiring Diagram	GM51414	32
18RESL		
Schematic Diagram	ADV-7353	33
Point-to-Point Wiring Diagram	GM52541	34

Figure 2-1 Drawing Numbers and Locations

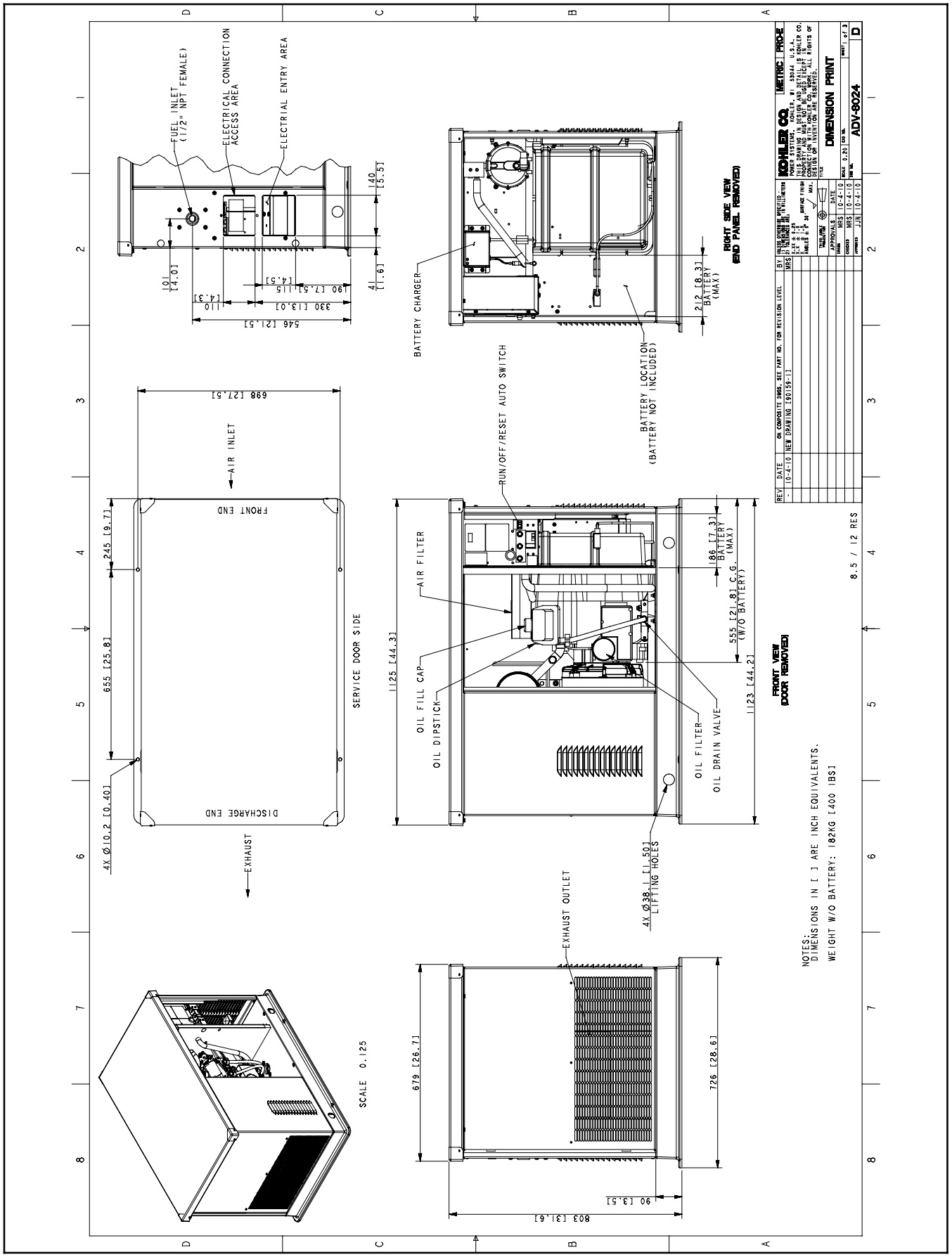


Figure 2-2 Generator Set Mounting Details and Dimensions, 12RESL/12RESM1 ADV-8024 Sheet 1

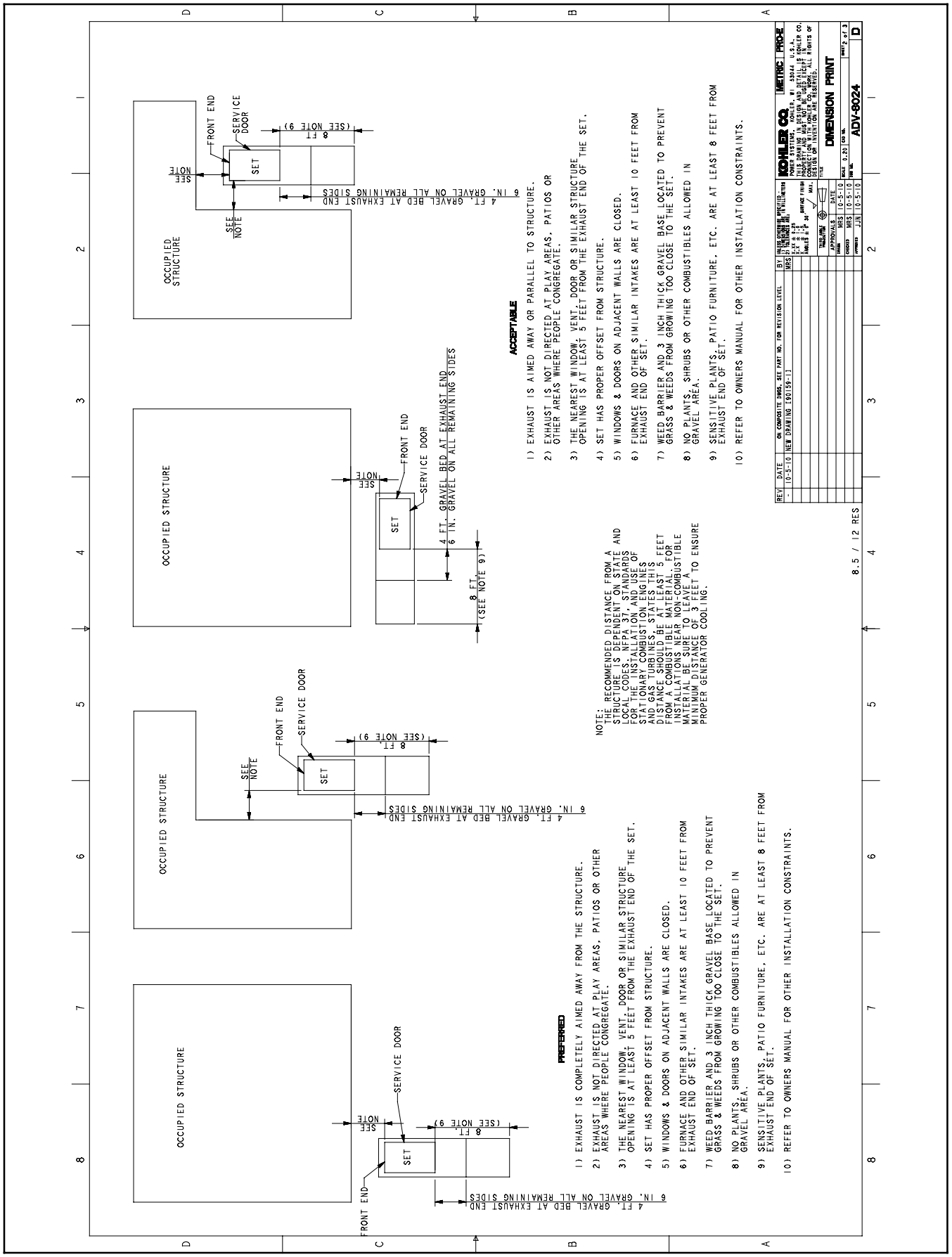


Figure 2-3 Generator Set Clearances, 12RESL/12RESM1 ADV-8024 Sheet 2

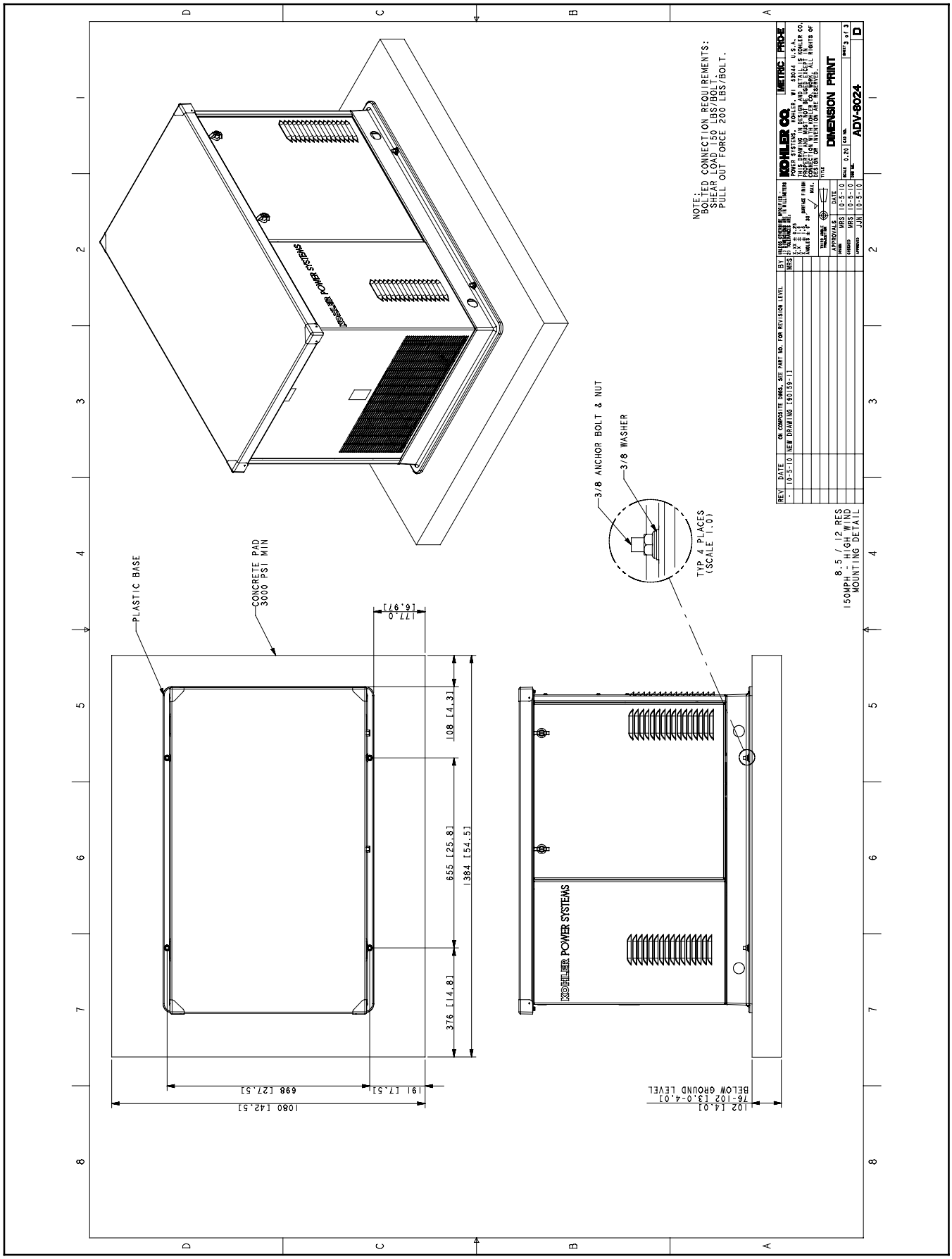


Figure 2-4 High Wind Mounting Detail, 12RESL/12RESM1 ADV-8024 Sheet 3

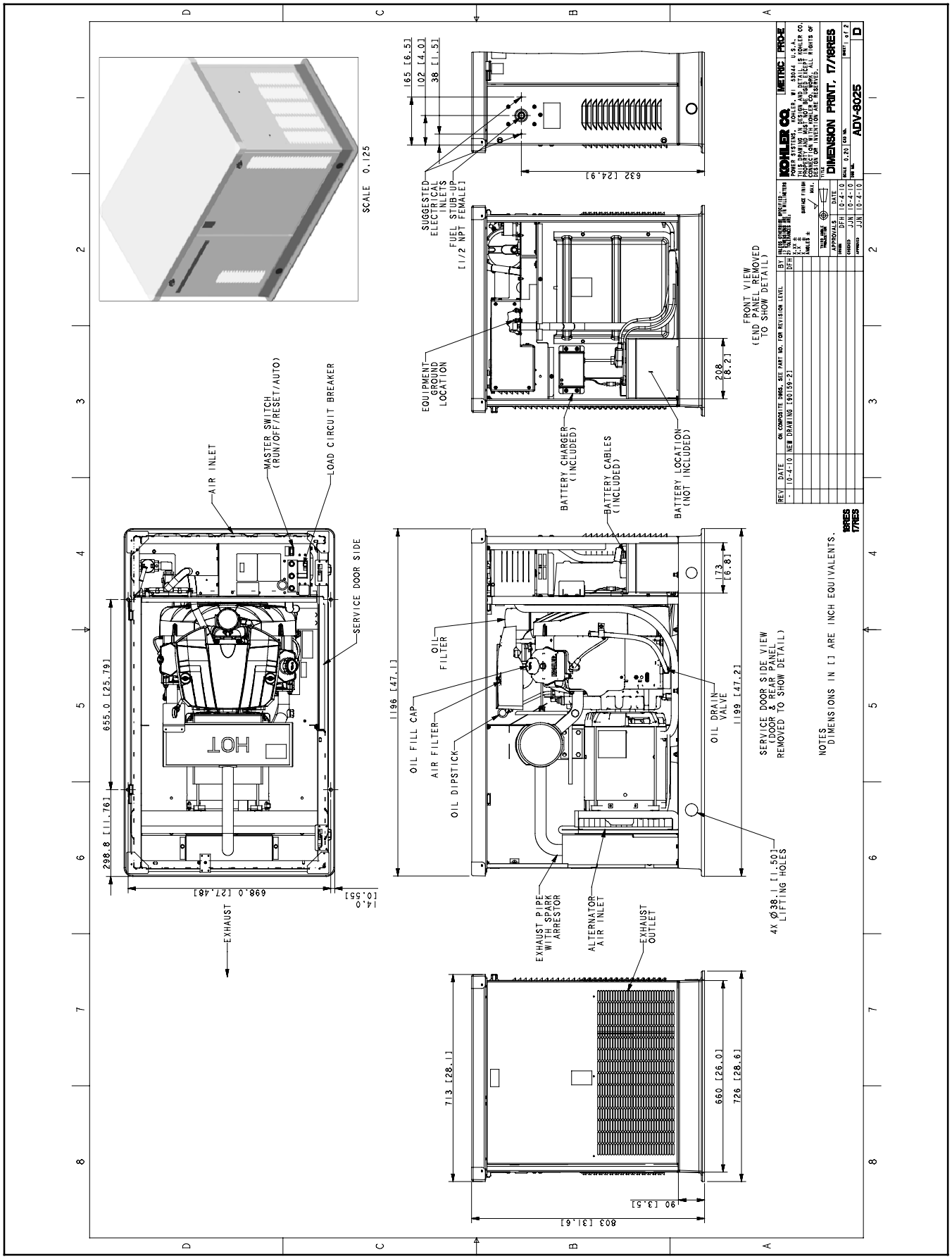


Figure 2-5 Generator Set Mounting Details and Dimensions, 18RES ADV-8025, Sheet 1

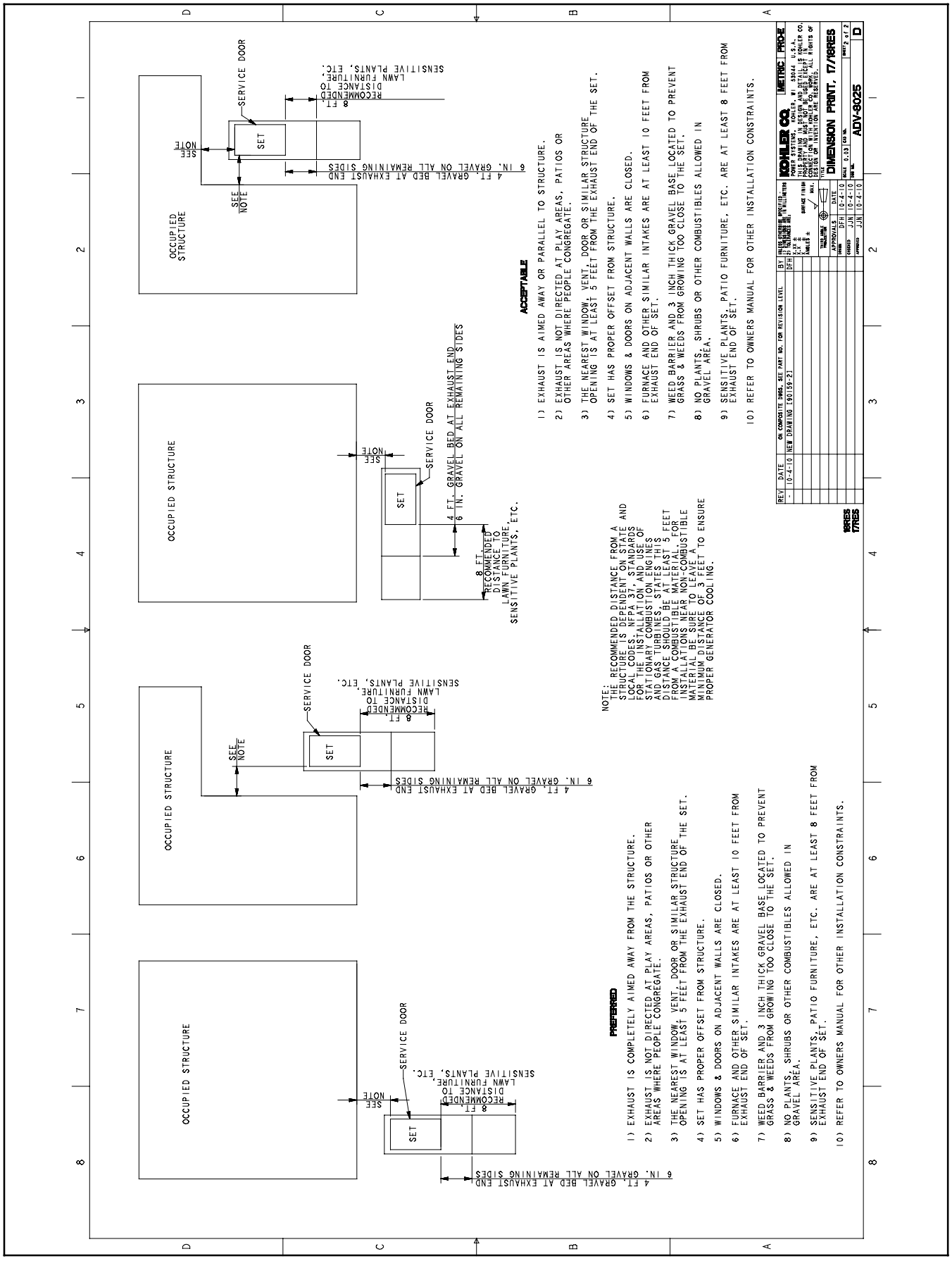


Figure 2-6 Generator Set Clearances,18RES ADV-8025, Sheet 2

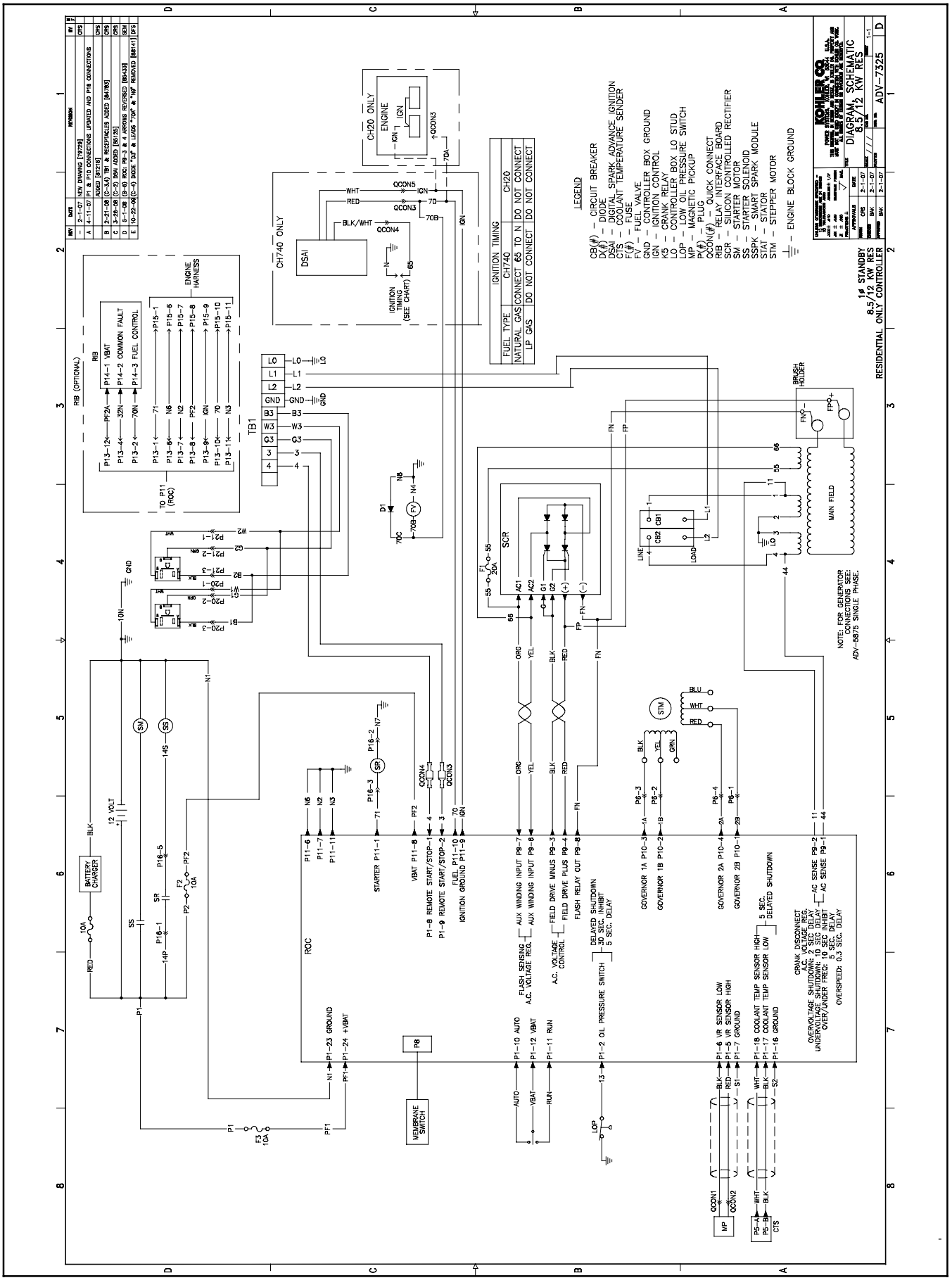


Figure 2-7 Schematic Diagram, Single Phase, 12RESL/12RESM1, ADV-7325-E

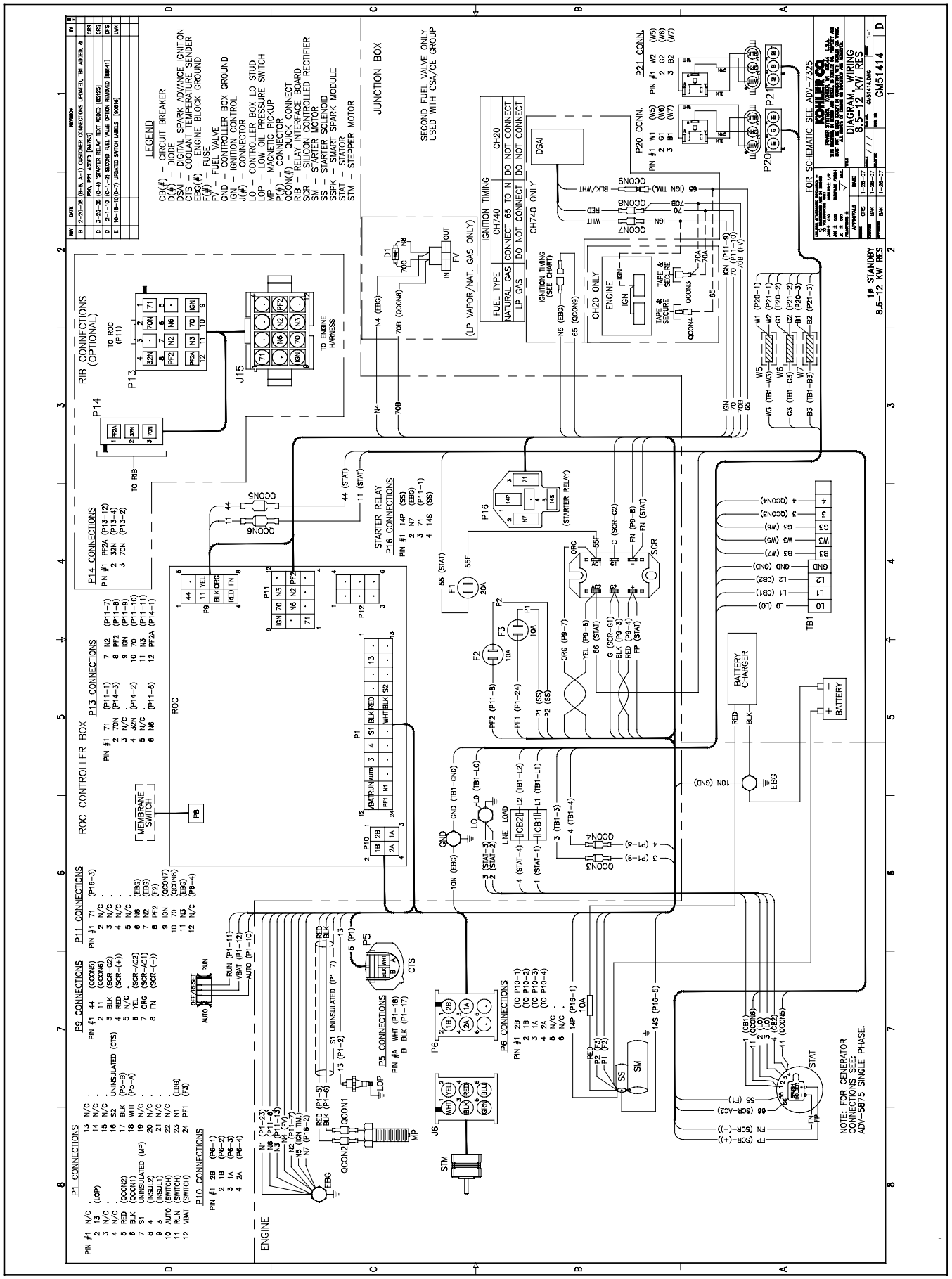


Figure 2-8 Point-to-Point Wiring Diagram, Single Phase, 12RESL/12RESM1, GM51414-E

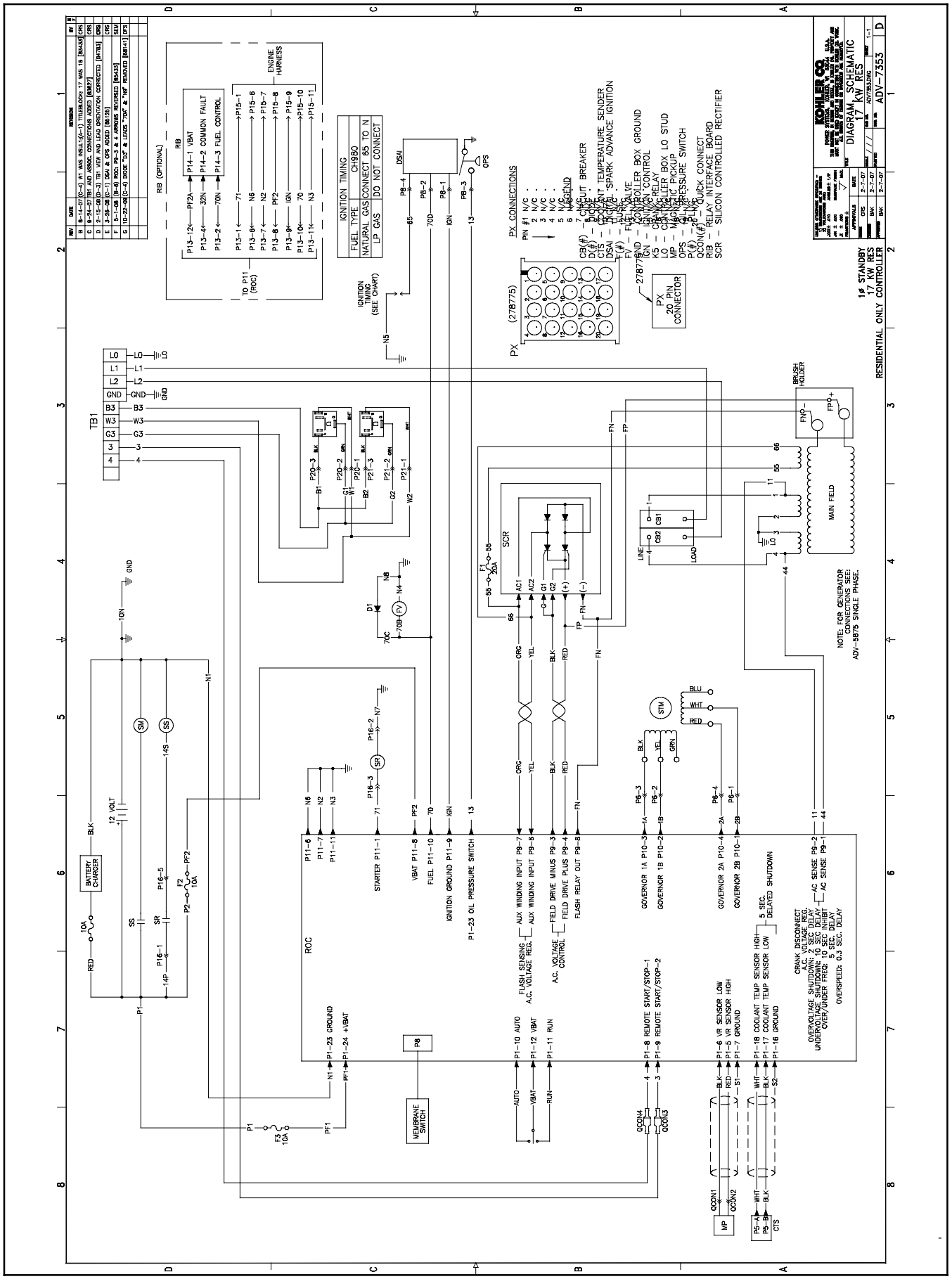


Figure 2-9 Schematic Diagram, Single Phase, 18RESL, ADV-7353-G

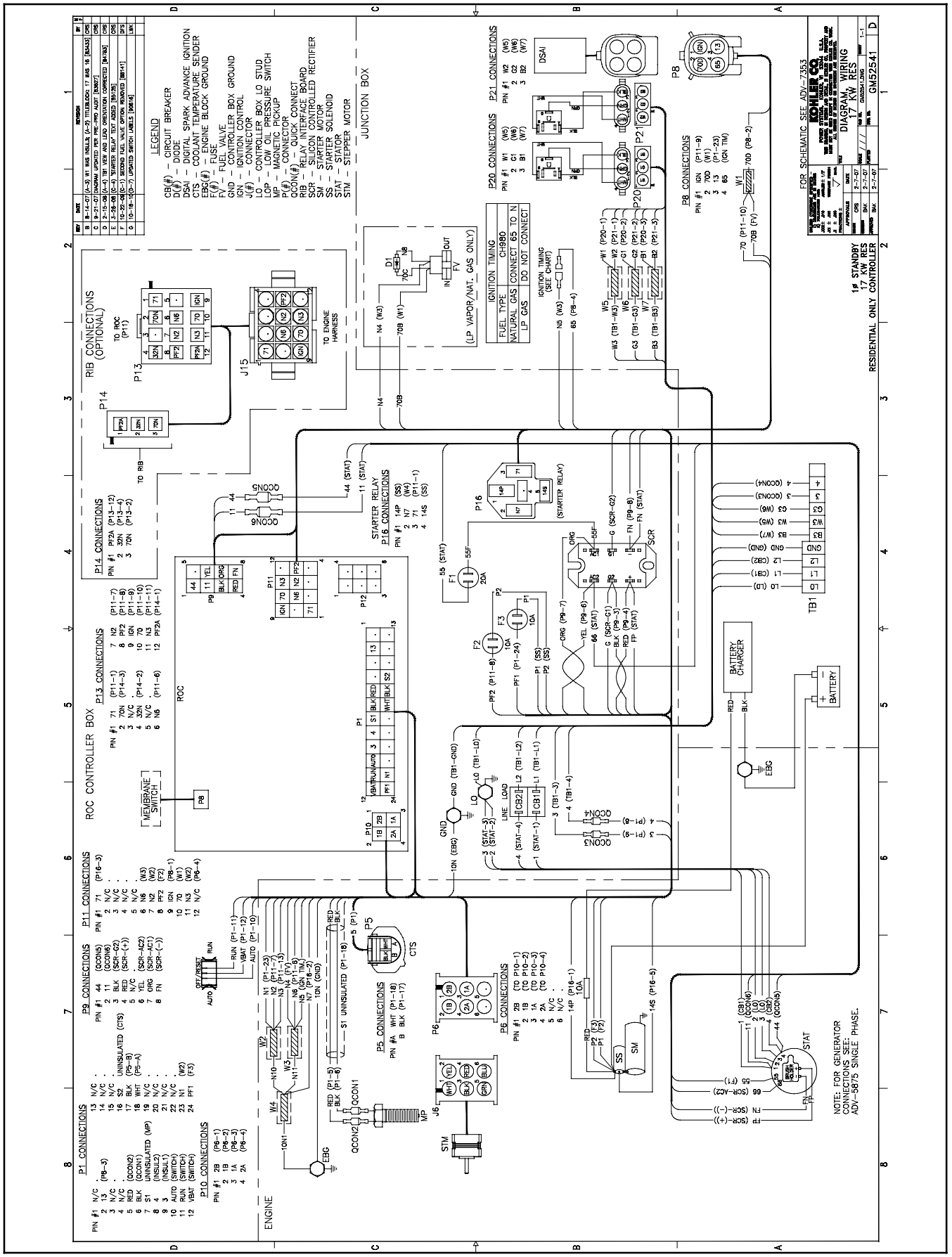


Figure 2-10 Point-to-Point Wiring Diagram, Single Phase, 18RESL, GM52541-G

Appendix A Abbreviations

The following list contains abbreviations that may appear in this publication.

A, amp	ampere
ABDC	after bottom dead center
AC	alternating current
A/D	analog to digital
ADC	advanced digital control; analog to digital converter
adj.	adjust, adjustment
ADV	advertising dimensional drawing
Ah	amp-hour
AHWT	anticipatory high water temperature
AISI	American Iron and Steel Institute
ALOP	anticipatory low oil pressure
alt.	alternator
Al	aluminum
ANSI	American National Standards Institute (formerly American Standards Association, ASA)
AO	anticipatory only
APDC	Air Pollution Control District
API	American Petroleum Institute
approx.	approximate, approximately
AQMD	Air Quality Management District
AR	as required, as requested
AS	as supplied, as stated, as suggested
ASE	American Society of Engineers
ASME	American Society of Mechanical Engineers
assy.	assembly
ASTM	American Society for Testing Materials
ATDC	after top dead center
ATS	automatic transfer switch
auto.	automatic
aux.	auxiliary
avg.	average
AVR	automatic voltage regulator
AWG	American Wire Gauge
AWM	appliance wiring material
bat.	battery
BBDC	before bottom dead center
BC	battery charger, battery charging
BCA	battery charging alternator
BCI	Battery Council International
BDC	before dead center
BHP	brake horsepower
blk.	black (paint color), block (engine)
blk. htr.	block heater
BMEP	brake mean effective pressure
bps	bits per second
br.	brass
BTDC	before top dead center
Btu	British thermal unit
Btu/min.	British thermal units per minute
C	Celsius, centigrade
cal.	calorie
CAN	controller area network
CARB	California Air Resources Board
CB	circuit breaker
cc	cubic centimeter
CCA	cold cranking amps
ccw.	counterclockwise
CEC	Canadian Electrical Code
cert.	certificate, certification, certified
cfh	cubic feet per hour
cfm	cubic feet per minute
CG	center of gravity
CID	cubic inch displacement
CL	centerline
cm	centimeter
CMOS	complementary metal oxide substrate (semiconductor)
cogen.	cogeneration
com	communications (port)
coml	commercial
Coml/Rec	Commercial/Recreational
conn.	connection
cont.	continued
CPVC	chlorinated polyvinyl chloride
crit.	critical
CRT	cathode ray tube
CSA	Canadian Standards Association
CT	current transformer
Cu	copper
cUL	Canadian Underwriter's Laboratories
CUL	Canadian Underwriter's Laboratories
cu. in.	cubic inch
cw.	clockwise
CWC	city water-cooled
cyl.	cylinder
D/A	digital to analog
DAC	digital to analog converter
dB	decibel
dB(A)	decibel (A weighted)
DC	direct current
DCR	direct current resistance
deg., °	degree
dept.	department
DFMEA	Design Failure Mode and Effects Analysis
dia.	diameter
DI/EO	dual inlet/end outlet
DIN	Deutsches Institut fur Normung e. V. (also Deutsche Industrie Normenausschuss)
DIP	dual inline package
DPDT	double-pole, double-throw
DPST	double-pole, single-throw
DS	disconnect switch
DVR	digital voltage regulator
E, emer.	emergency (power source)
ECM	electronic control module, engine control module
EDI	electronic data interchange
EFR	emergency frequency relay
e.g.	for example (*exempli gratia)*
EG	electronic governor
EGSA	Electrical Generating Systems Association
EIA	Electronic Industries Association
EI/EO	end inlet/end outlet
EMI	electromagnetic interference
emiss.	emission
eng.	engine
EPA	Environmental Protection Agency
EPS	emergency power system
ER	emergency relay
ES	engineering special, engineered special
ESD	electrostatic discharge
est.	estimated
E-Stop	emergency stop
etc.	et cetera (and so forth)
exh.	exhaust
ext.	external
F	Fahrenheit, female
fglass.	fiberglass
FHM	flat head machine (screw)
fl. oz.	fluid ounce
flex.	flexible
freq.	frequency
FS	full scale
ft.	foot, feet
ft. lb.	foot pounds (torque)
ft./min.	feet per minute
ftp	file transfer protocol
g	gram
ga.	gauge (meters, wire size)
gal.	gallon
gen.	generator
genset	generator set
GFI	ground fault interrupter
GND, ⏚	ground
gov.	governor
gph	gallons per hour
gpm	gallons per minute
gr.	grade, gross
GRD	equipment ground
gr. wt.	gross weight
H x W x D	height by width by depth
HC	hex cap
HCHT	high cylinder head temperature
HD	heavy duty
HET	high exhaust temp., high engine temp.
hex	hexagon
Hg	mercury (element)
HH	hex head
HHC	hex head cap
HP	horsepower
hr.	hour
HS	heat shrink
hsg.	housing
HVAC	heating, ventilation, and air conditioning
HWT	high water temperature
Hz	hertz (cycles per second)
IC	integrated circuit
ID	inside diameter, identification
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
IMS	improved motor starting
in.	inch
in. H_2O	inches of water
in. Hg	inches of mercury
in. lb.	inch pounds
Inc.	incorporated
ind.	industrial
int.	internal
int./ext.	internal/external
I/O	input/output
IP	iron pipe
ISO	International Organization for Standardization
J	joule
JIS	Japanese Industry Standard

k	kilo (1000)
K	kelvin
kA	kiloampere
KB	kilobyte (2^{10} bytes)
KBus	Kohler communication protocol
kg	kilogram
kg/cm^2	kilograms per square centimeter
kgm	kilogram-meter
kg/m^3	kilograms per cubic meter
kHz	kilohertz
kJ	kilojoule
km	kilometer
kOhm, kΩ	kilo-ohm
kPa	kilopascal
kph	kilometers per hour
kV	kilovolt
kVA	kilovolt ampere
kVAR	kilovolt ampere reactive
kW	kilowatt
kWh	kilowatt-hour
kWm	kilowatt mechanical
kWth	kilowatt-thermal
L	liter
LAN	local area network
L x W x H	length by width by height
lb.	pound, pounds
lbm/ft^3	pounds mass per cubic feet
LCB	line circuit breaker
LCD	liquid crystal display
ld. shd.	load shed
LED	light emitting diode
Lph	liters per hour
Lpm	liters per minute
LOP	low oil pressure
LP	liquefied petroleum
LPG	liquefied petroleum gas
LS	left side
L_{wa}	sound power level, A weighted
LWL	low water level
LWT	low water temperature
m	meter, milli (1/1000)
M	mega (10^6 when used with SI units), male
m^3	cubic meter
m^3/hr.	cubic meters per hour
m^3/min.	cubic meters per minute
mA	milliampere
man.	manual
max.	maximum
MB	megabyte (2^{20} bytes)
MCCB	molded-case circuit breaker
MCM	one thousand circular mils
meggar	megohmmeter
MHz	megahertz
mi.	mile
mil	one one-thousandth of an inch
min.	minimum, minute
misc.	miscellaneous
MJ	megajoule
mJ	millijoule
mm	millimeter
mOhm, mΩ	milliohm
MOhm, MΩ	megohm
MOV	metal oxide varistor
MPa	megapascal
mpg	miles per gallon
mph	miles per hour
MS	military standard
ms	millisecond
m/sec.	meters per second
MTBF	mean time between failure
MTBO	mean time between overhauls
mtg.	mounting
MTU	Motoren-und Turbinen-Union
MW	megawatt
mW	milliwatt
μF	microfarad
N, norm.	normal (power source)
NA	not available, not applicable
nat. gas	natural gas
NBS	National Bureau of Standards
NC	normally closed
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
Nm	newton meter
NO	normally open
no., nos.	number, numbers
NPS	National Pipe, Straight
NPSC	National Pipe, Straight-coupling
NPT	National Standard taper pipe thread per general use
NPTF	National Pipe, Taper-Fine
NR	not required, normal relay
ns	nanosecond
OC	overcrank
OD	outside diameter
OEM	original equipment manufacturer
OF	overfrequency
opt.	option, optional
OS	oversize, overspeed
OSHA	Occupational Safety and Health Administration
OV	overvoltage
oz.	ounce
p., pp.	page, pages
PC	personal computer
PCB	printed circuit board
pF	picofarad
PF	power factor
ph., ∅	phase
PHC	Phillips® head Crimptite® (screw)
PHH	Phillips® hex head (screw)
PHM	pan head machine (screw)
PLC	programmable logic control
PMG	permanent magnet generator
pot	potentiometer, potential
ppm	parts per million
PROM	programmable read-only memory
psi	pounds per square inch
psig	pounds per square inch gauge
pt.	pint
PTC	positive temperature coefficient
PTO	power takeoff
PVC	polyvinyl chloride
qt.	quart, quarts
qty.	quantity
R	replacement (emergency) power source
rad.	radiator, radius
RAM	random access memory
RDO	relay driver output
ref.	reference
rem.	remote
Res/Coml	Residential/Commercial
RFI	radio frequency interference
RH	round head
RHM	round head machine (screw)
rly.	relay
rms	root mean square
rnd.	round
ROM	read only memory
rot.	rotate, rotating
rpm	revolutions per minute
RS	right side
RTU	remote terminal unit
RTV	room temperature vulcanization
RW	read/write
SAE	Society of Automotive Engineers
scfm	standard cubic feet per minute
SCR	silicon controlled rectifier
s, sec.	second
SI	*Systeme international d'unites,* International System of Units
SI/EO	side in/end out
sil.	silencer
SN	serial number
SNMP	simple network management protocol
SPDT	single-pole, double-throw
SPST	single-pole, single-throw
spec	specification
specs	specification(s)
sq.	square
sq. cm	square centimeter
sq. in.	square inch
SS	stainless steel
std.	standard
stl.	steel
tach.	tachometer
TD	time delay
TDC	top dead center
TDEC	time delay engine cooldown
TDEN	time delay emergency to normal
TDES	time delay engine start
TDNE	time delay normal to emergency
TDOE	time delay off to emergency
TDON	time delay off to normal
temp.	temperature
term.	terminal
THD	total harmonic distortion
TIF	telephone influence factor
TIR	total indicator reading
tol.	tolerance
turbo.	turbocharger
typ.	typical (same in multiple locations)
UF	underfrequency
UHF	ultrahigh frequency
UL	Underwriter's Laboratories, Inc.
UNC	unified coarse thread (was NC)
UNF	unified fine thread (was NF)
univ.	universal
US	undersize, underspeed
UV	ultraviolet, undervoltage
V	volt
VAC	volts alternating current
VAR	voltampere reactive
VDC	volts direct current
VFD	vacuum fluorescent display
VGA	video graphics adapter
VHF	very high frequency
W	watt
WCR	withstand and closing rating
w/	with
w/o	without
wt.	weight
xfmr	transformer

Notes

Notes

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