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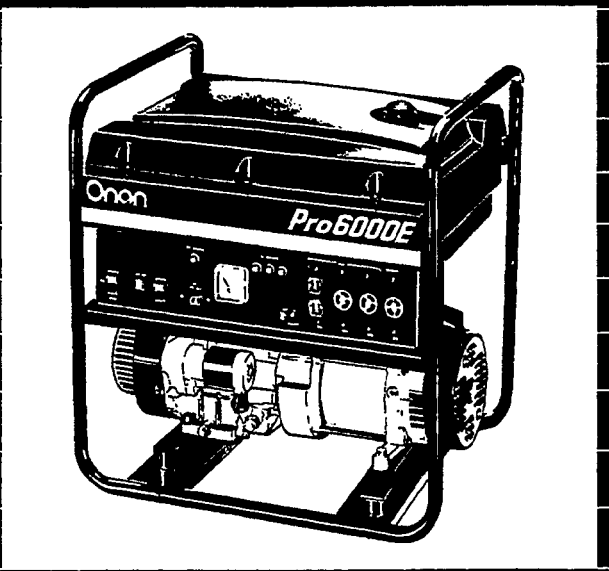
Onan Portable GenSets

Service Manual

EGH, EGS



Printed in U.S.A.

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Section 1. Introduction

ABOUT THIS MANUAL

This manual contains service information for the EGH and EGS series portable generator sets. The manual covers troubleshooting, disassembly, repair and adjustments for the engine, generator and control. Service technicians should be thoroughly familiar with the principles of gasoline engine operation and have a basic knowledge of electrical theory. Other Onan publications such as Electrical/Mechanical Fundamentals (932-0408), Onan Generator Training Manual (932-0404), and the Standard and Pro Series Operator's Manual (981-0130 for 60 Hz or 981-0131 for 50 Hz models) are recommended as additional sources of information.

Read all service procedures completely before beginning any repair work and observe all cautions and warnings. It is extremely important that the generator set be operated in compliance with any applicable state, local, or U.S. Forest Service codes or restrictions. Improper service can result in an unsafe condition that could result in severe personal injury, death, and/or equipment damage.

MODEL IDENTIFICATION

When contacting an Onan service center, always supply the complete model number and serial number as shown on the Onan nameplate. This information is necessary to identify the set when ordering replacement parts. See Figure 1-1.

Always use genuine Onan replacement parts obtained from an authorized Onan service center. Universal replacement parts (usually intended for automotive use) often look similar but do not perform to Onan specifications. Only genuine Onan replacement parts are designed and tested for the application.

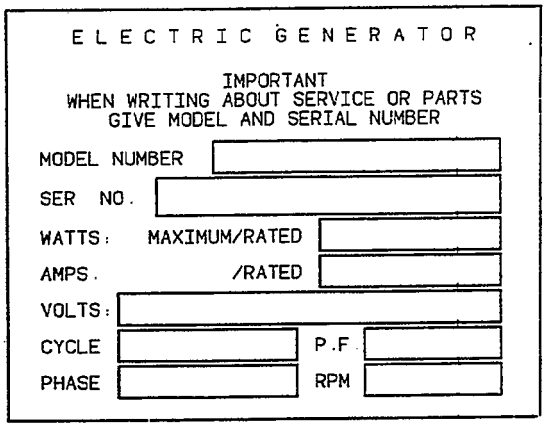


FIGURE 1-1. ONAN NAMEPLATE

⚠WARNING

INCORRECT SERVICE OR REPLACEMENT OF PARTS CAN RESULT IN SEVERE PERSONAL INJURY, DEATH, AND/OR EQUIPMENT DAMAGE. SERVICE PERSONNEL MUST BE QUALIFIED TO PERFORM ELECTRICAL AND MECHANICAL SERVICE.

Section 2. Specifications

TABLE 2-1. STANDARD SERIES SPECIFICATIONS - 60 HZ MODELS

MODEL	1.4 EGSAA	1.7 EGHAA	2.5 EGHAA	4.0 EGHAB	5.0 EGHAB
Engine Details					
Valve Design	SIDE VALVE	OHV	OHV	OHV	OHV
Engine Model Number	GS130	GH170	GH170	GH280	GH400
Displacement					
Inches³ (cm³)	7.93 (130)	10.31 (169)	10.31 (169)	16.72 (274)	23.74 (389)
Bore - Inches (mm)	2.36 (60)	2.64 (67)	2.64 (67)	3.11 (79)	3.31 (84.2)
Stroke - Inches (mm)	1.81 (46)	1.89 (48)	1.89 (48)	2.20 (56)	2.76 (70)
Compression Ratio	6.0:1	8.3:1	8.3:1	8.1:1	8.5:1
Engine Speed (RPM)	3600	3600	3600	3600	3600
Engine Oil Capacity					
Quarts (Litres)	0.58 (0.55)	0.63 (0.6)	0.63 (0.6)	0.95 (0.9)	1.16 (1.1)
Generator Set Details					
AC Output - 60 Hertz, 1Ø					
Voltage	120	120	120	120/240	120/240
Wattage (Max. Power)	1400	1700	2500	4000	5000
Wattage (Rated Power)	1200	1400	2000	3500	5000
Current (Rated Amperes)	10.0	12.5	16.7	29.2/14.6	41.6/20.8
Voltage Regulator Type	Capacitor	Capacitor	Capacitor	Transistor	Transistor
DC Output					
Watts	60	60	120	—	—
Volts x Amperes	12 x 5	12 x 5	12 x 10	—	—
Starting System	Recoil	Recoil	Recoil	Recoil	Recoil
Dry Weight					
Pounds (Kilograms)	70 (32)	75 (34)	85 (39)	130 (59)	170 (77)
Tune-Up Specs					
Spark Plug Gap					
Inches (mm)	0.039 (1.0)	0.028 (0.7)	0.028 (0.7)	0.028 (0.7)	0.039 (1.0)
Valve Lash					
Intake and Exhaust					
Inches	.0031-0.0055	0.002-0.0039	0.002-0.0039	0.002-0.0039	0.0012-0.0031
Millimeters	0.08-0.14	0.05-0.10	0.05-0.10	0.05-0.10	0.03-0.08

TABLE 2-2. STANDARD SERIES SPECIFICATIONS - 50 HZ MODELS

MODEL	1.4 EGHAM	2.0 EGHAM	3.5 EGHAM	5.0 EGHAM
Engine Details				
Valve Design	OHV	OHV	OHV	OHV
Engine Model Number	GH170	GH170	GH280	GH400
Displacement				
Inches³ (cm³)	10.31 (169)	10.31 (169)	16.72 (274)	23.74 (389)
Bore - Inches (mm)	2.64 (67)	2.64 (67)	3.11 (79)	3.31 (84.2)
Stroke - Inches (mm)	1.89 (48)	1.89 (48)	2.20 (56)	2.76 (70)
Compression Ratio	8.3:1	8.3:1	8.1:1	8.5:1
Engine Speed (RPM)	3000	3000	3000	3000
Engine Oil Capacity				
Quarts (Litres)	0.63 (0.6)	0.63 (0.6)	0.95 (0.9)	1.16 (1.1)
Generator Set Details				
AC Output - 50 Hertz, 1Ø				
Voltage	110/220	110/220	110/220	110/220
Wattage (Max. Power)	1400	2000	3500	5000
Wattage (Rated Power)	1400	1800	3000	4500
Current (Rated Amperes)	12.7/6.4	16.4/8.2	27.2/13.6	40.9/20.4
Voltage Regulator Type	*Capacitor/Transistor	*Capacitor/Transistor	Transistor	Transistor
DC Output				
Watts	100	100	—	—
Volts x Amperes	12 x 8.3	12 x 8.3	—	—
Starting System	Recoil	Recoil	Recoil	Recoil
Dry Weight				
Pounds (Kilograms)	80 (36.3)	90 (40.8)	140 (6.35)	170 (77)
Tune-Up Specs				
Spark Plug Gap				
Inches (mm)	0.028 (0.7)	0.028 (0.7)	0.028 (0.7)	0.039 (1.0)
Valve Lash				
Intake and Exhaust				
Inches	0.002-0.0039	0.002-0.0039	0.002-0.0039	0.0012-0.0031
Millimeters	0.05-0.10	0.05-0.10	0.05-0.10	0.03-0.08

*Spec A models have capacitor type voltage regulators.

TABLE 2-3. PRO SERIES SPECIFICATIONS - 60 HZ MODELS

PRO MODEL	2.5 EGHAA	4.0 EGHAB	4.0 EGHEB	5.0 EGHAB	5.0 EGHEB	6.0 EGHEB
Engine Details						
Engine Design	Gasoline 4-Cycle OHV, Single Cylinder, Air Cooled					
Engine Model Number	GH170	GH280	GH280	GH400	GH400	GH400
Displacement						
Inches³ (cm³)	10.31 (169)	16.72 (274)	16.72 (274)	23.74 (389)	23.74 (389)	23.74 (389)
Bore - Inches (mm)	2.64 (67)	3.11 (79)	3.11 (79)	3.31 (84.2)	3.31 (84.2)	3.31 (84.2)
Stroke - Inches (mm)	1.89 (48)	2.20 (56)	2.20 (56)	2.76 (70)	2.76 (70)	2.76 (70)
Compression Ratio	8.3:1	8.1:1	8.1:1	8.5:1	8.5:1	8.5:1
Engine Speed (RPM)	3600	3600	3600	3600	3600	3600
Engine Oil Capacity						
Quarts (Litres)	0.63 (0.6)	0.95 (0.9)	0.95 (0.9)	1.16 (1.1)	1.16 (1.1)	1.16 (1.1)
Generator Set Details						
AC Output - 60 Hz, 1Ø						
Voltage	120	120/240	120/240	120/240	120/240	120/240
Wattage (Maximum)	2500	4000	4000	5000	5000	6000
Wattage (Rated)	2000	3500	3500	5000	5000	5500
Current (Rated Amps)	16.7	29.2/14.6	29.2/14.6	41.6/20.8	41.6/20.8	45.8/22.9
Voltage Reg. Type	Capacitor	Transistor	Transistor	Transistor	Transistor	Transistor
DC Output						
Watts	120	120	120	120	120	120
Volts x Amperes	12 x 10	12 x 10	12 x 10	12 x 10	12 x 10	12 x 10
Starting System	Recoil	Recoil	Electric/Recoil	Recoil	Electric/Recoil	Electric/Recoil
Weight						
Pounds (Kilograms)	110 (50)	145 (66)	155 (70)	175 (79)	185 (84)	205 (93)
Battery Requirements:						
Battery (Group U1)	—	—	—	—	12-Volt	12-Volt
Cold Cranking Amps (at 32°F [0°C])	—	—	—	—	235	235
Tune-Up Specs						
Spark Plug Gap						
Inches (Millimeters)	0.028 (0.7)	0.028 (0.7)	0.028 (0.7)	0.039 (1.0)	0.039 (1.0)	0.039 (1.0)
Valve Lash						
Intake and Exhaust						
Inches	0.002-0.0039	0.002-0.0039	0.002-0.0039	0.0012-0.0031	0.0012-0.0031	0.0012-0.0031
Millimeters	0.05-0.10	0.05-0.10	0.05-0.10	0.03-0.08	0.03-0.08	0.03-0.08

TABLE 2-4. PRO SERIES SPECIFICATIONS - 50 HZ MODELS

PRO MODEL	2.0 EGHAM	3.5 EGHEM	5.0 EGHEM
Engine Details			
Engine Design	Gasoline 4-Cycle OHV, Single Cylinder, Air Cooled		
Engine Model Number	GH170	GH280	GH400
Displacement			
Inches³ (cm³)	10.31 (169)	16.72 (274)	23.74 (389)
Bore - Inches (mm)	2.64 (67)	3.11 (79)	3.31 (84.2)
Stroke - Inches (mm)	1.89 (48)	2.20 (56)	2.76 (70)
Compression Ratio	8.3:1	8.1:1	8.5:1
Engine Speed (RPM)	3000	3000	3000
Engine Oil Capacity			
Quarts (Litres)	0.63 (0.6)	0.95 (0.9)	1.16 (1.1)
Generator Set Details			
AC Output - 50 Hz, 1Ø			
Voltage	110/220	110/220	110/220
Wattage (Maximum)	2000	3500	5000
Wattage (Rated)	1800	3000	4500
Current (Rated Amps)	16.4/8.2	27.2/13.6	40.9/20.4
Voltage Reg. Type	*Capacitor/Transistor	Transistor	Transistor
DC Output			
Watts	100	100	100
Volts x Amperes	12 x 8.3	12 x 8.3	12 x 8.3
Starting System	Recoil	Recoil/Electric	Recoil/Electric
Weight			
Pounds (Kilograms)	119 (54)	165 (75)	207 (94)
Battery Requirements:			
Battery (Group U1)	—	12-Volt	12-Volt
Cold Cranking Amps (at 32°F [0°C])	—	235	235
Tune-Up Specs			
Spark Plug Gap			
Inches (Millimeters)	0.028 (0.7)	0.028 (0.7)	0.039 (1.0)
Valve Lash			
Intake and Exhaust			
Inches	0.002-0.0039	0.002-0.0039	0.0012-0.0031
Millimeters	0.05-0.10	0.05-0.10	0.03-0.08

*Spec A model has a capacitor type voltage regulator.

Section 3. Dimensions and Clearances

Dimensions and clearances can vary by engine size. The engine model number must be identified by referring to the *Specifications* section prior to using these tables.

Cylinder Head

Item	Engine Model	Factory Specification	Allowable Limit
Cylinder head surface flatness	GS130	—	0.4 mm 0.0157 in.
	GH-ALL	—	0.05 mm 0.0020 in.
Compression Pressure	GH-ALL	245 kPa or more 36 psi or more	196 kPa 28 psi

Valves

Valve Clearance (Intake and Exhaust)		GS130	0.08 to 0.14 mm 0.0031 to 0.0055 in.	—
		GH170, GH280	0.05 to 10 mm 0.0020 to 0.0039 in.	—
		GH400	0.03 to 0.08 mm 0.0012 to 0.0031 in.	—
Valve Seat Width		GS130 GH-ALL	1.00 to 1.30 mm 0.039 to 0.051 in.	1.7 mm 0.067 in.
Valve Seat Angle		GS130 GH-ALL	45°	—
Valve Face Angle		GS130 GH-ALL	45°	—
Clearance between Valve and Valve Guide	IN.			
		GS130	0.030 to 0.067 mm 0.0012 to 0.0026 in.	0.1 mm 0.0039
		GH170	0.020 to 0.044 mm 0.0008 to 0.0017 in.	0.1 mm 0.0039 in.
		GH280, GH400	0.025 to 0.055 mm 0.0010 to 0.0022 in.	0.1 mm 0.039 in.
	EX.	GS130	0.050 to 0.095 mm 0.0020 to 0.0037 in.	0.1 mm 0.0039 in.
		GH170	0.040 to 0.072 mm 0.0016 to 0.0028 in.	0.1 mm 0.0039 in.
		GH280, GH400	0.040 to 0.075 mm 0.0016 to 0.0030 in.	0.1 mm 0.0039 in.

Valves (Continued)

Item		Engine Model	Factory Specification	Allowable Limit
Valve Stem O.D.	IN.	GS130	5.968 to 5.980 mm 0.2350 to 0.2354 in.	—
		GH170	5.468 to 5.480 mm 0.2153 to 0.2157 in.	—
		GH280	6.460 to 6.475 mm 0.2543 to 0.2549 in.	—
		GH400	6.960 to 6.975 mm 0.2740 to 0.2746 in.	—
	EX.	GS130	5.94 to 5.96 mm 0.2339 to 0.2346 in.	—
		GH170	5.440 to 5.460 mm 0.2142 to 0.2150 in.	—
		GH280	6.440 to 6.460 mm 0.2535 to 0.2543 in.	—
		GH400	7.940 to 7.960 mm 0.3126 to 0.3134 in.	—
Valve Guide I.D.	IN.	GS130	6.010 to 6.035 mm 0.2366 to 0.2376 in.	—
		GH170	5.500 to 5.512 mm 0.2165 to 0.2170 in.	—
		GH280	6.500 to 6.515 mm 0.2559 to 0.2565 in.	—
		GH400	7.000 to 7.015 mm 0.2756 to 0.2762 in.	—
	EX.	GS130	6.010 to 6.035 mm 0.2366 to 0.2376 in.	—
		GH170	5.500 to 5.512 mm 0.2165 to 0.2170 in.	—
		GH280	6.500 to 6.515 mm 0.2559 to 0.2565 in.	—
		GH400	8.000 to 8.015 mm 0.3150 to 0.3156 in.	—

Valve Timing

Intake Valve	Open	GS130	58° to 70° before T.D.C.	—
		GH170, GH280	70° before T.D.C.	—
		GH400	85° before T.D.C.	—
	Close	GS130	98° to 110° after B.D.C.	—
		GH170	110° after B.D.C.	—
		GH280	128° after B.D.C.	—
		GH400	119° after B.D.C.	—

Valve Timing (Continued)

Item		Engine Model	Factory Specification	Allowable Limit
Exhaust Valve	Open	GS130	98° to 110° before B.D.C.	—
		GH170	110° before T.D.C.	—
		GH280	118° before T.D.C.	—
		GH400	128° before T.D.C.	—
	Close	GS130	58° to 70° after T.D.C.	—
		GH170	70° after B.D.C.	—
		GH280	80° after B.D.C.	—
		GH400	76° after B.D.C.	—

Valve Spring

Free Length	GS130	30.8 to 31.3 mm 1.2126 to 1.2323 in.	30.5 mm 1.2008 in.
	GH170	33.0 to 33.5 mm 1.2992 to 1.3189 in.	32.7 mm 1.2874 in.
	GH280	32.8 to 33.3 mm 1.2913 to 1.3110 in.	32.5 mm 1.2795 in.
	GH400	45.5 to 45.8 mm 1.7913 to 1.8031 in.	45.0 mm 1.7717 in.
Setting Load/Setting Length	GS130	6.8 kgf/24.5 mm 15.0 lbs./0.9946 in.	6.1 kgf/24.5 in. 13.4 lbs./0.9646 in.
	GH170	5.90 kgf/22.5 mm 13.0 lbs./0.886 in.	5.3 kgf/22.5 mm 11.7 lbs./0.886 in.
	GH280	6.44 kgf/27.0 mm 14.2 lbs./1.063 in.	5.6 kgf/27.0 mm 12.3 lbs./1.063 in.
	GH400	13.92 kgf/33.2 mm 30.7 lbs./1.307 in.	12.7 kgf/33.2 mm 28.0 lbs./1.307 in.
Tilt (Allowable squareness limit)	GS130 GH-ALL	—	1.5 mm 0.0590 in.

Rocker Arm (GH400 Only)

Clearance between Rocker Arm Shaft and Rocker Arm	GH400	0.016 to 0.045 mm 0.0006 to 0.0018 in.	0.15 mm 0.0059 in.
Rocker Arm Shaft O.D.	GH400	11.973 to 11.984 mm 0.4714 to 0.4718 in.	—
Rocker Arm I.D.	GH400	12.000 to 12.018 mm 0.4724 to 0.4732 in.	—

Tappet

Item	Engine Model	Factory Specification	Allowable Limit
Clearance between tappet and guide	GS130	0.020 to 0.052 mm 0.0008 to 0.0020 in.	0.1 mm 0.0039 in.
	GH170	0.035 to 0.075 mm 0.0014 to 0.0030 in.	0.1 mm 0.0039 in.
	GH280, GH400	0.030 to 0.070 mm 0.0012 to 0.0028 in.	0.1 mm 0.0039 in.
Tappet O.D.	GS130	5.968 to 5.980 mm 0.2350 to 0.2354 in.	—
	GH170, GH280	7.960 to 7.975 mm 0.3133 to 0.3140 in.	—
	GH400	8.960 to 8.975 mm 0.3528 to 0.3533 in.	—

Push Rod

Push Rod Alignment	GH-ALL	—	0.2 mm 0.0079 in.

Camshaft

Side Clearance	GS130 GH-ALL	—	0.2 mm 0.0079 in.
Cam Heights (IN., EX.)	GS130	24.65 mm 0.9705 in.	24.55 mm 0.9665 in.
	GH170	26.10 mm 1.0276 in.	26.00 mm 10.236 in.
	GH280	32.44 mm 1.2772 in.	32.34 mm 1.2732 in.
	GH400	34.685 to 34.715 mm 1.3656 to 1.3667 in.	34.50 mm 1.3583 in.
Camshaft Alignment	GS130 GH-ALL	—	0.05 mm 0.0020 in.
Oil Clearance of Camshaft Journal	GS130 GH-ALL	0.016 to 0.052 mm 0.00063 to 0.00205 in.	0.1 mm 0.0039 in.
Camshaft Journal O.D.	GS130-Gear side	19.980 to 19.993 mm 0.7866 to 0.7871 in.	—
	GS130-Flywheel side	13.966 to 13.984 mm 0.5498 to 0.5506 in.	—
	GH170	14.966 to 14.984 mm 0.5892 to 0.5899 in.	—
	GH280, GH400	17.966 to 17.984 mm 0.7073 to 0.7080 in.	—
Crankcase Bore I.D. (for Camshaft)	GH170	15.000 to 15.018 mm 0.5906 to 0.5913 in.	—
	GH280, GH400	18.000 to 18.018 mm 0.7087 to 0.7094 in.	—

Piston, Piston Ring

Item	Engine Model	Factory Specification	Allowable Limit
Piston Boss I.D.	GS130	12.995 to 13.003 mm 0.5116 to 0.5119 in.	13.05 mm 0.5138 in.
	GH170	14.995 to 15.003 mm 0.5904 to 0.5907 in.	15.05 mm 0.5925 in.
	GH280	17.994 to 18.002 mm 0.7084 to 0.7087 in.	18.05 mm 0.7106 in.
	GH400	19.995 to 20.003 mm 0.7872 to 0.7875 in.	20.04 mm 0.7890 in.
Piston Skirt O.D.	GS130	59.94 to 59.96 mm 2.3598 to 2.3606 in.	—
	GH170	66.955 to 66.970 mm 2.6360 to 2.6366 in.	66.87 mm 2.6327 in.
	GH280	78.950 to 78.970 mm 3.1083 to 3.1091 in.	78.87 mm 3.1051 in.
	GH400	84.150 to 84.170 mm 3.3130 to 3.3138 in.	84.05 mm 3.3091 in.
Piston Ring Thickness *Top Ring, Second Ring*	GH-ALL	1.47 to 1.49 mm 0.0579 to 0.0587 in.	1.45 mm 0.0571 in.
Oil Ring	GH170, GH280	2.47 to 2.49 mm 0.0972 to 0.0980 in.	2.45 mm 0.0965 in.
	GH400	2.85 to 2.95 mm 0.1122 to 0.1161 in.	—
Clearance between Piston Ring and Groove	GS130 GH-ALL	0.02 to 0.06 mm 0.0008 to 0.0024 in.	0.1 mm 0.0039 in.
Piston Ring Gap Top Ring, Second Ring	GS130, GH170 GH280	0.2 to 0.4 mm 0.0079 to 0.0157 in.	0.9 mm 0.0354 in.
	GH400	0.35 to 0.55 mm 0.0138 to 0.0217 in.	0.9 mm 0.0354 in.
Oil Ring	GS130, GH170 GH280	0.2 to 0.4 mm 0.0079 to 0.0157 in.	0.9 mm 0.0354 in.
	GH400	0.2 to 0.7 mm 0.0079 to 0.0276 in.	0.9 mm 0.0354 in.

Connecting Rod

Connecting Rod Alignment	GS130 GH-ALL	—	0.04 mm 0.0016 in.
Clearance between Piston Pin and Small End Bore	GS130 GH-ALL	0.010 to 0.025 mm 0.00039 to 0.00098 in.	0.1 mm 0.0039 in.
Piston Pin O.D.	GS130	13.000 to 13.005 mm 0.5118 to 0.5120 in.	—
	GH170	15.000 to 15.005 mm 0.5906 to 0.5907 in.	—
	GH280	18.000 to 18.005 mm 0.7087 to 0.7089 in.	—
	GH400	20.000 to 20.005 mm 0.7874 to 0.7876 in.	—

Connecting Rod (Continued)

Item	Engine Model	Factory Specification	Allowable Limit
Small End Bore	GS130	13.015 to 13.025 mm 0.5124 to 0.5128 in.	—
	GH170	15.015 to 15.025 mm 0.5911 to 0.5915 in.	—
	GH280	18.015 to 18.025 mm 0.7093 to 0.7096 in.	—
	GH400	20.015 to 20.025 mm 0.7880 to 0.7884 in.	—

Crankshaft

Crankshaft Alignment	GS130 GH-ALL	—	0.04 mm 0.0016 in.
Clearance between Crank Pin and Connecting Rod Big End Bore	GS130	0.018 to 0.054 mm 0.0007 to 0.0021 in.	0.1 mm 0.0039 mm
	GH170, GH280	0.015 to 0.040 mm 0.00059 to 0.00157 in.	0.1 mm 0.0039 in.
	GH400	0.015 to 0.050 mm 0.00059 to 0.00197 in.	0.1 mm 0.0039 in.
Crank Pin O.D.	GS130	23.967 to 23.982 mm 0.9436 to 0.9442 in.	—
	GH170	29.975 to 29.985 mm 1.1801 to 1.1805 in.	—
	GH280, GH400	33.475 to 33.485 mm 1.3179 to 1.3183 in.	—
Connecting Rod Big End Bore	GS130	24.00 to 24.021 mm 0.9449 to 0.9457 in.	—
	GH170	30.000 to 30.015 mm 1.1811 to 1.1817 in.	—
	GH280	33.500 to 33.515 mm 1.3189 to 1.3195 in.	—
	GH400	33.500 to 33.525 mm 1.3189 to 1.3199 in.	—
Side Clearance of Connecting Rod Crank Pin	GS130, GH170 GH280	0.4 to 1.1 mm 0.0157 to 0.0433 in.	1.3 mm 0.051 in.
	GH400	0.4 to 1.1 mm 0.016 to 0.043 in.	1.5 mm 0.059 in.
Side Clearance of Crankshaft	GS130, GH170 GH280	—	0.2 mm 0.0079 in.
	GH400	—	0.1 mm 0.0039 in.

Cylinder Liner

Item	Engine Model	Factory Specification	Allowable Limit
Cylinder Wear	GS130	60.00 to 60.02 mm 2.3622 to 2.370 in.	60.12 mm 2.3740 in.
	GH170	67.00 to 67.02 mm 2.6378 to 2.6386 in.	67.12 mm 2.6425 in.
	GH280	79.00 to 79.02 mm 3.1102 to 3.1110 in.	79.12 mm 3.1150 in.
	GH400	84.20 to 84.225 mm 3.3150 to 3.3159 in.	84.325 mm 3.3199 in.

Section 4. Torque Specifications

Mounting screws and nuts must be tightened to the specified torque settings listed in the following tables. Torque specifications can vary by engine size. The engine model number must be identified by referring to the *Specifications* section prior to using the engine torque specifications. The cylinder head mounting screws must be tightened in the proper sequence, refer to the *Engine - Block Assembly* section.

TABLE 4-1. ENGINE TORQUE SPECIFICATIONS

ITEM	ENGINE MODEL	FOOT • POUNDS	NEWTON • METERS
Spark Plug	All	7.2 to 18.1	9.8 to 24.5
Rocker Mounting Nut	GH170	43.4 to 50.6	58.8 to 68.6
	GH280	47.0 to 54.2	63.7 to 73.6
	GH400	72.3 to 86.8	98.1 to 117.7
Cylinder Head Screws	GS130	14.5 to 21.7	19.6 to 29.4
	GH170	18.1 to 23.9	24.5 to 32.4
	GH280	15.9 to 20.3	21.6 to 27.5
	GH400	30.4 to 36.9	41.2 to 50.0
Crankcase Screws	GS130	5.6 to 9.4	7.8 to 12.7
	GH170, GH280	10.1 to 14.5	13.7 to 19.6
	GH400		
Connecting Rod Screws	GS130	7.2 to 10.1	9.8 to 13.7
	GH170	10.1 to 14.5	13.7 to 19.6
	GH280, GH400	17.4 to 21.7	23.5 to 29.4
Rocker Arm Lock Nut	GH170	5.8 to 9.4	7.8 to 12.7
	GH280	8.0 to 12.3	10.8 to 16.7
Governor Lever Screw	GS130, GH170	5.1 to 8.7	6.9 to 11.8
	GH280	8.0 to 14.5	10.8 to 19.6
	GH400	10.1 to 13.0	13.7 to 17.6
Flywheel Mounting Nut	GS130	21.7 to 32.5	29.4 to 44.1
	GH170	43.4 to 50.6	58.8 to 68.6
	GH280	47.0 to 54.2	63.7 to 73.5
	GH400	72.3 to 86.8	98.1 to 117.7

TABLE 4-2. GENERATOR TORQUE SPECIFICATIONS

ITEM	FOOT • POUNDS	NEWTON • METERS
Rotor Through-Bolt	17	23
Stator Through-Bolt	4.3 - 6.5	5.9 - 8.8
Adapter Bracket to Engine	13 - 15.9	17.7 - 21.6
Output Terminal Nut	1.4 - 1.8	1.9 - 2.45

When tightening torques are not specified, tighten the screws and nuts according to Table 4-3. The torque setting for securing the generator set to the frame vibration isolators is 16 ft lbs (21.7 N•m).

TABLE 4-3. GENERAL USE TORQUE SPECIFICATIONS

Grade / Nominal Diameter	No-grade or 4T			7T		
	N•m	kgf•m	ft•lbs	N•m	kgf•m	ft•lbs
M5	2.45 to 3.92	0.25 to 0.40	1.82 to 2.89	3.9 to 6.9	0.4 to 0.7	2.9 to 5.1
M6	4.41 to 7.85	0.45 to 0.80	3.25 to 5.79	6.9 to 13.7	0.7 to 1.4	5.1 to 10.1
M8	10.8 to 19.6	1.1 to 2.0	8.0 to 14.5	17.7 to 32.4	1.8 to 3.3	13.0 to 23.9
M10	22.6 to 41.2	2.3 to 4.2	16.6 to 30.4	37.3 to 68.6	3.8 to 7.0	27.5 to 50.6

The grade numbers are indicated on top of the screw or bolt head.

Section 5. Preparing to Service

TROUBLESHOOTING

Before starting to service the generator set, follow a systematic troubleshooting procedure to locate the problem. For servicing purposes, the generator set can be divided into the following sections:

- Engine - Primary Systems
- Control
- Generator
- Engine - Block Assembly

This manual contains separate sections that cover each of these areas.

Several troubleshooting guides are included in this manual to help the service technician locate the cause of various malfunctions. Note that some malfunctions might have several possible causes. For this reason, the service technician might have to investigate several likely problem areas in order to isolate the source of the malfunction. Due to the complexity of the product, a troubleshooting chart cannot list every malfunction and the cause. In some situations, the service technician will have to rely on experience and a knowledge of the product to locate the problem and to service as required.

SPECIAL TOOLS

Engine Tools

Torque wrench (0-100 Ft-Lbs or 0-135 N•m)
Feeler gauge
Oil pressure gauge
Compression tester Spark plug gap gauge
Flywheel puller
Gear separator
Cylinder ridge reamer
Piston ring compressor
Piston ring spreader
Cylinder hone
Valve seat cutter
Wire brush
Piston groove cleaner
Outside micrometer set (0-4 in.)
Telescoping gauge set (0.5 to 6 in.)
Hole gauge (0.2 to 0.4 in.)
Valve seat replacement tool

Generator and Control

Lead or dead blow hammer
Battery hydrometer
VOM multimeter
Frequency meter
Armature growler
Load test panel
Jumper wires

SAFETY CONSIDERATIONS

Always consider the safety aspects of any service procedure. Generator sets present several hazards that the service technician must be aware of to complete the job. Read through the safety precautions listed on the inside cover page and become familiar with the various hazards listed in Table 5-1. Approach the job with a safety conscious attitude. Being safety conscious is the most effective way to avoid injury to yourself and to others. Reduce the chance that an accident will occur by adopting the following safeguards.

Safeguards to Avoid Hazards

- Use Personal Protection — Protect your body by wearing safety shoes, gloves, safety glasses, hard hat, and the appropriate safety equipment. Protective clothing includes protective apron. Leave rings and jewelry off and do not wear loose clothing that might get caught on equipment.

- Work to Reduce the Hazard — The workshop area and all pieces of equipment used can contribute to reducing the hazard potential. Keep guards and shields in place on machinery and maintain equipment in good working condition. Store flammable liquids in approved containers away from open flame, spark, pilot light, cigarette, or other ignition source. Keep the work area clean and well lighted, and provide adequate ventilation. Keep fire extinguisher and safety equipment nearby and be prepared to respond to an emergency.

TABLE 5-1
HAZARDS AND THEIR SOURCE

- Fire and Explosions
  - —Leaking or spilled fuel
  - —Hydrogen gas from battery
  - —Oily rags improperly stored
  - —Flammable liquids improperly stored
- Burns
  - —Hot exhaust pipes
  - —Hot engine and generator surfaces
  - —Electrical short in DC wiring system
- Poisonous Gases
  - —Carbon monoxide from faulty exhaust pipes, joints, or hangers
  - —Operating generator set where exhaust gases can accumulate
- Electrical Shock (AC)
  - —Improper generator set load connections
  - —Faulty electrical appliance
  - —Faulty generator set wiring
  - —Working in damp conditions
  - —Jewelry touching electrical components
- Rotating Machinery
  - —Jewelry or loose clothing catching in moving parts
- Slippery Surfaces
  - —Leaking or spilled oil
- Heavy Objects
  - —Lifting the generator set
  - —Removing heavy components

- Develop Safe Work Habits - Unsafe actions are identified as the cause of most accidents involving the use of tools and machines. Be familiar with the equipment and know how to use it carefully. Use the correct tool for the job and check its condition before starting. Observe the warnings and cautions in this manual and take special precautions when working around electrical equipment. Do not work alone if possible and do not take risks.

⚠WARNING ***Generator sets are heavy and can cause severe personal injury if dropped during service. Use adequate lifting devices and provide sufficient support for the set to avoid dropping. Keep hands and feet clear when lifting or moving the generator set.***

Section 6. Engine — Primary Systems

INTRODUCTION

The engine primary systems include the following:

- Exhaust system
- Cooling System
- Ignition system
- Crankcase Ventilation System
- Governor
- Fuel System
- Recoil Starter
- Electric Starter
- Oil Pump (GH400 Engine)
- Oil Pressure Relief Valve (GH400 Engine)
- Oil Watch System

The engine primary systems can be serviced without major disassembly of the set. Use the following troubleshooting guide to help locate problems related to the engine primary systems. Refer to Troubleshooting Generator Set Control (Section 7) for problems related to starting the generator set.

TABLE 6-1. TROUBLESHOOTING ENGINE PRIMARY SYSTEMS

⚠WARNING ***Many troubleshooting procedures present hazards that can result in severe personal injury or death. Only qualified service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Review safety precautions on inside cover page.***

TROUBLE	POSSIBLE CAUSE	CORRECTIVE ACTION
Engine Misfires	1. Faulty ignition due to: a. worn or fouled spark plug b. faulty ignition system c. faulty plug wire	 1a. Clean or replace spark plug. 1b. See *Ignition System* section. 1c. Check spark plug wire and replace if necessary.
	2. Lean fuel mixture due to: a. incorrectly adjusted carburetor b. incorrect float level c. dirt in carburetor d. vacuum leak	 2a. See *Carburetor Adjustment* section. 2b. Check carburetor float. 2c. Disassemble carburetor and clean all passages. 2d. Locate leak, check for loose carburetor.
	3. Contaminated fuel	3. Drain fuel tank and refill with fresh fuel.
	4. Dirty air cleaner	4. Clean or replace air cleaner.
Engine Backfires	1. Faulty ignition due to: a. worn or fouled spark plug b. faulty ignition system	 1a. Clean or replace spark plug 1b. See *Ignition System* section.
	2. Lean fuel mixture due to: a. incorrectly adjusted carburetor b. incorrect float level c. dirt in carburetor d. vacuum leak	 2a. See *Carburetor Adjustment* section. 2b. Check carburetor float. 2c. Disassemble carburetor and clean all internal passages. 2d. Locate leak, check for loose carburetor.
	3. Excessive engine wear	3. See *Engine Block Assembly* section.

TABLE 6-2. TROUBLESHOOTING ENGINE PRIMARY SYSTEMS

⚠WARNING ***Many troubleshooting procedures present hazards that can result in severe personal injury or death. Only qualified service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Review safety precautions on inside cover page.***

TROUBLE	POSSIBLE CAUSE	CORRECTIVE ACTION
Engine Lacks Power	1. Faulty ignition due to: a. worn or fouled spark plug b. faulty ignition system	 1a. Clean or replace spark plug. 1b. See *Ignition System* section.
	2. Dirty air cleaner	2. Clean or replace air cleaner.
	3. Restricted fuel flow due to plugged fuel filter	3. Clean or replace fuel filter.
	4. Incorrect fuel mixture due to: a. incorrectly adjusted carburetor b. incorrect float level or c. dirt in carburetor	 4a. See *Carburetor Adjustment* section. 4b. Check carburetor float. 4c. Disassemble carburetor and clean all internal passages.
	5. Exhaust system blocked or restricted	5. Locate and remove cause of blockage.
	6. Incorrect valve clearance or defective valve(s)	6. Adjust valve clearance/inspect valves (see *Engine Block Assembly* section).
	7. No load speed set too low	7. Adjust governor setting.
	8. Excessive engine wear or damage to engine	8. See *Engine Block Assembly* section.
	9. Choke valve blockage or choke lever set incorrectly	9. Open choke lever fully, if problem continues see *Fuel System* section.
Engine Overheats	1. Restricted air flow due to dirt or debris blocking air inlet or outlet	1. Clear away any debris that may restrict airflow.
	2. Dirt or oil covering engine cooling fins	2. Clean away all dirt and oil from engine cooling fins.
	3. Cooling fan plugged or broken	3. Inspect cooling fan, see *Generator Service* section.
	4. Lean fuel mixture due to: a. incorrectly adjusted carburetor b. incorrect float level c. dirt in carburetor	 4a. See *Carburetor Adjustment* section. 4b. Check carburetor float. 4c. Disassemble carburetor and clean all internal passages.

TABLE 6-3. TROUBLESHOOTING ENGINE PRIMARY SYSTEMS

⚠WARNING ***Many troubleshooting procedures present hazards that can result in severe personal injury or death. Only qualified service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Review safety precautions on inside cover page.***

TROUBLE	POSSIBLE CAUSE	CORRECTIVE ACTION
Black Exhaust Smoke	1. Rich fuel mixture due to: a. dirty air cleaner b. choke closed c. incorrectly adjusted carburetor d. dirt in the carburetor	 1a. Clean or replace air cleaner. 1b. Check choke setting. 1c. See *Carburetor Adjustment* section. 1d. Disassemble carburetor and clean all internal passages.
White or Blue Exhaust Smoke	1. Lean fuel mixture due to: a. dirty air cleaner b. incorrect float level c. incorrectly adjusted carburetor d. dirt in the carburetor 2. Clogged or faulty breather 3. Contaminated fuel 4. Excessive engine wear	 1a. Clean or replace air cleaner. 1b. Check carburetor float 1c. See *Carburetor Adjustment* section. 1d. Disassemble carburetor and clean all internal passages. 2. Clean or replace breather. 3. Drain and replace fuel. 4. See *Engine Block Assembly* section.
Engine Hunts or Surges	1. Sticking or binding governor linkage 2. Incorrect governor adjustment 3. Faulty governor spring 4. Incorrect fuel mixture due to: a. incorrectly adjusted carburetor b. incorrect float level or c. dirt in carburetor 5. Governor mechanism worn excessively 6. Fuel supply problem caused by: a. Dirty fuel filter b. Contaminated fuel supply	1. Check linkage alignment and straighten or replace. Clean governor linkage. 2. See *Governor* section. 3. Replace governor spring. 4a. See *Carburetor Adjustment* section. 4b. Check carburetor float. 4c. Disassemble carburetor and clean all internal passages. 5. See *Engine Block Assembly* section. 6a. Clean or replace fuel filter. 6b. Drain and refill fuel supply.

TABLE 6-4. TROUBLESHOOTING ENGINE PRIMARY SYSTEMS

⚠WARNING ***Many troubleshooting procedures present hazards that can result in severe personal injury or death. Only qualified service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Review safety precautions on inside cover page.***

TROUBLE	POSSIBLE CAUSE	CORRECTIVE ACTION
High Oil Consumption (Note: New engines sometimes have high oil consumption during break-in)	1. Oil viscosity is too light or oil is diluted	1. Drain oil and refill with correct viscosity oil.
	2. Crankcase breather valve is dirty or defective	2. Clean crankcase breather or replace if defective.
	3. Oil leaks	3. Locate source of leak and repair as required.
	4. Excessive engine wear	4. See *Engine Block Assembly* section.
	5. Light loading	5. Do not run set at no load for long periods of time.
Engine Shuts Down and Will Not Restart	1. Low oil level	1. Add oil as required.
	2. Low oil level switch defective	2. Replace oil level switch (see *Engine Block Assembly* section).
	3. Fouled spark plug	3. Clean or replace spark plug.
	4. Faulty fuel system	4. Refer to *Fuel System* section for service procedures.

EXHAUST SYSTEM

The exhaust system consists of a muffler assembly that has an exhaust pipe with a flange for mounting the muffler directly to the engine. The assembly also has a heat shield and a short exhaust outlet pipe (Figure 6-1). Most models also have a spark arrester screen that is located inside the exhaust outlet pipe.

The muffler must be serviced immediately if inspection reveals leaking joints or connections, loose fasteners, or broken or damaged components. Always replace a defective muffler assembly with a new original equipment replacement part. Do not attempt to repair a broken muffler assembly by welding and do not replace worn out components with parts that do not meet factory specifications. Mufflers with a spark arrester should be cleaned periodically to prevent build-up of carbon deposits on the spark arrester screen (see Maintenance Section of Operator's manual). Failure to provide and maintain a spark arrester muffler can be in violation of the law. Contact an Onan parts distributor for approved replacement exhaust parts.

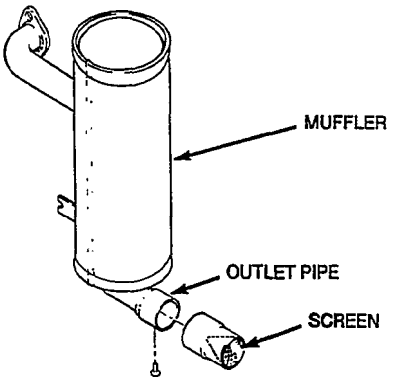


FIGURE 6-1. TYPICAL MUFFLER ASSEMBLY

⚠WARNING ***Exhaust gas presents the hazard of severe personal injury or death. Do not operate the generator set if there are any exhaust leaks. Have the exhaust system repaired before using the generator set.***

Disassembly: Allow generator set to cool before servicing.

1. Remove the heat shield that covers the exhaust pipe and engine at the top of the muffler.
2. Remove the mounting nuts that secure the muffler flange to the engine.
3. Remove the screws that secure the muffler to the muffler support bracket and remove the exhaust gasket.

Assembly: Obtain the required Onan original replacement parts and then proceed as indicated.

1. Install a new exhaust gasket. Mount the muffler flange to the engine and install the mounting nuts and support bracket screws finger tight to align all the mounting holes.
2. Tighten mounting hardware to the specified torque.
3. Install heat shield and secure with mounting screws.

COOLING SYSTEM

The engine and generator are both air cooled. A constant airflow is critical for the engine and generator to prevent excessive heat build-up. Engine cooling is accomplished by a centrifugal fan that is part of the engine flywheel (Figure 6-2). Air is drawn in through the openings in the spiral case and is forced out between the engine cowling and the engine cooling fins. The generator is cooled by a centrifugal fan located inside the generator assembly, on the engine end of the rotor shaft. The generator fan draws cooling air in through the generator end cover, across the stator and rotor, and then discharges the heated air through the air outlet in the adapter plate.

The air inlet openings and the air discharge openings must be kept free of any obstructions to avoid restricting airflow. Dirt, dust, or other debris that can clog the air openings should be removed during periodic maintenance. Debris might also become lodged between the cooling fins on the engine block and cylinder head. If this happens, heat transfer is greatly reduced and engine overheating can occur. Use a brush or low pressure compressed air to remove any dirt or debris that may be lodged in the engine cooling fins.

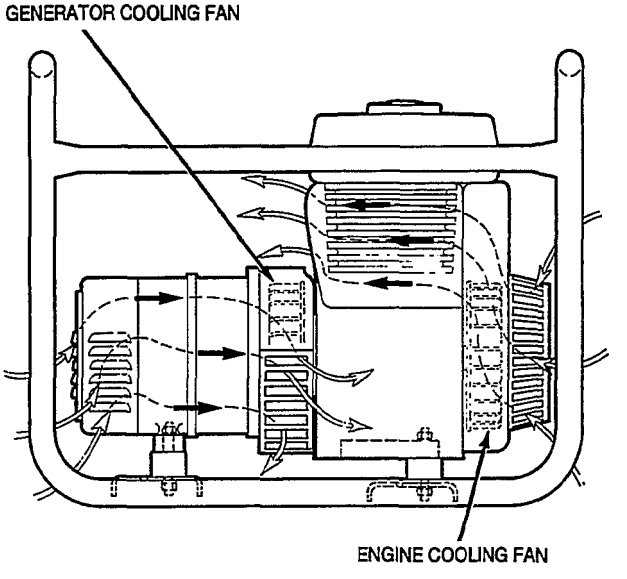


FIGURE 6-2. TYPICAL COOLING AIRFLOW

IGNITION SYSTEM

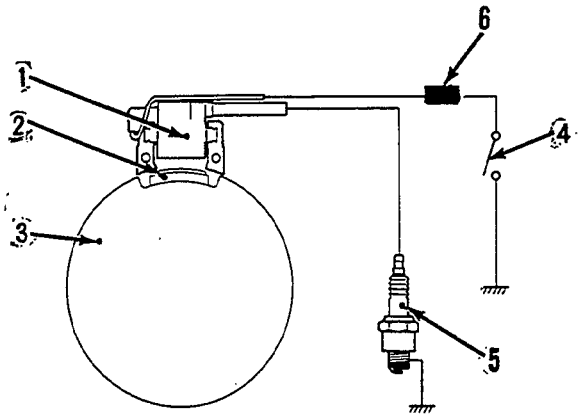
Two types of ignition systems are used. The overhead valve (GH) engines use a Transistor Magnet Ignition and the side valve (GS) engines use a Capacitor Discharge Ignition (CDI). Both systems are breakerless ignitions that are energized by a magnet mounted on the flywheel. For reliable generator set operation, the complete ignition system including the spark plug and associated wiring must be in good working order. If the spark plug (see Spark Plug section) and the wiring are in good working condition, and low or no spark is produced during engine cranking, proceed to the following ignition service sections.

Wiring

Check all ignition wiring for loose connections and cuts or breaks in the insulation. Clean all terminals and connections and test for continuity with an ohmmeter. Use a megger to check for breaks in the spark plug wire insulation.

Transistor Magnet Ignition

This ignition system consists of a Transistor Magnet Unit that contains two main parts: an Ignition Control Unit to generate primary current and secondary high voltage, and an Ignition Time Control Unit to induce high voltage in the ignition coil by controlling the primary current. The ignition system also consists of a magnet, mounted to the flywheel, that induces a voltage in the Ignition Control Unit when the engine is cranked over. See Figure 6-3.



C105F016

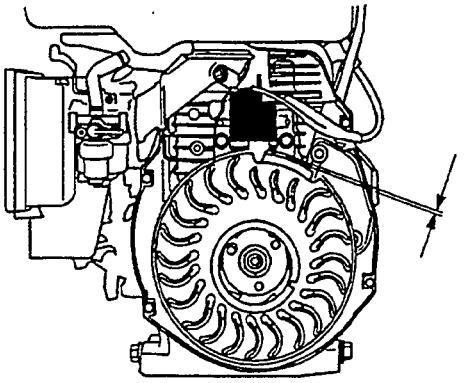
(1) TRANSISTOR MAGNET UNIT
(2) MAGNET
(3) FLYWHEEL
(4) STOP SWITCH
(5) SPARK PLUG
(6) 1P CONNECTOR

FIGURE 6-3. TRANSISTOR MAGNET IGNITION

Transistor Magnet Ignition check:

1. Measure the clearance between the Transistor Magnet Unit and the flywheel magnet (Figure 6-4).

2. If the clearance in not within 0.0157 to 0.0236 inches (0.4 to 0.6mm), loosen the mounting screws and adjust clearance to fall within specified clearance.



C105F066

FIGURE 6-4. MEASURIING CLEARANCE BETWEEN TRANSISTOR MAGNET UNIT AND FLYWHEEL MAGNET

3. Disconnect the 1P connector (Figure 6-3) from the stop switch.

4. Disconnect the high voltage lead from the spark plug.

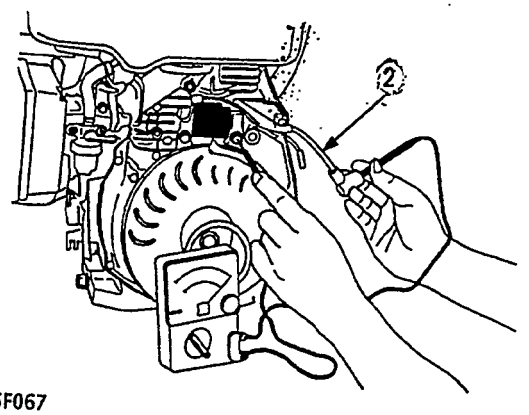
5. With an accurate analog ohmmeter, measure the resistance between the 1P connector and a clean metal ground point on the engine.

6. The resistance between the primary coil and ground, measured in step 5, should be approximately 0.5 to 1.3 ohms. If abnormal reading is measured, replace the Transistor Magnet Unit.

7. Measure the resistance between the spark plug lead and a clean metal ground point on the engine (Figure 6-5).

8. The resistance between the secondary coil and ground, measured in step 7, should be 9k to 13k ohms. If abnormal reading is measured replace the Transistor Magnet Unit.

9. The remaining circuitry of the Transistor Magnet Ignition Unit cannot be tested with a meter. If each of the components in the ignition system test good and low or no spark are produced, replace the Transistor Magnet Unit.

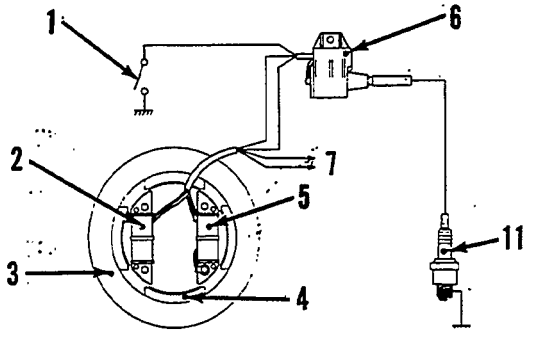


C105F067

FIGURE 6-5. CHECKING SECONDARY COIL

Capacitor Discharge Ignition

This ignition system consists of three main parts: A rectifying and Charging Unit (in the CDI Unit) that stores primary voltage from the exciter coil. An Ignition Time Indicating Unit (in the CDI Unit) that provides a timed signal to an SCR that delivers the stored voltage to the primary of the ignition coil. And an Ignition Coil Unit that generates high voltage between the primary and secondary winding for ignition spark. The ignition system also consists of a magnet, mounted to the flywheel, that induces a voltage in the exciter coil when the engine is cranked over. See Figure 6-6.



C105F019

(1) STOP SWITCH
(2) CHARGING COIL
(3) ROTOR
(4) MAGNET
(5) EXCITER COIL
(6) CDI UNIT
(7) CHARGING CIRCUIT
(8) SPARK PLUG

FIGURE 6-6. CAPACITOR DISCHARGE MAGNET IGNITION

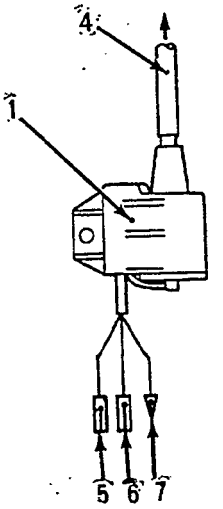
Capacitor Discharge Ignition Check:

1. Disconnect the 1P connectors (Figure 6-7) 5, 6, and 7. Also disconnect the high voltage lead from the spark plug.

2. Measure the resistance between the spark plug lead and connector 6 (black and white lead).

3. The resistance of the secondary coil, measured in step 2, should be less than infinity but not less than 3.7k ohms. If abnormal reading is measured, replace the Capacitor Discharge Unit.

4. Measure the resistance between connector 7 (black and red) and connector 6 (black and white) to check for a short or open circuit. If a short or open circuit is measured replace the Capacitor Discharge Unit.



C105F069

(1) CAPACITOR DISCHARGE UNIT (CDI)
(4) HIGH VOLTAGE CORD
(5) 1P CONNECTOR (BLACK)
(6) 1P CONNECTOR (BLACK/WHITE)
(7) 1P CONNECTOR (BLACK/RED)

FIGURE 6-7. CAPACITOR DISCHARGE UNIT

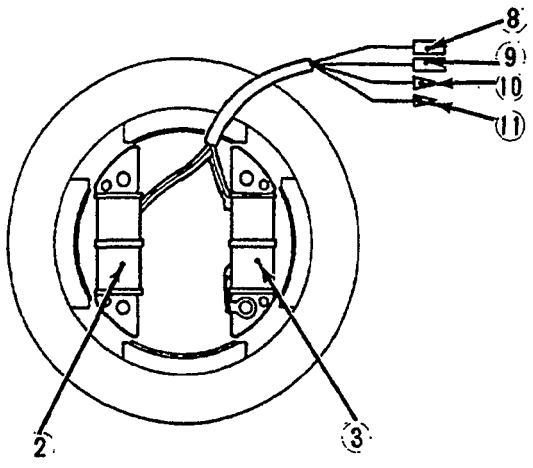
5. Disconnect leads 8, 9, 10, and 11 from the charge and exciter coils (Figure 6-8).

6. Measure the resistance of the charging coil between connectors 9 (yellow) and 10 (blue). Resistance should be approximately 0.2 ohms.

7. Measure the resistance of the exciter coil between connectors 8 (black and red lead) and 11 (black and white lead). The resistance should be approximately 240 ohms.

8. If abnormal reading is measured, replace the ignition coil unit.

9. The remaining circuitry of the Capacitor Discharge Ignition Unit cannot be tested with a meter. If each of the components in the ignition system test good and low or no spark are produced, replace the Capacitor Discharge Unit.



C105F070

(2) CHARGING COIL
(3) EXCITER COIL
(8) 1P CONNECTOR (BLACK/RED)
(9) 1P CONNECTOR (YELLOW)
(10) 1P CONNECTOR (BLUE)
(11) 1P CONNECTOR (BLACK/WHITE)

FIGURE 6-8. IGNITION COIL UNIT

Spark Plug

Remove and inspect the spark plug at the intervals indicated in the Operator's Manual. Clean the electrode with a wire brush to remove carbon deposits. Measure and reset the electrode gap to the specified setting (Figure 6-9). Replace the spark plug if the electrode or insulator are deformed or cracked.

The spark plug is located behind the control panel on the 5.0 and 6.0 kW Pro models. If necessary, the fuel tank can be raised for easier service access as follows:

1. Let the generator set cool down completely. Check fuel level in the fuel tank and reduce the level if tank is full to avoid spilling. Use a pump designed for use with fuels to lower fuel tank level and store fuel in a clean container designed for fuel storage.

2. Close the fuel shutoff valve on the bottom of the fuel tank.

3. Remove the fuel tank mounting nuts and raise the control panel side of the fuel tank high enough to access the spark plug. Support the fuel tank to prevent tilting or dropping.

⚠WARNING ***Fuel presents the hazard of fire or explosion that can cause severe personal injury or death. Shut fuel valve and handle fuel tank carefully to prevent fuel leakage. Reduce fuel level in fuel tank to reduce the risk of spilling fuel. Do not permit any flame, spark, pilot light, cigarette, or other ignition source near the fuel system. Keep an ABC type fire extinguisher nearby.***

A careful examination of the plug can often pinpoint the source of an engine problem. The following section covers some common spark plug conditions and the probable cause.

- Carbon fouled - Check for a poor high tension lead connection or low compression.
- Oil fouled - Check for faulty choke operation, rich fuel mixture, or dirty air filter.
- Burned or Overheated - Check for leaking intake manifold gasket, lean fuel mixture, or incorrect spark plug type.
- Chipped insulator - Bend only side electrode when setting gap.
- Splash Fouled - Check for accumulated combustion chamber deposits. See Cylinder Head section.
- Light Tan or Grey Deposits - Normal plug color.

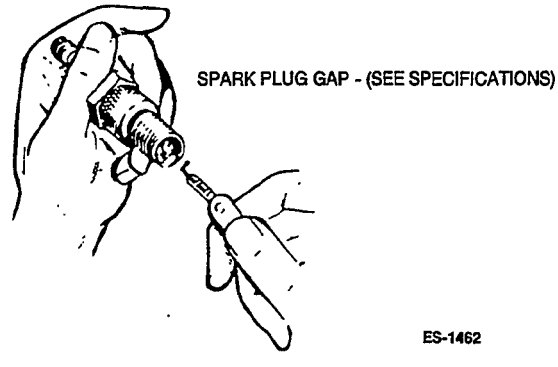


FIGURE 6-9. MEASURING PLUG GAP

CRANKCASE VENTILATION SYSTEM

The crankcase breather prevents pressure from building up in the crankcase. It also prevents oil contamination by removing moisture or gasoline vapors and other harmful blow-by materials from the crankcase. These vapors are routed to the carburetor where they are mixed with the incoming air and burned in the combustion chamber. A sticky breather valve can cause oil leaks, high oil consumption, rough idle, reduced engine power, and a rapid formation of sludge and varnish within the engine. If the crankcase becomes pressurized, as evidenced by oil leaks at the seals, use the following procedures to service.

Remove the breather tube and access the breather (see Engine Block Assembly, section 9). Remove the breather from the cylinder head and inspect it. The reed valve must be flat with no sign of creases or other damage. If the breather is defective, replace it. If the breather is dirty, clean it in parts cleaning solvent. Check breather tube and air passages for clogging and clean as required.

⚠WARNING ***Most parts cleaning solvents are flammable and can result in severe personal injury if used improperly. Follow the manufacturer's recommendations when cleaning parts.***

GOVERNOR

The engine governor maintains a constant engine speed under various load conditions to limit variations in generator output voltage and frequency. Engine speed variations directly affect the frequency, and to a lesser extent the output voltage of the generator. An increase in engine speed will cause a corresponding increase in generator frequency and a decrease in engine speed will cause a corresponding decrease in frequency. Voltage is held fairly constant by the voltage regulator when small variations in engine speed occur.

⚠WARNING ***Contact with moving parts can cause severe personal injury. Keep clothing, jewelry, hands, and fingers clear while adjusting the engine.***

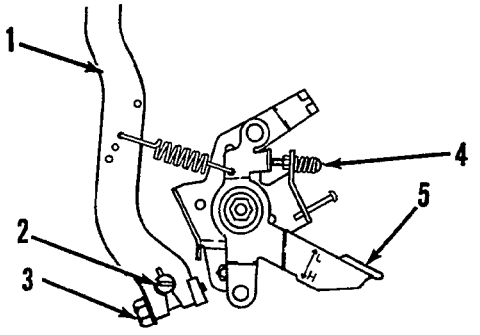
⚠WARNING ***A hot muffler and other generator set components can cause severe burns. Always allow the generator set to cool before touching any components.***

Governor and Engine Speed Adjustments

An accurate frequency meter should be connected to the generator in order to correctly adjust the engine speed. A binding in the governor shaft, governor linkage, or carburetor throttle will cause erratic governor action or alternate increase and decrease in the engine speed (hunting). A rich or lean carburetor adjustment can cause hunting and a fouled spark plug can cause missing and hunting.

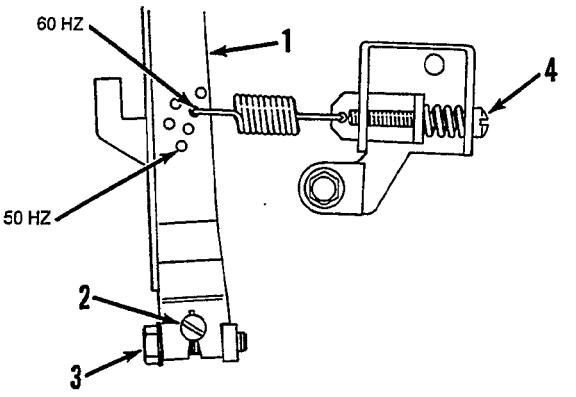
The carburetor adjustment screws must be correctly adjusted before governor adjustments are made. If the carburetor needs adjusting, refer to the Carburetor Adjustments section before making final adjustments to the governor.

GS130 ENGINE



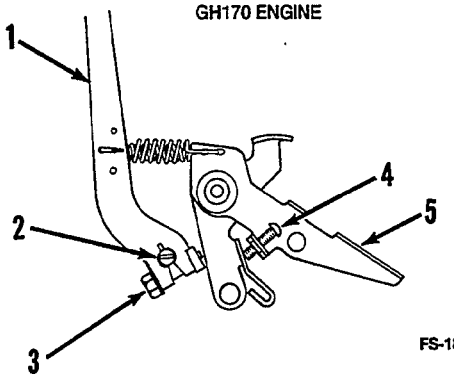
FS-1828

GH280 ENGINE
WITH IDELMATIC



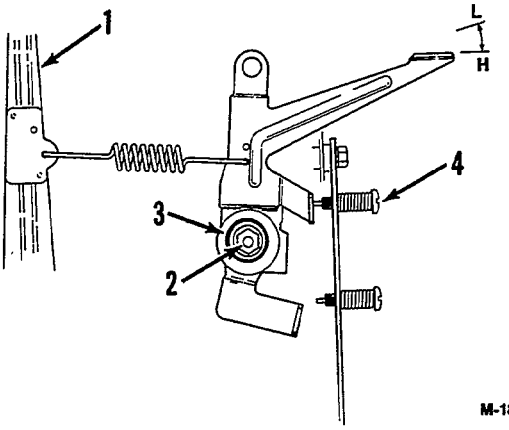
FS-1830-1

GH170 ENGINE



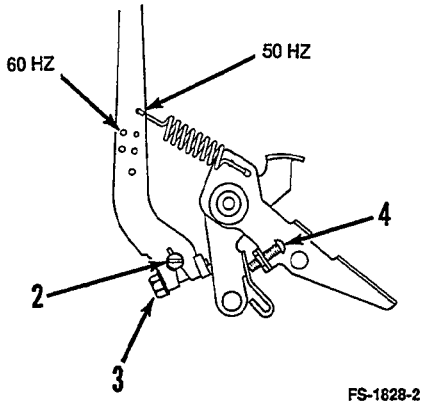
FS-1828-3

GH400 ENGINE



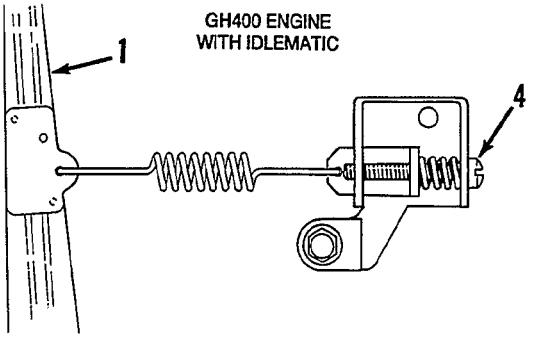
M-1876

GH280 ENGINE



FS-1828-2

GH400 ENGINE
WITH IDLEMATIC



FS-1830-2

(1) GOVERNOR LEVER
(2) GOVERNOR LEVER SHAFT
(3) SCREW
(4) HIGH-SPEED ADJUSTING SCREW
(5) SPEED CONTROL LEVER

NOTE: SEE SPECIFICATION SECTION FOR MODEL ENGINE NUMBER REFERENCE

FIGURE 6-10. GOVERNOR ADJUSTMENTS

Disconnect all loads from the generator set. An accurate frequency meter should be connected to the generator output receptacle. Adjustments should be made in the following sequence. To adjust the engine speed only, proceed to step 4.

1. Check the governor linkage for binding or excessive looseness. Check the springs for bending or damage and straighten or replace as needed. Make sure the spring(s) are attached to the correct mounting hole (Figure 6-10).

2. Loosen the screw at the lower end of the governor lever (Figure 6-10).

3. Hold the throttle valve in the fully open position with the governor lever. Turn the groove on the governor lever shaft fully clockwise with a screwdriver and tighten in that position. Tighten the governor lever tightening screw to 5.1 to 8.7 ft lbs (6.9 to 11.8 N•m). Check to make sure throttle is held in the fully open position after tightening.

4. Start the engine. Make sure the speed control lever is in the high speed position or that the Idlematic is Off on Pro models with Idlematic. Operate the generator set with no-load until it is warm. Refer to Figure 6-10.

5. Check the no-load frequency for a normal reading of 63.5 ±0.5 Hz (3780 - 3840 rpm) or 53.5 ± 0.5 Hz (3180 - 3240 rpm) for 50 Hz models.

6. If an abnormal reading is measured, adjust the speed as follows:

   Models Without Idlematic: Move the speed control lever to a position between the high and low speed settings. Adjust the high speed screw by turning it counterclockwise to increase engine speed or clockwise to decrease engine speed.

   Models Below 5 kW: One full turn of the adjustment screw will change the frequency approximately 1-1/4 Hertz. Do not turn the adjustment screw more than 2 turns.

   5 kW Models: One full turn of the adjustment screw will change the frequency approximately 4 Hertz. Do not turn the adjustment screw more than 1/2 turn.

   After making an initial adjustment, move the speed control lever to the high speed setting and recheck frequency. Repeat this process until a normal no-load speed is obtained.

   Models With Idlematic: Set the Idlematic control to On. Adjust the high speed screw by turning it clockwise to increase engine speed or counterclockwise to decrease engine speed. One full turn of the adjustment screw will change the frequency approximately 3.7 Hertz. Do not turn the adjustment screw more than 3/4 turns. After making an initial adjustment, set the Idlematic control to Off and recheck frequency. Repeat this process until a normal no-load speed is obtained.

   Springs tend to lose their calibrated tension through fatigue after long usage and may require replacement. If the governor action is erratic after adjustments are made, replace the spring. If this does not improve operation, the problem may be within the governor mechanism (see engine Block Assembly, section 9).

FUEL SYSTEM

The main components of the fuel system are the carburetor, air filter assembly, and fuel filter. Each of the components in the fuel system must be in good working condition and the carburetor must be properly adjusted for efficient generator set operation. Refer to the following sections for servicing each of these components. See Figure 6-11.

Air Filter Assembly

Service the air filter at the intervals recommended in the Operator's Manual. In dusty conditions, service the air filter more often. When replacing the air filter, use only an Onan-approved filter. There are three types of air filter assemblies used on these models: foam filter only, foam wrapper on paper element, and paper element only. Follow the filter service procedures that apply to the filter system on the generator set.

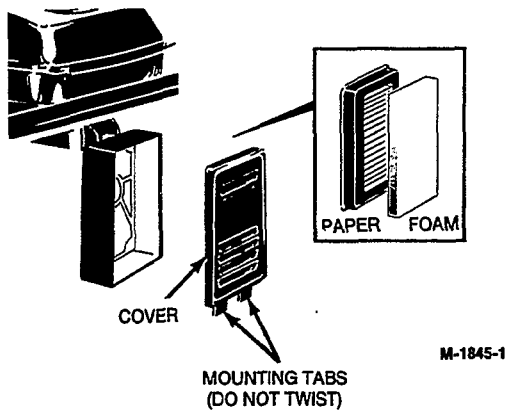
1. Carefully remove the air cleaner cover and remove the air cleaner element.

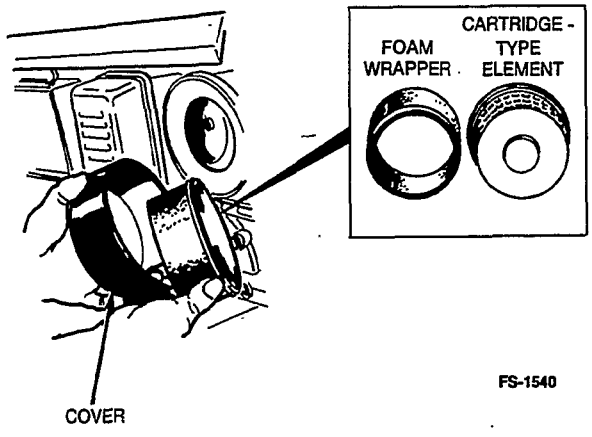
2. Follow the service procedures listed by the type of filter used.

   Foam Wrapper On Paper Filter: Remove foam wrapper and wash in detergent and water. Dry foam wrapper thoroughly. Use low pressure air on the inside of the paper element to remove dust and dirt. Replace paper element at every sixth cleaning or sooner if dusty operating conditions exist.

   Paper Filter Only: Use low pressure air on the inside of the paper element to remove dust and dirt. Replace paper element at every sixth cleaning or sooner if dusty operating conditions exist.

3. Reassemble filter into the housing and carefully install the air cleaner cover.





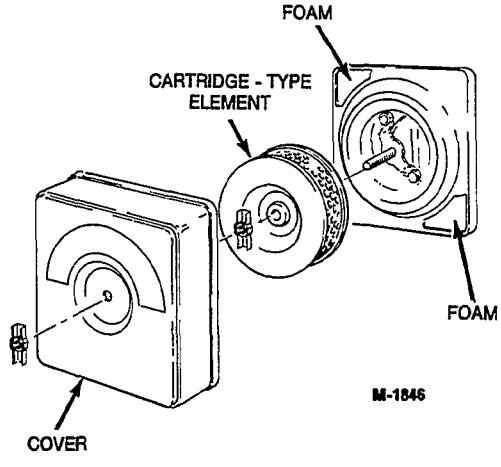


FIGURE 6-11. AIR CLEANER SERVICE

Fuel Filter

Clean or replace the fuel filter at the interval recommended in the Operator's manual or if performance problems occur and bad fuel is suspected. Refer to Figure 6-12.

⚠WARNING ***Fuel presents the hazard of fire or explosion that can cause severe personal injury or death. Do not permit any flame, spark, pilot light, cigarette, or other ignition source near the fuel system. Inspect for fuel leaks any time service is performed on the fuel system. Keep a fire extinguisher rated ABC near work area.***

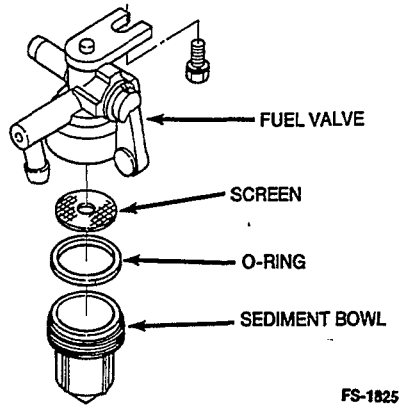
Service fuel filter on models with fuel sediment bowls as follows:

1. Turn the fuel supply valve to the closed position and allow the set to operate until it runs out of fuel. Let the generator set cool down before proceeding.
2. Remove the fuel line from the fuel shutoff valve and collect the fuel in a suitable container.
3. Unscrew the sediment bowl from the fuel supply valve and clean it.
4. Remove the screen and clean any dirt and particulate off the screen.
5. Reinstall the screen and sediment bowl. Attach the fuel line securely to the fuel shutoff valve.

Service in-line fuel filters as follows:

1. Turn the fuel supply valve to the closed position and allow the set to operate until it runs out of fuel. Let the generator set cool down before proceeding.
2. Remove in-line fuel filter and collect fuel in a suitable container. Discard used fuel filter and install new fuel filter. Attach fuel lines securely to the fuel filter to prevent fuel leakage.

Models with the fuel shutoff located below the fuel tank have a filter screen mounted inside the fuel shutoff elbow. The screen should be cleaned when performance problems occur or bad fuel is suspected.



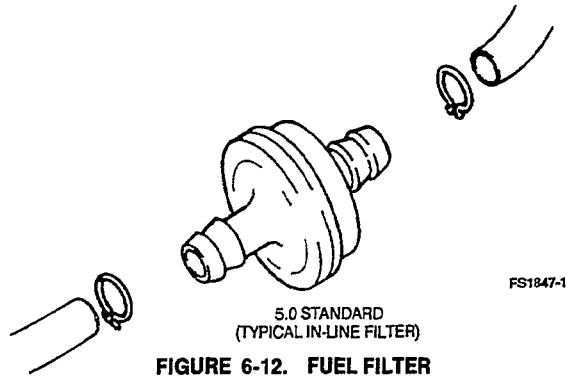


FIGURE 6-12. FUEL FILTER

Carburetor

The following section describes carburetor removal, disassembly, cleaning and adjusting procedures. Carburetor problems that are not corrected by carburetor adjustments are usually the result of gummed-up fuel passages or worn internal parts.

⚠WARNING ***Fuel presents the hazard of fire or explosion that can cause severe personal injury or death. Close the fuel valve and drain the fuel from the float chamber when servicing carburetor. Do not permit any flame, spark, pilot light, cigarette, or other ignition source near the fuel system. Keep an ABC type fire extinguisher nearby.***

Carburetor Removal:

1. Remove the carburetor and flange (Figure 6-13).
2. Carefully remove the governor connecting rod and spring.
3. Loosen the drain screw and drain the fuel from the float chamber (Figure 6-14).

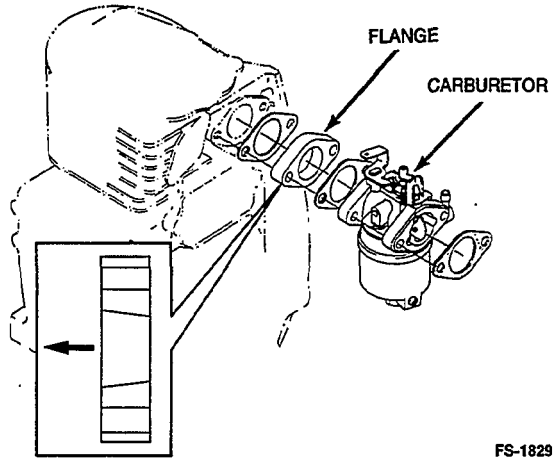


FIGURE 6-13. CARBURETOR REMOVAL

Carburetor Disassembly and Cleaning:

1. Carefully note the position while removing all parts.
2. Remove the float chamber and main nozzle holder.
3. Carefully note the position of the float assembly parts, then slide out the arm pin and remove the float and the needle valve together. Replace float if it contains fuel.
4. Remove the main jet and main nozzle.

   Do not remove the choke or throttle plates, shafts, arms or governor link bushing unless they are defective.
5. Soak all metal parts in carburetor cleaner. Do not use carburetor cleaner on non-metal parts.
6. Clean carburetor air passage with compressed air. Be careful to remove any dust or dirt between the needle valve and valve seat or fuel overflow could result. Do not use wire or other objects for cleaning that might increase the size of critical passages.

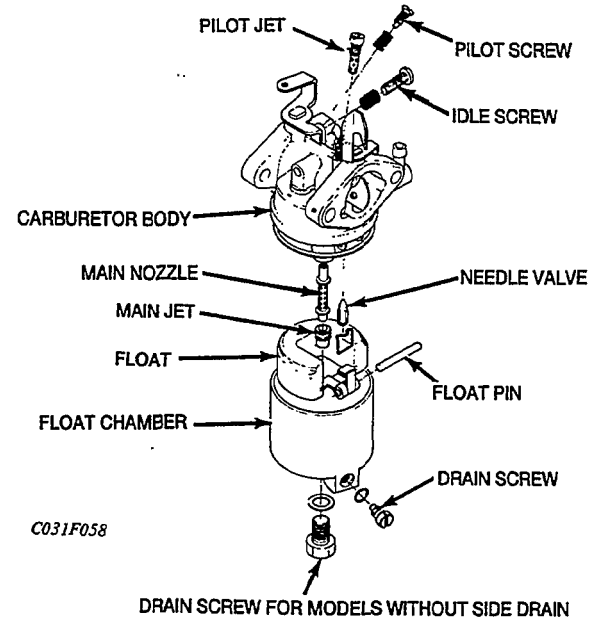


FIGURE 6-14. TYPICAL CARBURETOR ASSEMBLY

Carburetor Adjustments:

A pilot screw that is out of adjustment can cause a loss of power and engine damage. Before adjusting the carburetor make sure the ignition system is working properly and the governor is correctly set.

⚠WARNING ***Contact with hot or moving parts can cause severe personal injury. Keep clothing, jewelry, hands and fingers clear while adjusting carburetor. Do not touch generator set or muffler during or after operation.***

Start the engine and allow it to warm up for 10 minutes. The location of the adjustment screws are shown in Figure 6-14. Use the following procedures to adjust:

1. Stop the generator set and attach a frequency meter (and voltmeter on sets without voltmeters) to the 120 VAC receptacle.
2. Turn the pilot screw in gently until it is seated and then back it out approximately 1-1/2 turns.
3. Start the engine and make sure the engine speed lever is set to high "H". Verify that the frequency is within 62.5 + or - 0.5 hertz. Refer to Governor section if adjustment is necessary to obtain required frequency.
4. Move the governor arm to bring the throttle up against the stop screw. Adjust the stop screw to obtain a setting of 55 + or - 1 hertz.

5. Adjust the pilot screw while observing the frequency meter and voltmeter to obtain the highest possible reading.

6. Release the governor linkage and observe the stability of the set. Add and remove a load to make sure the set does not bog down or hunt. If erratic operation occurs, back the pilot screw out slightly and recheck. Return to the Governor section to make final adjustments.

RECOIL STARTER

Recoil starters are included with each of the portable models, including the electric start models. If the starter rope or recoil spring require service, carefully follow the instructions listed below. The following instructions are for a typical recoil starter, some design variations occur between models and attention should be paid to the disassembly process to help in reassembly.

⚠WARNING ***Contact with sharp or moving parts can cause severe personal injury. Work carefully and wear protective eye wear, gloves, and clothing when working on the recoil starter due to the possibility of sharp flying and rotating parts.***

Recoil Starter Disassembly:

1. Remove the recoil starter assembly from the spiral case (Figure 6-15) and check operation. If the recoil starter operates properly and the engine was difficult to turn over, the problem could be in the Engine Block Assembly (Section 9).

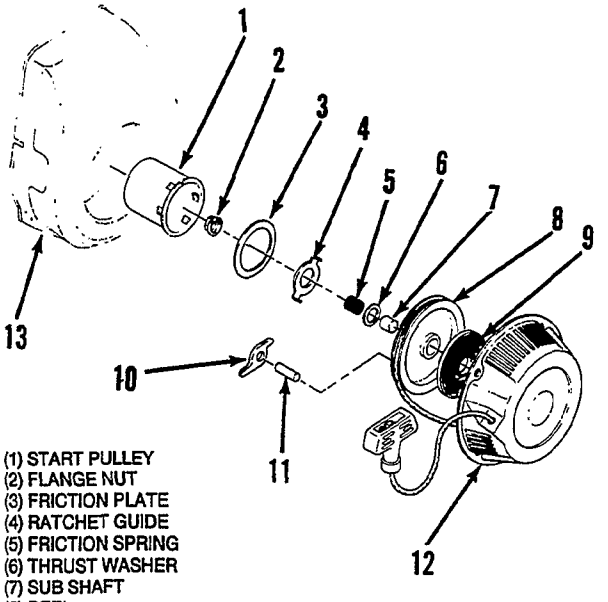


FIGURE 6-15. TYPICAL RECOIL STARTER ASSEMBLY

2. Slowly pull the starter rope out by its handle until it is all the way out. Note the number of revolutions required to pull rope all the way out.

3. Hold the reel with pressure in the direction of the arrow shown in Figure 6-16 to prevent it from unwinding. Remove the rope from the reel, keep pressure on the reel and carefully allow the reel to slowly unwind until it stops rotating.

4. If rope replacement is all that is needed, proceed to step 5 of the assembly section. If spring replacement is necessary proceed to step 5 of this section.

⚠WARNING ***Moving parts can cause severe personal injury. Do not proceed without using protective eye wear, gloves and clothing.***

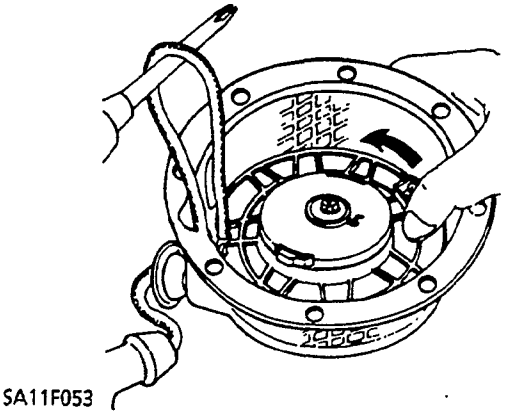


FIGURE 6-16. STARTER ROPE REMOVAL

5. Remove the friction plate mounting nut, friction plate, ratchet guide, ratchet, and friction spring (Figure 6-15).

6. Proceed carefully because the spiral spring is always under tension and it can spring out (unwind) when lifting the reel. Slowly lift out the reel while rotating it slightly clockwise and counterclockwise to disengage the spiral spring from the spring hook. Note the direction that the coil is wound.

7. Carefully remove the spring and replace it in the same direction that it came out according to the assembly instruction in the following section.

Recoil Starter Assembly:

⚠WARNING ***Moving parts can cause severe personal injury. Do not proceed without using protective eye wear, gloves and clothing.***

1. Engage the outer end of the spiral spring in the notch in the recoil starter and rewind the spring into the reel.

2. If the outer end of the spiral spring projects outward after winding the spring, bend the end inward. Make sure inner end of the spiral spring will come in contact with the shaft.

3. Apply heat resistant grease to the spring.

4. With the reel and spiral spring in alignment with the starter shaft, install the reel. Install the friction spring, ratchet guide, ratchet, friction plate and mounting nut on the starter shaft. Secure clutch plate mounting nut (Figure 6-15).

5. Carefully wind the reel in the direction shown in Figure 6-16 the number of revolutions counted during disassembly. Hold the reel to prevent it from unwinding.

6. Install the starter rope by threading it through the reel and out the opening in the starter case. Secure the rope to the starter handle and allow the starter coil to slowly unwind.

7. Check ratchet operation before installing the recoil starter on the generator set.

ELECTRIC STARTER

A 12-volt electric starter with negative ground is used for cranking the generator set on certain models. Because the starter is an integral part of the set control system, check the control circuitry (refer to the Control section) before servicing the starter. Test the starter and starter solenoid prior to disassembling the starter for service. Use the following procedures to disassemble, inspect, and reassemble the starter.

Starter Test

1. Disconnect the battery and control leads from the starter and starter solenoid (tag leads).

2. Remove the starter assembly from the generator set.

3. Disconnect the lead from the "C" terminal of the starter.

4. Connect a jumper lead from the battery positive (+) to the lead removed in step 3 (Figure 6-17).

5. Connect a jumper lead momentarily between the starter body and the negative (-) battery terminal.

6. If the motor does not run, proceed to Starter Service, if the motor does run, proceed to the Starter Solenoid Test.

Starter Solenoid Test (GH280 Engine)

1. Connect a jumper lead between the battery positive (+) terminal and the starter solenoid "S" terminal (Figure 6-18).

2. Momentarily connect a jumper lead between the battery negative (-) terminal and the solenoid body. The solenoid contacts should close. If the solenoid does not activate, replace it.

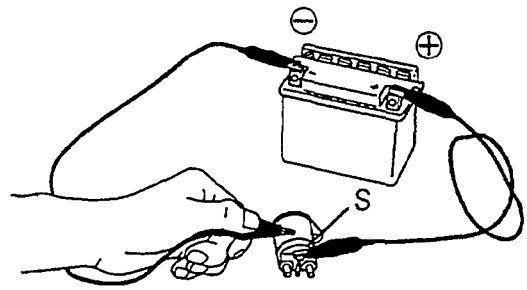


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FIGURE 6-17. STARTER MOTOR TEST

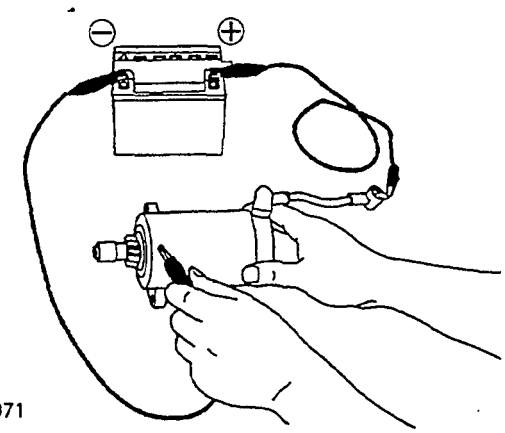

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FIGURE 6-18. STARTER SOLENOID TEST (GH280 Engine)

Starter Solenoid Test (GH400 Engine)

1. Connect jumper leads from the battery negative (-) terminal to the body of the solenoid and to the "C" terminal of the solenoid (Figure 6-19).

2. Do not energize solenoid for more than five seconds or component failure can occur. The solenoid should activate when a jumper is connected between the battery positive (+) terminal and the solenoid "S" terminal. The solenoid should remain activated when the jumper is removed from the negative (-) battery terminal.

3. If the solenoid does not activate and work as described in step 2, replace it.

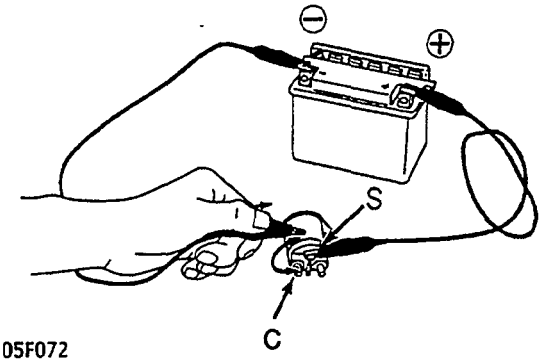

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FIGURE 6-19. STARTER SOLENOID TEST (GH400 ENGINE)

Starter Service

⚠WARNING ***Contact with moving parts can cause severe personal injury. Work carefully when disassembling the starter because it contains springs that are under tension. Wear protective eye wear during service.***

To completely disassemble the starter, refer to Figures 6-20 or 6-21. Be careful when removing the brush and commutator to avoid damage. The brush springs are under tension and should be removed carefully.

(1) SNAP RING
(2) BUSHING
(3) SPRING
(4) OVERRUNNING CLUTCH
(5) HOUSING
(6) O-RING
(7) CONTACTOR
(8) ARMATURE
(9) YOKE
(10) BRUSH HOLDER
(11) O-RING
(12) BRUSH
(13) END-FRAME

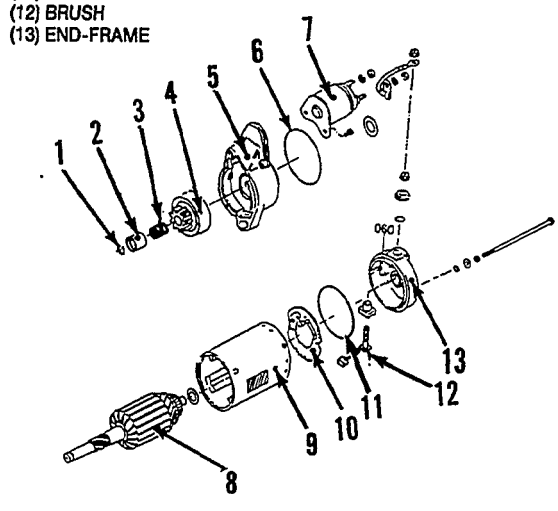

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FIGURE 6-20. STARTER ASSEMBLY - GH280 ENGINE

(1) PLUG
(2) BUSHING
(3) STARTER DRIVE HOUSING
(4) MAGNET SWITCH MOUNTING NUT
(5) DRIVE LEVER
(6) PINION STOP NUT
(7) GASKET
(8) MAGNET SWITCH
(9) NUT
(10) WASHER
(11) SNAP RING
(12) OVERRUNNING CLUTCH
(13) ARMATURE
(14) THROUGH BOLT
(15) YOKE
(16) BRUSH
(17) CONNECTING LEAD
(18) BRUSH HOLDER
(19) BRUSH SPRING
(20) INSULATOR
(21) BUSHING
(22) END FRAME
(23) COVER

*APPLY GREASE

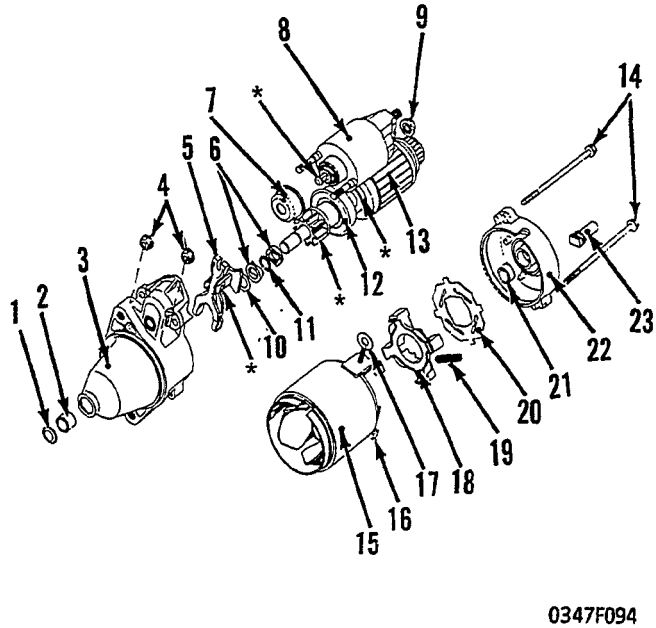

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FIGURE 6-21. STARTER ASSEMBLY - GH400 ENGINE

Starter Checks

Overrunning Clutch

1. Check the clutch for smooth operation (Figure 6-22.).

2. The overrunning clutch should engage and rotate with the pinion shaft and disengage in reverse.

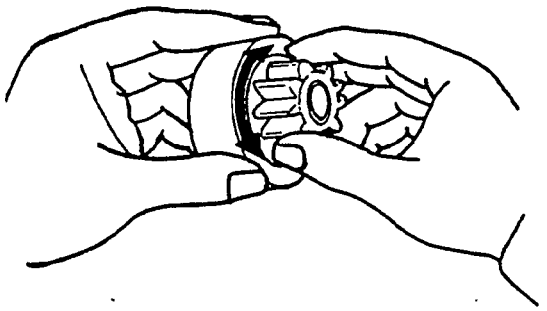

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FIGURE 6-22. OVERRUNNING CLUTCH

Armature

1. Use an ohmmeter to check for continuity between the armature segments as shown in Figure 6-23.

2. Continuity should be measured between each of the segments. If any of the segments are open, replace the armature.

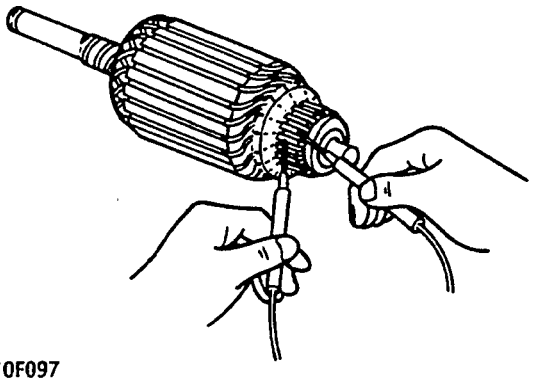

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FIGURE 6-23. MEASUREMENT BETWEEN COMMUTATOR SEGMENTS

3. Measure continuity between the commutator segments and the armature coil core (Figure 6-24), and between commutator segments and the armature shaft (Figure 6-25).

4. If continuity is measured between the commutator segments and the armature coil core or armature shaft, replace the armature.

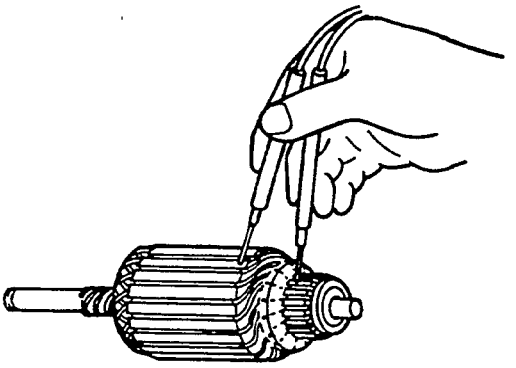

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FIGURE 6-24. COMMUTATOR TO CORE MEASUREMENT

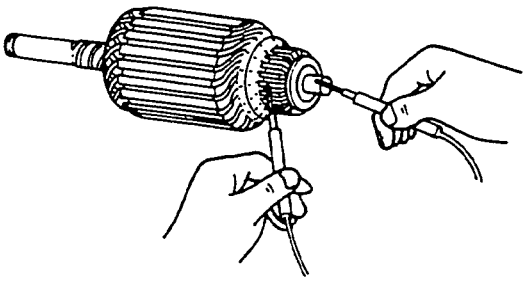

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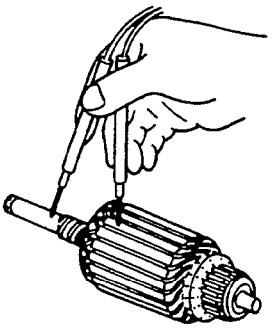
FIGURE 6-25. COMMUTATOR TO SHAFT MEASUREMENT

5. Check for continuity between the armature coil core and the armature shaft (Figure 6-26). If continuity is measured replace the armature.



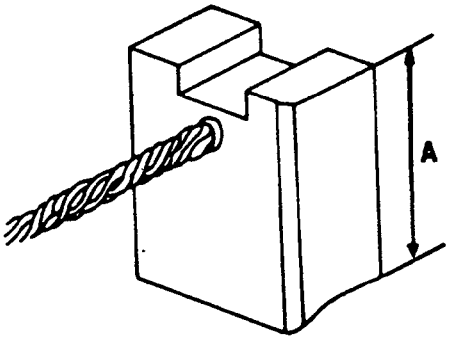
SA10F100

FIGURE 6-26. ARMATURE CORE TO SHAFT MEASUREMENT

Brush Wear

1. Measure the brush length, dimension "A" in Figure 6-27.

2. If the length is less than 0.366 in (9.3 mm) on GH280 engine starter or 0.236 in (6.0 mm) on GH400 engine starter, replace the brush holder assembly.

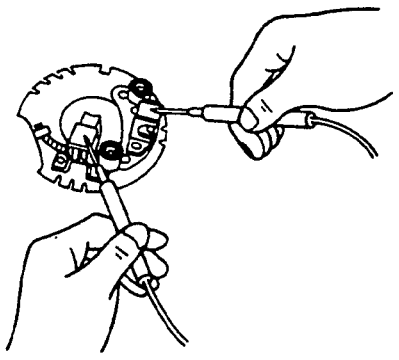


C022F059

FIGURE 6-27. MEASURING BRUSH LENGTH

Brush Holder

1. Check continuity between the positive (+) brush holder and ground (Figure 6-28). If continuity is measured replace the brush holder.



SA10F102

FIGURE 6-28. BRUSH HOLDER CHECK

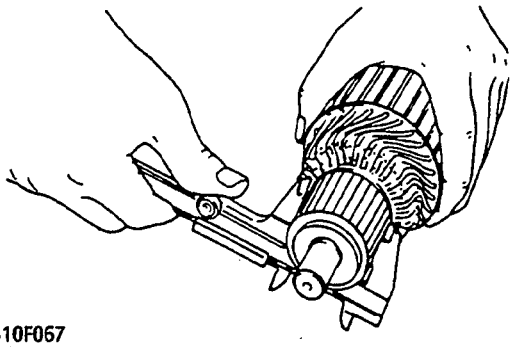
Commutator and Mica

1. If the commutator surface is dirty or dusty, clean it with sandpaper.

2. Measure the commutator O.D. at several points with a vernier caliper (Figure 6-29).

3. If the minimum O.D. is less than 1.039 in (26.4 mm) on GH280 engine starter or 1.063 in (27 mm) on GH400 engine starter, replace the armature.

4. If the difference between measurements exceeds 0.016 in (0.4 mm), correct the commutator on a lathe.

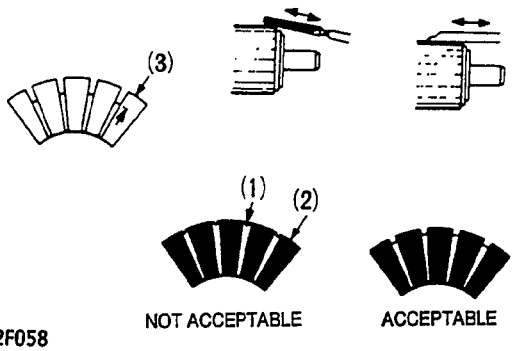


0610F067

FIGURE 6-29. MEASURING COMMUTATOR O.D.

5. Measure the mica undercut depth (Figure 6-30).

6. If the undercut depth is less than 0.0079 in (0.2 mm), use a saw blade to under cut the mica between the segments.



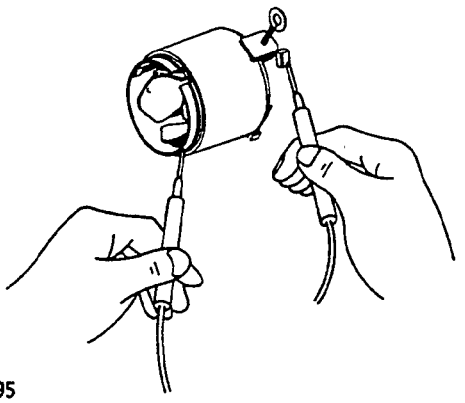
C022F058

(1) MICA
(2) SEGMENT
(3) DEPTH OF MICA

FIGURE 6-30. MICA UNDERCUT SERVICE

Field Coil (GH400 ENGINE)

1. Check continuity across the yoke and brush with an ohmmeter (Figure 6-31). If continuity is not measured replace the yoke assembly.

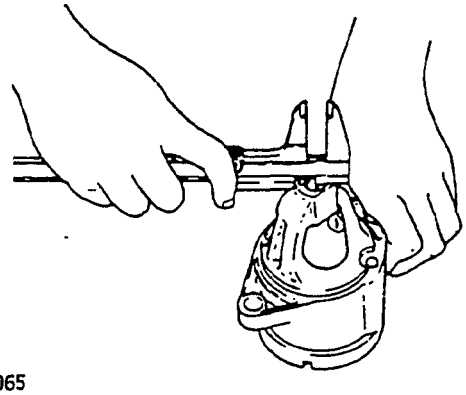


0347F095

FIGURE 6-31. FIELD COIL CHECK

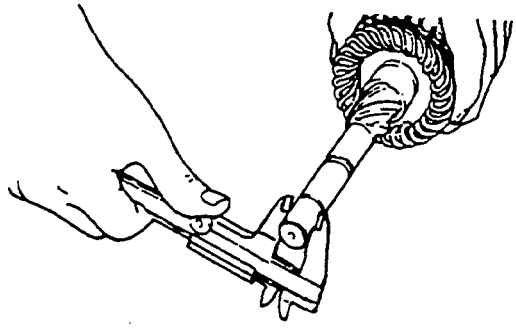
Armature Shaft Bushings (GH400) Engine)

1. Measure the bushing I.D. on the front and rear bushing (Figure 6-32).
2. Measure the Armature shaft O.D. on both ends (Figure 6-33).
3. If the clearance exceeds 0.0079 in (0.2 mm) replace the bushing.



0610F065

FIGURE 6-32. MEASURING BUSHING I.D.



0610F066

FIGURE 6-33. MEASURING ARMATURE SHAFT O.D.

OIL PUMP (GH400 ENGINE)

The engine uses a trochoid type oil pump. The pump consists of a 4-lobe inner rotor that is eccentrically engaged with the 5-lobe outer rotor (Figure 6-35). The inner rotor is driven by the crankshaft via gears, which in turn rotate the outer rotor. The two rotors rotate in the same direction and the difference in the number of lobes creates space between the lobes. As the space between the lobes becomes smaller, the oil pressure increases and oil is pumped out. When the space between the lobes begins to increase, a negative pressure is created that draws oil into the oil pump. The oil pump output pressure and wear can be checked as described in the following sections.

⚠WARNING ***Hot and moving parts can cause severe personal injury. Attach and remove oil pressure gauge when set is not running. Do not touch set during operation and do not touch hot surfaces after operation.***

Oil Pressure Check:

1. Remove the engine block screw plug and attach an oil pressure tester as shown in Figure 6-34.
2. Check to make sure engine oil level is full.
3. Start the engine and allow it to warm up.
4. Measure the oil pressure at full speed. Oil pressure should measure 4 psi (29 kPa) or more. If oil pressure is less than normal, proceed to Oil Pump Wear Check.

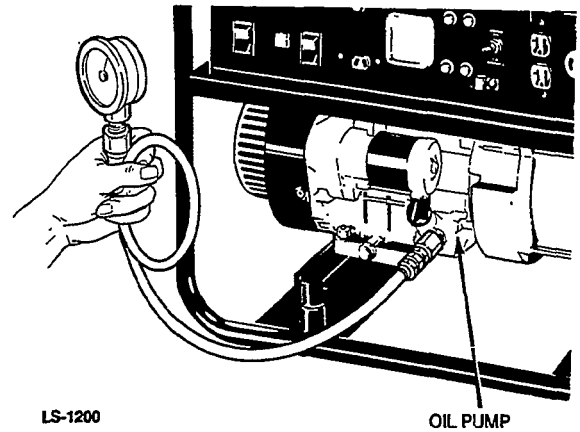
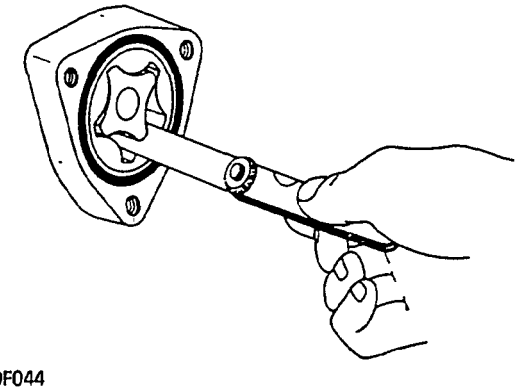


FIGURE 6-34. CHECKING OIL PRESSURE

Oil Pump Wear Check:

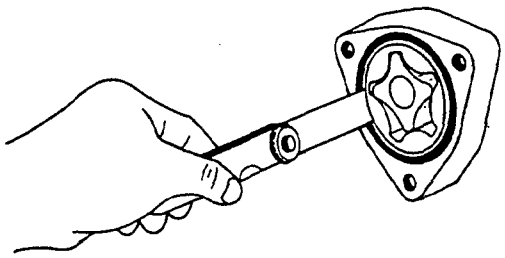
1. Drain engine oil.
2. Remove the oil pump cover (Figure 6-34).
3. Measure the clearance between the high point on the inner rotor and a high point on the outer rotor with a feeler gauge (Figure 6-35).
4. If the clearance exceeds 0.0079 inches (0.20 mm) replace the oil pump rotor assembly.



0610F044

FIGURE 6-35. MEASURING CLEARANCE BETWEEN ROTORS

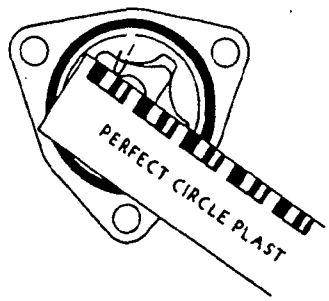
5. Measure the clearance between the outer rotor and the pump body with a feeler gauge (Figure 6-36).
6. If the clearance exceeds 0.0098 inches (0.25 mm) replace the oil pump rotor assembly.



0610F045

FIGURE 6-36. MEASURING CLEARANCE BETWEEN OUTER ROTOR AND PUMP BODY

7. Put a strip of press gauge onto the rotor face with grease (Figure 6-37).
8. Install the cover and tighten the mounting screws.
9. Carefully remove the cover and measure the depression of press gauge with a sheet of gauge.
10. If the clearance exceeds 0.0098 inches (0.25 mm) replace the oil pump rotor assembly.



0610F046

FIGURE 6-37. MEASURING CLEARANCE BETWEEN ROTOR AND COVER

OIL PRESSURE RELIEF VALVE (GH400 ENGINE)

The relief valve prevents damage to the lubricating system due to high oil pressure. The valve is a piston type direct acting relief valve. When oil pressure exceeds the upper limit, the relief valve is pushed back and excess oil is allowed to escape. To inspect and clean the relief valve, remove the plug, gasket, spring and relief valve as shown in Figure 6-38.

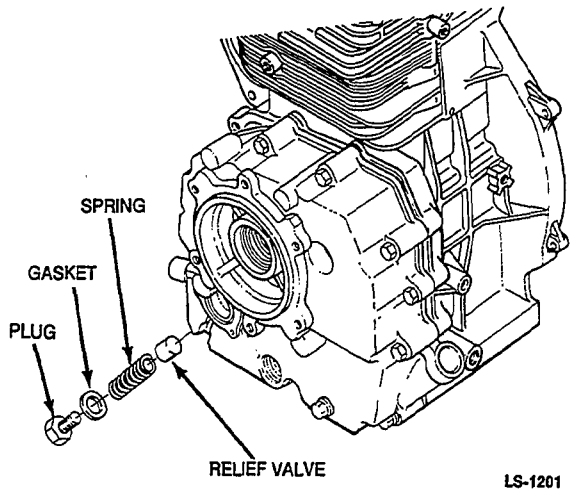


FIGURE 6-38. OIL PRESSURE RELIEF VALVE

OIL WATCH SYSTEM

Each model contains an Oil Watch System that is designed to prevent engine damage due to a low oil level (or low oil pressure on models with the GH400 engine). The actual design of the Oil Watch System varies with engine size and type. Figure 6-39 show a typical Oil Watch System. Each system consists of an Oil Watch Unit, an LED lamp, and an Oil Level Switch or Oil Pressure Switch.

Oil Level Switch: uses a float to monitor the oil level in the crankcase. When the oil level goes below the normal working level, the float moves down and closes the switch. A continuity test of the switch can be made between the lead from the Oil Level Switch and ground. The meter will indicate an open circuit when the crankcase has a sufficient oil level and indicate a short when the oil level is below the normal working level.

Oil Pressure Switch (GH400): senses crankcase oil pressure and closes its contacts when the crankcase oil pressure goes below 4 psi.

Oil Watch Unit (Except GH400): when the Oil Level Switch closes, the ignition voltage, from the primary of the Ignition Coil, is grounded through the Oil Watch unit and the Oil Level Switch causing the engine to stop. At the same time the Oil Watch Unit, powered by the voltage from the ignition coil, sends a signal to the LED lamp causing it to illuminate, indicating that the oil level is low.

Oil Watch Unit (GH400): has a built in time delay of approximately 15 seconds that prevents the engine from being shut down before the oil pump has enough time to build up oil pressure. After the delay, if the oil pressure is not at least 4 psi, the Low Oil Pressure Switch will ground the ignition voltage and cause the engine to stop. At the same time, the Oil Watch Unit sends a signal to the LED causing it to illuminate, indicating that the oil pressure is low.

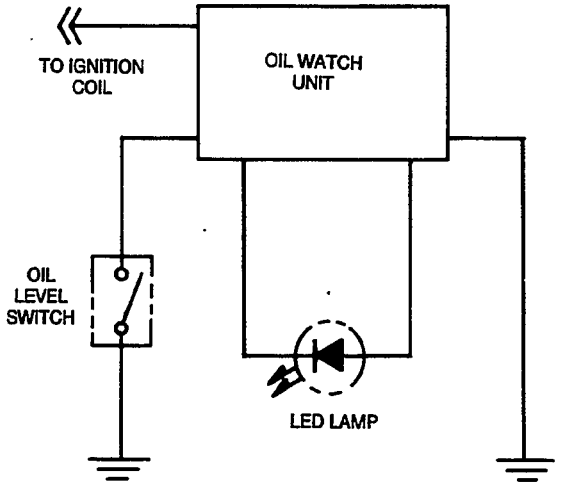


FIGURE 6-39. TYPICAL OIL WATCH SYSTEM

Section 7. Control

INTRODUCTION

The control system includes all of the functions that relate to starting, monitoring for fault conditions, instrumentation, battery charging, and stopping. This section describes the control components, control operation, and basic troubleshooting procedures for the control system.

CONTROL PANEL

This section describes the function and operation of the generator set controls for all of the models. Some control features are not available on certain models. Review each of the control descriptions that apply to your specific model.

Control Components

Engine On/Off Switch (Standard Series): Mounted on the engine, allows engine starting when the On/Off switch is set to the On position. When the switch is set to the Off position, it stops engine operation.

On/Stop Switch (Pro Series): Allows the engine to be started any time that the switch is in the On position. Stops engine operation when held in the Stop position.

Start/On/Stop Switch (Electric Start Models): Pushing switch into the Start position begins engine cranking. When engine starts, release the switch and it will return to the On position. To stop the engine, hold the switch in the Stop position until the engine stops running.

Low Oil Light: Indicates low engine oil level. Low Oil Light will flash during cranking (except GH400 engine) or will flash during operation and the generator set will stop if the engine oil level is below the low working level.

Fuel Gauge: Indicates the present fuel level in the generator set fuel tank.

Voltmeter: Indicates generator AC output line voltage.

AC and DC Circuit Breakers: Provide protection for the generator from short circuits or overloads.

Full Power Switch: Allows operator to select full power operation from the 120 VAC receptacles or shared power between the 120 VAC and 240 VAC receptacles. Switch setting also affects voltmeter readings; refer to voltmeter description.

Idlematic Switch: Automatic engine speed control. In the On position, the engine operates at idle speed until a load is applied. The Idlematic automatically increases the engine to full speed when a load is applied. This feature reduces engine wear and conserves energy. In the Off position the engine operates at full speed.

Additional Controls

Fuel Valve: Controls fuel flow to engine. Setting fuel valve to Open position allows fuel to flow to engine. Set fuel valve to Closed position when generator set is not in use.

Choke Lever: Restricts air flow to the carburetor for starting a cold engine.

Speed Control Lever: Sets engine speed. This lever should be maintained in the high speed ("H") position at all times. Periodically check setting to make sure it is in the proper position.

CONTROL OPERATION

This section describes the control operation for both the electric start and recoil start models. Follow the control operation that is similar to your specific model. Refer to the schematic diagram for your specific model to help follow the circuit description (see Section 11). For actual engine starting, refer to the Operator's manual to review important safety precautions and operating instructions.

Electric Start

Holding the Start/On/Stop switch in the Start position connects battery positive (B+) to the start solenoid. The solenoid energizes and closes the solenoid switch. The solenoid switch connects battery positive (B+) to the starter and the engine begins to crank. As the engine starts to run, the Start/On/Stop switch should be released. The switch will automatically return to the center (On) position and the engine will continue to run. In the On position, power is no longer connected to the starter solenoid and the solenoid switch opens removing power from the starter motor.

Electric start models can also be recoil started when the start/on/stop switch is placed in the On position.

Recoil Start

Move the Engine On/Off switch, located on the engine housing, to the On position. This opens a ground path from the Ignition Control Unit and allows ignition spark to develop in the magneto-type ignition when the recoil starter is pulled.

Oil Watch

The Oil Watch monitors the engine oil level. If the engine oil level is low, the Oil Watch indicator illuminates and the Oil Watch grounds the output from the Ignition Control Unit to stop the engine.

Battery Charge Circuit - Electric Start Models Only

The charging circuit supplies battery charge voltage. It consists of an AC output voltage from the Ignition Control Unit. The output is rectified to DC by a diode. This charges the battery at a variable rate (1 ampere maximum) during set operation. The charge rate varies with the generator load and battery condition.

Stopping

Holding the Start/On/Stop, On/Stop, or Engine On/Off switch (depending on model) in the Off position causes the output from the Ignition Control Unit to be grounded. This eliminates ignition voltage and stops the engine. If switch does not stop engine, check to make sure switch wiring is making proper contact.

CONTROL TROUBLESHOOTING

Use the following troubleshooting guide to help locate problems related to the control components only. Refer to the appropriate wiring diagram in Section 11, for wiring terminal identifications.

The troubleshooting guide covers both the electric start models and the recoil start models. After identifying the problem, refer to the guide for the possible cause and the recommended corrective action.

Always refer to the specific wiring diagram that corresponds to the model number of the generator set when troubleshooting.

TABLE 7-1. CONTROL TROUBLESHOOTING

⚠WARNING ***Many troubleshooting procedures present hazards that can result in severe personal injury or death. Only qualified service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Review safety precautions on inside cover page.***

TROUBLE	POSSIBLE CAUSE	CORRECTIVE ACTION
Engine Does Not Crank (Electric Start Models Only)	1. Defective Start/On/Stop switch.	1. Check switch for continuity and replace if defective.
	2. Open circuit in wiring between Start/On/Stop switch and starter solenoid or between battery and starter.	2. Check wiring and connections for continuity and repair if defective.
	3. Insufficient voltage for cranking due to: a. Battery not charged, or b. terminal connections loose or dirty c. defective charge circuit d. defective Ignition Control Unit charge circuit.	3a. Check condition of battery and recharge or replace as needed. 3b. Clean and tighten battery cable connections, starter connections and ground connections. 3c. Check diode and replace if defective. 3d. Refer to Section 6, Engine - Primary Systems for test procedures.
	4. Defective starter solenoid or starter.	4. Refer to Section 6, Engine - Primary Systems for test procedures.

TABLE 7-2. CONTROL TROUBLESHOOTING

⚠WARNING ***Many troubleshooting procedures present hazards that can result in severe personal injury or death. Only qualified service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Review safety precautions on inside cover page.***

TROUBLE	POSSIBLE CAUSE	CORRECTIVE ACTION
Engine Does Not Start (Recoil Start Models Only)	1. Defective On/Stop or Engine On/Off switch.	1. Check switch for continuity and replace if defective.
	2. Open circuit in wiring between On/Stop or Engine On/Off switch.	2. Check wiring and connections for continuity and repair if defective.
	3. Defective Ignition Module	3. Refer to Section 6, Engine - Primary Systems for test procedures.
	4. Low oil level	4. Check oil level and fill if necessary.
Full Power Switch Does Not Function Properly (Only used on certain models)	1. Defective Full Power switch	1. Check switch for continuity and replace if defective.
	2. Wire connections to Full Power switch are not making contact or are miswired.	2. Check for good wire connections and compare connections with wiring diagram in Section 11.
Idlematic Does Not Operate (Only used on certain models)	1. Defective Idlematic switch.	1. Check switch for continuity and replace if defective.
	2. Wire connections to Idlematic switch, Idlematic Control, or Idlematic Solenoid are not making contact or are miswired	2. Check for good wire connections and compare connections with wiring diagram in Section 11.
	3. Defective Idlematic Solenoid.	3. Check Idlematic solenoid for a binding plunger movement.
	4. Defective Idlematic Control.	4. Check to see that the appropriate generator leads pass through the current transformer. Test Idlematic Control.
Engine Cannot Be Turned Off With Switch	1. Defective Start/On/Stop switch, On/Start switch, or Engine On/Off switch.	1. Check switch for continuity and replace if defective.
	2. Open circuit in switch wiring.	2. Check wire connections to switch.

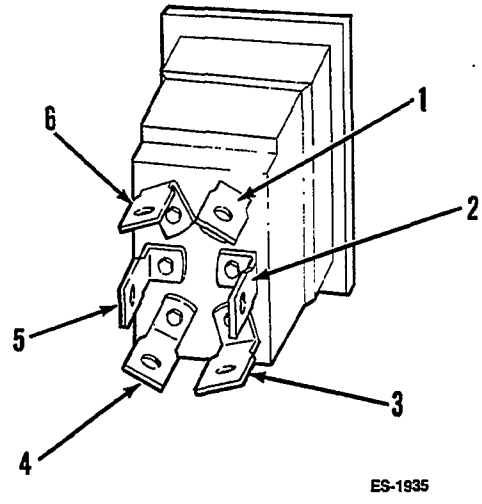
CONTROL TESTS

The following control component checks are an aid to isolating faulty components. Disconnect battery leads (electric start models) before servicing. Always disconnect the negative (-) battery cable first to reduce the risk of arcing.

⚠WARNING ***Many troubleshooting procedures present hazards that can result in severe personal injury or death. Only qualified service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Review safety precautions on the inside cover page.***

Start/On/Stop Switch

Remove the control panel mounting screws and pull the panel forward. Disconnect and tag the wires from the switch and connect an ohmmeter to the contacts shown in Figure 7-1. Continuity should be measured between terminals 1 - 2 and 5 - 6 when the switch is held in one direction and between 2 - 3 and 4 - 5 when the switch is held in the other position. Infinity should be measured between each of these pairs of contacts when the switch is released to its normally open center position. If an abnormal reading is measured replace the switch.



SWITCH CONTACTS (REAR VIEW)

FIGURE 7-1. START/ON/OFF SWITCH TEST

On/Stop Switch

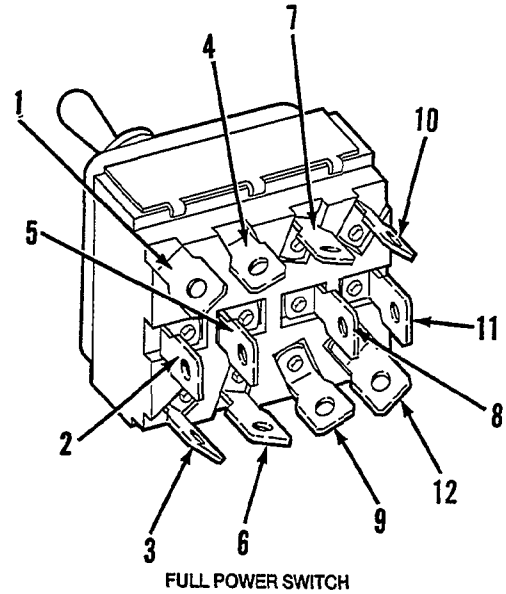
Remove the control panel mounting screws and pull the panel forward. Disconnect the wires from the switch and connect an ohmmeter between the two contacts on the rear of the switch. The meter should indicate infinity when the switch is in the On position and continuity when the switch is in the Stop position. If an abnormal reading is measured replace the switch.

Engine On/Off Switch

Remove the switch mounting bracket and disconnect the wires from the switch. Connect an ohmmeter between the two contacts on the rear of the switch. The meter should indicate infinity when the switch is in the On position and continuity when the switch is in the Off position. If an abnormal reading is measured replace the switch.

Full Power Switch

Remove the control panel mounting screws and pull the panel forward. Disconnect and tag the wires from the switch. Connect an ohmmeter to each set of contacts shown in Figure 7-2. Continuity should be measured as indicated by the schematic in Figure 7-2. The schematic shows the switch in the AC 120V Only (full power) position. The dotted lines indicate continuity in the AC 120/240V position. If an abnormal reading is measured replace the switch.



FULL POWER SWITCH CONTACTS
SHOWN IN FULL POWER —
AC 120V - POSITION

FIGURE 7-2. FULL POWER SWITCH TEST

Idlematic Switch

Remove the control panel mounting screws and pull the panel forward. Disconnect the wires from the switch and connect an ohmmeter between the two contacts on the rear of the switch. The meter should indicate continuity when the switch is in the On position and infinity when the switch is in the Off position. If an abnormal reading is measured replace the switch.

Idlematic Control and Idlematic Solenoid

When the Idlematic switch is set to On and the generator set is running at no-load, the Idlematic Control should sense the no load condition and supply the Idlematic Solenoid with 9 to 17 VDC. The solenoid should pull on the governor arm to reduce the engine speed. If the Idlematic switch checks good, check for free movement of the solenoid plunger. Also check all wire connections to the Idlematic Control, Idlematic Switch and Idlematic Solenoid. If plunger movement is good and the wiring is good, prepare to measure DC voltage at solenoid.

⚠WARNING ***Electrical shock can cause severe personal injury or death. Use extreme caution when working on electrical circuitry. Attach and remove meter leads only when generator set is not operating. Do not touch meter or meter leads during testing.***

Connect a DC voltmeter to the leads from the Idlematic Solenoid (Figure 7-3). Start generator set and push Idlematic switch to On. Observe voltmeter reading. Stop generator set operation. If 9 to 17 VDC was measured and the solenoid did not operate, replace the solenoid. If no or low voltage was measured, replace the Idlematic Control.

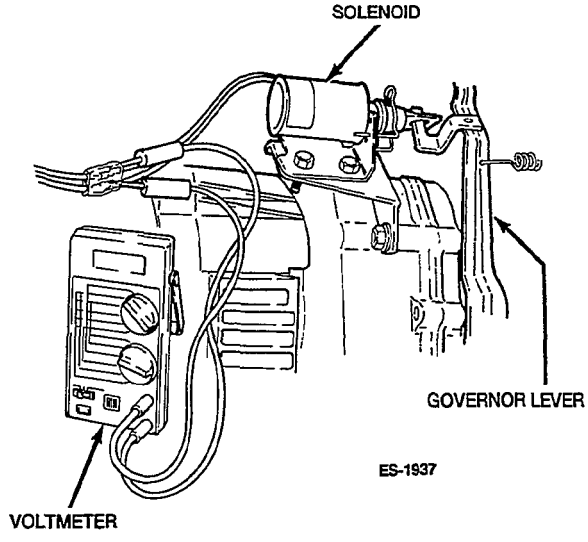


FIGURE 7-3. IDLEMATIC SOLENOID TEST

Section 8. Generator

INTRODUCTION

The generator is a revolving-field, self-exciting, 2-pole design. A capacitor-type or transistor-type voltage regulator is used, depending on model (see *Specifications* section). All AC and DC load connections are made through outlets on the control panel or generator housing. AC and DC circuit breakers provide overload protection for the generator.

This section is divided into five parts:

- Generator Description
- Generator Operation
- Generator Troubleshooting
- Generator Service
- Generator Testing

The first part of each section covers generators that use the capacitor-type voltage regulator; the second part covers generators that use the transistor-type voltage regulator. Refer to the *Specifications* section to determine which type of voltage regulator is used in each specific model.

GENERATOR DESCRIPTION FOR MODELS WITH CAPACITOR-TYPE VOLTAGE REGULATOR

The following section describes the generator components. Refer to Figure 8-1. The generator consists of the following major components:

- Stator
- Rotor
- Diode Assembly
- Generator Cooling
- Capacitor-Type Voltage Regulator

Stator

The stator consists of three coils: a main coil, a sub coil, and a DC coil. These coils are wound around slots in the stator laminations. The main coil generates the AC output. The sub coil provides excitation to help magnetize the rotor. The DC coil is used to provide power to the DC output circuit.

Rotor

The rotor is a brushless design with permanent magnets at the top of the two outer poles for initial excitation. Each pole has a coil wrapped around it and a rectifying diode is connected to each coil. The two coils on the rotor work with the sub coil on the stator to magnetize the entire rotor core.

The rotor consists of a center shaft that holds the rotor laminations, a press fit bearing, and a centrifugal cooling fan. The entire assembly is connected directly to the tapered engine crankshaft by means of a through bolt. The rotor is supported on the other end by the end bell, which mates with the rotor bearing. The end bell is secured to the adapter.

Diode Assembly

The diode assembly is used for full-wave rectification of the AC output from the stator DC coil. This circuit provides the 12-volt DC output.

Generator Cooling

Cooling airflow for the generator is provided by a centrifugal fan that is mounted on the engine end of the rotor shaft. Air is drawn through the end cover and across the stator and rotor assemblies, then discharges out the adapter openings.

Capacitor-Type Voltage Regulator

A capacitor is connected to the sub coil of the stator assembly. The capacitor establishes a voltage by causing a leading current to flow through the coil. The capacitor also allows the generator to compensate for voltage changes to maintain the output voltage at a constant level.

GENERATOR OPERATION FOR MODELS WITH CAPACITOR-TYPE VOLTAGE REGULATOR

The schematic shown in Figure 8-2 is provided to help follow the generator operating description. Always refer to the specific schematic that corresponds to the model number of the generator set when troubleshooting.

When the rotor assembly begins revolving, the permanent magnets in the rotor induce a small amount of AC voltage across the stator main coil and sub coil. With the capacitor connected to the stator sub coil, this voltage causes a leading current to flow through the coil producing magnetism in the coil. This magnetism induces a voltage in the coils of the revolving rotor. The diode connected to the rotor coil rectifies the current in the coil to produce a DC current. DC current flowing through the coil increases the magnetism of the rotor to create a more powerful magnet.

1	Adaptor	11	Screw Holder Cap.
2	Stator	12	End cover
3	Stator cover	13	Bolt endcover
4	Rotor	14	DC Diode assy.
5	Ball Bearing		
6	Bolt rotor mount.		
7	End Bell		
8	Bolt Stator mount.		
9	Capacitor		
10	Holder Capacitor		

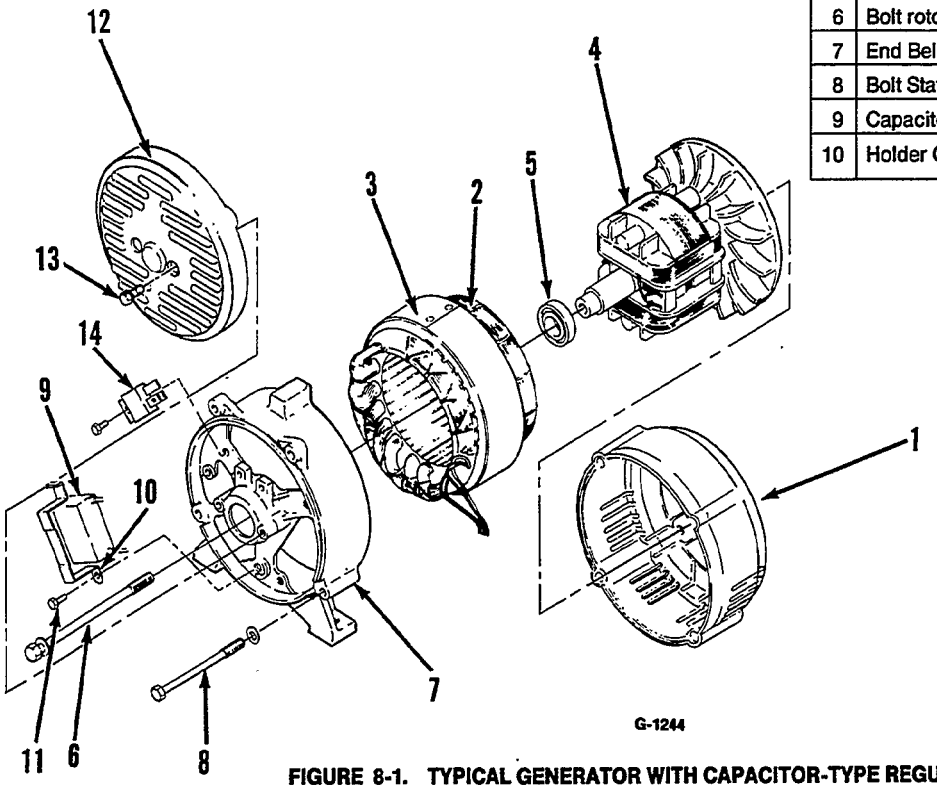


FIGURE 8-1. TYPICAL GENERATOR WITH CAPACITOR-TYPE REGULATION

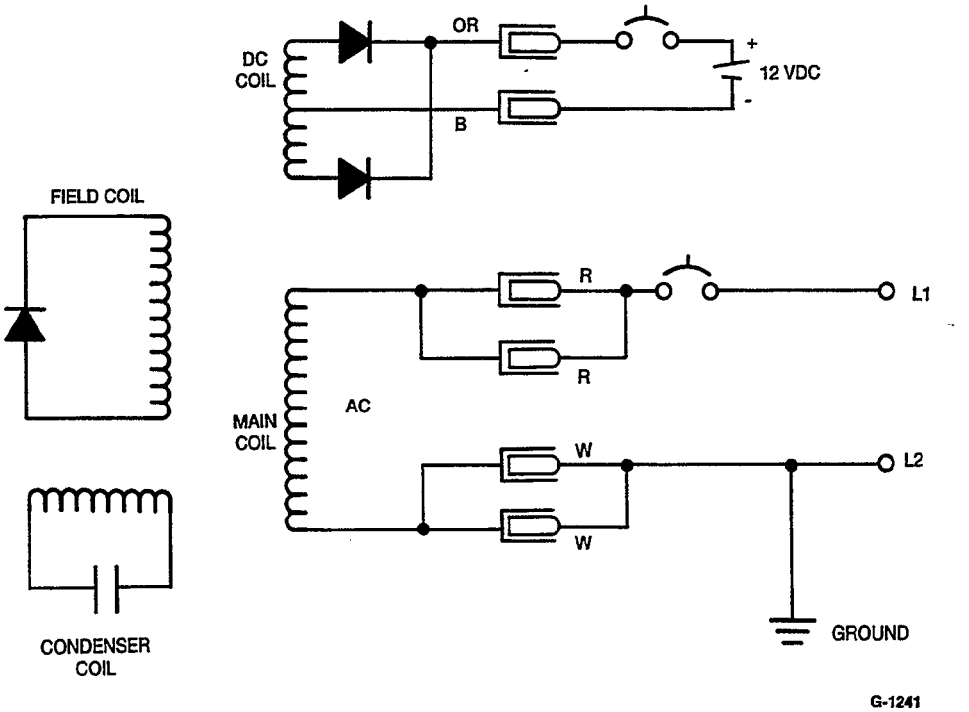


FIGURE 8-2. TYPICAL GENERATOR SCHEMATIC FOR MODELS WITH CAPACITOR-TYPE REGULATOR

The strongly magnetized rotor causes an increase in the amount of AC voltage induced in the stator, this causes a stronger leading current to flow through the stator sub coil. This process continues until the engine comes up to speed and a constant voltage is reached.

When a load is connected to the generator, an increase in the stator main coil current would cause a drop in the output voltage due to the impedance (AC resistance) of the winding; however, the leading current, caused by the capacitor connected to the sub coil, reduces the winding resistance to a value below the no-load condition. This current, coupled with the load current, increases the main coil magnetism to compensate for the voltage drop due to the load. In this way, the voltage output remains fairly constant with varying loads.

GENERATOR DESCRIPTION FOR MODELS WITH TRANSISTOR-TYPE VOLTAGE REGULATION

The following section describes the generator components. Refer to Figure 8-3. The generator consists of the following major components:

- Stator
- Rotor
- Brushes
- Diode Assembly
- Generator Cooling
- Voltage Regulator

Stator

The stator consists of three coils: a main coil, a sub coil, and a DC coil. These coils are wound around slots in the stator laminations. The main coil generates the AC output. The sub coil provides excitation to help magnetize the rotor. The DC coil is used to provide power to the DC output circuit. There is also a small winding on the stator that is used for voltage sensing by the voltage regulator.

Rotor

The rotor has permanent magnets placed at the top of the two outer poles for initial excitation. Coils are wound around each of the two poles to magnetize the entire core.

The rotor consists of a center shaft that holds the rotor laminations, two slip rings, a press fit bearing, and a centrifugal cooling fan. The entire assembly is connected directly to the tapered engine crankshaft by means of a through bolt. The rotor is supported on the other end by the end bell, which is placed over the rotor bearing and secured to the adapter.

Brushes and Brush Block

The brush block is a one piece molded part that mounts to the end bell and contains two brushes. The brushes ride on the rotor slip rings. The excitation voltage from the sub coil of the stator assembly is supplied to the voltage regulator and then to the rotor coil through the brushes. Each brush is kept in contact with its slip ring by a spring mounted inside the brush block. The spring exerts just the right amount of pressure to provide good contact and provide long brush life.

Diode Assembly

The diode assembly is used for full-wave rectification of the AC output from the stator DC coil. This circuit provides the 12-volt DC output.

Generator Cooling

Cooling airflow for the generator is provided by a centrifugal fan that is mounted on the engine end of the rotor shaft. Air is drawn through the end cover and across the stator and rotor assemblies, then discharges out the adapter openings.

Voltage Regulator

The voltage regulator is mounted inside the end cover. The voltage regulator is a transistor-type automatic voltage regulator (AVR) that is used to maintain the output voltage at a constant level.

GENERATOR OPERATION FOR MODELS WITH TRANSISTOR-TYPE VOLTAGE REGULATION

The schematic shown in Figure 8-4 is provided to help follow the generator operating description. Always refer to the specific schematic that corresponds to the model number of the generator set when troubleshooting.

When the rotor assembly begins revolving, the permanent magnets, mounted on the rotor, induce a small AC voltage across the stator sub coil. The sub coil voltage is fed into the transistor-type voltage regulator and is then applied, as DC voltage, to the rotor field coil through the brushes and slip rings. As the current flows through the field coil it magnetizes the rotor core and makes magnetic lines of force that induce an AC voltage in the main coil of the stator. The amount of AC voltage induced in the stator main coil increases as the engine speed increases. The voltage regulator monitors and controls the amount of AC voltage provided from the main coil to the load (see the Voltage Regulator Operation section). The output voltage is fed to the external load through the outlets mounted on the generator end cover or on the control panel.

1	Adaptor	11	Brush Holder assy.
2	Stator	12	End cover
3	Stator cover	13	Bolt endcover
4	Rotor	14	DC Diode assy.
5	Ball Bearing	15	Terminal assy.
6	Bolt rotor mount.	16	Screw DC diode
7	End Bell		
8	Bolt Stator mount.		
9	AVR		
10	Bolt AVR mount.		

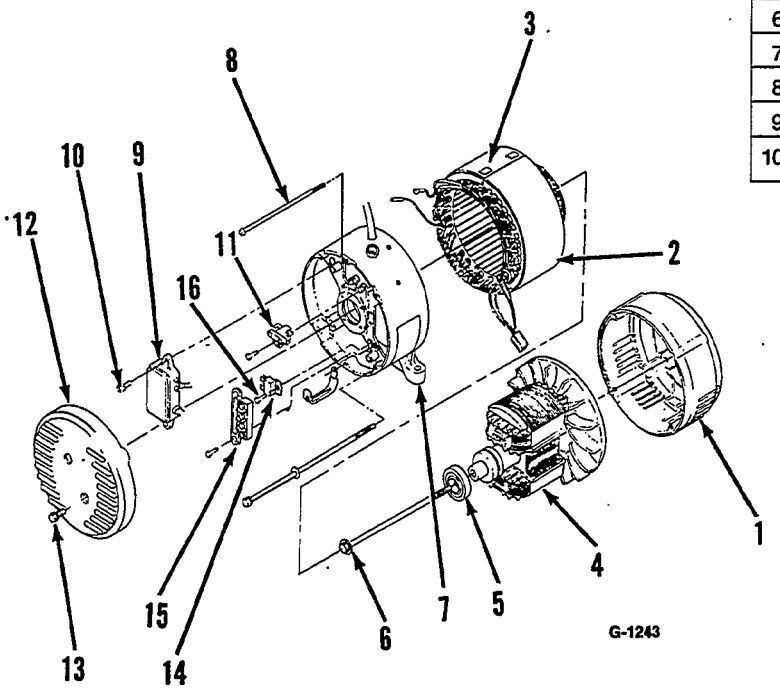


FIGURE 8-3. TYPICAL GENERATOR WITH TRANSISTOR-TYPE REGULATION

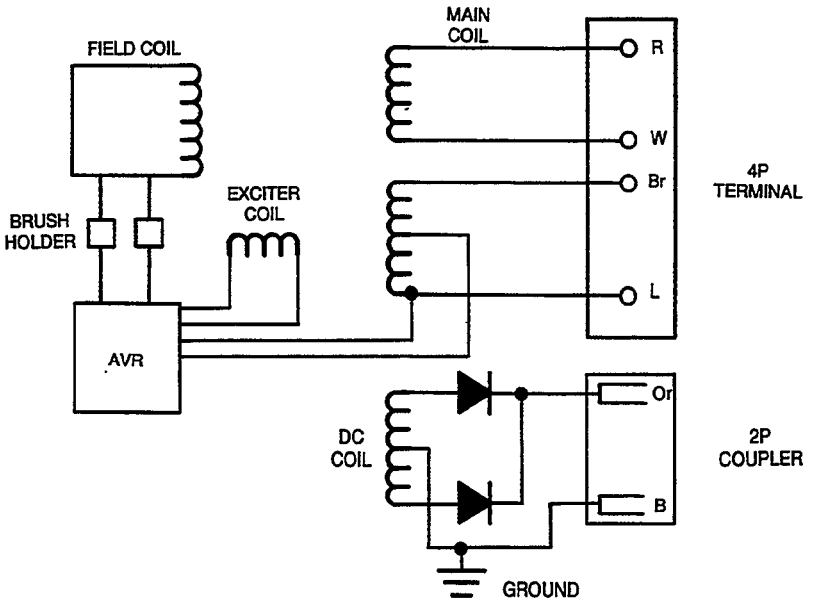


FIGURE 8-4. TYPICAL SCHEMATIC FOR GENERATORS WITH TRANSISTOR-TYPE REGULATION

TRANSISTOR-TYPE VOLTAGE REGULATOR OPERATION

The transistor-type automatic voltage regulator can maintain a steady output voltage even when the load and engine speed vary. The regulator constantly measures the output voltage generated at the stator main coil. If the output voltage exceeds the specified voltage, the voltage regulator reduces the current to the stator field coil, causing the output voltage to decrease. When additional load is applied to the generator, the output voltage starts to decrease. The regulator senses a decrease in output voltage and increases the current to the rotor field until the reference voltage and the output voltage match. By repeating this process, the rated output voltage is held constant with various amounts of load.

GENERATOR TROUBLESHOOTING

Use the following troubleshooting guide to help locate problems related to the generator. Figures 8-1 and 8-3 show the location of most of the generator components. Refer to the wiring diagrams in Figures 8-2 and 8-4 for location of the wiring terminal connections. It is not necessary to remove the stator or rotor for troubleshooting. All of the test points are located inside the generator end cover. After identifying the problem, refer to the troubleshooting guide for the possible cause and the recommended corrective action. Refer to the *Generator Testing* section for component test procedures.

Refer to the troubleshooting table that applies to the type of voltage regulator used in the specific model being serviced (see *Specifications* section).

TABLE 8-1. TROUBLESHOOTING CHART FOR MODELS WITH CAPACITOR-TYPE VOLTAGE REGULATOR

⚠WARNING ***Many troubleshooting procedures present hazards that can result in severe personal injury or death. Only qualified service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Review safety precautions on inside cover page.***

TROUBLE	POSSIBLE CAUSE	CORRECTIVE ACTION
No AC Output Voltage	1. Open AC circuit breaker 2. Open circuit between stator main coil and AC receptacle. Defective receptacle. 3. Defective stator main coil.	1. Locate cause of overload and correct as required. Reset breaker. 2. Check for continuity and correct if circuit is open. Check for defective receptacle. 3. Test stator main coil for open, shorted, or grounded windings and replace if defective.
AC output voltage only 3 to 18 VAC	1. Defective stator sub coil. 2. Defective rotor coil or defective rotor winding diode. 3. Open or shorted capacitor.	1. Test stator sub coil for open, shorted, or grounded windings and replace if defective. 2. Test rotor coil for open, shorted, or grounded winding and defective diode. Replace rotor if defective. 3. Test capacitor for open or short and replace if defective.

TABLE 8-2. TROUBLESHOOTING CHART FOR MODELS WITH CAPACITOR-TYPE VOLTAGE REGULATOR

⚠WARNING ***Many troubleshooting procedures present hazards that can result in severe personal injury or death. Only qualified service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Review safety precautions on inside cover page.***

TROUBLE	POSSIBLE CAUSE	CORRECTIVE ACTION
AC Output Voltage Too Low or Too High	1. Engine governor incorrectly adjusted	1. Refer to *Engine Primary System* section.
Noisy Generator	1. Worn rotor shaft bearing. 2. Rotor and stator rubbing together due to: a. varnish lumps b. rotor misaligned with crankshaft	1. Replace end bearing. 2a. Check for varnish lumps between rotor and stator and remove as required. 2b. Follow specified assembly procedures to correct rotor to crankshaft alignment.
Generator Overheats	1. Generator overloaded due to defective circuit breaker 2. Airflow restricted due to dirt or debris covering vent openings in cover or adapter. 3. Stator windings covered with oil or dirt 4. Defective windings in rotor or stator.	1. Replace circuit breaker. Do Not exceed specified load when operating set. 2. Clean away all dirt or debris as required. 3. Clean stator windings 4. Test each component for open, grounded, or shorted windings and replace if defective.
Low or No DC Output	1. Open DC circuit breaker. 2. Open circuit between Stator DC coil and diode assembly or between diode assembly and receptacle. 3. Defective stator DC coil. 4. Defective diode assembly.	1. Locate cause of overload and correct as required. Reset breaker. 2. Check for continuity and correct if circuit is open. Check for defective receptacle. 3. Test stator DC coil for open, grounded or shorted windings. 4. Test Diode Assembly for open or short.

TABLE 8-3. TROUBLESHOOTING CHART FOR MODELS WITH TRANSISTOR-TYPE VOLTAGE REGULATOR

⚠WARNING ***Many troubleshooting procedures present hazards that can result in severe personal injury or death. Only qualified service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Review safety precautions on inside cover page.***

TROUBLE	POSSIBLE CAUSE	CORRECTIVE ACTION
No AC Output Voltage	1. Open AC circuit breaker 2. Open circuit between stator main coil and AC receptacle. Defective receptacle. 3. Defective stator main coil.	1. Locate cause of overload and correct as required. Reset breaker. 2. Check for continuity and correct if circuit is open. Check for defective receptacle. 3. Test stator main coil for open, shorted, or grounded windings and replace if defective.
AC output voltage only 6 to 18 VAC	1. Defective rotor coil. 2. Defective stator sub coil. 3. Faulty brushes or slip rings. 4. Faulty Voltage Regulator (AVR). 5. Faulty permanent magnet in rotor.	1. Test rotor coil for open, shorted, grounded windings and replace if defective. 2. Test stator sub coil for open, shorted, or grounded winding and replace if defective. 3. Check brushes and replace if defective. Inspect slip rings and clean if needed. 4. If the rotor and stator test good, and the brush block and slip rings are good, replace the AVR module and recheck. 5. Replace rotor after checking other possible causes for 6 to 18 VAC.
AC Output Voltage Too Low or Too High	1. Engine governor incorrectly adjusted. 2. Faulty voltage regulator (AVR)	1. Check engine speed. Refer to *Engine Primary System* section. 2. Replace the AVR module and recheck.
Noisy Generator	1. Worn rotor shaft bearing. 2. Rotor and stator rubbing together due to: a. varnish lumps b. rotor misaligned with crankshaft	1. Replace end bearing. 2a. Check for varnish lumps between rotor and stator and remove as required. 2b. Follow specified assembly procedures to correct rotor to crankshaft alignment.

TABLE 8-4. TROUBLESHOOTING CHART FOR MODELS WITH TRANSISTOR-TYPE VOLTAGE REGULATOR

⚠WARNING ***Many troubleshooting procedures present hazards that can result in severe personal injury or death. Only qualified service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Review safety precautions on inside cover page.***

TROUBLE	POSSIBLE CAUSE	CORRECTIVE ACTION
Generator Overheats	1. Generator overloaded due to defective circuit breaker	1 Replace circuit breaker. Do Not exceed specified load when operating set.
	2. Airflow restricted due to dirt or debris covering vent openings in cover or adapter.	2. Clean away all dirt or debris as required.
	3. Stator windings covered with oil or dirt	3. Clean stator windings
	4. Defective windings in in rotor or stator.	4. Test each component for open, grounded, or shorted windings and replace if defective.
Low or No DC Output	1. Open DC circuit breaker.	1. Locate cause of overload and correct as required. Reset breaker.
	2. Open circuit between Stator DC coil and diode assembly or between diode assembly and receptacle.	2. Check for continuity and correct if circuit is open. Check for defective receptacle.
	3. Defective stator DC coil.	3. Test stator DC coil for open, grounded or shorted windings.
	4. Defective diode assembly.	4. Test Diode Assembly for open or short.

GENERATOR SERVICE

This section describes the procedures for generator stator and rotor removal and installation for all models. Refer to Figure 8-1 or 8-3 to identify the various generator components described in each section.

⚠CAUTION ***Careless handling of the rotor or stator can damage the insulation on the windings. Do not allow windings to be brushed or scraped during service.***

Stator Removal

1. Remove the generator end cover and disconnect all wiring connectors. Tag wires if connectors are not polarized or color matched.

⚠CAUTION ***On models with transistor-type voltage regulators, the brush block assembly will be damaged during disassembly if it is not removed.***

2. On models with transistor-type voltage regulators: Remove the brush block assembly (Figure 8-5) by removing the Phillips head mounting screw. Pull brush block off mounting stud and lift to remove.
3. Remove the mounting bolts that secure the end bell to the frame.
4. Remove the stator mounting bolts that secure the end bell to the adapter, and carefully pull the end bell and stator assembly off together. Be careful not to damage the rotor windings.
5. For stator replacement only: Remove the two Phillips head screws that secure the stator to the end bell. Carefully separate the end bell from the stator assembly to prevent damage to the windings.

Rotor Removal

1. Loosen the rotor thru-bolt two or three turns and tap rotor thru-bolt head with a lead hammer to loosen the rotor from the tapered shaft. Be careful not to strike the slip rings or rotor windings.
2. Remove rotor thru-bolt and carefully remove the rotor and place it on a soft surface to prevent damage to windings.

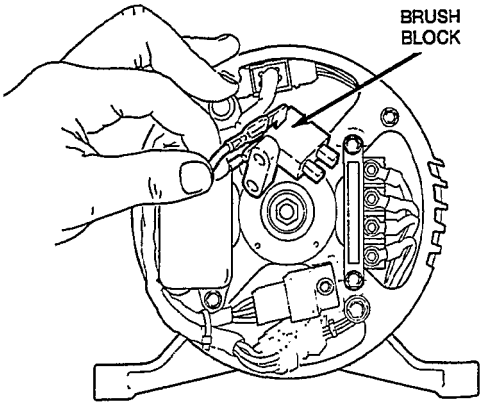


FIGURE 8-5. BRUSH BLOCK

Rotor Installation

1. Clean tapered mounting shaft and rotor shaft to remove all dirt and oil.
2. Carefully install rotor onto tapered shaft. Insert thru-bolt into mounting shaft and hand tighten.
3. Secure rotor with a strap wrench (Figure 8-6) and tighten to specified torque.

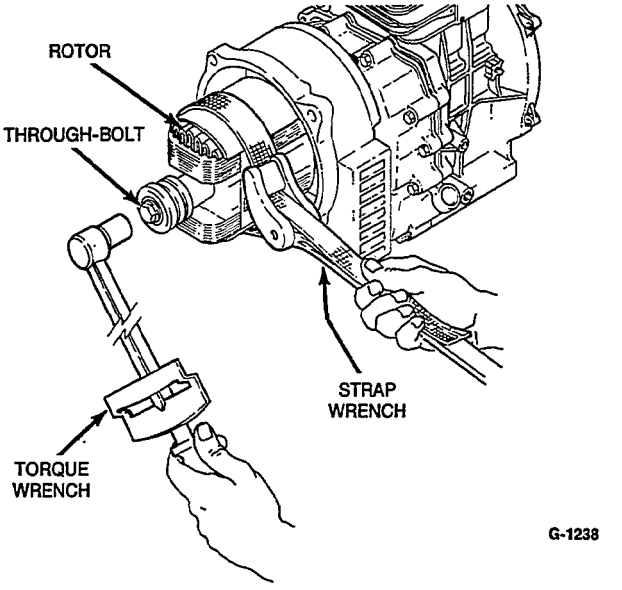


FIGURE 8-6. SECURING ROTOR FOR INSTALLATION

Stator Installation

1. Assemble end bell to stator if previously removed. Use two mounting screws to secure the stator to the end bell.
2. Install stator assembly over rotor. Be careful to avoid damaging rotor windings. Push stator assembly into position until seated with adapter on engine.
3. Secure stator assembly to the adapter using four stator mounting bolts tighened to the specified torque.
4. Secure end bell to mounting frame and tighten to the specified torque.
5. Pull recoil starter over slowly to check stator and rotor alignment. Rotor should move without rubbing against the stator.
6. Reconnect all wire connections. If applicable, tighten terminal block mounting nuts to the specified torque.
7. On models with transistor-type voltage regulators: Install brush block onto mounting stud and secure with mounting screw (Figure 8-5).
8. Place end cover over end bell and secure.

Rotor Bearing Replacement

The rotor bearing is press fit on the rotor shaft. Read through each of the following procedures before starting replacement. Refer to Figure 8-7.

1. Remove the rotor assembly as described in the Generator Service section.
2. Cover the end of the rotor shaft with a hardened washer to prevent deformation of the shaft during bearing removal. Use a small gear puller to remove the bearing.
3. Place the rotor shaft, engine end down, on a rod or other mating surface that will protect the rotor shaft taper and cooling fan from damage.
4. Press rotor bearing onto rotor shaft (press on inner race of Bearing only) until it rests in its original position.

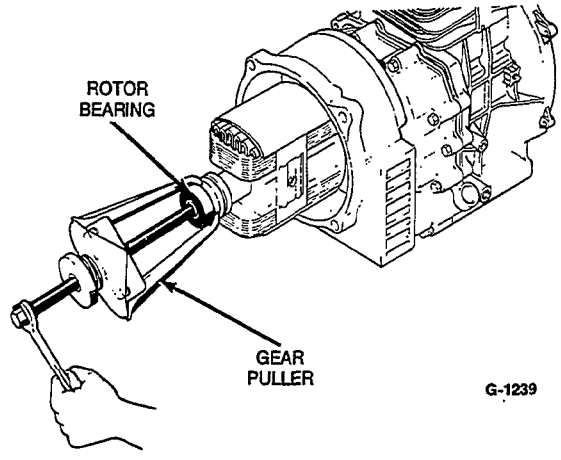


FIGURE 8-7. ROTOR BEARING REMOVAL

GENERATOR TESTING FOR MODELS WITH CAPACITOR-TYPE VOLTAGE REGULATION

This section covers test procedures for the generator windings, the regulator capacitor, and for the diode assembly. Follow the troubleshooting procedures in this section to locate the possible cause of the problem, then perform the recommended corrective action. Remove the generator end cover and perform tests as described. If the generator set has been running, allow the generator set to cool down completely before making resistance measurements.

Check all wire harness connectors and leads for continuity prior to component testing or generator disassembly. Refer to wire diagrams for lead locations.

Stator Test

The stator main, sub, and DC coils can be tested with an ohmmeter. Testing for shorted windings requires a digital type ohmmeter that can read to within 0.01 ohms. The stator can be tested without removing it from the generator. Figure 8-8 shows the stator test points.

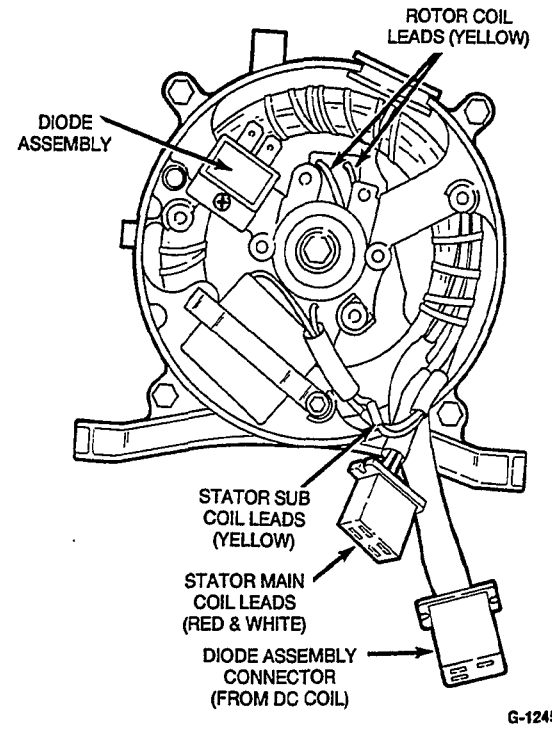


FIGURE 8-8. GENERATOR TESTING

TABLE 8-5. GENERATOR WINDING RESISTANCE

GENERATOR SIZE/Hz	1.4 kW - 60 Hz 1.7kW - 60 Hz	2.5 kW - 60 Hz	1.4 kW - 50 Hz 2.0 kW - 50 Hz
STATOR			
Main Coil	0.7 - 1.4Ω	0.5 - 1.0Ω	1.0 - 1.5Ω
Sub Coil	7Ω	8Ω	6.7Ω
DC Coil	0.8Ω	0.6Ω	0.65Ω
ROTOR			
Coil	13.5Ω	23.5Ω	23.5Ω

Stator Main Coil Test:

Remove the connector from the stator main coil and connect the meter leads (Figure 8-8) to the red and white leads from the stator main coil. Refer to Table 8-5 for the stator main coil resistance value. A high resistance reading indicates an open winding. A reading of less than the value shown indicates a shorted winding. If an open or shorted winding is detected, replace the stator.

Stator Sub Coil Test:

Remove the connector from the stator sub coil and connect the meter leads (Figure 8-8) to the yellow leads from the stator sub coil. Refer to Table 8-5 for the stator sub coil resistance value. A high resistance reading indicates an open winding. A reading of less than the value shown indicates a shorted winding. If an open or shorted winding is detected, replace the stator.

Stator DC Coil Test:
Remove the connector from the diode assembly and connect the meter leads (Figure 8-8) to the grey leads from the stator DC coil. Refer to Table 8-5 for the DC coil resistance value. A high resistance reading indicates an open winding. A reading of less than the value shown indicates a shorted winding. If an open or shorted winding is detected, replace the stator.

Stator Ground Test:
Remove the wire connectors from the stator main coil, sub coil, and diode assembly. Set the ohmmeter to the highest resistance scale and then connect one test prod to the metal stator lamination stack. Touch the other test prod to red or white terminal from the main coil. Repeat the test for the sub coil by measuring between the stator stack and one of the yellow leads from the stator sub coil. Also repeat the test for the DC coil by measuring between the stator stack and one of the grey leads from the stator DC coil. A reading of less than one megohm indicates a ground. Replace a grounded stator with a new stator.

If stator tests good, proceed to rotor tests.

Rotor Test

The rotor can be tested without removing it from the generator. Remove the generator end cover and refer to Figure 8-8 for the test points.

Rotor Coil Test:
The rotor coil winding has a diode connected in series with it. Using pointed meter test prods, touch ohmmeter test prods to the two posts that the yellow rotor winding leads attach to (see Figure 8-8). It is necessary to pierce the insulation on the posts to obtain an accurate reading of the winding resistance. Also, because a diode is attached in series with the windings, the meter leads must be reversed for a second reading. (Repeat this test with the second rotor winding used on models 1.4 EGSAA and 1.7 EGHAA.) Refer to Table 8-5 for the rotor coil resistance value. It is normal to measure a high resistance reading in one direction and the listed resistance reading in the other direction. A high resistance reading in both directions indicates an open winding or diode. A reading of less than the value shown in Table 8-3 in one direction indicates a shorted winding or diode. If an open or short condition is detected, replace the rotor.

Rotor Coil Ground Test:
To test for grounds, set the ohmmeter to the highest resistance scale. Touch one test prod to the rotor shaft and hold it there. Touch the other test prod to one of the posts that the yellow rotor winding leads attach to (see Figure 8-8). It is necessary to pierce the insulation on the posts to obtain an accurate reading. (Repeat this test with the second rotor winding on models 1.4 EGSAA and 1.7 EGHAA.) A reading of less than one megohm indicates the rotor is grounded. Replace a grounded rotor with a new rotor.

Capacitor Test

The capacitor can be tested with a capacitor checker or an analog ohmmeter. Disconnect both wire leads connected to the capacitor and attach meter (Figure 8-8). A capacitor checker attached to the capacitor leads should indicate approximately 13 mfd. An analog ohmmeter connected to the capacitor leads should cause the meter to momentarily deflect toward continuity and then indicate infinity. Reversing the meter should provide the same indication. Replace a shorted or open capacitor.

Diode Assembly Test

The diode assembly contains two diodes in one potted assembly. The diode assembly can be tested with an ohmmeter that has a diode measurement setting or a high resistance scale that uses an internal 9-volt battery. Remove the wire connector from the diode assembly and attach the test leads as shown in Figure 8-9. Reverse meter leads and check continuity in the opposite direction. Repeat test for second diode. Each diode should indicate continuity in one direction and infinite resistance in the other direction.

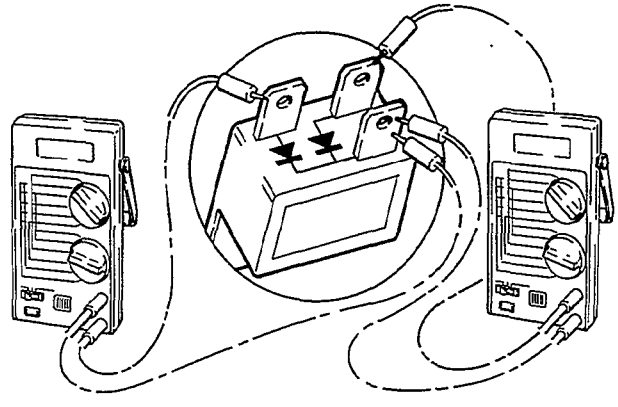


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FIGURE 8-9. TESTING DIODE ASSEMBLY

GENERATOR TESTING FOR MODELS WITH TRANSISTOR-TYPE VOLTAGE REGULATION

This section covers test procedures for the generator windings and for the brushes and slip rings. Refer to the previous section for diode assembly testing. Follow the troubleshooting procedures in this section to locate the possible cause of the problem, then perform the recommended corrective action. Remove the generator end cover and perform tests as described. If the generator set has been running, allow the generator set to cool down completely before making resistance measurements.

Check all wire harness connectors and leads for continuity prior to component testing or generator disassembly. Refer to wire diagrams for lead locations.

Stator Test

The stator main, sub, and DC coils can be tested with an ohmmeter. Testing for shorted windings requires a digital type ohmmeter that can read to within 0.01 ohms. The stator can be tested without removing it from the generator. Figure 8-10 shows the stator test points.

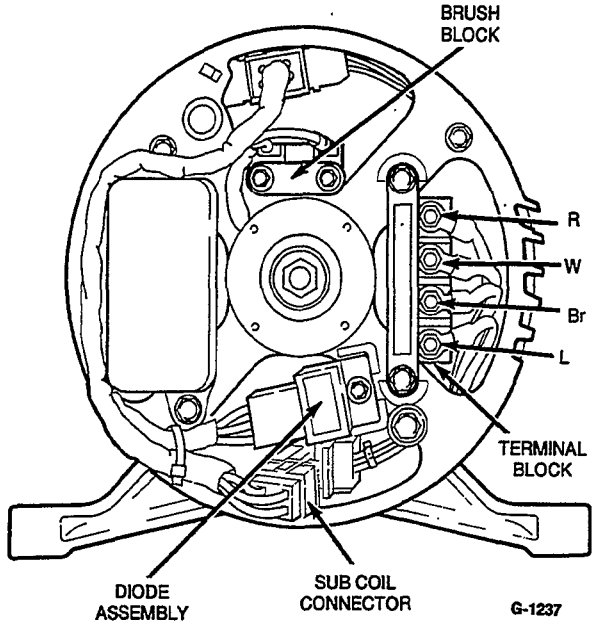


FIGURE 8-10. GENERATOR TESTING

Stator Main Coil Test:

Remove the stator leads from the terminal block and connect the meter leads (see Figure 8-10) to the red and white leads from the stator main coil. Repeat test for second stator main coil brown and blue leads. Refer to Table 8-6 for the stator main coil resistance value. A high resistance reading indicates an open winding. A reading of less than the value shown indicates a shorted winding. If an open or shorted winding is detected, replace the stator.

Stator Sub Coil Test:

Remove the connector from the stator sub coil and connect the meter leads (see Figure 8-10) to the yellow leads from the stator sub coil. Refer to Table 8-6 for the stator sub coil resistance value. A high resistance reading indicates an open winding. A reading of less than the value shown indicates a shorted winding. If an open or shorted winding is detected, replace the stator.

Stator DC Coil Test:

Remove the connector from the diode assembly and connect the meter leads (see Figure 8-10) to the grey leads from the stator DC coil. Refer to Table 8-6 for the DC coil resistance value. A high resistance reading indicates an open winding. A reading of less than the value shown indicates a shorted winding. If an open or shorted winding is detected, replace the stator.

Stator Ground Test:

Remove the main coil wires from the terminal block and remove the sub coil and diode assembly wire connectors. Set the ohmmeter to the highest resistance scale and then connect one test prod to the metal stator lamination stack. Touch the other test prod to the red or white terminal from the main coil. Repeat the test for the other main coil (brown or blue lead) and the sub coil by measuring between the stator stack and one of the yellow leads from the stator sub coil. Repeat the test again for the DC coil by measuring between the stator stack and one of the grey leads from the stator DC coil. A reading of less than one megohm indicates a ground. Replace a grounded stator with a new stator.

If stator tests good, proceed to rotor tests.

Rotor Test

The rotor can be tested with an ohmmeter. Remove the generator end cover and remove the brush block assembly (see Generator Service section) for testing. Refer to Figure 8-11 for the test points.

TABLE 8-6. GENERATOR WINDING RESISTANCE

GENERATOR SIZE/Hz	4 kW - 60 Hz	5 kW - 60 Hz	6 kW - 60 Hz	2 kW - 50 Hz	3.5 kW - 50 Hz	5 kW - 50 Hz
STATOR						
Main Coil	0.7 - 1.0Ω	0.7 - 1.0Ω	0.9 - 1.0Ω	1.0 - 1.4Ω	0.5 - 0.7Ω	0.3 - 0.5Ω
Sub Coil	1.2 - 1.6Ω	1.0 - 1.4Ω	0.8 - 1.2Ω	2.1 - 2.5Ω	1.1 - 1.4Ω	0.8 - 1.2Ω
DC Coil	0.6 - 1.0Ω	0.5 - 1.0Ω	0.4 - 1.0Ω	0.4 - 0.8Ω	0.4 - 0.6Ω	0.4 - 0.6Ω
ROTOR						
Coil	47Ω	55Ω	65Ω	46Ω	47 - 54Ω	61Ω

Rotor Coil Test:
Touch ohmmeter meter test prods to the slip rings (Figure 8-11). Make certain that good contact is made. It may be necessary to clean the slip rings as described in the Slip Ring Check section. Refer to Table 8-6 for the rotor coil resistance value. If an open or short condition is detected, replace the rotor.

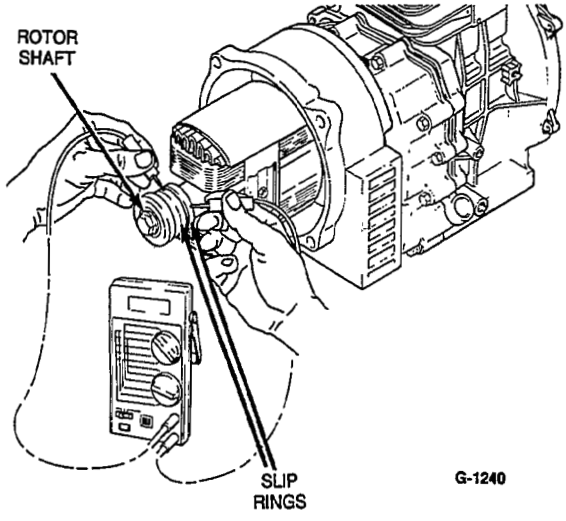


FIGURE 8-11. ROTOR TESTING

Rotor Winding Ground Test:
To test for grounds, set the ohmmeter to the highest resistance scale. Touch one test prod to one of the slip rings and touch the other test prod to the rotor shaft. A reading of less than one megohm indicates the rotor is grounded. Replace a grounded rotor with a new rotor.

Brush Assembly Check

Follow the stator removal instructions through the brush block assembly removal procedure in the Generator Service section. Check for excessive brush wear. Measure the height of the brushes as shown in Figure 8-12. If the brushes are less than the minimum height, or if the brushes have a rough slip ring surface, replace the brush assembly.

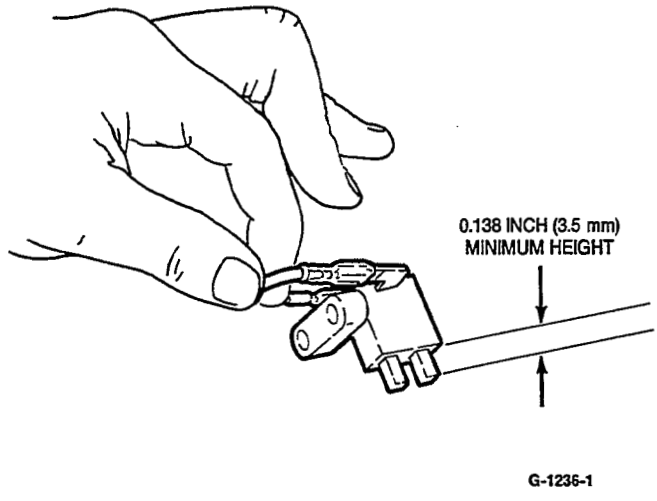


FIGURE 8-12. BRUSH HEIGHT MEASUREMENT

Slip Ring Check

Follow Generator Service section through stator removal. Inspect the slip rings for signs of dirt, oil, or other contaminants. Also check for roughness in the brush contact area. Wipe slip ring surface clean. Rough slip rings can be refurbished using a commutator stone. Use the following procedure to service:

1. Follow Generator Service procedures to remove the rotor.
2. Place rotor in machine lathe and center. Turn rotor and use commutator stone (Onan tool #420-0259) against rotating slip rings to clean and true slip rings. Turn rotor until all grooves or roughness are smoothed out.

⚠WARNING ***Contact with rotating machinery can result in severe personal injury. Keep hands and fingers clear while servicing slip rings.***

⚠CAUTION ***Careless handling of rotor can damage the insulation on the windings.***

3. Clean rotor and prepare for reinstallation. Follow Generator Service section to install rotor and remaining generator components.

Transistor-Type Voltage Regulator

There are no specific tests that can be made on the transistor-type voltage regulator. When the voltage regulator does not appear to be working properly, and the other generator components test good, replace the voltage regulator and check for proper operation.

Section 9. Engine - Block Assembly

INTRODUCTION

This section covers service procedures for the engine block assembly. This assembly includes the cylinder block, cylinder head, valve system, piston, connecting rod, crankshaft, and camshaft. The following section is divided into three main subjects: engine disassembly, engine part inspections, and valve adjustments.

The 1.4 EGSAA model uses a side valve (GS) engine. All other models use an overhead valve (GH) engine. Some of the service procedures for these two engine types are different. The engine disassembly procedures will be listed separately. The GH400 engine has an engine balancer system that is unique to that engine and will be described separately. The overhead valve (GH) engines have a mechanical compression release system that is described at the end of this section.

Performing major service on the engine block assembly requires removal of the generator (Section 8) and the primary engine systems (Section 7). Refer to the appropriate section for the disassembly procedures.

Make sure the engine oil has been drained before starting engine block disassembly. Remove the oil fill cap and oil drain plug to remove engine oil.

SIDE VALVE ENGINE DISASSEMBLY

A suggested order of disassembly for the engine block follows:

1. Spark plug, cylinder head, and head gasket
2. Crankcase cover, gasket, and shims
3. Valve cover, breather assembly, intake and exhaust valves
4. Camshaft, cam gear, and lifters
5. Piston and crankshaft

Cylinder Head

Remove the cylinder head for cleaning when poor engine performance is noticed or to inspect the valves. Use the following procedures to service. See Figure 9-1.

⚠CAUTION ***Warping can occur if the head is removed while hot. Wait until the engine has cooled before removing cylinder head.***

1. Remove the spark plug, cylinder head, and head gasket.

2. Clean out all carbon deposits. Be careful not to damage the gasket mating surfaces. The head is made of aluminum and can be damaged by careless handling.

3. Use a new gasket during reassembly and make sure that the smooth side of the gasket faces down.

4. Place cylinder head in position and torque all mounting bolts to half the specified torque. Then tighten all mounting bolts to the specified mounting torque.

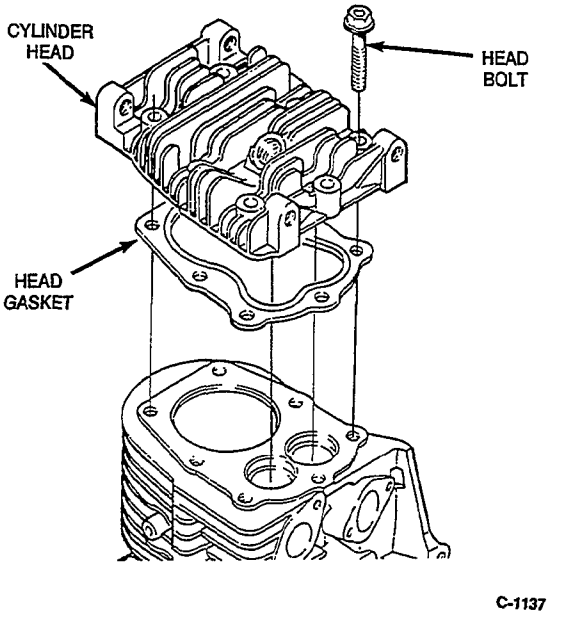


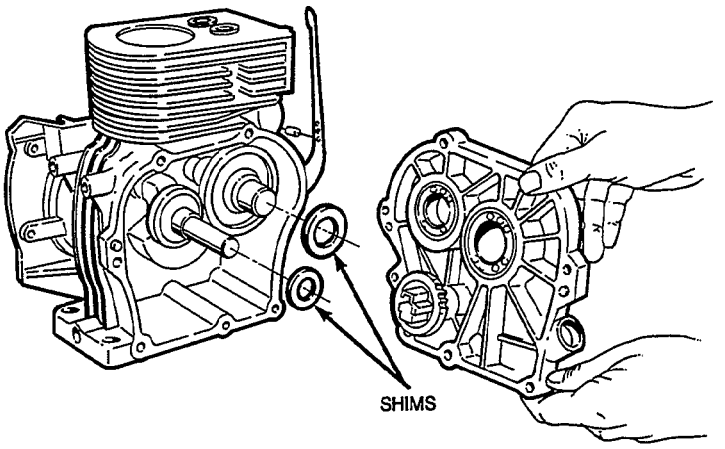
FIGURE 9-1. CYLINDER HEAD REMOVAL

Crankcase Cover

1. Remove any burrs from the crankshaft key groove with sandpaper. See Figure 9-2.

2. Remove the crankcase cover mounting bolts. Hold the cover and lightly tap the end of the crankshaft with a plastic faced hammer to loosen cover. Be careful not to lose crankshaft and camshaft shims. Shim widths differ and they must be reassembled in their original positions.

3. Use a new gasket and clean the crankcase cover and the engine block gasket mating surfaces. Place crankcase cover in position and secure until all bolts are tightened to the specified torque (see Torque Specifications section). When installing the cover make sure the governor shaft is properly positioned.

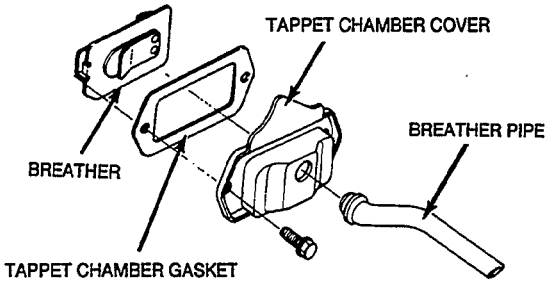


C-1126

FIGURE 9-2. CRANKCASE COVER

Tappet Chamber Cover and Breather Assembly, Intake and Exhaust Valves

1. Remove the tappet chamber cover and breather assembly. See Figure 9-3.
2. Remove the valve spring collet and retainer for the intake and exhaust valve. See Figure 9-4.
3. Remove the Intake and exhaust valves.

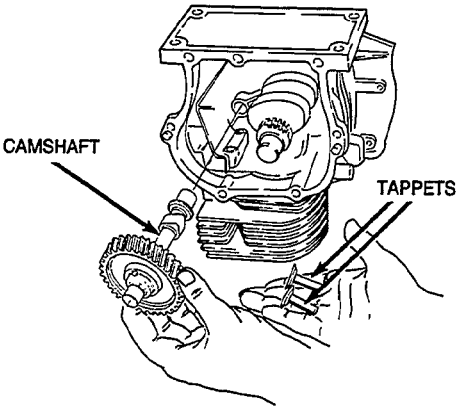


C031F051

FIGURE 9-3. TAPPET CHAMBER COVER AND BREATHER ASSEMBLY

Camshaft and Tappets

1. Place the engine upside down on a flat surface.
2. Pull out the camshaft and cam gear as an assembly (Figure 9-5.).
3. Remove the valve tappets. The tappet clearances differ and the tappets must be reassembled in their original positions.
4. When reassembling the cam gear and the crank gear, align the marks as shown in Figure 9-6.



C-1127

FIGURE 9-5. CAMSHAFT AND TAPPET REMOVAL

(1) Exhaust valve
(2) Intake valve
(3) Valve spring
(4) Retainer
(5) Collet

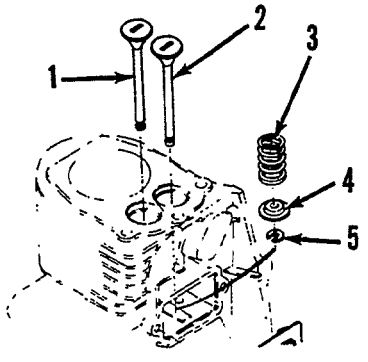


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FIGURE 9-4. INTAKE AND EXHAUST VALVE REMOVAL

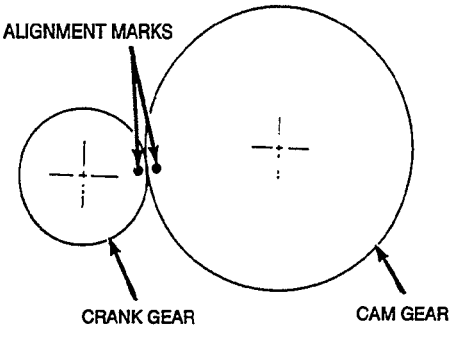

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FIGURE 9-6. CAM GEAR AND CRANK GEAR ALIGNMENT

Piston and Crankshaft

The piston assembly consists of the piston, piston pin, and connecting rod assembly. After piston removal, all parts must be carefully inspected for damage and wear. Remove the carbon from the top of the cylinder bore and check for a ridge.

Remove ridge with a ridge reamer before attempting piston removal. Remove the piston as follows:

⚠CAUTION ***Improper use of a ridge reamer can damage the cylinder bore. Follow tool manufacturer's instructions and be careful when using a ridge reamer.***

1. Remove two bolts from connecting rod. Mark direction of assembly for connecting rod, cap, and splasher (Figure 9-7).
2. Lift the rod cap from the rod and push the piston assembly through the top of the cylinder. Be careful not to scratch the crankpin or the cylinder wall when removing.
3. Remove the crankshaft after the connecting rod and piston have been removed, carefully pull the crankshaft out of the oil seal and bearing.
4. For installation, lubricate the bearings with engine oil. Slide the crankshaft into the bearing. Install the crankcase cover and check to see that the crankshaft turns freely.

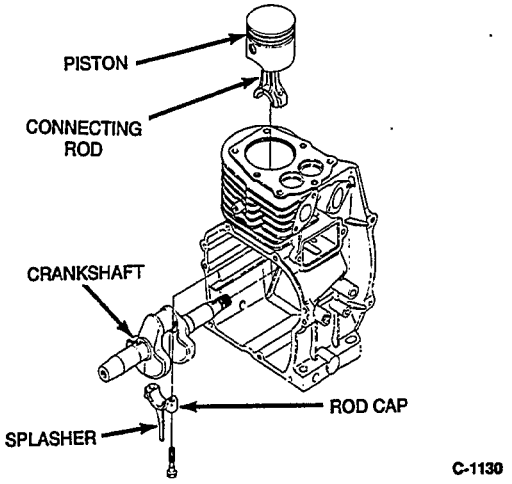


FIGURE 9-7. PISTON AND CRANKSHAFT REMOVAL

Oil Level Switch

Remove the oil level switch from inside the crankcase if the switch is defective or if the engine block will be cleaned or replaced.

OVER HEAD VALVE ENGINE DISASSEMBLY

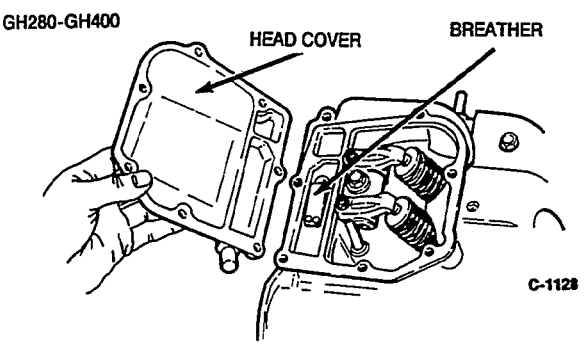
A suggested order of disassembly for the engine block assembly follows:

1. Head cover and breather
2. Rocker arms, push rods, and cylinder head
3. Intake and exhaust valves
4. Crankcase cover and camshaft
5. Connecting rod and piston
6. Crankshaft and governor lever shaft

Head Cover and Breather

Remove the head cover to gain access to the cylinder head and valve system. Use the following procedure to service.

1. Remove head cover mounting bolts and pull off head cover. See Figure 9-8.
2. Remove the breather element (on some models the breather cover must be removed first). Observe breather orientation for reassembly.
3. Clean head cover being careful not to damage the gasket sealing area.
4. Clean cylinder head cover and cylinder head thoroughly in gasket mating area. Install new gasket with grooved side facing the cylinder head. Make sure breather assembly is installed correctly.
5. Place head cover in position and torque until all bolts are tightened to the specified torque.



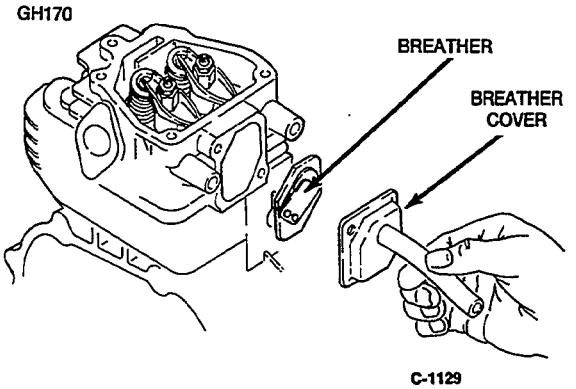


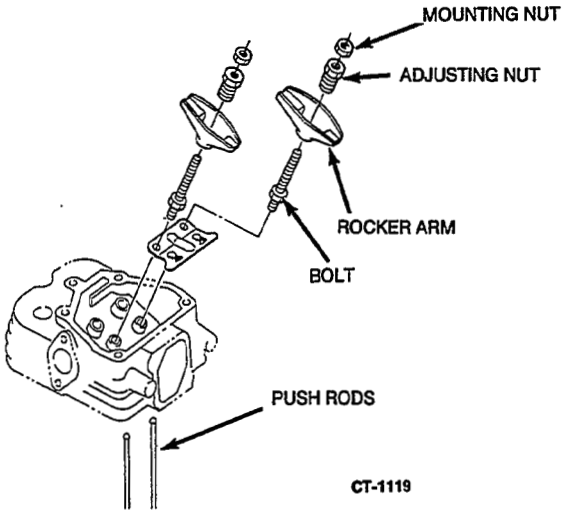
FIGURE 9-8. HEAD COVER AND BREATHER REMOVAL

Rocker Arms, Push Rods and Cylinder Head

Remove the cylinder head for cleaning when poor engine performance is noticed or to inspect the valves. Use the following procedures to service.

1. Remove Rocker arm mounting nuts, then remove rocker arms and push rods (Figure 9-9).

GH170, GH280



GH400

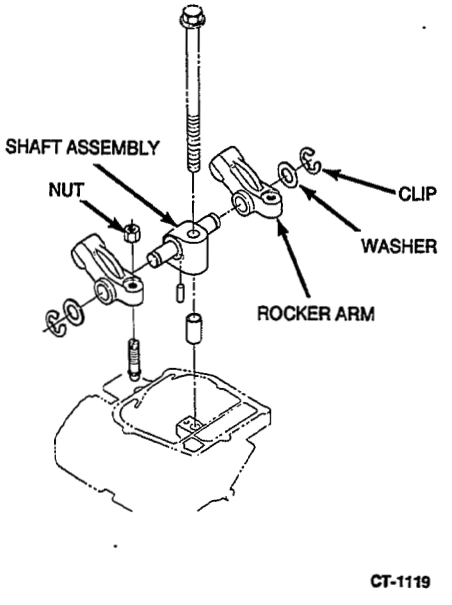


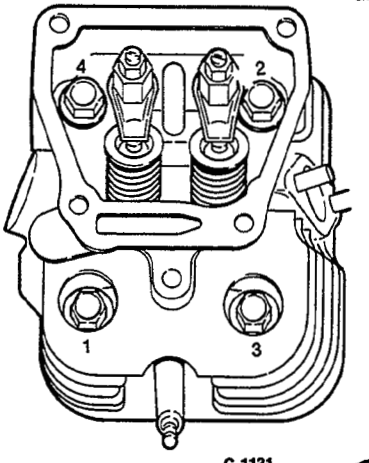
FIGURE 9-9. ROCKER ARM REMOVAL

2. Remove spark plug.
3. Remove the cylinder head mounting bolts and lift off the head. Remove the head gasket.

⚠CAUTION ***Warping can occur if the head is removed while hot. Wait until the engine has cooled before removing cylinder head.***

4. Remove all carbon deposits from cylinder head. Be careful not to damage outer sealing surface where gasket fits. The head is made of aluminum and can be damaged by careless handling.
5. Use new head gasket and clean both cylinder head and cylinder block thoroughly where gasket rests.
6. Place head in position and follow head torque tightening sequence shown in Figure 9-10. Start out tightening all bolts to 14 ft-lb (19.6 N•m), then tighten to the specified torque (see Torque Specification section).

GH170, GH280



GH400

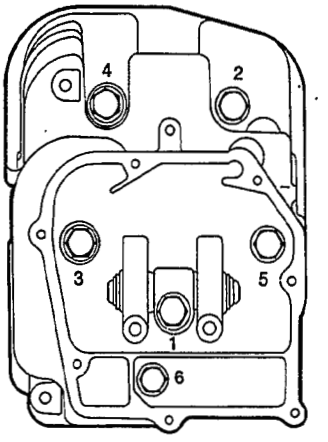


FIGURE 9-10. CYLINDER HEAD TIGHTENING SEQUENCE

Intake and Exhaust Valves

Depress the valve spring retainer using a 9/16 inch crows foot wrench on a 6 inch extension and remove keeper. See Figure 9-11. Remove spring retainer and spring, then remove valve. When reinstalling apply oil to the valve stem.

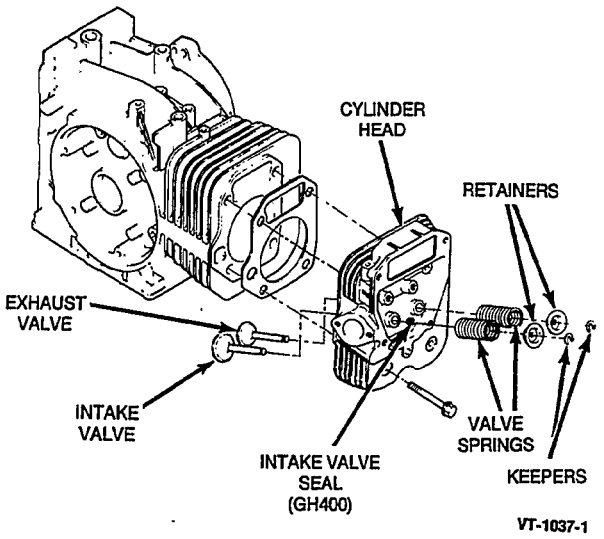


FIGURE 9-11. VALVE REMOVAL

Crankcase Cover

1. Remove the crankcase cover mounting bolts. The crankcase is fixed at two places with knockout pins. Do not attempt to pry the crankcase cover off or damage can result (Figure 9-12). Hold the crankcase cover and lightly tap the end of the shaft with a plastic hammer.
2. Remove the crankcase cover very carefully to prevent the shaft from scraping the lip surface of the oil seal.
3. Remove and tag shims from the crankshaft and camshaft. Shim widths differ and they must be reassembled in their original positions.

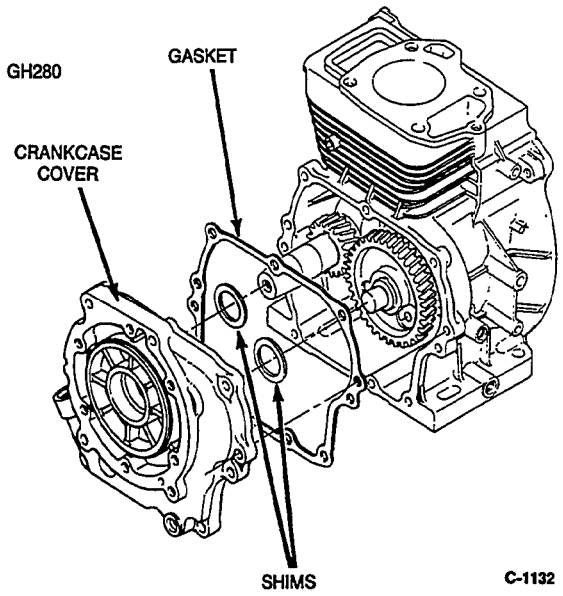


FIGURE 9-12. CRANKCASE COVER

4. Use a new gasket and clean the crankcase cover and the engine block where the gasket rests. Place crankcase cover in position and torque until all bolts are tightened to the specified torque (see Torque Specifications section). When installing the cover make sure the governor shaft is properly positioned.

Camshaft and Tappets (GH Models Except for GH400)

1. Place the engine upside down on a clean flat surface.
2. Pull out the camshaft and cam gear as an assembly (Figure 9-13).
3. Remove the tappets. Tappet clearances differ and the tappets must be reassembled in their original positions.
4. For installation, apply oil to the tappets and the tooth surface of the cam gear. Align the marks on the cam gear and crank gear as shown in Figure 9-14.

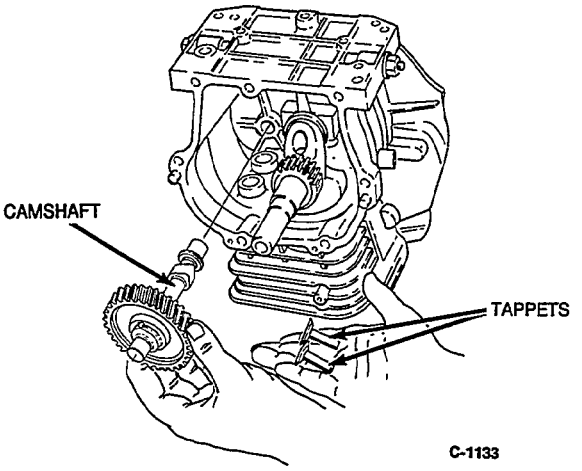


FIGURE 9-13. CAMSHAFT AND TAPPET REMOVAL

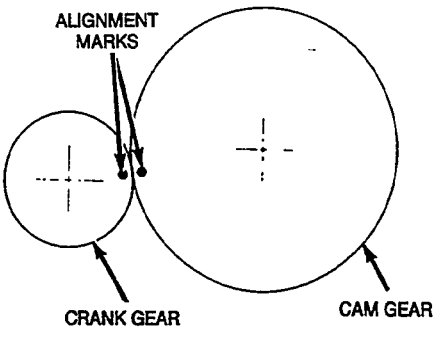


FIGURE 9-14. CAM GEAR AND CRANKGEAR ALIGNMENT

Piston and Crankshaft (GH Models Except for GH400)

The piston assembly consists of the piston, piston pin, and connecting rod assembly. After piston removal, all parts must be carefully inspected for damage and wear. Remove the carbon from the top of the cylinder bore and check for a ridge. Remove ridge with a ridge reamer before attempting piston removal. Remove the piston as follows:

⚠CAUTION ***Improper use of a ridge reamer can damage the cylinder bore. Follow tool manufacturer's instructions and be careful when using a ridge reamer.***

1. Remove two bolts from connecting rod. Mark direction of assembly for connecting rod, cap, and splasher.
2. Lift the rod cap from the rod and push the piston assembly through the top of the cylinder (Figure 9-15). Be careful not to scratch the crankpin or the cylinder wall when removing.

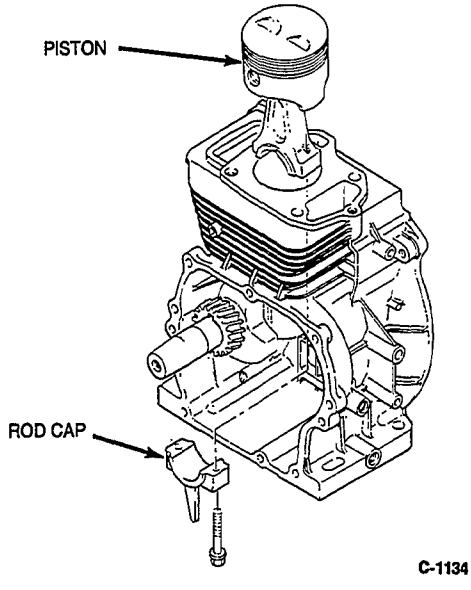


FIGURE 9-15. PISTON REMOVAL

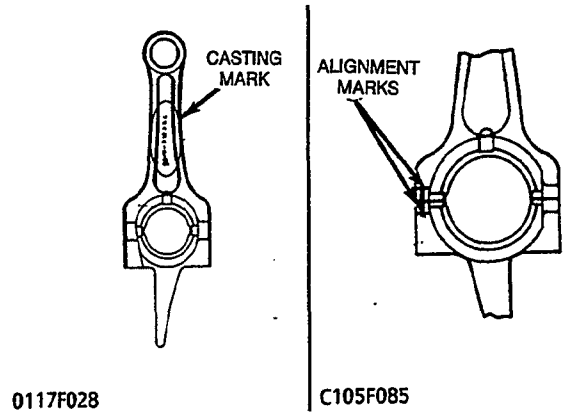


FIGURE 9-16. CONNECTING ROD AND CAP MARKINGS

3. Remove the crankshaft after the connecting rod and piston have been removed, carefully pull the crankshaft out of the oil seal and bearing.
4. Remove the crankshaft after the connecting rod and piston have been removed, carefully pull the crankshaft out of the oil seal and bearing.
5. For installation, lubricate the bearings with engine oil. Slide the crankshaft into the bearing. Install the crankcase cover and check to see that the crankshaft turns freely.
6. Assemble the connecting rod so the casting mark faces the flywheel (Figure 9-16). Also align the marks on the cap and the connecting rod.

Balancer Shaft 1 and 2 - GH400 Engine

Carefully pull out the two balancer shafts. When reinstalling, make sure that the two balancer gears and the crankshaft gear marks are in alignment as shown in Figure 9-17.

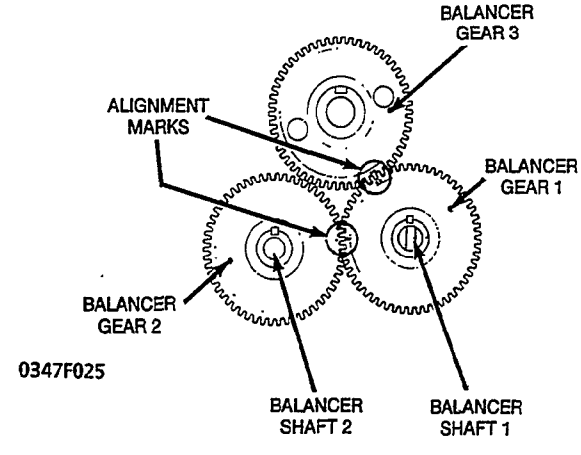


FIGURE 9-17. GEAR ALIGNMENT

Piston and Connecting Rod - GH400 Engine

1. Remove the connecting rod screws and remove the connecting rod cap (Figure 9-18).
2. Turn the crankshaft to bring the piston to top dead center.
3. Push the piston assembly out through the top of the cylinder. Be careful not to scratch the crankpin or the cylinder wall.
4. For installation, lubricate the bearings and inside surface of the cylinder wall with engine oil. Align the marks on the cap and the connecting rod (Figure 9-19).

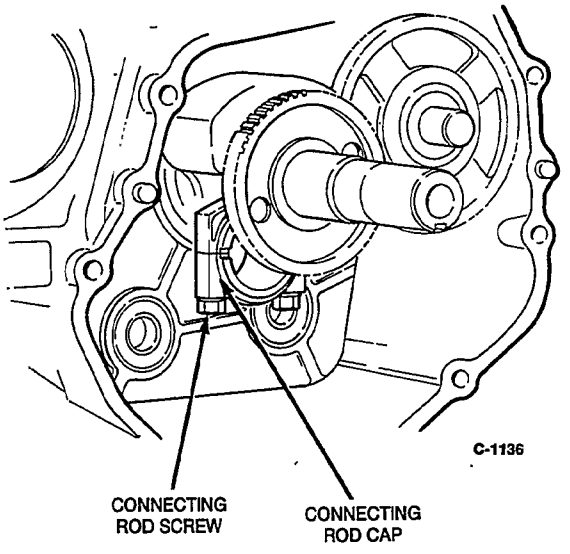


FIGURE 9-18. PISTON REMOVAL

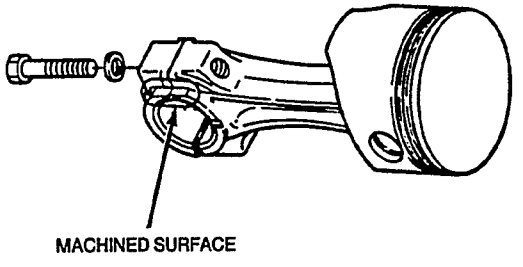


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FIGURE 9-19. ROD CAP ALIGNMENT

Crankshaft, Camshaft and Tappets - GH400 Engine

1. Place the cylinder block upside down on a flat clean surface.
2. Pull out the crankshaft and the camshaft at the same time (Figure 9-20).
3. Remove the tappets.
4. For installation, apply grease to the oil seal lip and be careful not to roll it when installing the crankshaft. Be sure to align the alignment marks on the crank gear and cam gear as shown in Figure 9-21.

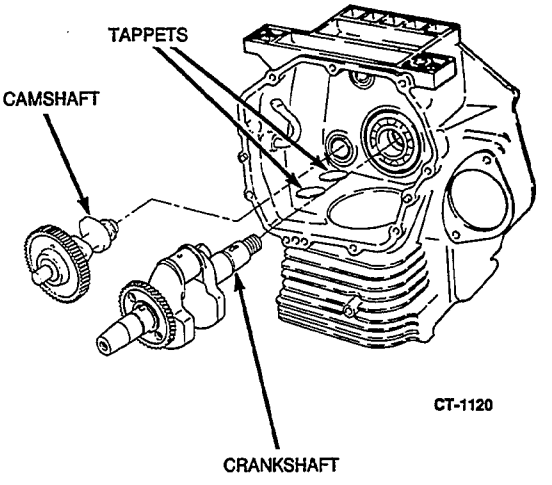

FIGURE 9-20. CRANKSHAFT AND CAMSHAFT REMOVAL

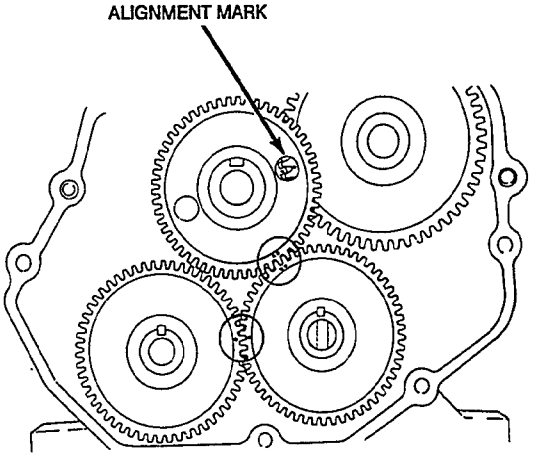

FIGURE 9-21. CRANK GEAR AND CAM GEAR ALIGNMENT

Governor

With the crankcase cover removed, the governor can be inspected or disassembled for service, if necessary. The governor assembly must spin freely on the center pin without excessive looseness or wobble. Sleeve tip wear is the most common cause of governor failure. If governor sleeve, gear, or flyweights are worn or otherwise damaged, replace them. To disassemble, remove the snap ring from the governor center pin and slide governor gear assembly off mounting shaft being careful not to lose outer washer. See Figure 9-22. To install governor, assemble in reverse order of removal (see inset drawing, Figure 9-22, for position of flyweight and sleeve).

To remove the governor shaft, remove the retainer clip outside the block then pull the governor shaft in through the crankcase.

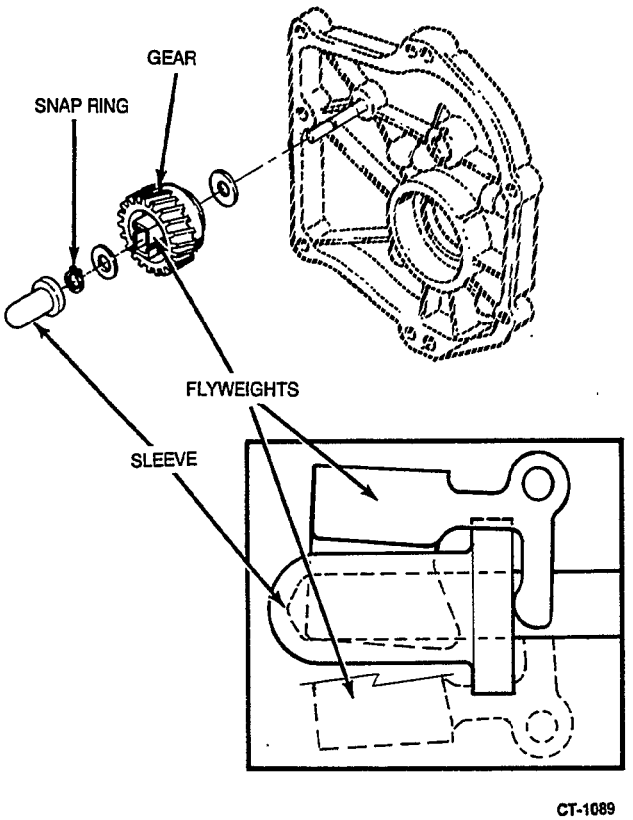

FIGURE 9-22. GOVERNOR

Bearings

One bearing is pressed into the engine block and the other bearing is pressed into the crankcase cover. The bearing in the engine block can be pressed out after the oil seal is removed (see following section). The bearing in the crankcase cover can be pulled out using a puller. Clean the bearing mounting surfaces and press new bearings back in.

Oil Seal

Use an oil seal remover to pry the oil seal out of the engine block. Clean the oil seal resting surface and lubricate surface before installing new oil seal. Press new oil seal into the engine block until oil seal is flush with cylinder block boss (Figure 9-23). Lubricate the lips of the oil seal with a light coating of grease. This provides initial lubrication until engine oil reaches the seal.

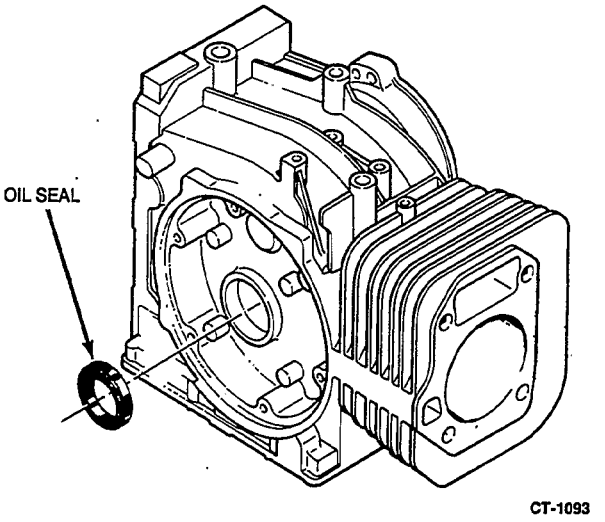

FIGURE 9-23. OIL SEAL

Timing Gears

If replacement of either the crankshaft gear or the camshaft gear becomes necessary, it is recommended that both gears be replaced. Each of these gears are pressed on. The crankshaft gear requires a gear separator and puller to remove and the camshaft gear requires a press to remove. Both gears can be installed using a press. These gears use a Woodruff key to provide correct positioning on the shaft. Each timing gear is stamped with an "O" near the edge. The gear teeth must mesh so that these marks exactly coincide when the gears are installed in the engine.

Oil Level Switch

Remove the oil level switch from inside the crankcase if the switch is defective or if the engine block will be cleaned or replaced.

INSPECTION OF ENGINE PARTS

The following section describes procedures for inspecting each of the major engine components.

Cylinder Head

1. Clean the cylinder head surface.
2. Place a straight edge on the top of the cylinder head as shown in Figure 9-24. Use a feeler gauge to measure the amount of distortion.
3. If the measurement exceeds the specified limit, replace the cylinder head.

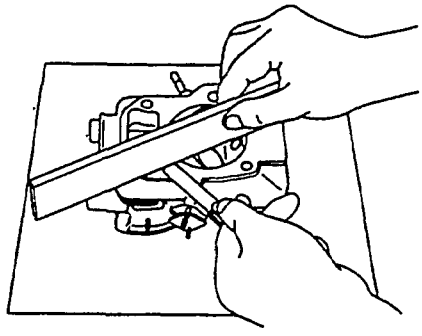

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FIGURE 9-24. CYLINDER HEAD SURFACE FLATNESS

Cylinder Block

Cleaning:

After removing the piston, crankshaft, cylinder head, etc., inspect the block for cracks and extreme wear. If block is still serviceable, prepare it for cleaning as follows:

1. Scrape all old gasket material from block.
2. Remove grease and scale from cylinder block by agitating in a bath of commercial cleaning solution or hot soapy washing solution.
3. Rinse block in clean hot water to remove cleaning solution.

Inspection:

When rebuilding the engine, thoroughly inspect block for any condition that would make it unfit for further use. This inspection must be made after all parts have been removed and block has been thoroughly cleaned and dried.

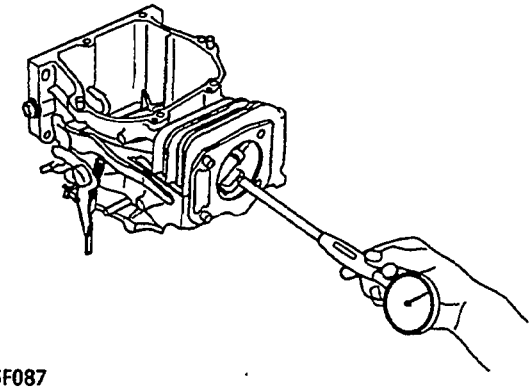
1. Make a thorough check for cracks using any standard method of crack detection. One method of crack detection follows: Minute cracks may be detected by coating the suspected area with a mixture of 25 percent kerosene and 75 percent light motor oil. Wipe the part dry and immediately apply a coating of zinc oxide (white lead) dissolved in wood alcohol. If cracks are present, the white coating will become discolored at the defective area. Replace a cracked cylinder block.
2. Inspect all machined surfaces and threaded holes. Carefully remove any nicks or burrs from machined surfaces. Clean out tapped holes and clean up any damaged threads.
3. Check cylinder head mounting area for flatness with a straight edge and a feeler gauge.

Cylinder Bore Inspection:

Inspect cylinder bore for scuffing, scratches, wear, and scoring. If cylinder bore is scuffed, scratched, scored, or worn, the block must be bored to an oversize or replaced.

When the appearance of the cylinder bore is good and there are no scuff marks, check cylinder bore for wear or out-of-round as follows:

1. Measure the I.D. of the cylinder liner with a cylinder gauge at six points as shown in Figure 9-25.
2. If the measurement exceeds the allowable limit, the cylinder will need to be bored to an oversize and then be honed.



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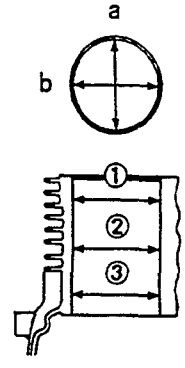

C105F088

FIGURE 9-25. MEASURING CYLINDER WEAR

Piston, Rings, and Connecting Rod

The piston has two compression rings and one oil control ring. Remove these rings from the piston using a piston ring expander as shown in Figure 9-26.

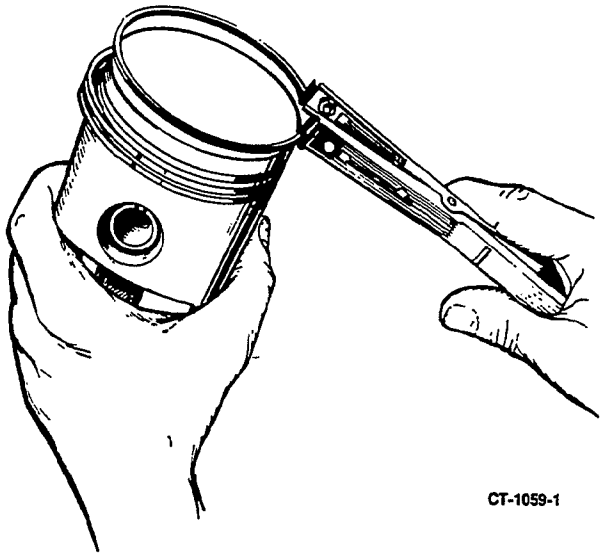

FIGURE 9-26. REMOVING PISTON RINGS

Remove the piston pin retainer from each side and push the piston pin out. Remove dirt and deposits from the piston surfaces with parts cleaning solvent. Clean the piston ring grooves with a groove cleaner (Figure 9-27) or the end of a piston ring filed to a sharp point. Care must be taken not to remove metal from the groove sides.

⚠CAUTION ***Using caustic cleaning solvent or wire brush for cleaning pistons will damage piston. Use only parts cleaning solvent. When cleaning the connecting rod in solvent, include the rod bore. Blow out all passages with low pressure compressed air.***

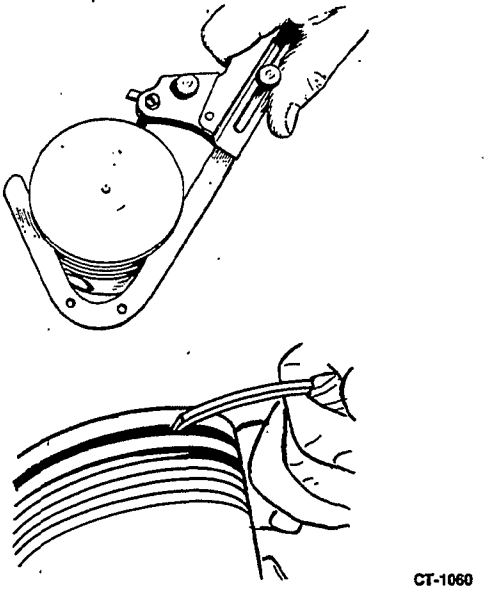

FIGURE 9-27. CLEANING RING GROOVES

The following section covers inspection procedures for piston and connecting rod.

Piston Inspection: Inspect the piston for fractures at the ring lands, skirt, and pin bosses. Check for wear at the ring lands using a new ring and feeler gauge as shown in Figure 9-28. Replace the piston when the side clearance of the rings exceed the specified limit.

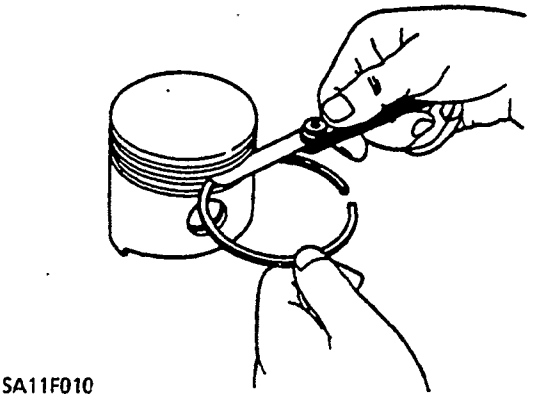

FIGURE 9-28. CHECKING RING LAND

Piston Skirt O.D. Measurement:

1. Measure the piston skirt O.D. with an outside micrometer (Figure 9-29).
2. If the measurement is less than the allowable limit, replace the piston.

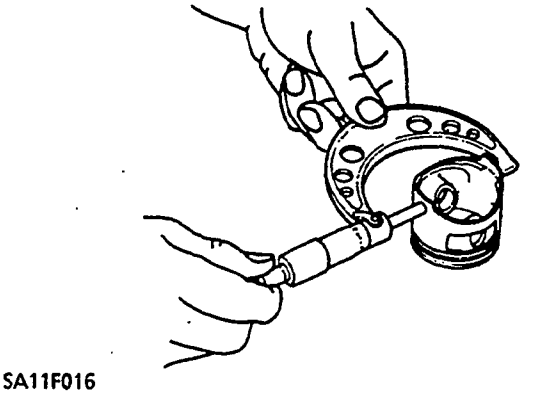

FIGURE 9-29. PISTON SKIRT MEASUREMENT

Piston Boss I.D.:

1. Measure the piston boss I.D. in both the vertical and horizontal direction with a cylinder gauge (Figure 9-30).
2. If the measurement exceeds the allowable limit, replace the piston.

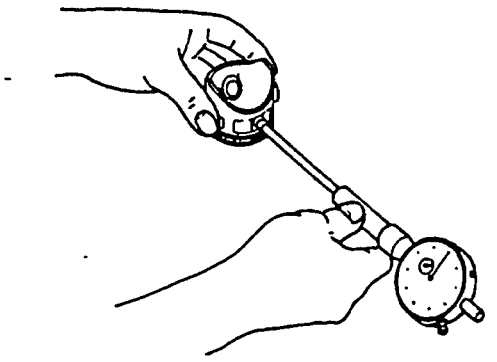

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FIGURE 9-30. PISTON BOSS I.D.

Piston Ring Gap

1. Insert piston ring into cylinder. Use piston head to push ring down to bottom of cylinder.
2. Measure the ring gap with a feeler gauge as shown in Figure 9-31.
3. If the ring gap exceeds the allowable limit, replace the ring.

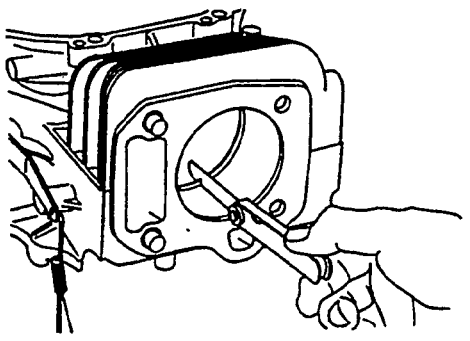

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FIGURE 9-31. MEASURING RING GAP

Piston Ring Thickness

1. Measure the piston ring thickness with an outside micrometer a (Figure 9-32.).
2. If the thickness is less than the allowable limit, replace the ring.

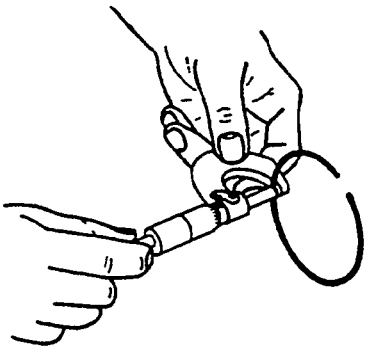

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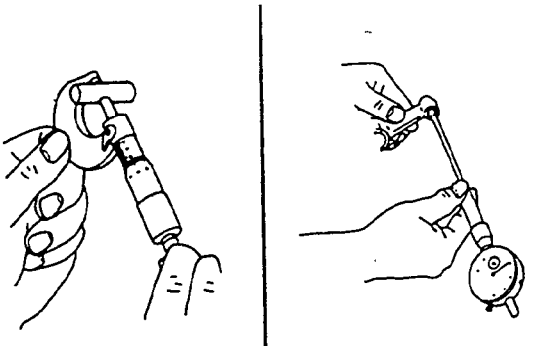
FIGURE 9-32. RING THICKNESS

Piston Assembly

Install the rings on the piston beginning with the oil control ring. Use a piston ring spreader to prevent twisting or excessive expansion of the ring. Compression rings are marked with the word "top" or a mark on one side of the ring to indicate which side faces the top of the piston. Unmarked rings may be installed either way. Stagger ring gaps 120 degrees apart. Do not position ring gaps on thrust face of cylinder.

Clearance between Piston Pin and Connecting Rod Small End Bore

1. Measure the piston pin O.D. and connecting rod small end bore with a micrometer (Figure 9-33). Then calculate the difference.
2. If the clearance exceeds the allowable limits, replace them.

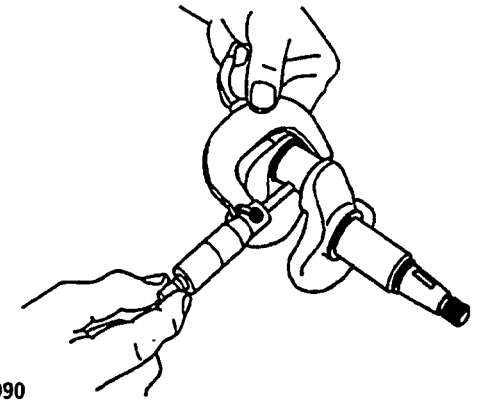


SA11F013 SA11F021

FIGURE 9-33. PISTON PIN AND CONNECTING ROD CLEARANCE

Clearance between Crank pin and Connecting Rod Big End Bore

1. Measure the crank pin O.D. and the connecting rod big end bore with a micrometer, and calculate the difference (Figure 9-34).
2. If the clearance exceeds the allowable limits, replace them.



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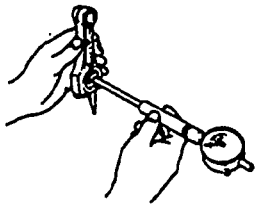

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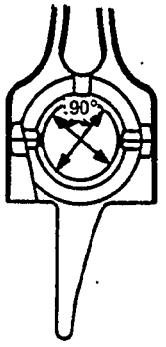

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FIGURE 9-34. CRANK PIN AND CONNECTING ROD CLEARANCE

Side Clearance of Connecting Rod on Crank Pin

1. Assemble the connecting rod to the crank pin.
2. Measure the side clearance with a feeler gauge (Figure 9-35).
3. If the clearance exceeds the allowable limits, replace them.

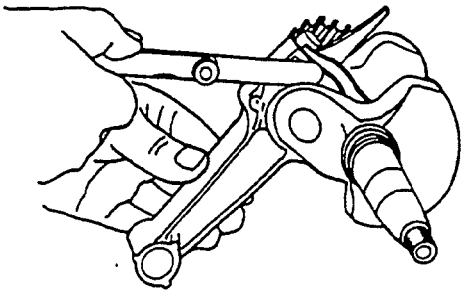

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FIGURE 9-35. SIDE CLEARANCE OF CONNECTING ROD ON CRANK PIN

Cam Heights for Intake and Exhaust

1. Measure the height of the cam at its highest point with an outside micrometer (Figure 9-36).
2. If the measurement is less than the allowable limit, replace the camshaft.

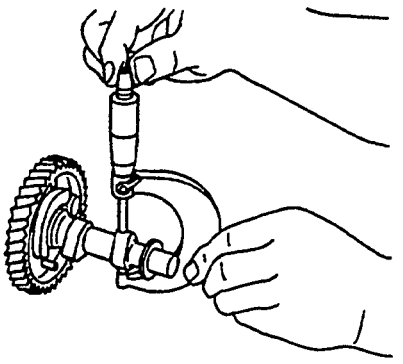

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FIGURE 9-36. INTAKE AND EXHAUST CAM HEIGHTS

Side Clearance of Crankshaft

1. Set a dial gauge, as shown in Figure 9-37, push the shaft in and measure the clearance.
2. If the side clearance exceeds the allowable limits, adjust with shims.

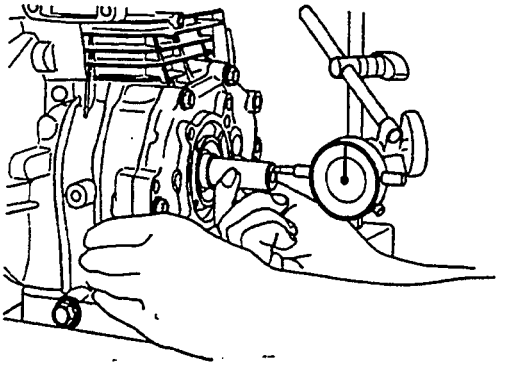

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FIGURE 9-37. SIDE CLEARANCE OF CRANKSHAFT

Rocker Arm Shaft to Rocker Arm Clearance - GH400 Engine

1. Measure the rocker arm shaft O.D. with an outside micrometer (Figure 9-38).
2. Measure the rocker shaft hole I.D. with an inside micrometer, and calculate the clearance.
3. If the clearance exceeds the allowable limit, replace the rocker arm.
4. If the clearance still exceeds the limit replace the rocker arm shaft.

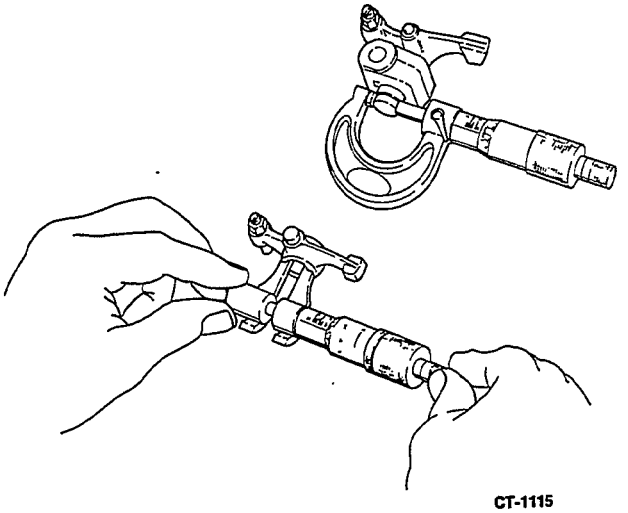

FIGURE 9-38. ROCKER ARM AND SHAFT CLEARANCE

VALVE SYSTEM

This section is divided into two main parts: side valve inspection and service, and overhead valve inspection and service. A properly functioning valve system is essential for good engine performance. Use the following procedures to inspect and service the valve system.

Check the valve face for evidence of burning, warping, out-of-round, and carbon deposits (see Figure 9-39). Burning and pitting are caused by the valve failing to seat tightly. This condition is often caused by hard carbon particles on the seat. It may also be due to weak valve springs, insufficient tappet clearance, warping, and misalignment.

Warping occurs mainly due to exposure to intense heat. Out-of-round wear follows when the seat is pounded by a valve whose head is not in line with the stem and guide. If a valve face is burned or warped, or the stem is worn, install a new one.

Too much clearance in the intake guide admits air and oil into the combustion chamber affecting carburetion, increasing oil consumption, and making heavy carbon deposits. Carbon insulates metal and retains the heat. This increases combustion chamber temperature and causes warping and burning.

Unburned carbon residue gums valve stems and causes them to stick in the guide. Deposits of hard carbon with sharp points projecting become white hot and cause pre-ignition and pinging.

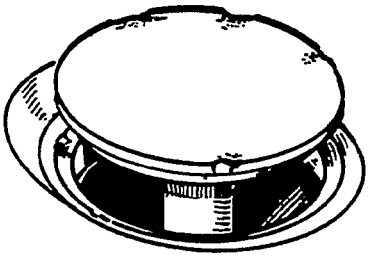

FIGURE 9-39. VALVE FACE

SIDE VALVE INSPECTION AND SERVICE

Check Clearance Between Valve and Valve Guide

1. Remove carbon from valve guide.
2. Check to make sure the valve stem is not bent.
3. Mount a dial gauge on the cylinder as shown in Figure 9-40.
4. Measure the clearance at the point where the valve contacts the valve guide.

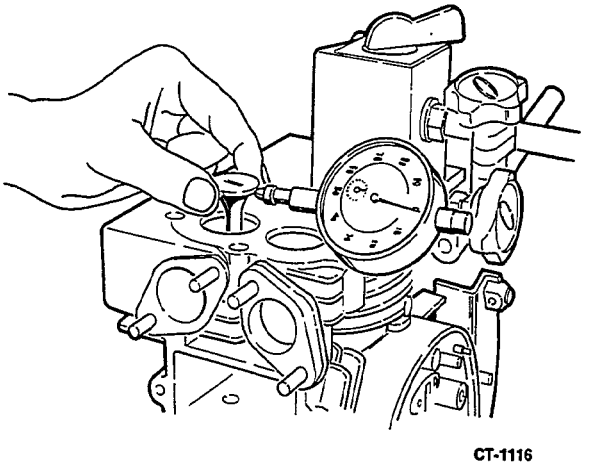

FIGURE 9-40. VALVE TO VALVE GUIDE CLEARANCE

Check Valve Seat Surface Width

1. Clean the valve seat surface.
2. Measure the valve seat width using a vernier calipers (Figure 9-41).
3. Apply red lead to the valve surface to check for scratches or unevenness.
4. When valve seat exceeds the allowable limit, regrind valve seat as follows.

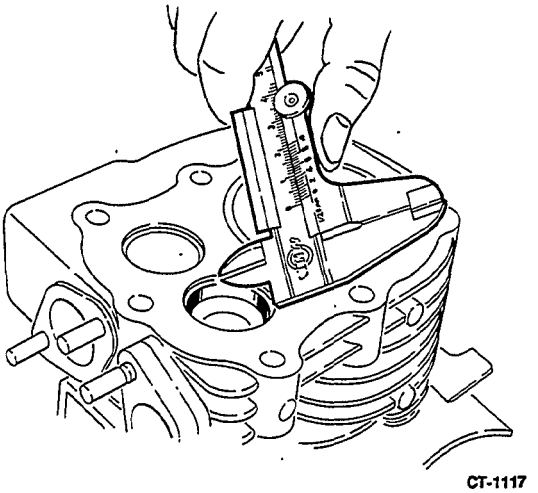

FIGURE 9-41. MEASURING VALVE SEAT WIDTH

Regrinding seat surface:

1. Grind valve seat surface with a cutter.
2. Use a cutter appropriate for the valve seat surface and valve guide diameter.
3. Valve seat width gets wider with use. Cut and readjust the width with a 15° cutter (Figure 9-42).
4. Grind the seat surface scratches and unevenness with a 45° cutter.
5. Grind the inner surface with a 65° to 70° cutter to finish the seat width to the specified dimension.
6. Use a grinding compound to finish the seat surface.

(A) Contact surface with valve
(B) Valve seat surface before readjustment
(C) Valve seat surface after readjustment
A. 45° cutter B. 15° cutter C. 70° cutter

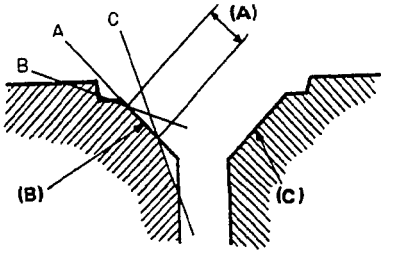

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FIGURE 9-42. REGRINDING VALVE SEAT

Check Valve Spring Free Length

1. Measure the valve spring length (dimension "A") with a vernier calipers (Figure 9-43).
2. If spring length is less than 1.2 inches (30.5 mm) replace the valve spring.

Check Valve Spring Squareness

1. Place the spring on a surface plate and use a square (Figure 9-43) to check squareness.
2. Turn the spring and measure to obtain the greatest dimension "B".
3. Check for spring damage and scratches.
4. Replace the spring if it is damaged or out of square by more than 0.0591 inches (1.5 mm).

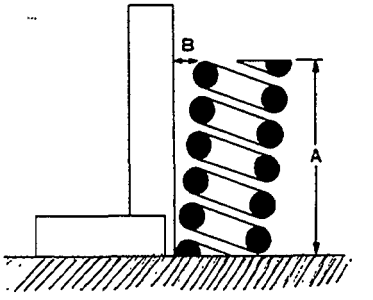

FIGURE 9-43. VALVE SPRING FREE LENGTH AND SQUARENESS MEASUREMENT

Checking Valve Clearance

1. Set the piston at top dead center.
2. Measure the clearance with a feeler gauge as shown in Figure 9-44.
3. If the clearance is less than the reference value of 0.0031 to 0.0055 inches (0.08 to 0.14 mm), grind the valve stem to adjust.

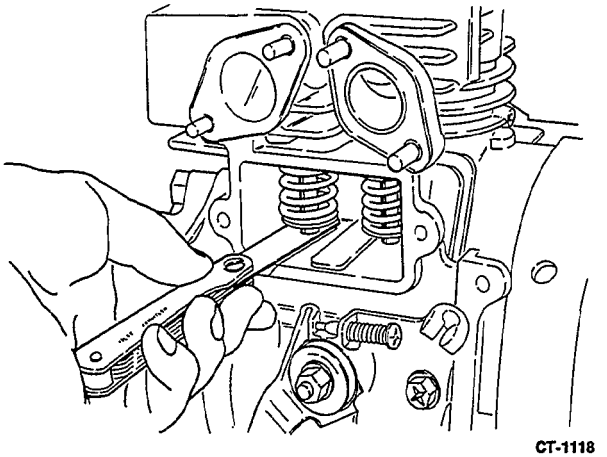

FIGURE 9-44. CHECKING VALVE CLEARANCE

OVERHEAD VALVE INSPECTION AND SERVICE

Check Clearance Between Valve Stem and Valve Guide.

1. Measure the valve stem O.D. with an outside micrometer (Figure 9-45).
2. Measure the valve guide at the largest point with a small hole gauge.
3. If the clearance exceeds the allowable limit, replace the valve guide and valve.

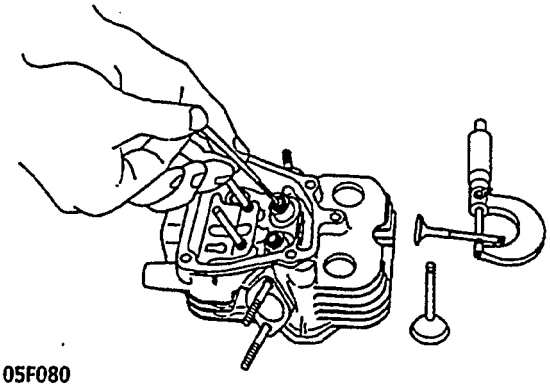

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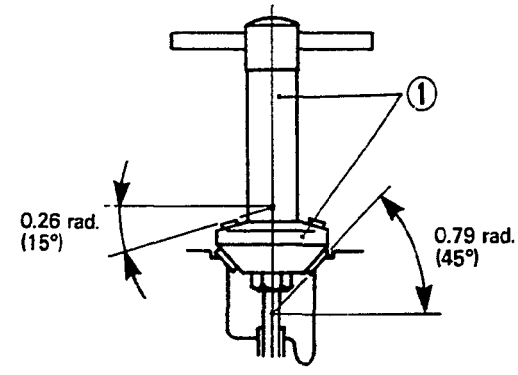
FIGURE 9-45. CLEARANCE BETWEEN VALVE STEM AND VALVE GUIDE

Check Valve Seat Surface Width

1. Clean the valve seat surface.
2. Measure the valve seat width (Figure 9-46) with a vernier calipers.
3. Apply red lead to the valve surface to check for scratches or unevenness.
4. When the measurement is within the allowable limit, check the seating ratio. If the ratio is less than 70%, the valve seat needs to be reground.
5. If the measurement exceeds the allowable limit, replace the valve and regrind the valve seat (see Regrinding Seat Surface).

Regrinding Seat Surface:

1. Grind valve seat surface with a 45° cutter. Use a cutter appropriate for the valve seat surface and valve guide diameter (Figure 9-46).
2. Install valve and check for contact between valve face and valve seat with red lead. (If the valve has been in use for a long time the seat tends to come in contact with the upper side of the valve face.)
3. Cut and readjust the width using a 15° cutter so the valve seat width makes contact in the same dimension as the valve face width.
4. Cut the valve seat surface again with a 45° cutter and recheck the contact between the valve and seat.
5. Repeat steps three and four until the correct contact is achieved.
6. Lap the valve seat until the seated rate is more than 70% of the total contact area.
7. Use a grinding compound to finish the seat surface.



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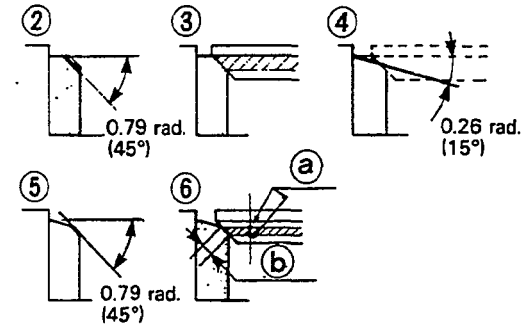

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(1) Valve Seat Cutter
(2) 0.79 rad. (45°) Cutter
(3) Contact Check
(4) 0.26 rad. (15°) Cutter
(5) 0.79 rad. (45°) Cutter
(6) Contact Check

(a) Identical Dimensions
(b) Seat Surface Width

FIGURE 9-46. REGRINDING VALVE SEAT

Check Valve Spring Free Length

1. Measure the valve spring length (dimension "A") with a vernier calipers (Figure 9-43).
2. If spring length is less than the allowable limit replace it.

Check Valve Spring Squareness

1. Place the spring on a surface plate and use a square (Figure 9-43) to check squareness.
2. Turn the spring and measure to obtain the greatest dimension "B".
3. Check for spring damage and scratches.
4. Replace the spring if it is damaged or out of square by more than 0.0591 inches (1.5 mm).

Checking Valve Clearance

The engine is equipped with adjustable valve tappets. Adjust the valve clearance only when the engine is at ambient temperature. Proceed as follows:

1. Inspect valve stems for proper alignment with tappets.
2. Advance the engine until both of the valves are closed and there is no pressure on the valve lifters (piston at top dead center).
3. Clearances are shown in the Specifications section. For each valve, the gauge should just pass between the top of the valve stem and the rocker arm (Figure 9-47.).
4. Check the cylinder head mounting bolt torque (see Cylinder Head, this section), before performing valve lash adjustment.
5. To correct the valve clearance, place a wrench on the adjusting nut and a wrench on the outer locking nut. Loosen the outer locking nut and turn the adjusting nut as needed to obtain the correct clearance. Tighten locking nut after adjustment is made.
6. Recheck the valve clearance after adjustment has been made and also check the rocker arm bolts to see that they have not loosened as a result of adjusting the valve clearance.

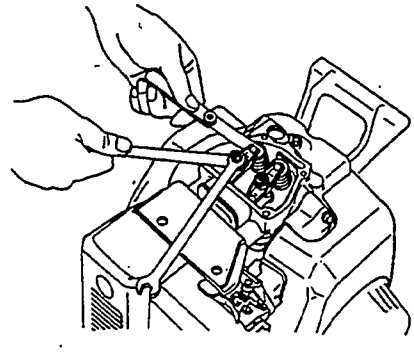

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FIGURE 9-47. CHECKING VALVE CLEARANCE

Intake Valve Seal Replacement - GH400 Engine

A worn or cracked valve seal can cause high oil consumption and spark plug fouling. Replace a defective intake valve seal as follows:

1. Pull the old valve seal out carefully to avoid damaging the valve guide.
2. Coat the intake valve stem with engine oil and insert it into the valve guide.
3. Press valve seal into valve guide by hand.
4. After insertion, use a special tool made for installing the valve seal (Figure 9-48) to press the seal into the valve guide until the shoulder of the seal rests against the cylinder head.

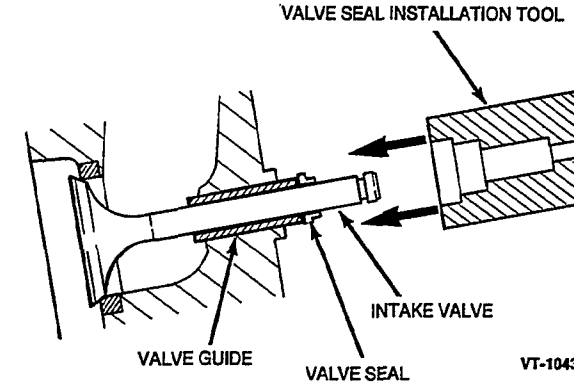


FIGURE 9-48. VALVE SEAL INSTALLATION

COMPRESSION RELEASE SYSTEM

The overhead valve engines have a compression release system that decreases the amount of effort required to start the engine with the recoil starter (Figure 9-49). If it becomes difficult to crank the engine over with the recoil starter, and the recoil starter mechanism works properly when it is removed from the generator set, the problem may be in the compression release system. The system works as follows:

1. As the engine is started, a spring (4) pulls in on a flyweight (3) which in turn pushes a decompression pin (2) upward.
2. The decompression pin pushes up and opens the exhaust valve (1) momentarily to release compression and make recoil starting easier.
3. As the engine speeds up, the flyweight is forced outward by centrifugal force and the decompression pin moves down so that it no longer contacts the exhaust valve.

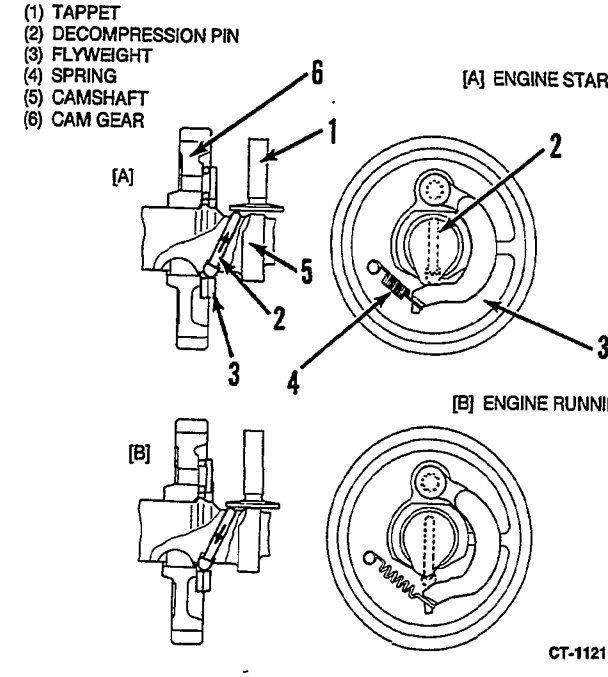


FIGURE 9-49. COMPRESSION RELEASE SYSTEM

Section 10. Service Checklist

⚠WARNING

EXHAUST GAS IS DEADLY!

Exhaust gases contain carbon monoxide, an odorless and colorless gas. Carbon monoxide is poisonous and can cause unconsciousness and death. Symptoms of carbon monoxide poisoning can include:

- ***Dizziness***
- ***Nausea***
- ***Headache***
- ***Weakness and Sleepiness***
- ***Throbbing in Temples***
- ***Muscular Twitching***
- ***Vomiting***
- ***Inability to Think Coherently***

IF YOU OR ANYONE ELSE EXPERIENCE ANY OF THESE SYMPTOMS, GET OUT INTO THE FRESH AIR IMMEDIATELY. If symptoms persist, seek medical attention. Shut down the unit and do not operate until it has been inspected and repaired.

Protection against carbon monoxide inhalation includes proper installation and regular, frequent visual and audible inspections of the complete exhaust system.

GENERAL

After servicing, inspect and test the generator set to confirm that it will operate properly and will pull the full rated load. Check each of the following areas before putting the set into service.

LUBRICATION

If the engine oil was drained during service, fill the crankcase with oil of the recommended classification and viscosity. Refer to the Operator's manual for the specific recommendations and procedures.

WIRING

Verify that all wiring connections are tight and are routed properly. Check each of the following:

- Control Wires
- Ground Strap
- Battery Cables (Electric Start Models Only)

INITIAL START ADJUSTMENTS

⚠WARNING ***Inhalation of exhaust gas can result in severe personal injury or death. Do not operate the generator set in poorly ventilated areas such as indoors, inside tanks, confined areas, depressions, or any area where exhaust gases might accumulate. Locate the exhaust outlet so that exhaust gases will not accumulate during operation.***

⚠WARNING ***Due to the danger of severe personal injury or death, do not operate the generator set in hazardous areas where it might ignite gases, combustibles, or explosive materials.***

Open the fuel valve, Make sure that the speed control lever is set to high ("H"). If necessary, close the choke for starting. Start the generator set. If necessary, adjust the governor speed adjustment screw to obtain a safe no-load operating speed. With no load applied, listen for any unusual sounds or vibrations. Close the choke as the engine warms up. When the choke is completely open, adjust the carburetor and governor as specified in the Fuel System section.

OUTPUT CHECK

Use a load test panel to apply progressively greater loads until full load is reached. Operate the generator set at its full rated output to make sure the set operates properly.

EXHAUST SYSTEM

With the generator set operating, inspect the entire exhaust system including the muffler and exhaust pipe. Visually and audibly inspect all welds, connections, and joints. If leaks are detected, shut the generator set down and make repairs before operating the generator set. Repair corroded exhaust components before leaks occur.

⚠WARNING ***Inhalation of exhaust gases can result in severe personal injury or death. Inspect exhaust system audibly and visually for leaks. Repair leaks before returning the generator set to service.***

FUEL SYSTEM

With the generator set operating, inspect the fuel supply line, filter, fuel tank, and fittings for leaks. Check flexible sections for cuts, cracks, and abrasions and make sure they are not rubbing against anything that could cause breakage.

⚠WARNING ***Leaking fuel will create a fire hazard that can result in severe personal injury or death if ignited. If leaks are detected, shut the generator set down and correct leak immediately.***

CONTROL

Start and stop the generator set several times using the controls to verify that they are functioning properly.

MECHANICAL

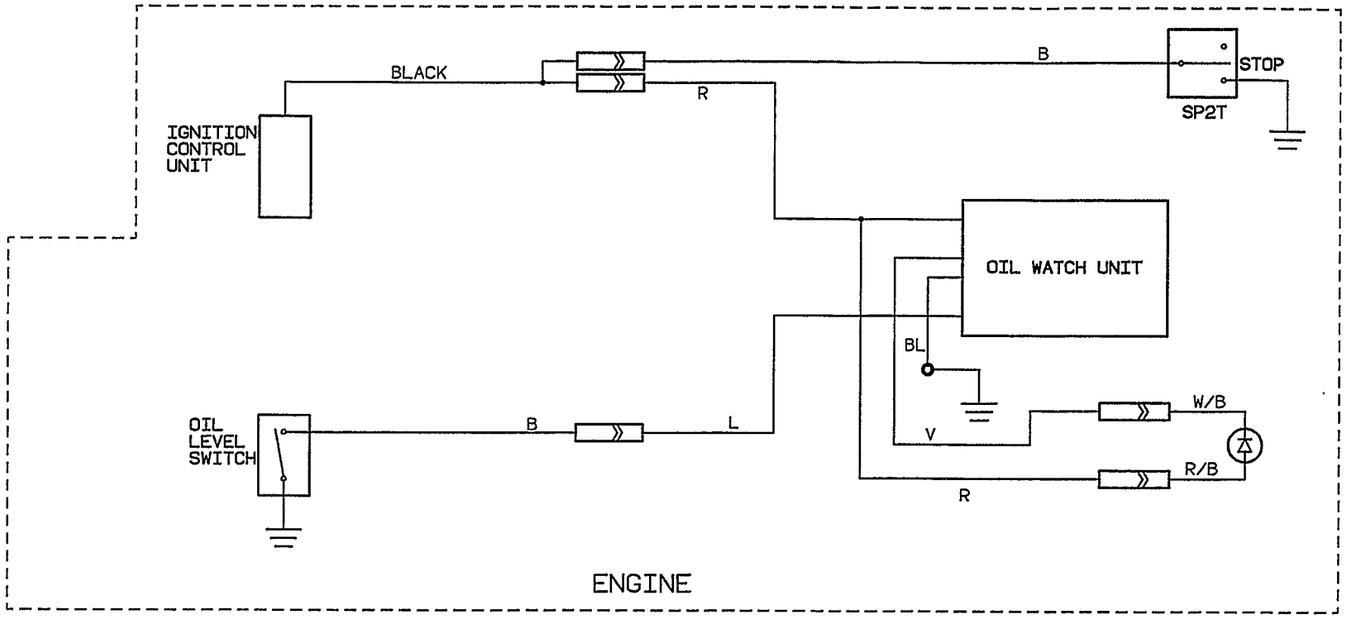
Stop the generator set and inspect for leaking gaskets, loose fasteners, damaged components, or interference problems and repair as required.

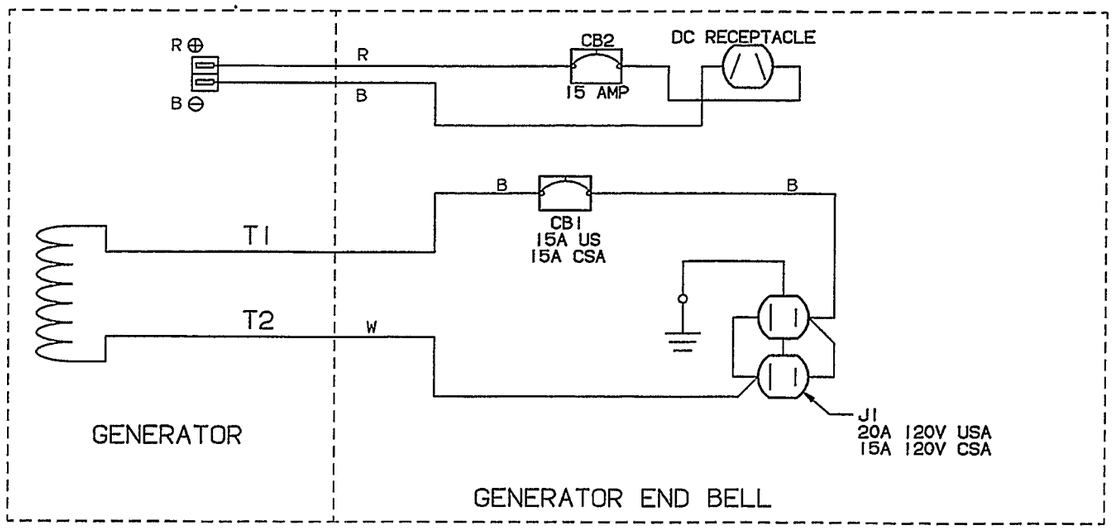
Section 11. Wiring Diagrams

NOTES

This section contains the wiring diagrams for the 60 Hertz portable generator sets. Refer to the listing below to identify the drawing number and page location.

625-2290 D





I.N NO.	LTR	NO.	REVISION	ZONE	DR	CHKR	APPROVED	DATE
35,450	A	1	PRODUCTION RELEASE	-	TKP	JK	W.R.	11-7-89
36,545	B	1	MISC CHNGS PER MFG REQUEST	-	CE	CE	[illegible]	3-13-90

NOTES:

1. A 15A 120V RECEPTACLE IS ALSO ACCEPTABLE FOR USA APPLICATION.
2. UNLESS TERMINATED WITH LUGS, ALL LEADS TO RECEPTACLES SHALL BE SOLDER DIPPED.

CADAM DWG

DO NOT SCALE PRINT

ITEM	PART NO.	DWG SIZE	QTY	DESCRIPTION OR MATERIAL
				MINNEAPOLIS, MINNESOTA 55432

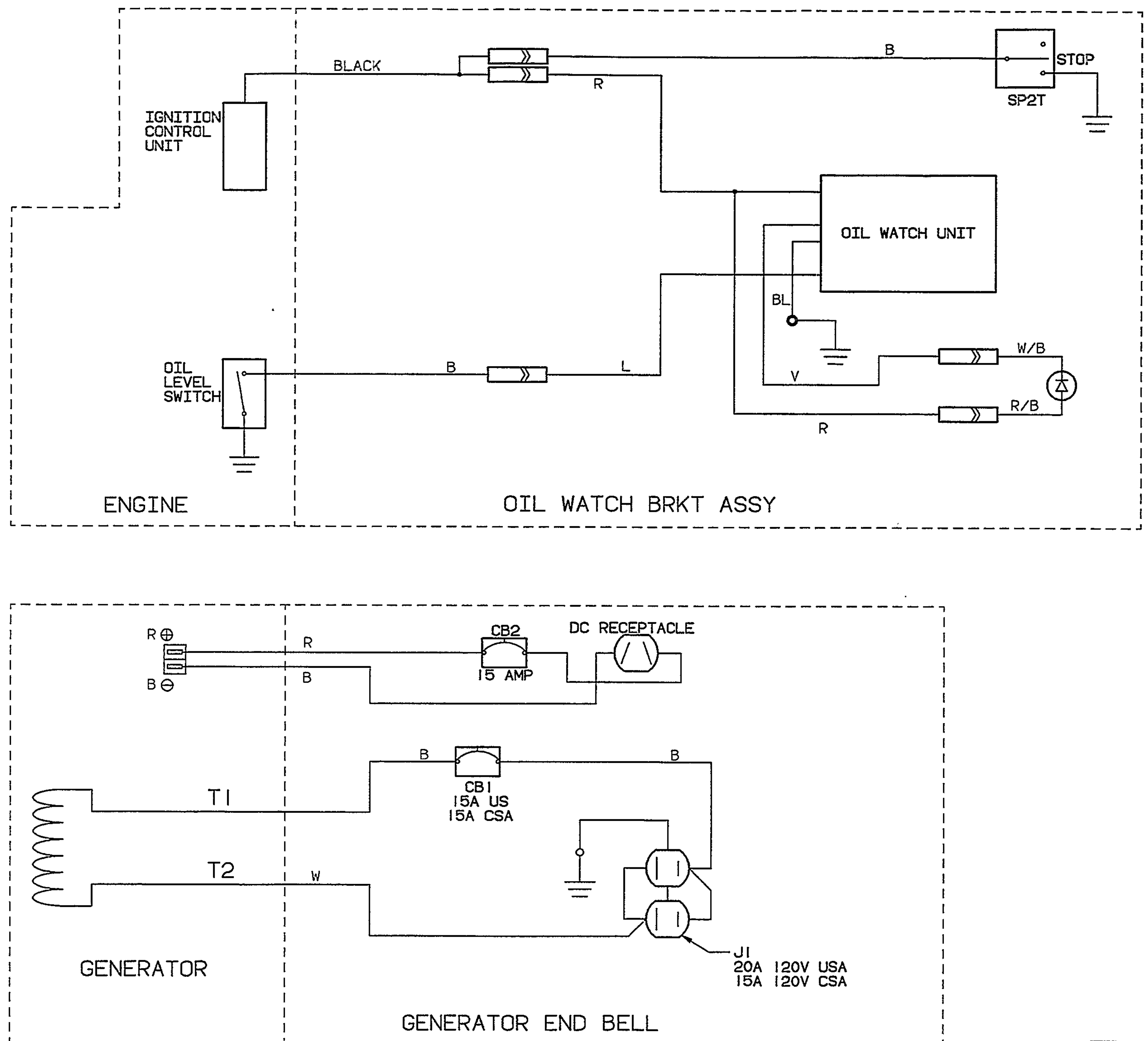
	NAME	DATE
DR	DAVE PETERMEIER	11-6-89
CHK'R	J KRAGE	11-8-89
APPROVED	W J LEHMANN	11-7-89

1.4 kW STD

TITLE: WIRING DIAGRAM

DWG NO: 625-2290 SHEET 1-1 DWG SIZE D

625-2289 D



NOTES:

1. A 15A 120V RECEPTACLE IS ALSO ACCEPTABLE FOR USA APPLICATION.
2. UNLESS TERMINATED WITH LUGS, ALL LEADS TO RECEPTACLES SHALL BE SOLDER DIPPED.

CADAM DWG

DO NOT SCALE PRINT

DR DAVE PETERMEIER 11-6-89
CHK J KRAGE 11-3-89
APPROVED W J LEHMANN 11-7-89

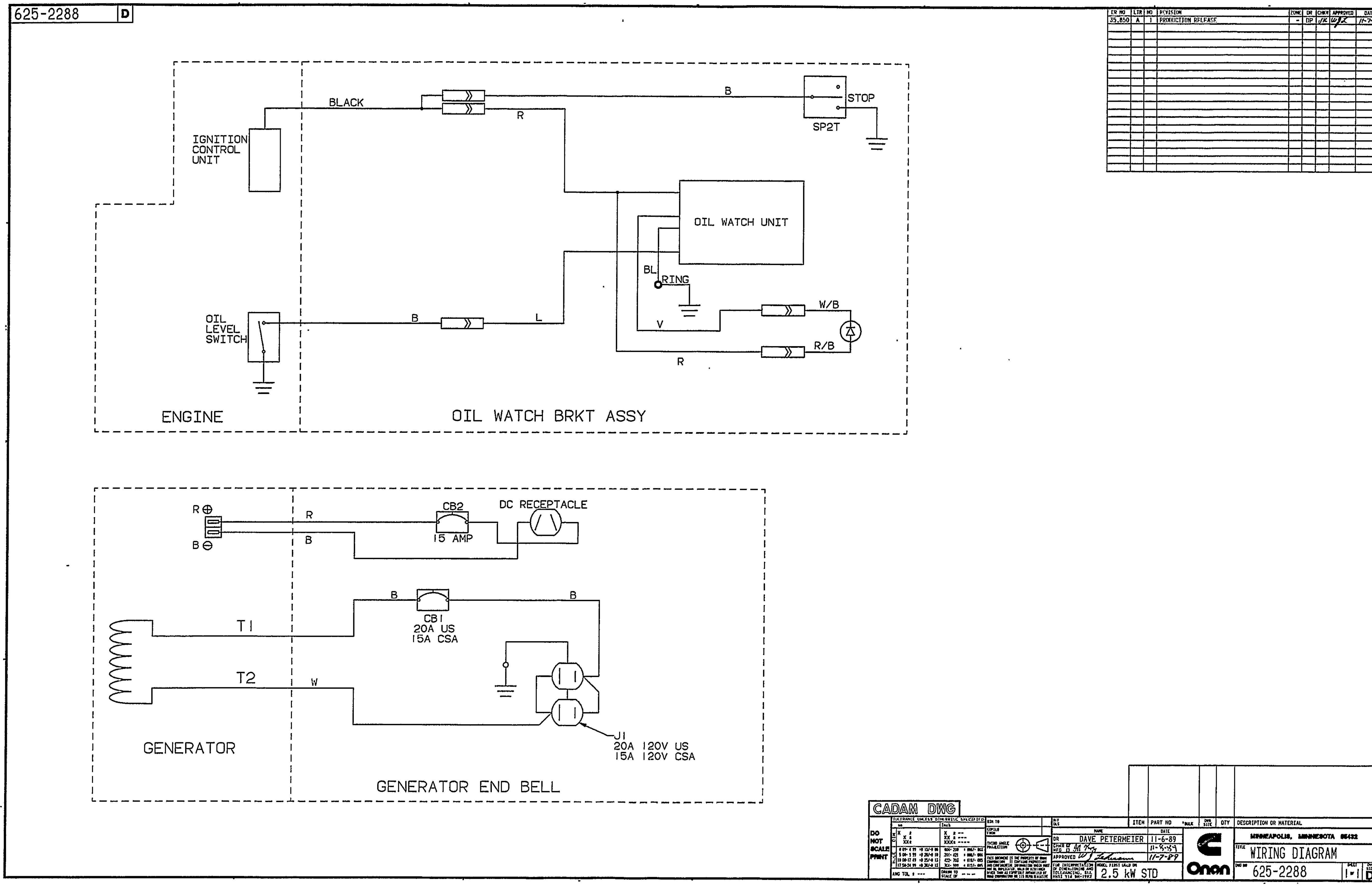
1.7 kW STD

Onan

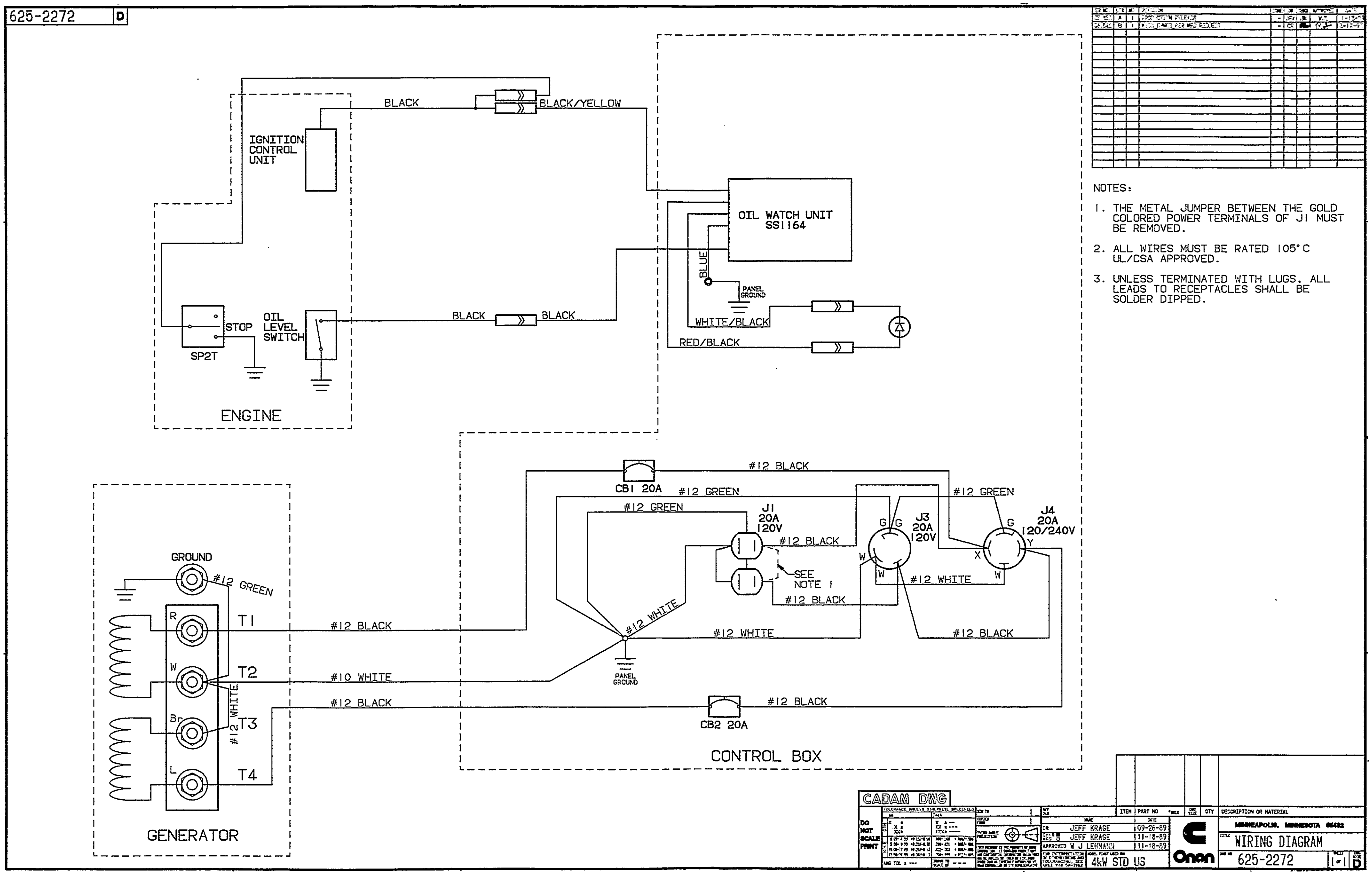
MINNEAPOLIS, MINNESOTA 55432

WIRING DIAGRAM

625-2289 D

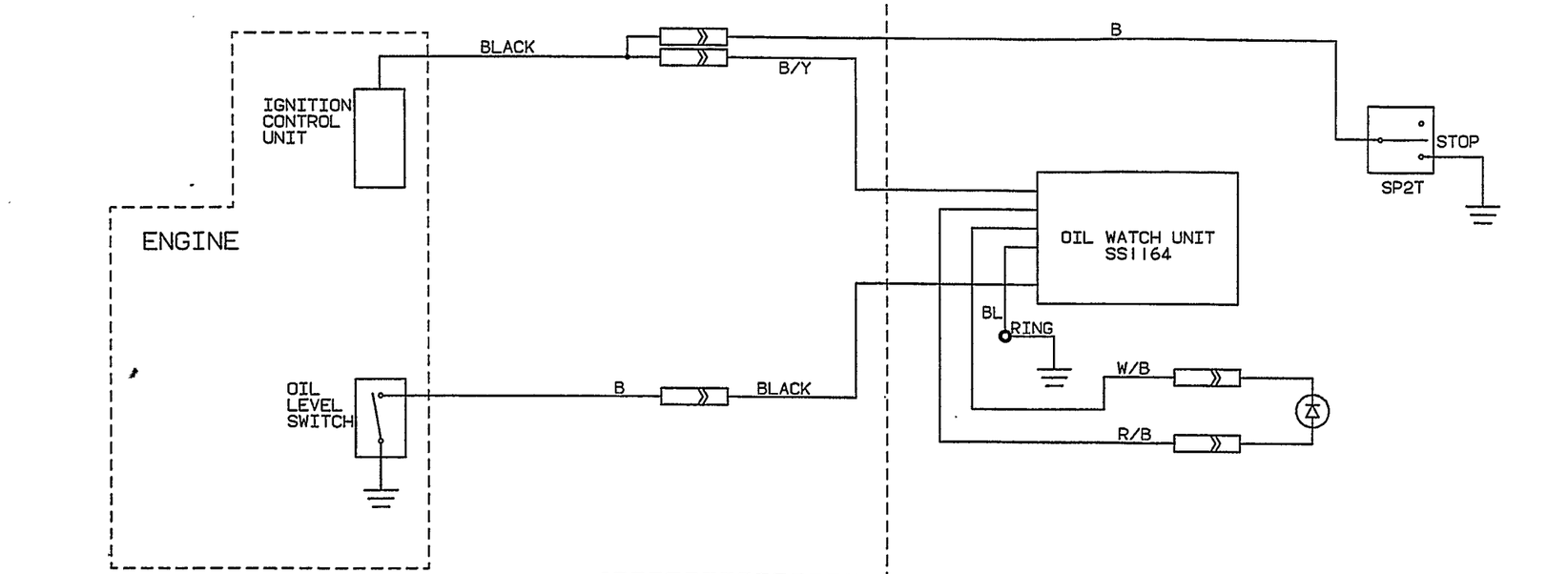


625-2288 D
BLACK
B
R
STOP
SP2T
IGNITION CONTROL UNIT
OIL WATCH UNIT
BL
RING
W/B
V
R/B
R
OIL LEVEL SWITCH
B
L
ENGINE
OIL WATCH BRKT ASSY
R
B
CB2
15 AMP
DC RECEPTACLE
B
B
CB1
20A US
15A CSA
T1
T2
W
J1
20A 120V US
15A 120V CSA
GENERATOR
GENERATOR END BELL
PRODUCTION RELEASE
CADAM DWG
DAVE PETERMEIER 11-6-89
11-7-89
WIRING DIAGRAM
625-2288
2.5 kW STD
MINNEAPOLIS, MINNESOTA
Onan


625-2272 D
BLACK
BLACK/YELLOW
IGNITION CONTROL UNIT
OIL WATCH UNIT SS1164
BLUE
PANEL GROUND
WHITE/BLACK
RED/BLACK
STOP
OIL LEVEL SWITCH
SP2T
BLACK
BLACK
ENGINE
NOTES:
1. THE METAL JUMPER BETWEEN THE GOLD COLORED POWER TERMINALS OF J1 MUST BE REMOVED.
2. ALL WIRES MUST BE RATED 105°C UL/CSA APPROVED.
3. UNLESS TERMINATED WITH LUGS, ALL LEADS TO RECEPTACLES SHALL BE SOLDER DIPPED.
CB1 20A
#12 BLACK
#12 GREEN
#12 GREEN
#12 GREEN
J1 20A 120V
J3 20A 120V
J4 20A 120/240V
G G X Y W W W
#12 BLACK
SEE NOTE 1
#12 WHITE
#12 BLACK
#12 WHITE
#12 WHITE
#12 BLACK
GROUND
#12 GREEN
R T1
W T2
Br T3
L T4
#12 WHITE
#12 BLACK
#10 WHITE
#12 BLACK
PANEL GROUND
CB2 20A
#12 BLACK
CONTROL BOX
GENERATOR
CADAM DWG
DO NOT SCALE PRINT
JEFF KRAGE 09-26-89
JEFF KRAGE 11-18-89
APPROVED W J LEHMANN 11-18-89
4kW STD US
MINNEAPOLIS, MINNESOTA 55432
Onan
WIRING DIAGRAM
625-2272
1 of 1 D

625-2277 D

FR NO	LTR	NO	REVISION	ZONE	DR	CHKR	APPROVED	DATE
35,850	A	1	PRODUCTION RELEASE	-	JFK	JK	WJL	11-18-89
36,786	B	1	GFI WAS STD DUPLEX RECPTL	38	CSE	WL	RS	5-9-90
		2	J3 WAS 20 A	28	CSE	WL	RS	5-9-90
37,553	C	1	ADDED NUMBER TO OIL WATCH UNIT	3C	CSE	CE	WJL	9-26-90



CADAM DWG

DO NOT SCALE PRINT

ITEM	PART NO.	QTY	DESCRIPTION OR MATERIAL
			MINNEAPOLIS, MINNESOTA 55432

	NAME	DATE
DR	JEFF KRAGE	09-26-89
CHKR	JEFF KRAGE	11-18-89
APPROVED	W J LEHMANN	11-18-89

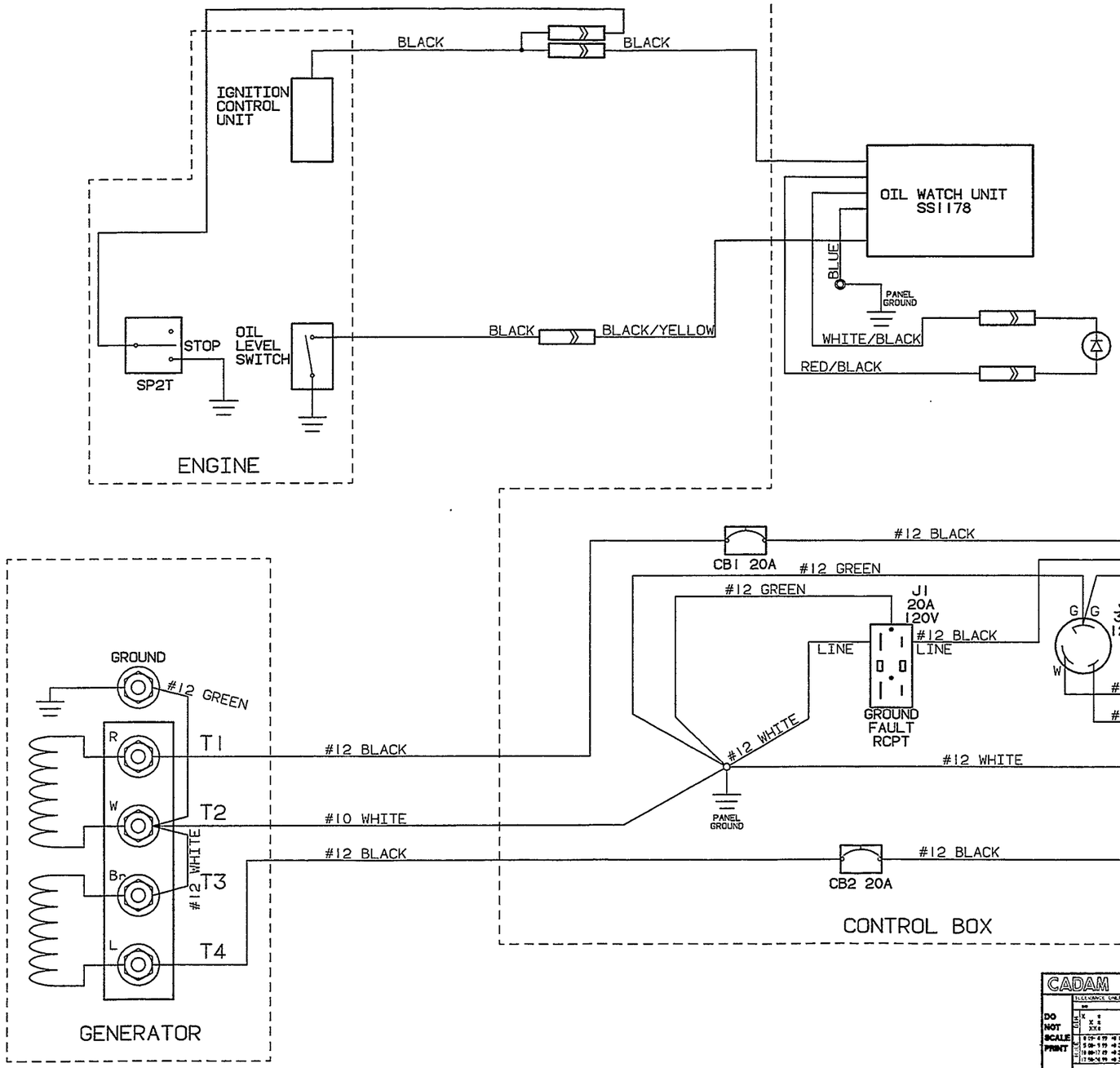
4kW STD CSA

Onan

TITLE WIRING DIAGRAM

DWG NO. 625-2277 SHEET 1 OF 1 REV D

625-2350 D



NOTES:

1. ALL WIRES MUST BE RATED 105° C UL/CSA APPROVED.
2. UNLESS TERMINATED WITH LUGS, ALL LEADS TO RECEPTACLES SHALL BE SOLDER DIPPED.

CADAM DWG

DO NOT SCALE PRINT

ITEM	PART NO	QTY	DESCRIPTION OR MATERIAL

DR C.S.EDWARDS 3-30-90

APPROVED 4/10/90

MINNEAPOLIS, MINNESOTA 55432

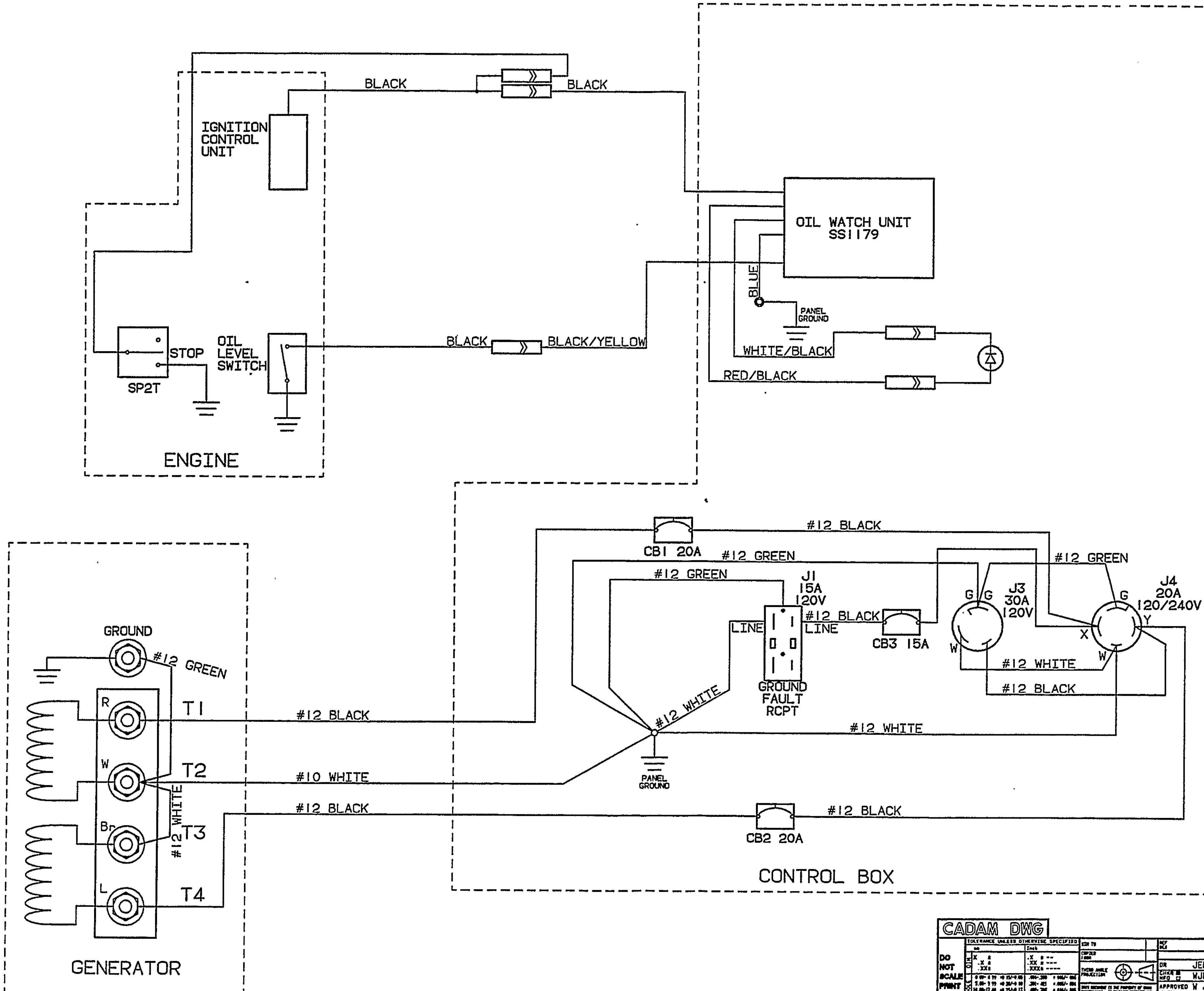
TITLE WIRING DIAGRAM

MODEL 5kW STD US

DWG NO 625-2350 SHT 1 OF 1 REV D

625-2294 D

ER NO	LTR	NO	REVISION	ZONE	DR	CHKR	APPROVED	DATE
35,944	A	1	PRODUCTION RELEASE	-	JFK	W.U.	W.N.	11-18-89
36,786	B	1	CHANGED J1 TO GFI RCPT	3B	CSE	CE	WJL	04-24-90
		2	ADDED WIRE SIZES AND COLORS	-	CSE	CE	WJL	04-24-90
		3	ADDED NOTES	1D	CSE	CE	WJL	04-24-90
		4	ADDED NUMBER TO OIL WATCH UNIT	3D	CSE	CE	WJL	04-24-90
		5	J3 WAS 20 AMP	3B	CSE	CE	WJL	04-24-90
		6	MOVED START STOP SWITCH TO ENGINE	6C	CSE	CE	WJL	04-24-90
		7	REMOVED CHARGE COIL	5C	CSE	CE	WJL	04-24-90
[illegible]	C	1	OIL WATCH UNIT WAS #SS1178	3C	CSE	CE	WL	09-26-90



NOTES:

1. ALL WIRES MUST BE RATED 105°C UL/CSA APPROVED.
2. UNLESS TERMINATED WITH LUGS, ALL LEADS TO RECEPTACLES SHALL BE SOLDER DIPPED.

CADAM DWG

DO NOT SCALE PRINT

NAME		DATE
DR	JEFF KRAGE	11-18-89
CHKR / MFG	WJL	11-27-89
APPROVED	W J LEHMANN	11-28-89

FOR INTERPRETATION OF DIMENSIONING AND TOLERANCING, SEE ANSI Y14.5M-1982

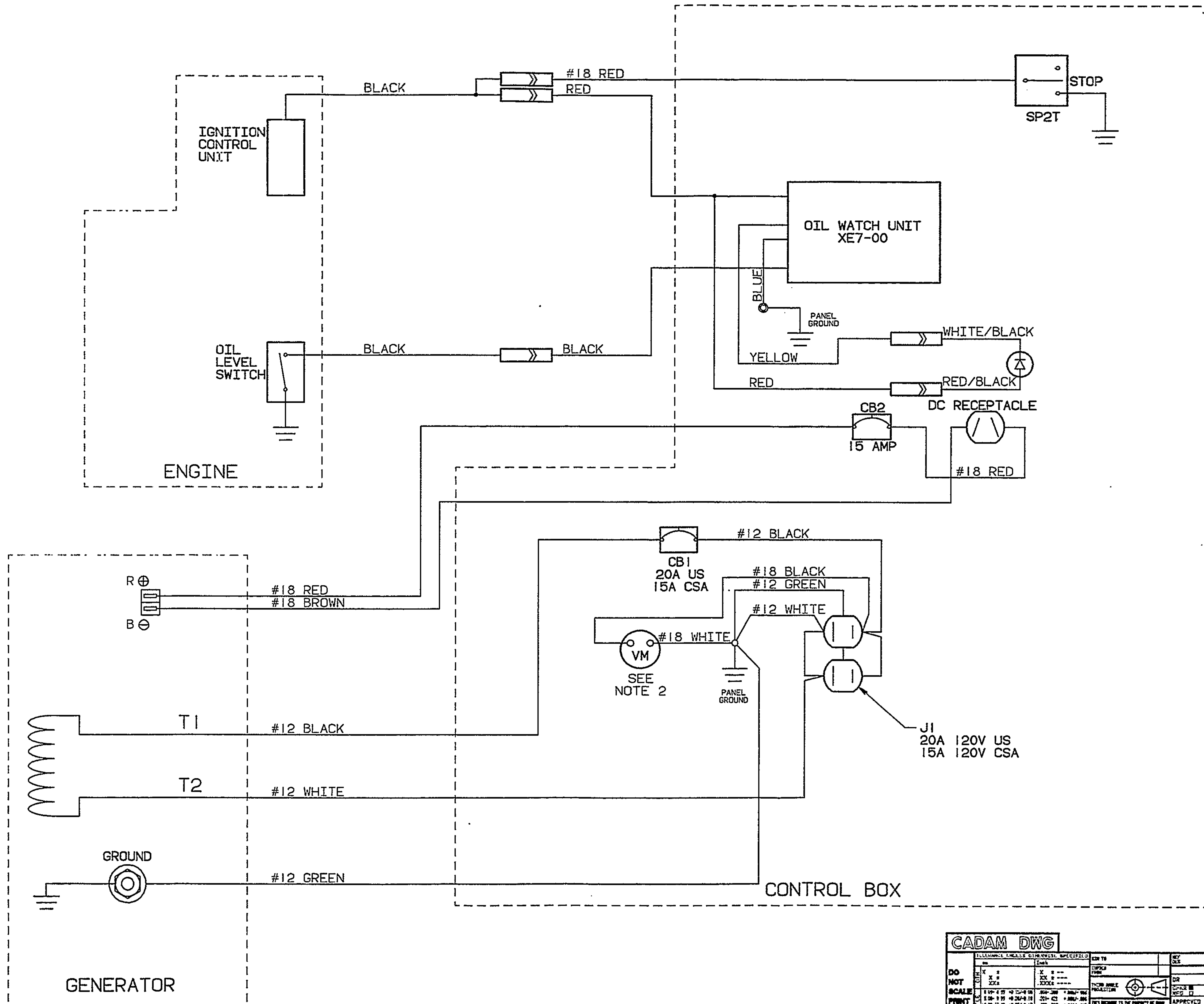
MODEL FIRST USED ON: 5kW STD CSA

Onan — MINNEAPOLIS, MINNESOTA 55432

TITLE: WIRING DIAGRAM

DWG NO: 625-2294 SHEET 1 of 1 DWG SIZE D

625-2273 D



NOTES:

1. ALL WIRES MUST BE RATED 105°C UL/CSA APPROVED.
2. DO NOT USE EXCESSIVE TORQUE ON VOLTMETER CONNECTIONS.
3. UNLESS TERMINATED WITH LUGS, ALL LEADS TO RECEPTACLES SHALL BE SOLDER DIPPED.

CADAM DWG

DO NOT SCALE PRINT

NAME	DATE
DR JEFF KRAGE	09-26-89
DAVE PETERMEIER	11-7-89
APPROVED W J LEHMANN	11-7-89

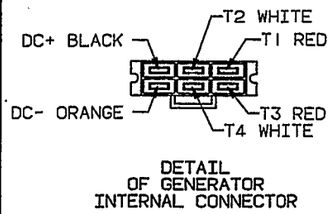
2.5 kW PRO

Onan — MINNEAPOLIS, MINNESOTA 55432

TITLE WIRING DIAGRAM

DWG NO 625-2273 SHEET 1 of 1 DWG SIZE D

625-2360 D



DETAIL
OF GENERATOR
INTERNAL CONNECTOR

ER NO.	LTR	NO	REVISION	ZONE	DR	CHKR	APPROVED	DATE
36,786	A	1	PRODUCTION RELEASE	-	CSE	WZ		04-24-90

NOTES:

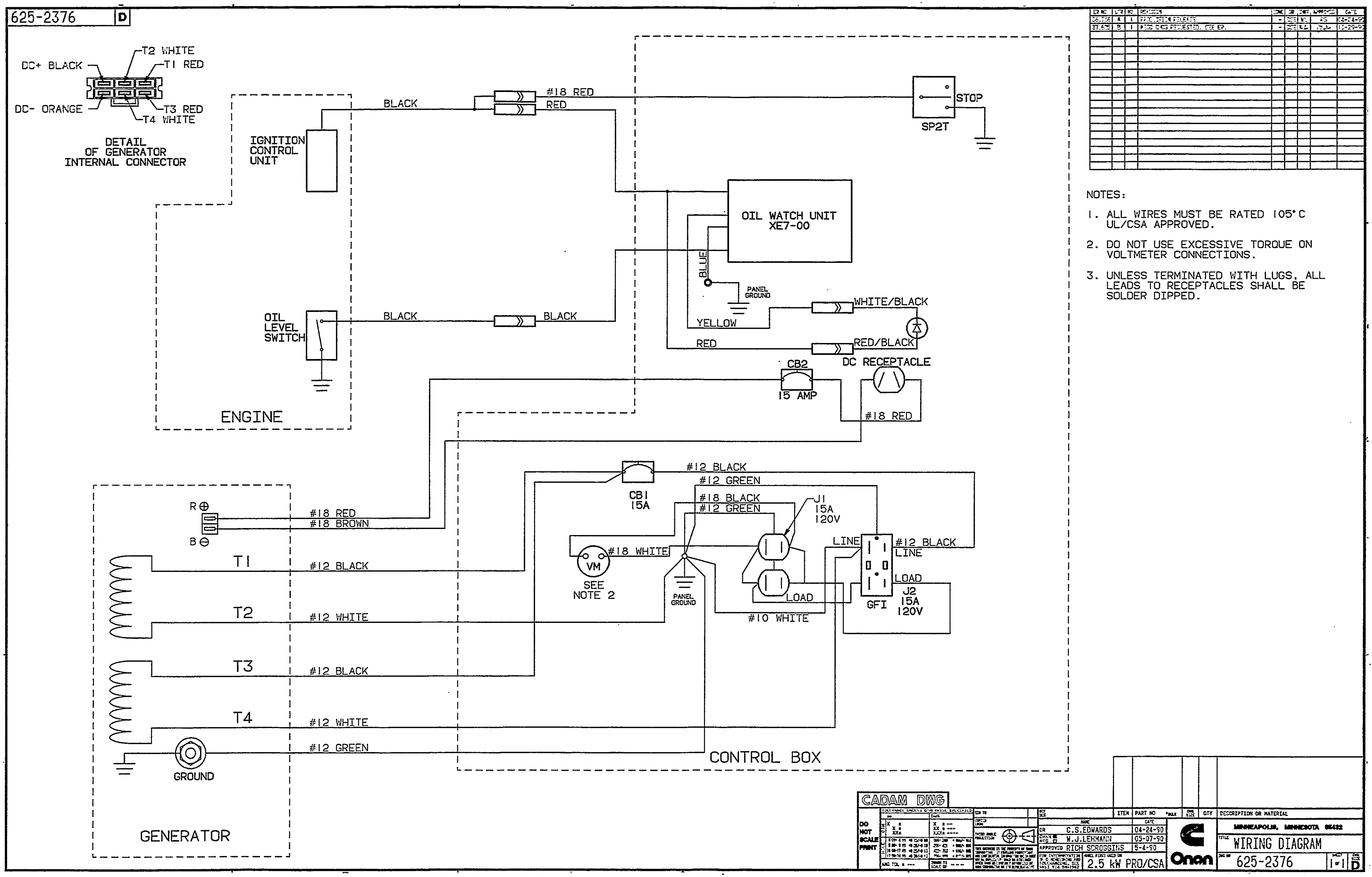
1. ALL WIRES MUST BE RATED 105°C UL/CSA APPROVED.
2. DO NOT USE EXCESSIVE TORQUE ON VOLTMETER CONNECTIONS.
3. UNLESS TERMINATED WITH LUGS, ALL LEADS TO RECEPTACLES SHALL BE SOLDER DIPPED.

CADAM DWG

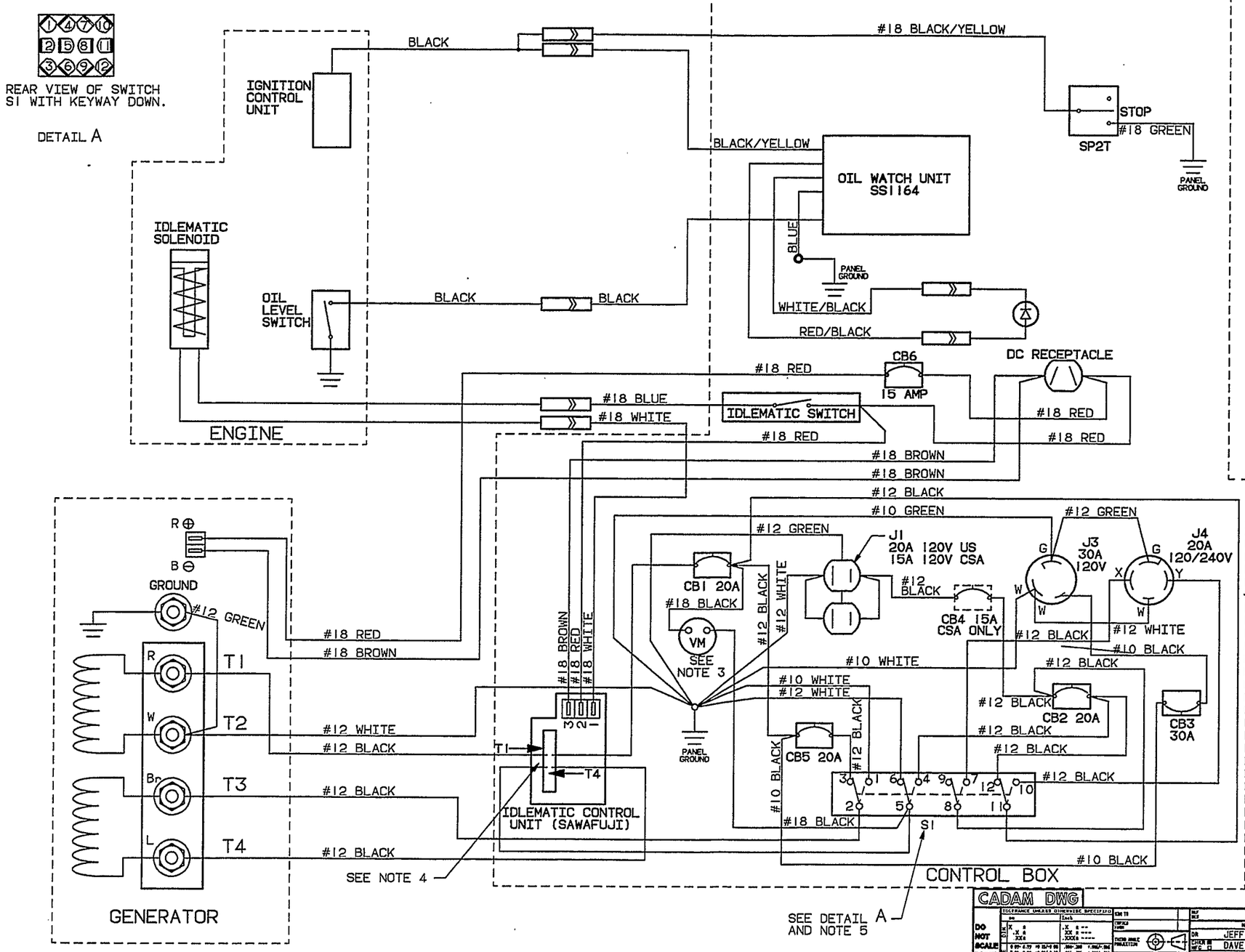
ITEM	PART NO	REV LTR	QTY	DESCRIPTION OR MATERIAL
				MINNEAPOLIS, MINNESOTA 55432

DR C.S.EDWARDS 04-24-90
CHK'R MFG
APPROVED 5/4/90
2.5 kW PRO/US

TITLE WIRING DIAGRAM
DWG NO 625-2360
SHEET 1 of 1
REV LTR D


625-2376 D
DC+ BLACK
T2 WHITE
T1 RED
DC- ORANGE
T3 RED
T4 WHITE
DETAIL OF GENERATOR INTERNAL CONNECTOR
IGNITION CONTROL UNIT
OIL LEVEL SWITCH
ENGINE
BLACK
#18 RED
RED
STOP
SP2T
OIL WATCH UNIT XE7-00
BLUE
PANEL GROUND
YELLOW
WHITE/BLACK
RED/BLACK
CB2
15 AMP
DC RECEPTACLE
#18 RED
#12 BLACK
#12 GREEN
#18 BLACK
#12 GREEN
CB1 15A
J1 15A 120V
#18 WHITE
VM
SEE NOTE 2
LINE
LOAD
#10 WHITE
GFI
J2 15A 120V
R
B
#18 RED
#18 BROWN
T1
T2
T3
T4
#12 BLACK
#12 WHITE
#12 GREEN
GROUND
GENERATOR
CONTROL BOX
NOTES:
1. ALL WIRES MUST BE RATED 105°C UL/CSA APPROVED.
2. DO NOT USE EXCESSIVE TORQUE ON VOLTMETER CONNECTIONS.
3. UNLESS TERMINATED WITH LUGS, ALL LEADS TO RECEPTACLES SHALL BE SOLDER DIPPED.
CADAM DWG
DO NOT SCALE PRINT
ITEM
PART NO
QTY
DESCRIPTION OR MATERIAL
NAME
DATE
DR C.S.EDWARDS 04-24-90
W.J.LEHMANN 05-07-90
APPROVED RICH SCROGGINS 5-4-90
2.5 kW PRO/CSA
Onan
MINNEAPOLIS, MINNESOTA 55432
TITLE WIRING DIAGRAM
625-2376
1 of 1
D

625-2274 D



ER NO.	LTR	NO.	REVISION	ZONE	BY	CHK	APPROVED	DATE
35,850	A	1	PRODUCTION RELEASE	-	JFK	DP	WJL	11-7-89
36,545	B	1	MISC CHGS PER MFG REQUEST	-	CE	CE	WJL	3-12-90

NOTES:

1. ALL WIRES MUST BE RATED 105°C UL/CSA APPROVED.
2. UNLESS TERMINATED WITH LUGS, ALL LEADS TO RECEPTACLES SHALL BE SOLDER DIPPED.
3. DO NOT USE EXCESSIVE TORQUE ON VOLTMETER CONNECTIONS.
4. NOTE REVERSE DIRECTIONS. (LEADS FROM GENERATOR MUST PASS THROUGH IDLEMATIC CONTROL IN OPPOSITE DIRECTIONS.)
5. FULL POWER SWITCH S1 SHOWN IN 120 VOLT POSITION.

CADAM DWG

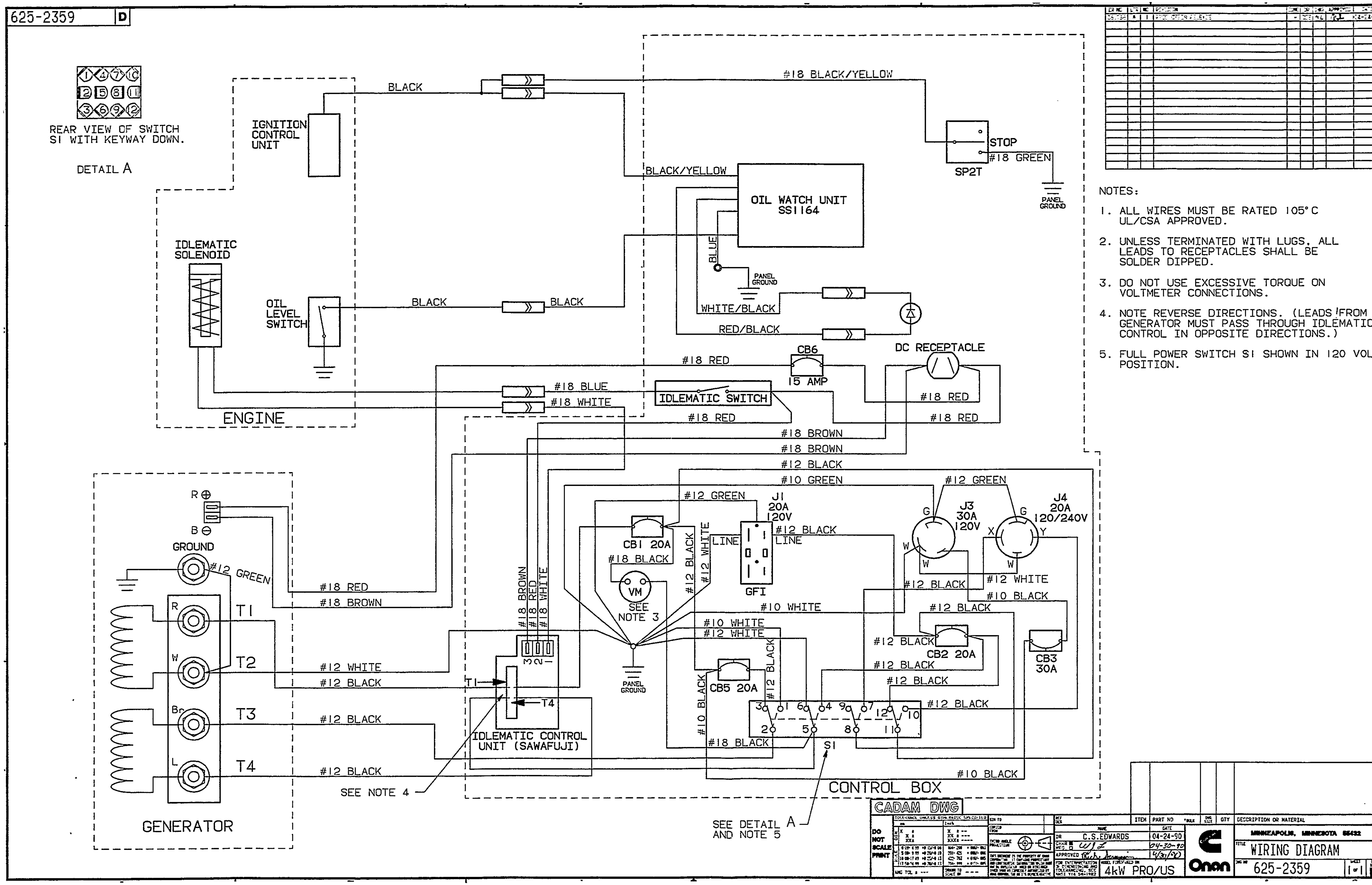
NAME	DATE
DR JEFF KRAGE	10-19-89
CHK MFG ENG DAVE PETERMEIER	11-7-89
APPROVED W J LEHMANN	11-7-89

MINNEAPOLIS, MINNESOTA 55432

TITLE WIRING DIAGRAM

4kW PRO

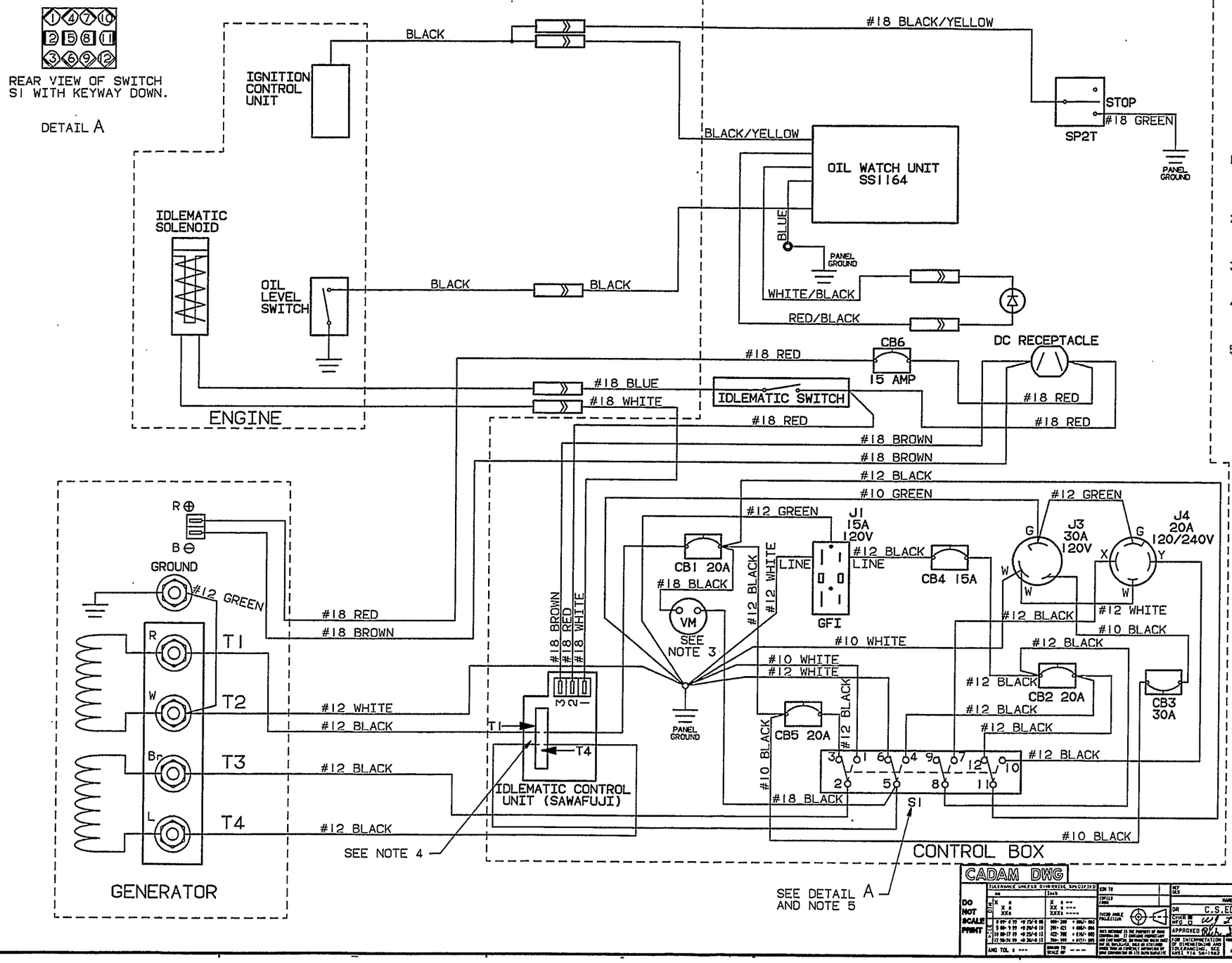
DWG NO. 625-2274 SHEET 1 of 1 SIZE D



NOTES:

1. ALL WIRES MUST BE RATED 105°C UL/CSA APPROVED.
2. UNLESS TERMINATED WITH LUGS, ALL LEADS TO RECEPTACLES SHALL BE SOLDER DIPPED.
3. DO NOT USE EXCESSIVE TORQUE ON VOLTMETER CONNECTIONS.
4. NOTE REVERSE DIRECTIONS. (LEADS FROM GENERATOR MUST PASS THROUGH IDLEMATIC CONTROL IN OPPOSITE DIRECTIONS.)
5. FULL POWER SWITCH S1 SHOWN IN 120 VOLT POSITION.

625-2375 D



ER NO	LTR	NO	REVISION	ZONE	DR	CHKR	APPROVED	DATE
36,766	A	1	PRODUCTION RELEASE	-	CSE	W/L		04-24-90

NOTES:

1. ALL WIRES MUST BE RATED 105°C UL/CSA APPROVED.
2. UNLESS TERMINATED WITH LUGS, ALL LEADS TO RECEPTACLES SHALL BE SOLDER DIPPED.
3. DO NOT USE EXCESSIVE TORQUE ON VOLTMETER CONNECTIONS.
4. NOTE REVERSE DIRECTIONS. (LEADS FROM GENERATOR MUST PASS THROUGH IDLEMATIC CONTROL IN OPPOSITE DIRECTIONS.)
5. FULL POWER SWITCH S1 SHOWN IN 120 VOLT POSITION.

CADAM DWG

DO NOT SCALE PRINT

ITEM	PART NO	SYM	QTY	DESCRIPTION OR MATERIAL

DR C.S.EDWARDS 04-24-90
CHKR W/L 04-30-90
APPROVED 4/30/90

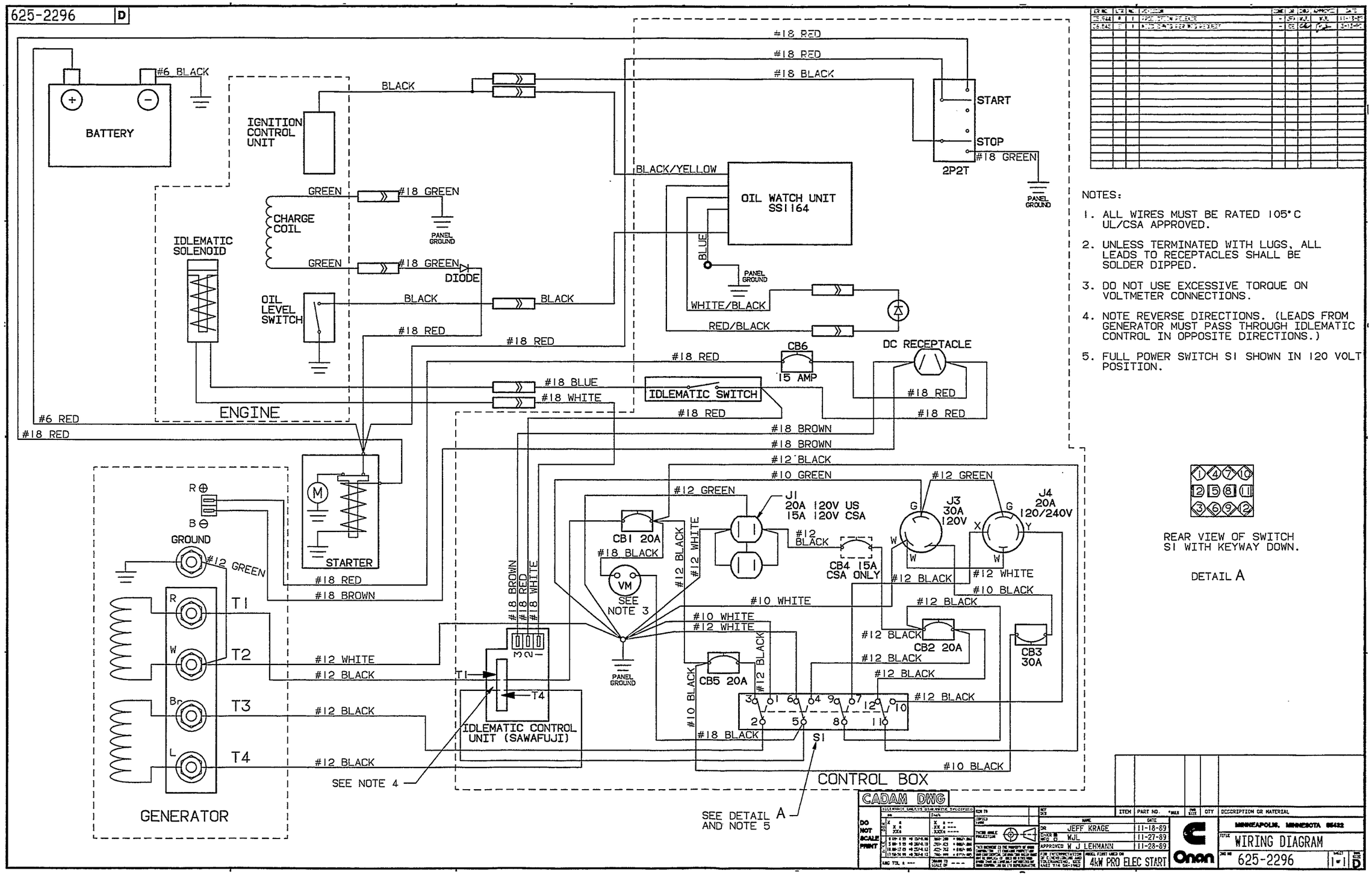
4kW PRO/CSA

Onan
MINNEAPOLIS, MINNESOTA 55432

TITLE WIRING DIAGRAM

DWG NO 625-2375 SHEET 1 of 1 REV LTR D

625-2296 D



NOTES:

1. ALL WIRES MUST BE RATED 105°C UL/CSA APPROVED.
2. UNLESS TERMINATED WITH LUGS, ALL LEADS TO RECEPTACLES SHALL BE SOLDER DIPPED.
3. DO NOT USE EXCESSIVE TORQUE ON VOLTMETER CONNECTIONS.
4. NOTE REVERSE DIRECTIONS. (LEADS FROM GENERATOR MUST PASS THROUGH IDLEMATIC CONTROL IN OPPOSITE DIRECTIONS.)
5. FULL POWER SWITCH S1 SHOWN IN 120 VOLT POSITION.

REAR VIEW OF SWITCH S1 WITH KEYWAY DOWN.

DETAIL A

CADAM DWG

DO NOT SCALE PRINT

ITEM	PART NO.	CVR WIRE	QTY	DESCRIPTION OR MATERIAL

	NAME	DATE
DR	JEFF KRAGE	11-18-89
CHECK	WJL	11-27-89
APPROVED	W J LEHMANN	11-28-89

MINNEAPOLIS, MINNESOTA 55432

TITLE: WIRING DIAGRAM

DWG NO 625-2296 SHEET 1 OF 1 REV D

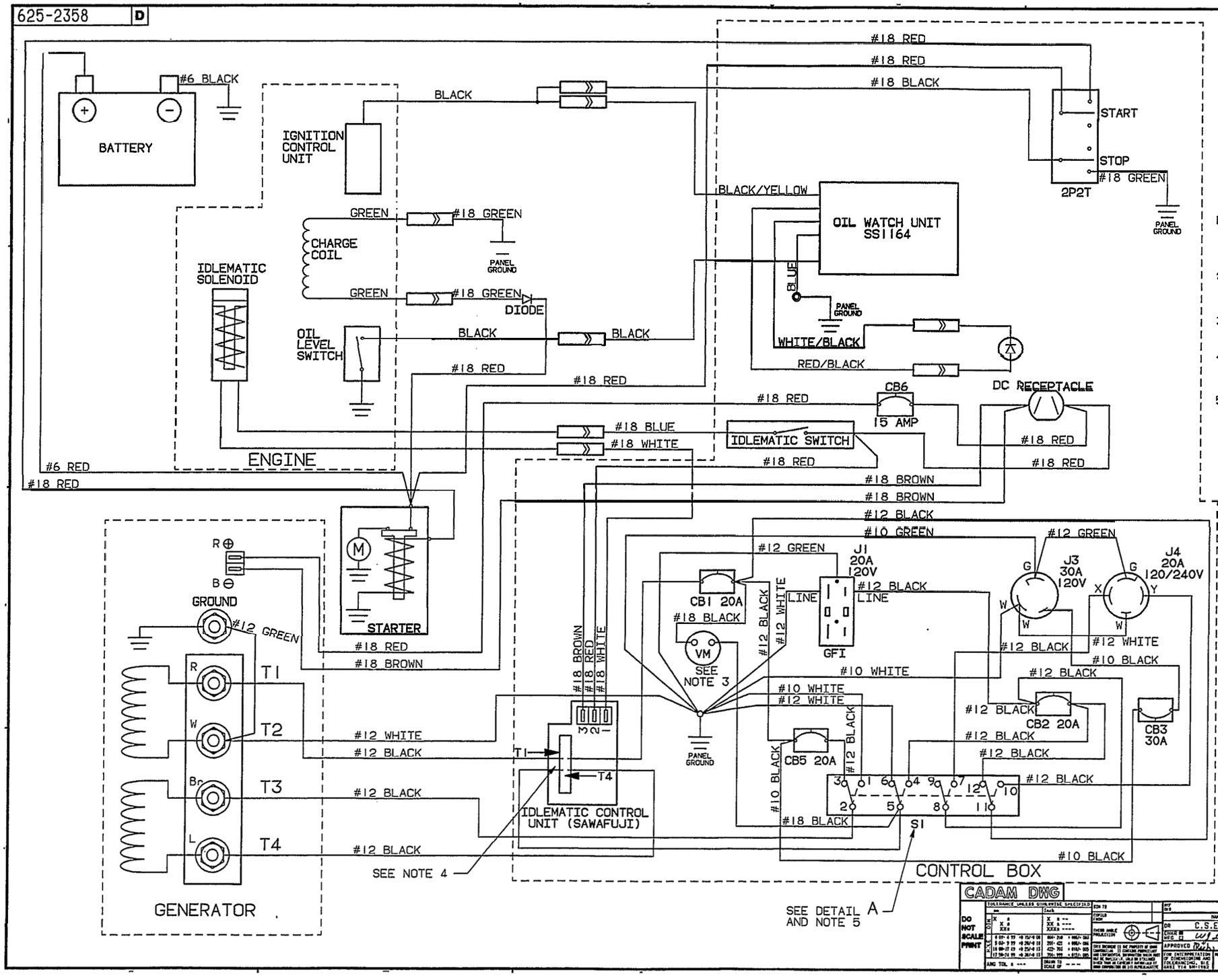
FOR INTERPRETATION OF DIMENSIONS AND TOLERANCES REFER TO MIL-STD-100

MODEL FIRST USED ON 4KW PRO ELEC START

Onan

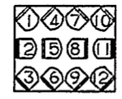
625-2358 D

EP NO	LTR	NO	REVISION	ZONE	DR	CHKR	APPROVED	DATE	
36,786	A	1	PRODUCTION RELEASE	-	CSE	WL	RJ	04-24-	D



NOTES:

1. ALL WIRES MUST BE RATED 105°C UL/CSA APPROVED.
2. UNLESS TERMINATED WITH LUGS, ALL LEADS TO RECEPTACLES SHALL BE SOLDER DIPPED.
3. DO NOT USE EXCESSIVE TORQUE ON VOLTMETER CONNECTIONS.
4. NOTE REVERSE DIRECTIONS. (LEADS FROM GENERATOR MUST PASS THROUGH IDLEMATIC CONTROL IN OPPOSITE DIRECTIONS.)
5. FULL POWER SWITCH S SHOWN IN 120 VOL POSITION.



REAR VIEW OF SWITCH SI WITH KEYWAY DOWN.

DETAIL A

CADAM DWG

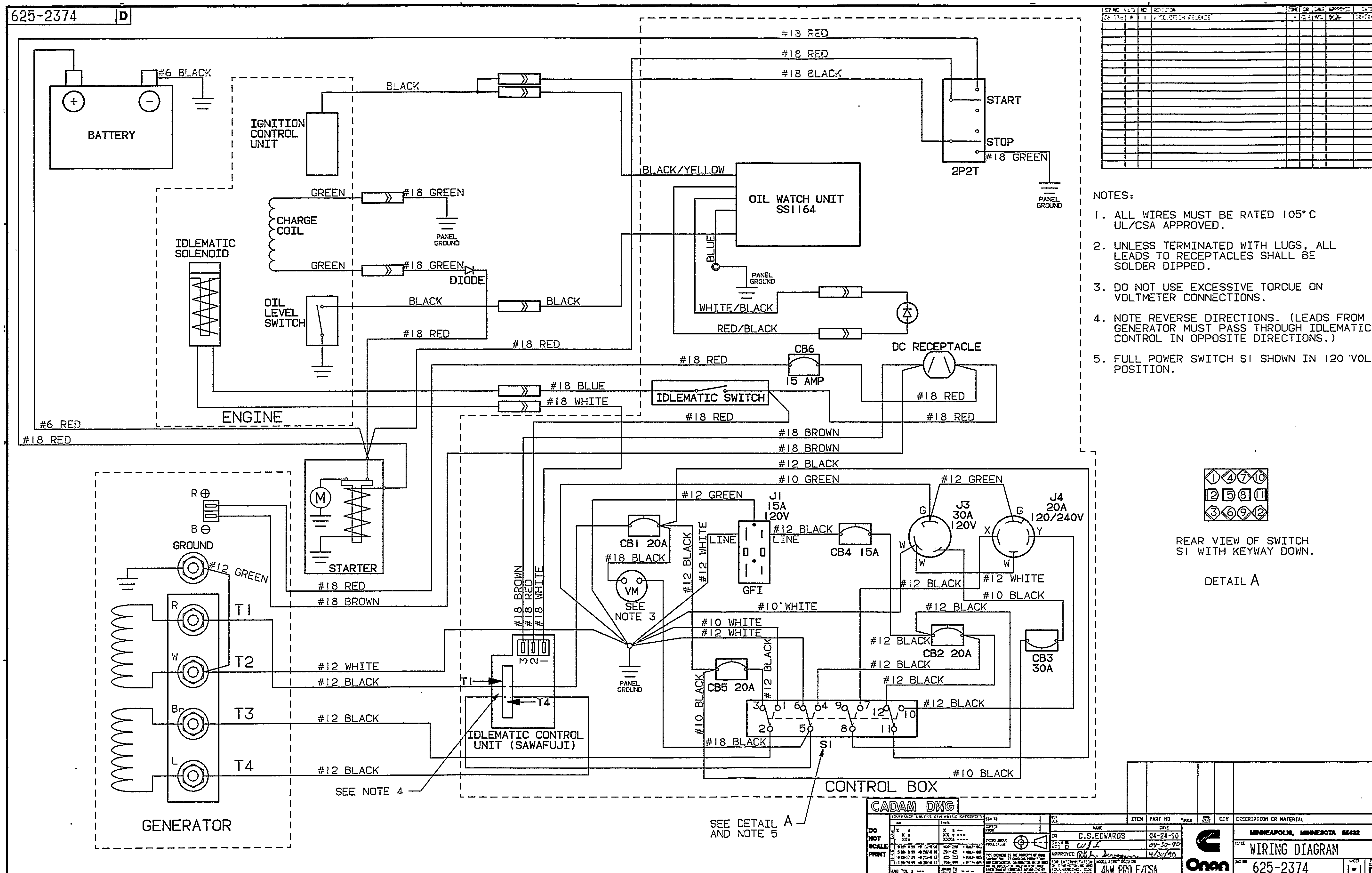
DO NOT SCALE PRINT

ITEM	PART NO	QTY	DESCRIPTION OR MATERIAL
DR	C.S.EDWARDS	04-24-90	MINNEAPOLIS, MINNESOTA 55432
ENGR	WL	04-30-90	
APPROVED		4/30/90	
MODEL FIRST USED ON	4kW PRO E/US		

Onan

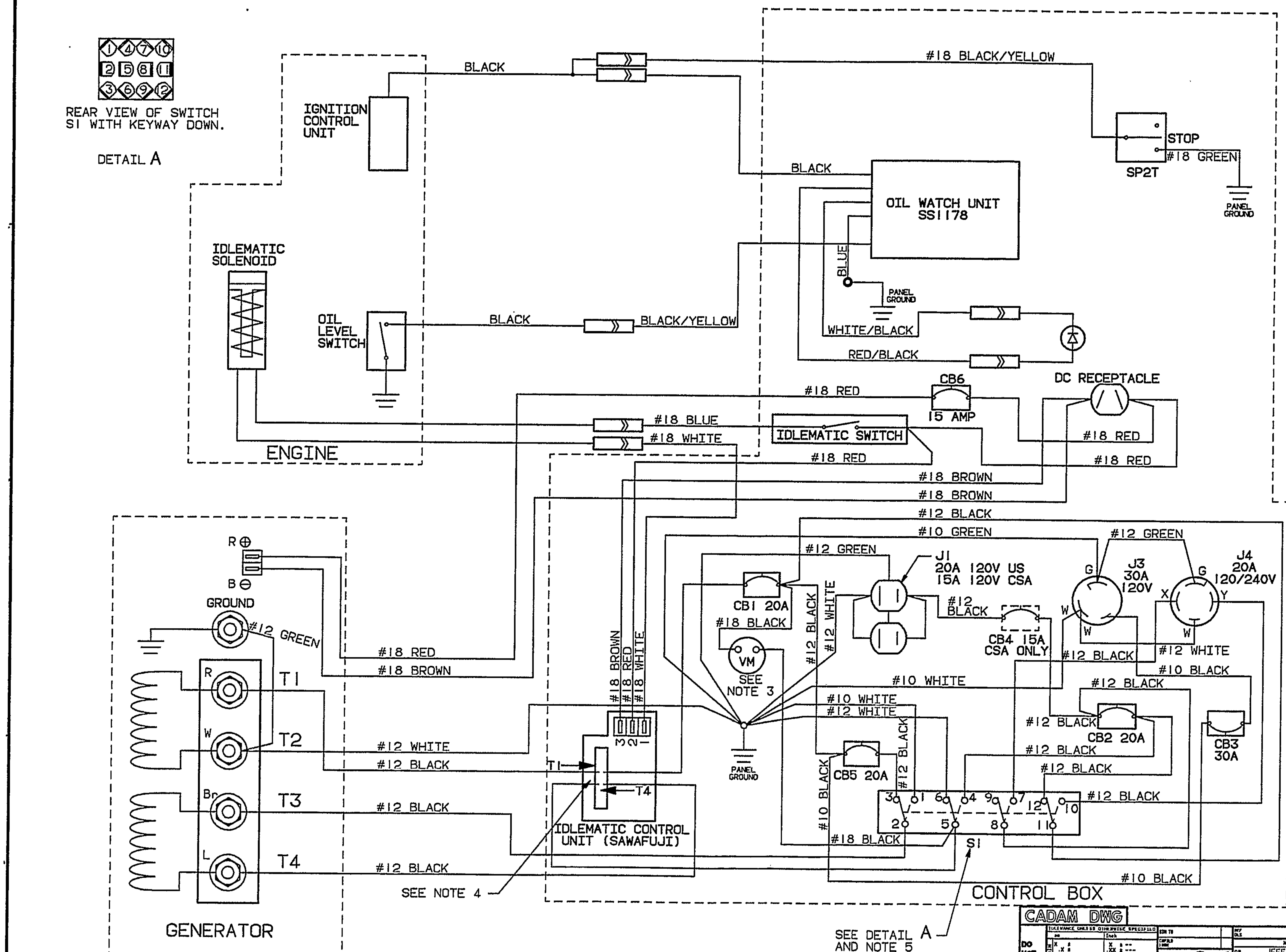
TITLE WIRING DIAGRAM

DWG NO 625-2358 SHEET 1 of 1 REV D


625-2374 D
BATTERY
#6 BLACK
IGNITION CONTROL UNIT
BLACK
CHARGE COIL
GREEN
#18 GREEN
PANEL GROUND
DIODE
IDLEMATIC SOLENOID
OIL LEVEL SWITCH
ENGINE
#6 RED
#18 RED
#18 BLUE
#18 WHITE
START
STOP
#18 GREEN
2P2T
#18 BLACK
BLACK/YELLOW
OIL WATCH UNIT SS1164
BLUE
WHITE/BLACK
RED/BLACK
CB6 15 AMP
DC RECEPTACLE
IDLEMATIC SWITCH
#18 BROWN
#12 BLACK
#10 GREEN
#12 GREEN
STARTER
GROUND
GENERATOR
T1
T2
T3
T4
#12 WHITE
CB1 20A
#18 BLACK
VM
SEE NOTE 3
J1 15A 120V
LINE
GFI
CB4 15A
J3 30A 120V
J4 20A 120/240V
#10 WHITE
#10 BLACK
CB2 20A
CB3 30A
CB5 20A
S1
IDLEMATIC CONTROL UNIT (SAWAFUJI)
SEE NOTE 4
CONTROL BOX
SEE DETAIL A AND NOTE 5
NOTES:
1. ALL WIRES MUST BE RATED 105°C UL/CSA APPROVED.
2. UNLESS TERMINATED WITH LUGS, ALL LEADS TO RECEPTACLES SHALL BE SOLDER DIPPED.
3. DO NOT USE EXCESSIVE TORQUE ON VOLTMETER CONNECTIONS.
4. NOTE REVERSE DIRECTIONS. (LEADS FROM GENERATOR MUST PASS THROUGH IDLEMATIC CONTROL IN OPPOSITE DIRECTIONS.)
5. FULL POWER SWITCH S1 SHOWN IN 120 VOLT POSITION.
REAR VIEW OF SWITCH S1 WITH KEYWAY DOWN.
DETAIL A
CADAM DWG
C.S.EDWARDS
04-24-90
MINNEAPOLIS, MINNESOTA 55432
WIRING DIAGRAM
4kW PRO E/CSA
Onan
625-2374

625-2285 D

ER NO.	LTR	NO.	REVISION	ZONE	DR	CHKR	APPROVED	DATE
35,850	A	1	PRODUCTION RELEASE	-	JFK	DP	WJL	11-7-89
36,645	B	1	MISC CHNGS PER MFG REQUEST	-	CE	CE	RJ	3-12-90



NOTES:

1. ALL WIRES MUST BE RATED 105°C UL/CSA APPROVED.
2. UNLESS TERMINATED WITH LUGS, ALL LEADS TO RECEPTACLES SHALL BE SOLDER DIPPED.
3. DO NOT USE EXCESSIVE TORQUE ON VOLTMETER CONNECTIONS.
4. NOTE REVERSE DIRECTIONS. (LEADS FROM GENERATOR MUST PASS THROUGH IDLEMATIC CONTROL IN OPPOSITE DIRECTIONS.)
5. FULL POWER SWITCH S1 SHOWN IN 120 VOLT POSITION.

CADAM DWG

DO NOT SCALE PRINT

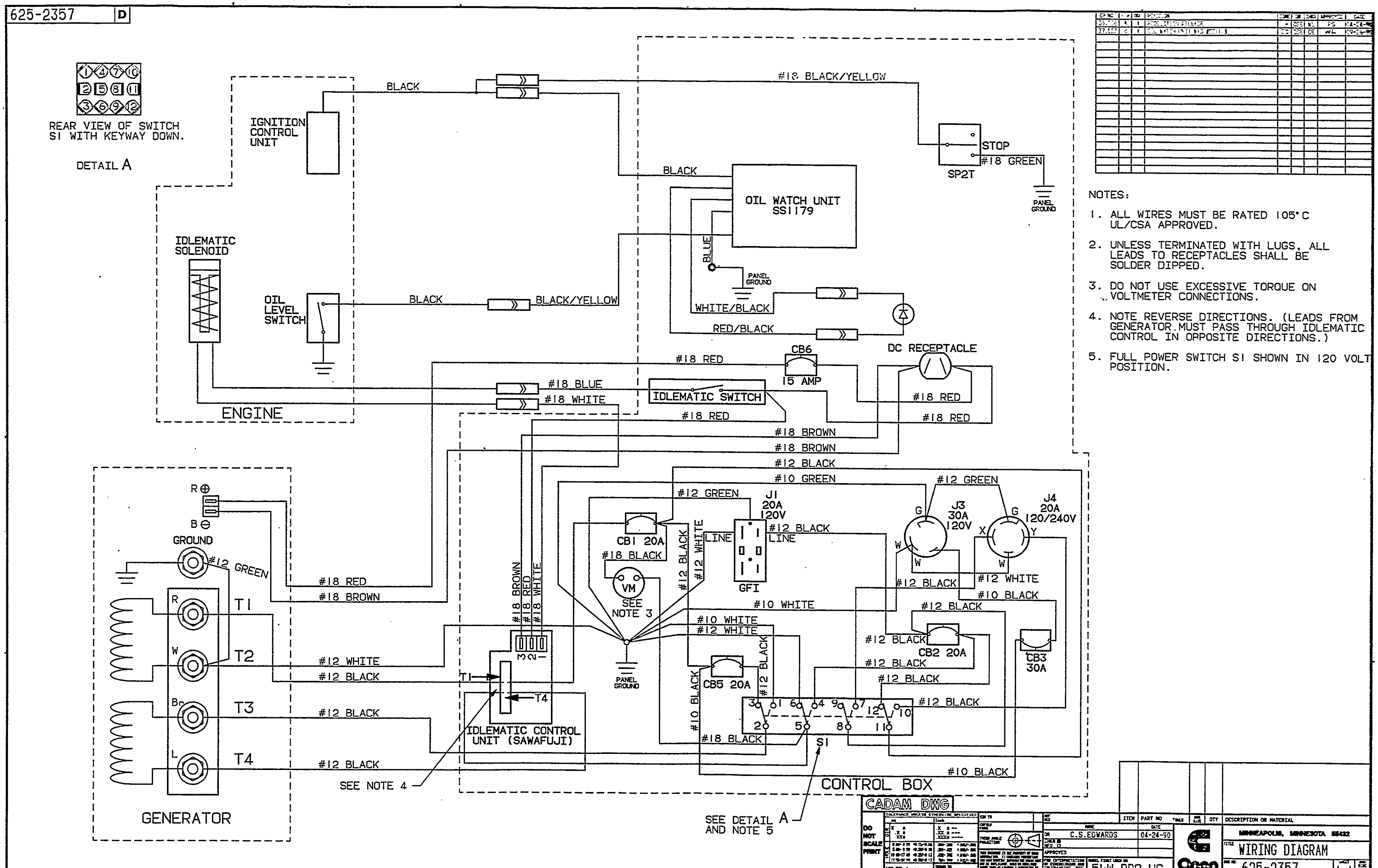
NAME	DATE
DR JEFF KRAGE	10-19-89
CHKR DAVE PETERMEIER	11-7-89
APPROVED W J LEHMANN	11-7-89

MODEL FIRST USED ON: 5kW PRO

Onan — MINNEAPOLIS, MINNESOTA 55432

TITLE: WIRING DIAGRAM

DWG NO. 625-2285 SHEET 1 of 1 DWG SIZE D



NOTES:

1. ALL WIRES MUST BE RATED 105°C UL/CSA APPROVED.
2. UNLESS TERMINATED WITH LUGS, ALL LEADS TO RECEPTACLES SHALL BE SOLDER DIPPED.
3. DO NOT USE EXCESSIVE TORQUE ON VOLTMETER CONNECTIONS.
4. NOTE REVERSE DIRECTIONS. (LEADS FROM GENERATOR MUST PASS THROUGH IDLEMATIC CONTROL IN OPPOSITE DIRECTIONS.)
5. FULL POWER SWITCH S1 SHOWN IN 120 VOLT POSITION.

CADAM DWG

DR C.S.EDWARDS 04-24-90

MINNEAPOLIS, MINNESOTA 55432

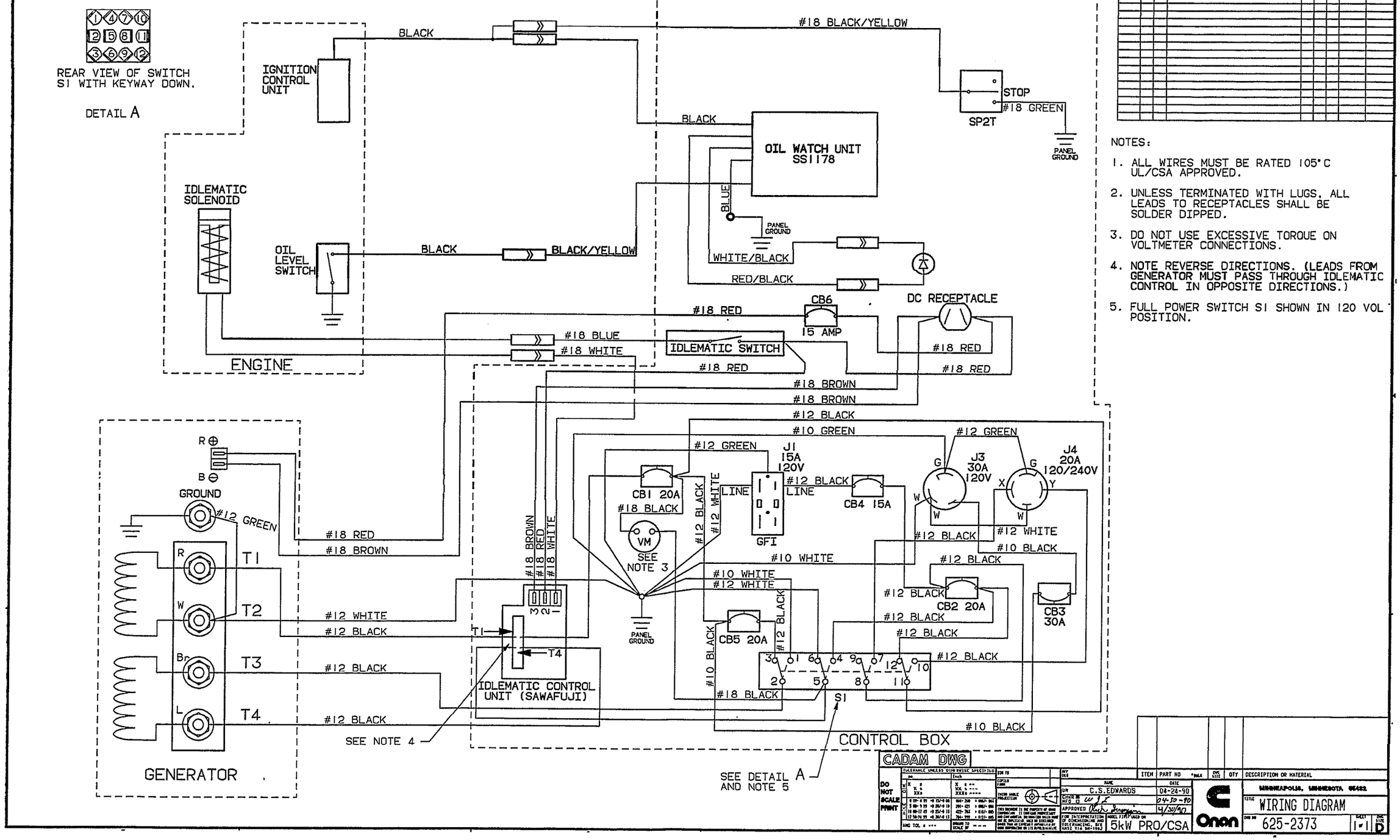
WIRING DIAGRAM

5kW PRO US

Onan 625-2357 D

625-2373 D

ER NO	LTR	NO	REVISION	ZONE	DR	CHKR	APPROVED	DATE
36,786	A	1	PRODUCTION RELEASE	-	CSE	WL		04-24-90



NOTES:

1. ALL WIRES MUST BE RATED 105°C UL/CSA APPROVED.
2. UNLESS TERMINATED WITH LUGS, ALL LEADS TO RECEPTACLES SHALL BE SOLDER DIPPED.
3. DO NOT USE EXCESSIVE TORQUE ON VOLTMETER CONNECTIONS.
4. NOTE REVERSE DIRECTIONS. (LEADS FROM GENERATOR MUST PASS THROUGH IDLEMATIC CONTROL IN OPPOSITE DIRECTIONS.)
5. FULL POWER SWITCH S1 SHOWN IN 120 VOL POSITION.

CADAM DWG

DO NOT SCALE PRINT

ITEM	PART NO	MAT	SYS	QTY	DESCRIPTION OR MATERIAL

	NAME	DATE
DR	C.S.EDWARDS	04-24-90
CHKR	W.L.	04-30-90
APPROVED		4/30/90

MODEL FIRST USED ON: 5kW PRO/CSA

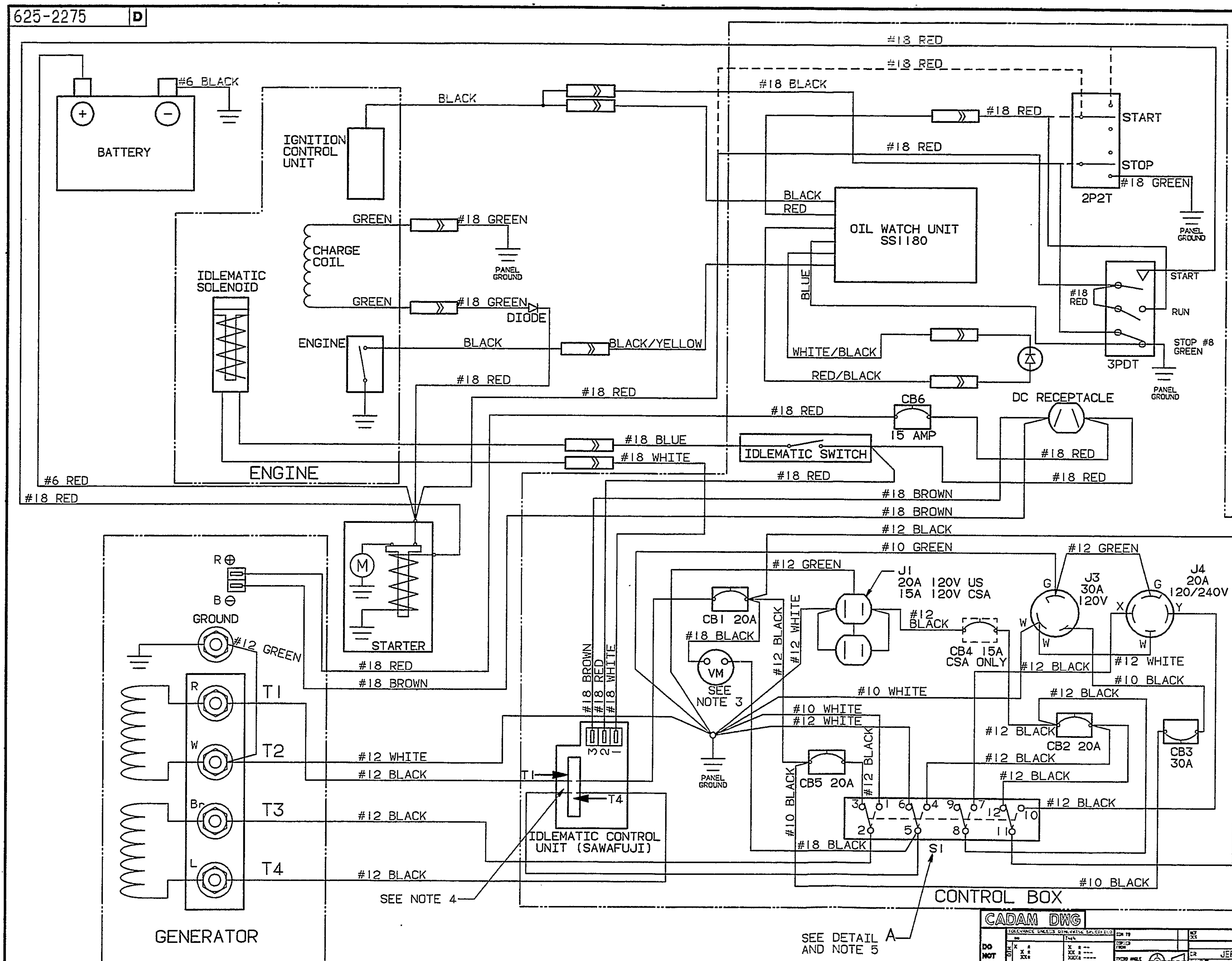
Onan

MINNEAPOLIS, MINNESOTA, 55432

TITLE: WIRING DIAGRAM

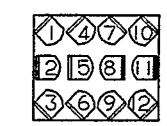
DWG NO: 625-2373 SHEET 1 of 1 REV D

625-2275 D



NOTES:

1. ALL WIRES MUST BE RATED 105° C UL/CSA APPROVED.
2. UNLESS TERMINATED WITH LUGS, ALL LEADS TO RECEPTACLES SHALL BE SOLDER DIPPED.
3. DO NOT USE EXCESSIVE TORQUE ON VOLTMETER CONNECTIONS.
4. NOTE REVERSE DIRECTIONS. (LEADS FROM GENERATOR MUST PASS THROUGH IDLEMATIC CONTROL IN OPPOSITE DIRECTIONS.)
5. FULL POWER SWITCH S1 SHOWN IN 120 VOLT POSITION.
6. DASHED LINES INDICATE CONNECTIONS WHEN USED.



REAR VIEW OF SWITCH S1 WITH KEYWAY DOWN.

DETAIL A

CADAM DWG

DO NOT SCALE PRINT

DR	JEFF KRAGE	11-19-89
CHAR ENG	DAVE PETERMEIER	11-7-89
APPROVED	W J LEHMANN	11-7-89

5kW PRO ELEC START

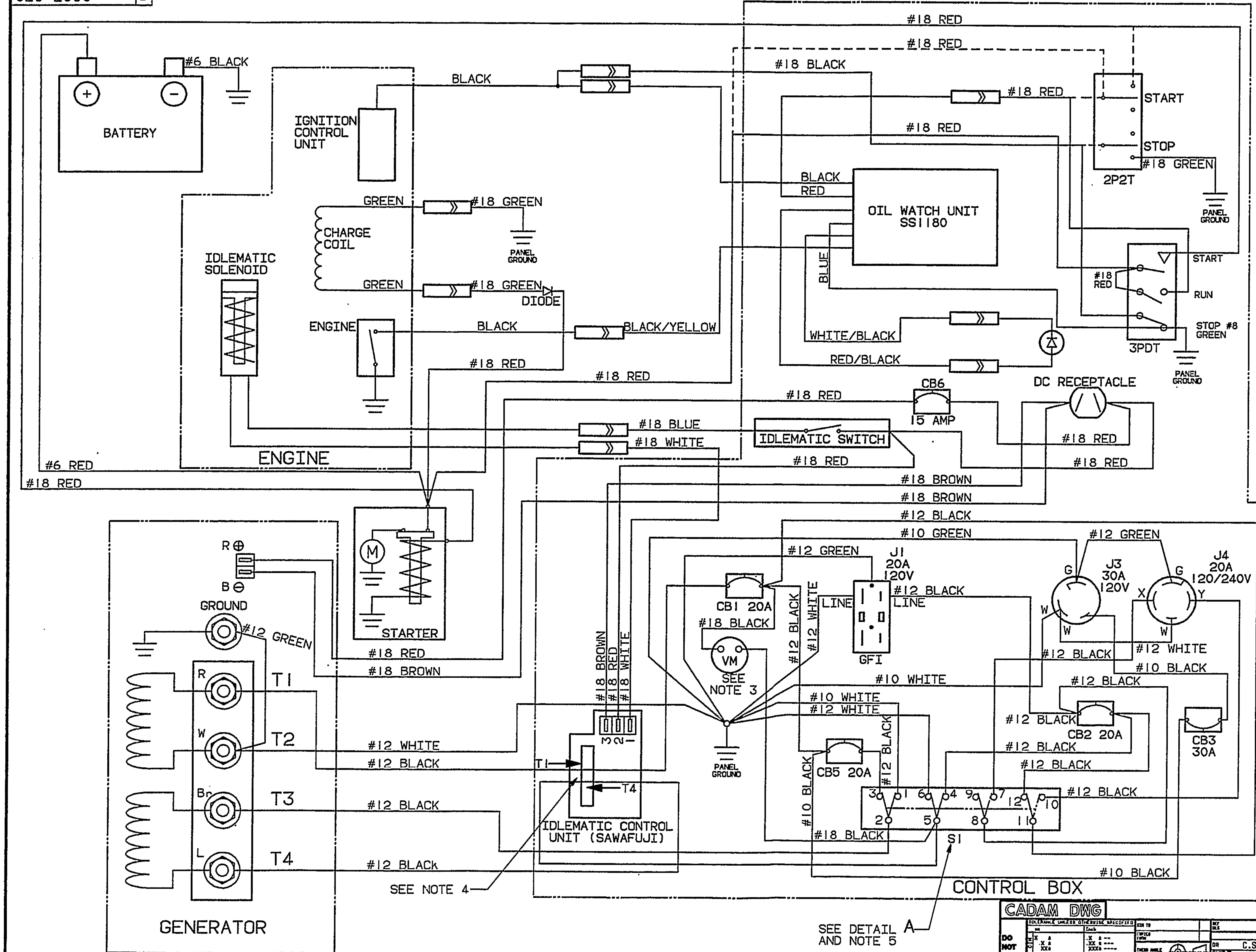
Onan — MINNEAPOLIS, MINNESOTA 55432

TITLE: WIRING DIAGRAM

DWG NO 625-2275 SHEET 1 of 1 D

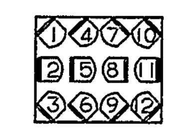
625-2356 D

ER NO.	LTR	NO.	REVISION	ZONE	DR	CHKR	APPROVED	DATE
36,786	A	1	PRODUCTION RELEASE	-	CSE	WL	RS	04-24-90
38898	B	1	ADDED 3PDT SWITCH AND NOTE 6	-	DM	[illegible]	WJH	07-07-93



NOTES:

1. ALL WIRES MUST BE RATED 105°C UL/CSA APPROVED.
2. UNLESS TERMINATED WITH LUGS, ALL LEADS TO RECEPTACLES SHALL BE SOLDER DIPPED.
3. DO NOT USE EXCESSIVE TORQUE ON VOLTMETER CONNECTIONS.
4. NOTE REVERSE DIRECTIONS. (LEADS FROM GENERATOR MUST PASS THROUGH IDLEMATIC CONTROL IN OPPOSITE DIRECTIONS.)
5. FULL POWER SWITCH S1 SHOWN IN 120 VOLT POSITION.
6. DASHED LINES INDICATE CONNECTIONS WHEN USED.



REAR VIEW OF SWITCH S1 WITH KEYWAY DOWN.

DETAIL A

CADAM DWG

ITEM	PART NO.	*BULK	DWG SIZE	QTY	DESCRIPTION OR MATERIAL

DO NOT SCALE PRINT

	NAME	DATE
DR	C.S.EDWARDS	04-24-90
CHKR / MFG	W J LEHMORN	04-30-90
APPROVED	RICH SCROGGINS	04-30-90

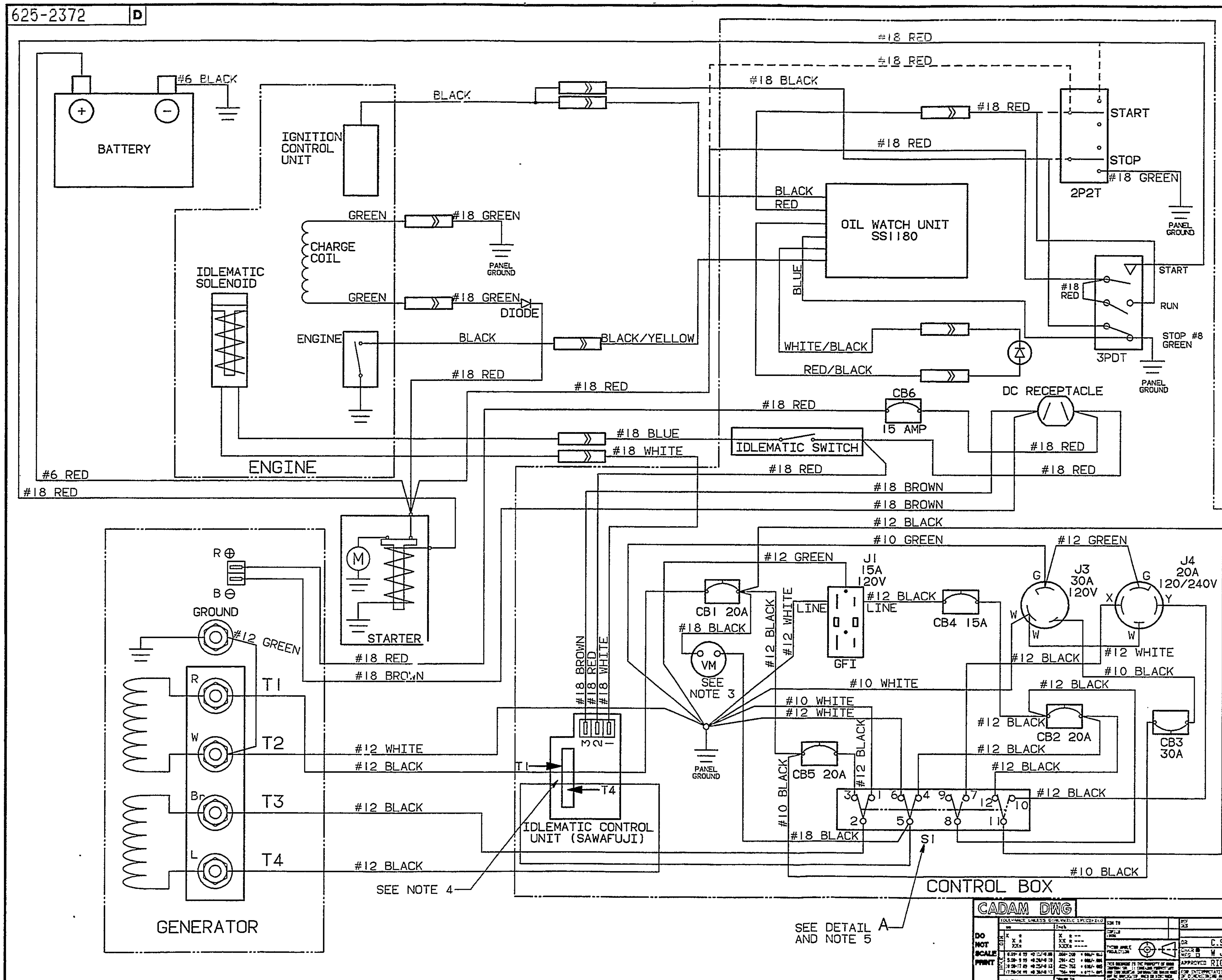
MODEL FIRST USED ON: 5kW PRO E/US

Onan — MINNEAPOLIS, MINNESOTA 55432

TITLE: WIRING DIAGRAM

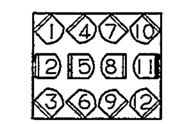
DWG NO. 625-2356 SHEET 1 of 1 DWG SIZE D

625-2372 D



NOTES:

1. ALL WIRES MUST BE RATED 105°C UL/CSA APPROVED.
2. UNLESS TERMINATED WITH LUGS, ALL LEADS TO RECEPTACLES SHALL BE SOLDER DIPPED.
3. DO NOT USE EXCESSIVE TORQUE ON VOLTMETER CONNECTIONS.
4. NOTE REVERSE DIRECTIONS. (LEADS FROM GENERATOR MUST PASS THROUGH IDLEMATIC CONTROL IN OPPOSITE DIRECTIONS.)
5. FULL POWER SWITCH S1 SHOWN IN 120 VOLT POSITION.
6. DASHED LINES INDICATE CONNECTIONS WHEN USED.



REAR VIEW OF SWITCH S1 WITH KEYWAY DOWN.

DETAIL A

CADAM DWG

DR	C.S.EDWARDS	04-24-90
	W J LEHMORN	04-30-90
APPROVED	RICH SCROGGINS	04-30-90

5kW PRO E/CSA

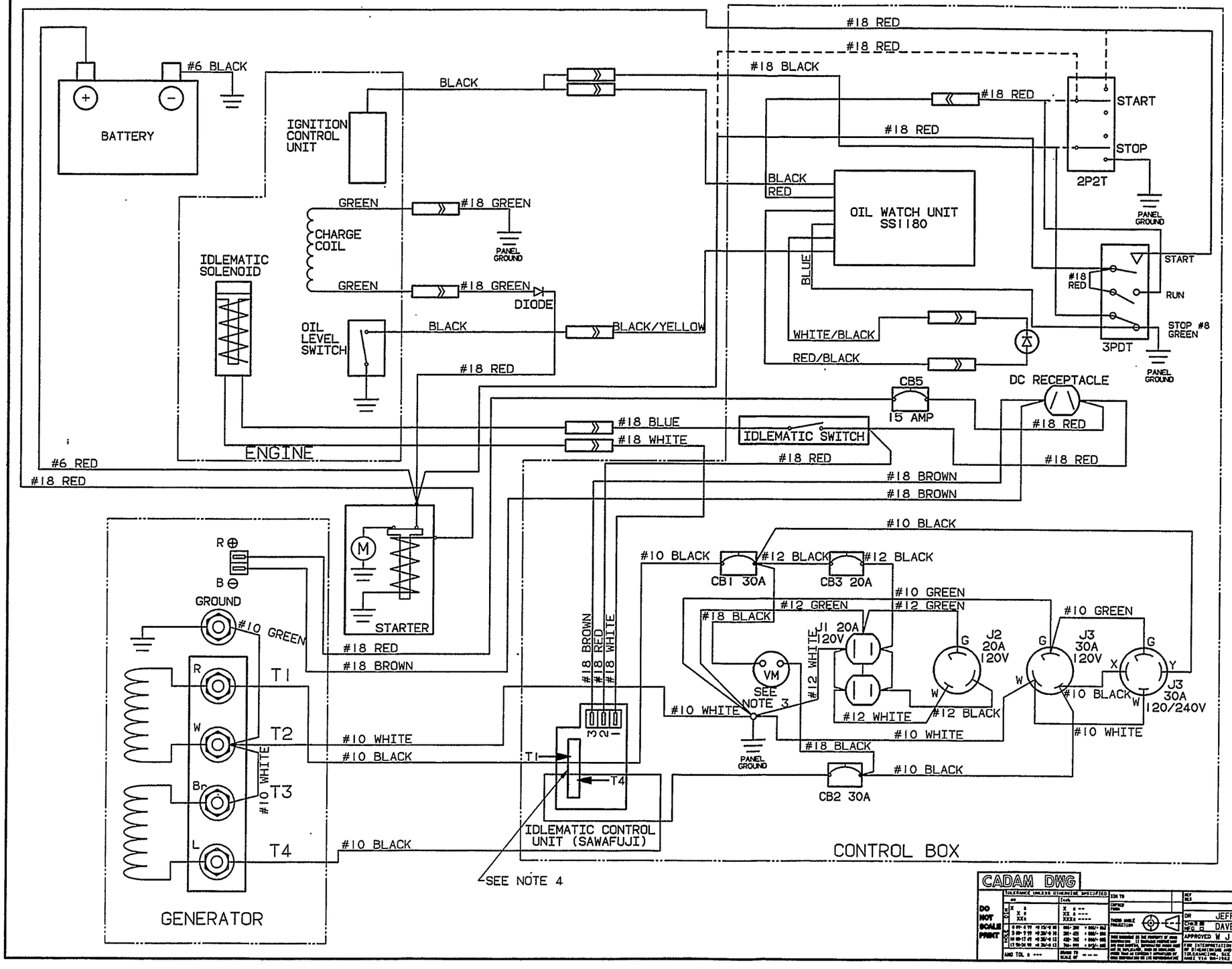
Onan — MINNEAPOLIS, MINNESOTA 55432

WIRING DIAGRAM

625-2372 D

625-2276 D

ER NO	LTR	NO	REVISION	ZONE	DR	CHKR	APPROVED	DATE
35,850	A	1	PRODUCTION RELEASE	-	JFK	DP	WJL	11-7-89
36,545	B	1	MISC CHNGS PER MFG REQUEST	-	CE	CE	RS	3-14-90
38898	C	1	ADDED 3PDT SWITCH AND NOTE 5	-	DN	[illegible]	[illegible]	07-07-93



NOTES:

1. ALL WIRES MUST BE RATED 105°C UL/CSA APPROVED.
2. UNLESS TERMINATED WITH LUGS, ALL LEADS TO RECEPTACLES SHALL BE SOLDER DIPPED.
3. DO NOT USE EXCESSIVE TORQUE ON VOLTMETER CONNECTIONS.
4. NOTE REVERSE DIRECTIONS. (LEADS FROM GENERATOR MUST PASS THROUGH IDLEMATIC CONTROL IN OPPOSITE DIRECTIONS.)
5. DASHED LINES INDICATE CONNECTIONS WHEN USED.

CADAM DWG

DO NOT SCALE PRINT

	NAME	DATE
DR	JEFF KRAGE	09-26-89
CHKR MFG	DAVE PETERMEIER	11-7-89
APPROVED	W J LEHMANN	11-7-89

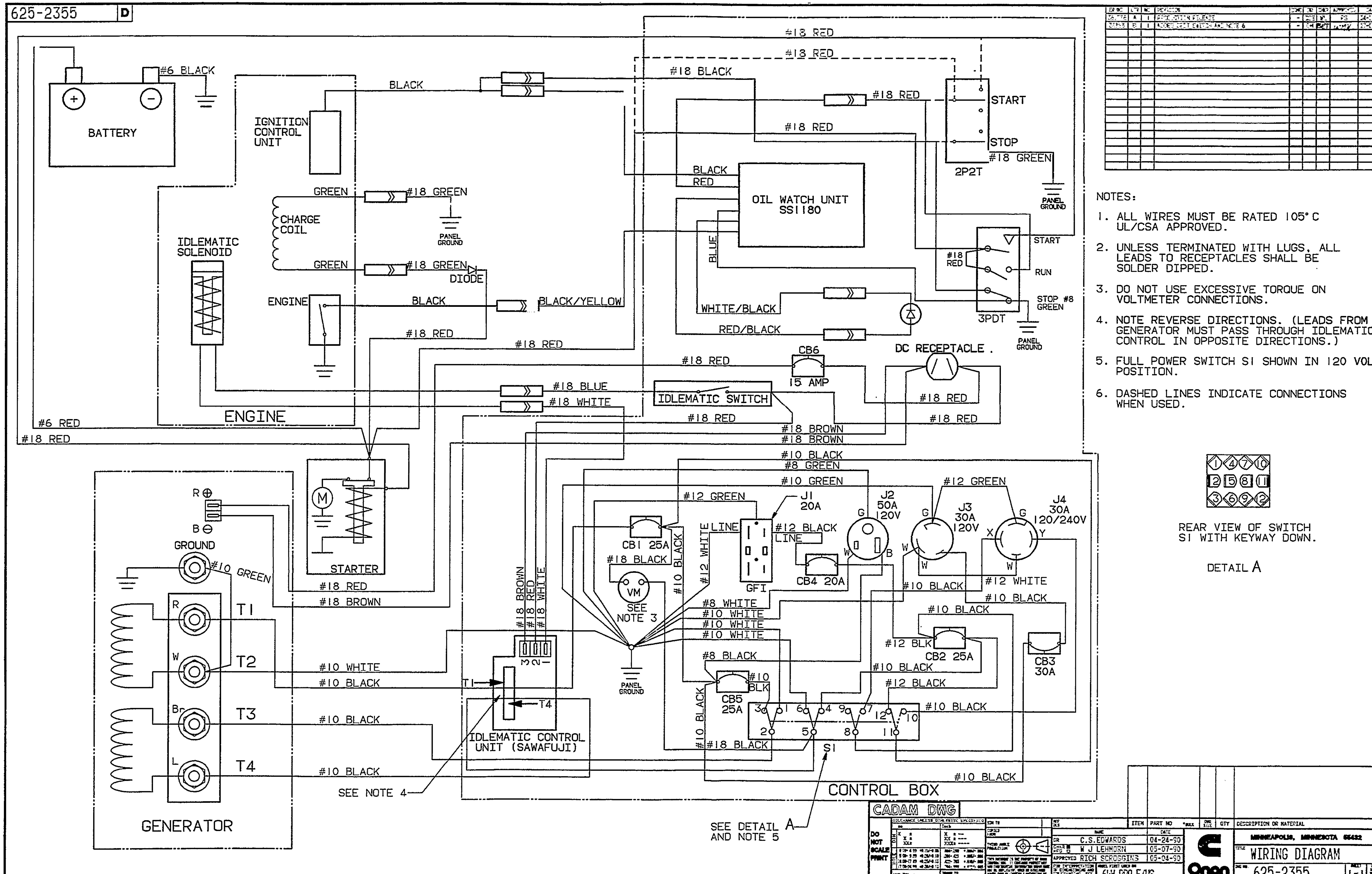
6kW PRO ELEC START

Onan

MINNEAPOLIS, MINNESOTA 55432

TITLE: WIRING DIAGRAM

DWG NO 625-2276 SHEET 1 of 1 REV D



NOTES:

1. ALL WIRES MUST BE RATED 105°C UL/CSA APPROVED.
2. UNLESS TERMINATED WITH LUGS, ALL LEADS TO RECEPTACLES SHALL BE SOLDER DIPPED.
3. DO NOT USE EXCESSIVE TORQUE ON VOLTMETER CONNECTIONS.
4. NOTE REVERSE DIRECTIONS. (LEADS FROM GENERATOR MUST PASS THROUGH IDLEMATIC CONTROL IN OPPOSITE DIRECTIONS.)
5. FULL POWER SWITCH S1 SHOWN IN 120 VOLT POSITION.
6. DASHED LINES INDICATE CONNECTIONS WHEN USED.

625-2371 D

ER NO	LTR	NO	REVISION	ZONE	DR	CHKR	APPROVED	DATE
36,786	A	1	PRODUCTION RELEASE	-	CSE	WL	RS	04-24-90
38898	B	1	ADDED 3PDT SWITCH AND NOTE 6		DM	BeT	WJH	07-07-93

NOTES:

1. ALL WIRES MUST BE RATED 105°C UL/CSA APPROVED.
2. UNLESS TERMINATED WITH LUGS, ALL LEADS TO RECEPTACLES SHALL BE SOLDER DIPPED.
3. DO NOT USE EXCESSIVE TORQUE ON VOLTMETER CONNECTIONS.
4. NOTE REVERSE DIRECTIONS. (LEADS FROM GENERATOR MUST PASS THROUGH IDLEMATIC CONTROL IN OPPOSITE DIRECTIONS.)
5. FULL POWER SWITCH S1 SHOWN IN 120 VOLT POSITION.
6. DASHED LINES INDICATE CONNECTIONS WHEN USED.

REAR VIEW OF SWITCH S1 WITH KEYWAY DOWN.

DETAIL A

BATTERY
#6 BLACK
BLACK
IGNITION CONTROL UNIT
GREEN
#18 GREEN
CHARGE COIL
PANEL GROUND
IDLEMATIC SOLENOID
DIODE
ENGINE
BLACK/YELLOW
#18 RED
#6 RED
ENGINE
STARTER
GROUND
#10 GREEN
R
W
Br
L
T1
T2
T3
T4
GENERATOR
#10 WHITE
#10 BLACK
SEE NOTE 4
#18 BLUE
#18 WHITE
#18 BROWN
IDLEMATIC CONTROL UNIT (SAWAFUJI)
SEE NOTE 3
VM
OIL WATCH UNIT SS1180
BLACK
RED
BLUE
WHITE/BLACK
RED/BLACK
START
STOP
2P2T
3PDT
RUN
STOP #8 GREEN
CB6
15 AMP
DC RECEPTACLE
IDLEMATIC SWITCH
CB1 25A
CB2 25A
CB3 30A
CB4 15A
CB5 25A
GFI
J1 15A 120V
J2 50A 120V
J3 30A 120V
J4 30A 120/240V
LINE
#12 BLACK
#12 WHITE
#12 GREEN
#10 BLACK
#8 GREEN
#10 GREEN
#8 WHITE
#10 WHITE
#8 BLACK
#12 BLK
#10 BLK
#18 BLACK
#10 BLACK
S1
SEE DETAIL A AND NOTE 5
CONTROL BOX

CADAM DWG

ITEM	PART NO	QTY	DESCRIPTION OR MATERIAL
			MINNEAPOLIS, MINNESOTA 55432

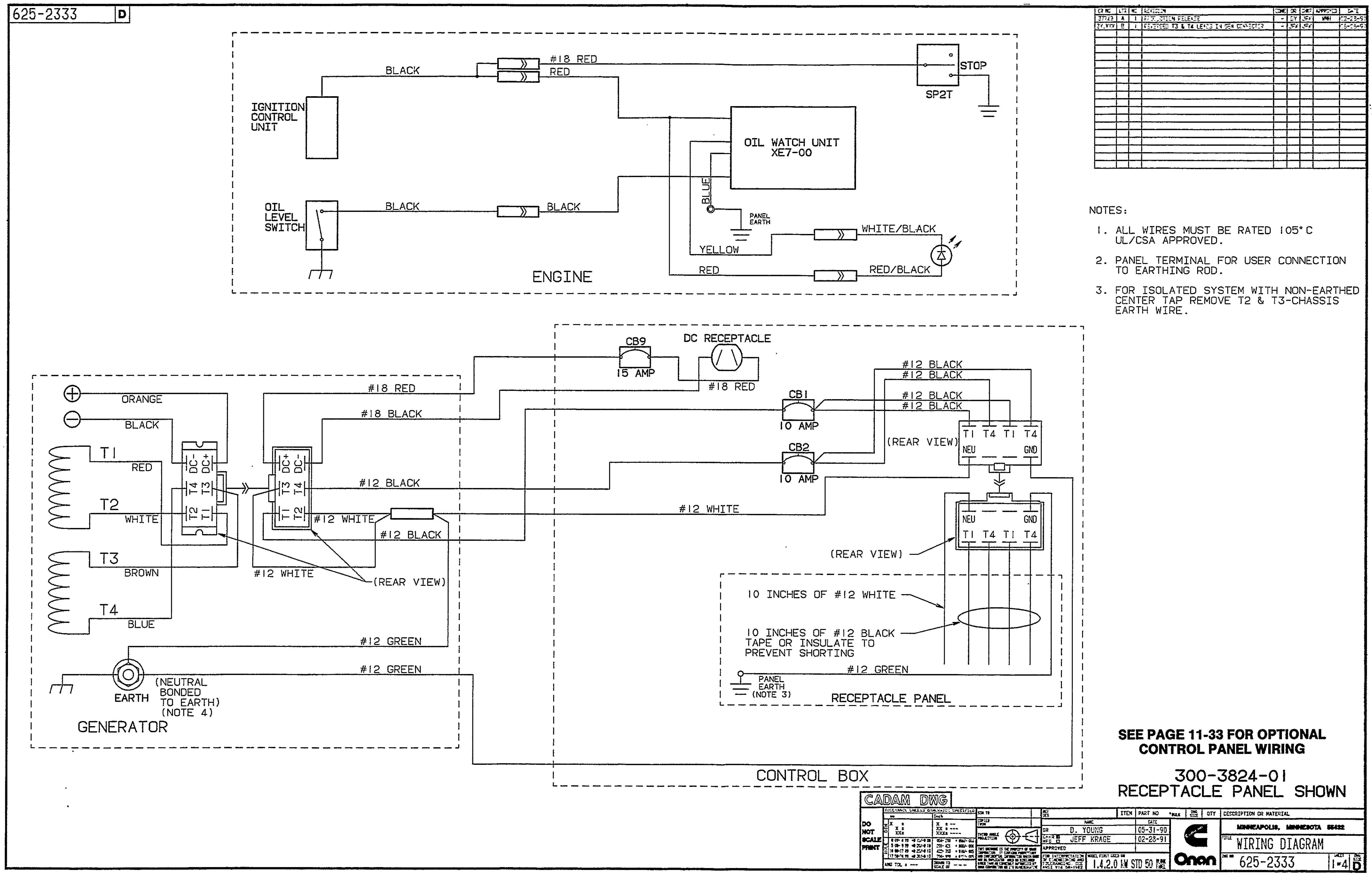
	NAME	DATE
DR	C.S.EDWARDS	04-24-90
CHK	W J LEHMORN	05-07-90
APPROVED	RICH SCROGGINS	05-04-90

6kW PRO E/CSA

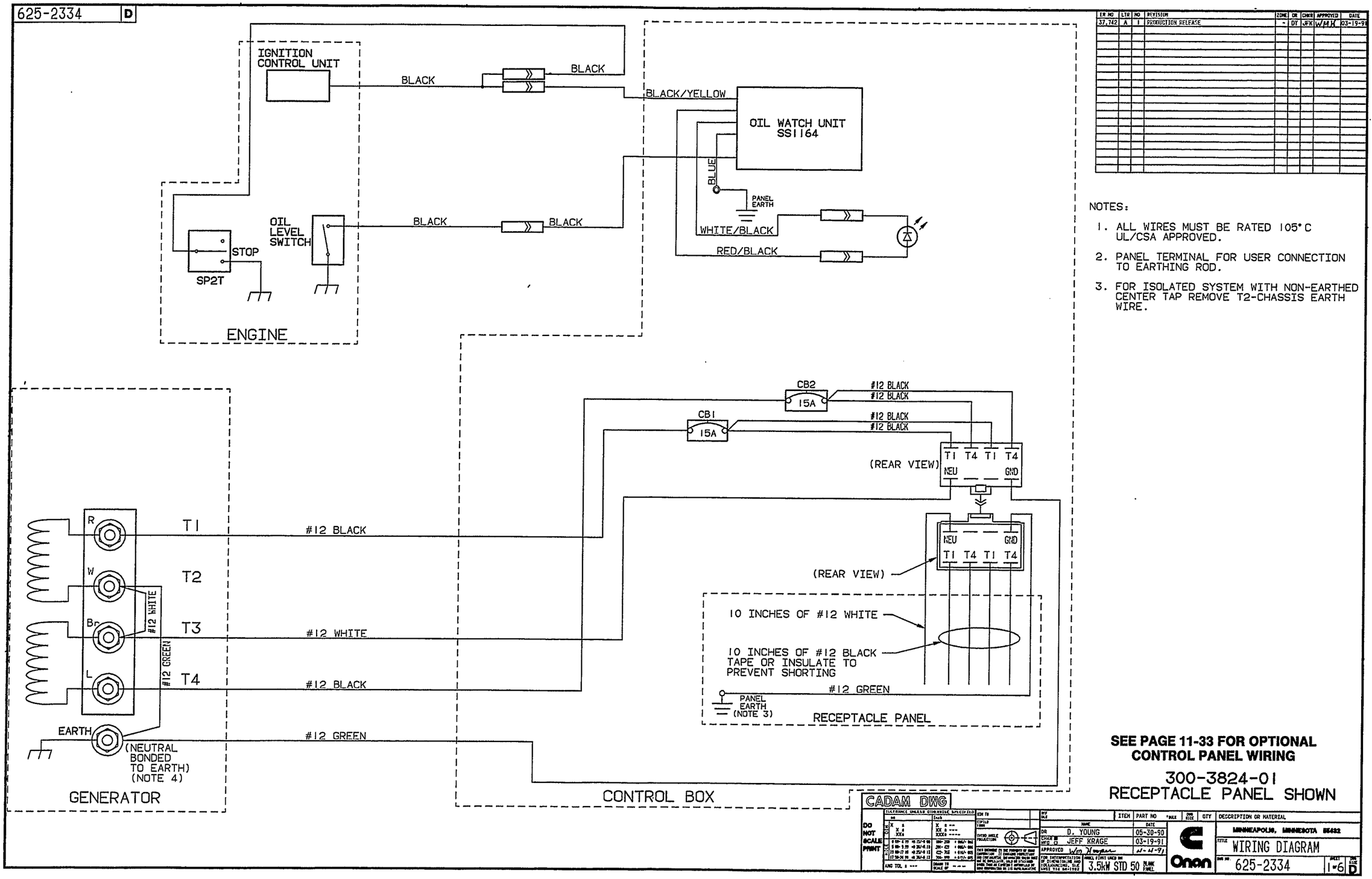
TITLE WIRING DIAGRAM

DWG NO. 625-2371 SHT 1 of 1 REV D

DO NOT SCALE PRINT


625-2333 D
IGNITION CONTROL UNIT
BLACK
#18 RED
RED
STOP
SP2T
OIL WATCH UNIT XE7-00
OIL LEVEL SWITCH
BLACK
BLACK
BLUE
PANEL EARTH
WHITE/BLACK
YELLOW
RED
RED/BLACK
ENGINE
NOTES:
1. ALL WIRES MUST BE RATED 105°C UL/CSA APPROVED.
2. PANEL TERMINAL FOR USER CONNECTION TO EARTHING ROD.
3. FOR ISOLATED SYSTEM WITH NON-EARTHED CENTER TAP REMOVE T2 & T3-CHASSIS EARTH WIRE.
CB9
15 AMP
DC RECEPTACLE
#18 RED
ORANGE
BLACK
#18 RED
#18 BLACK
T1
RED
T2
WHITE
T3
BROWN
T4
BLUE
DC- DC+
T4 T3
T2 T1
DC+ DC-
T3 T4
T1 T2
#12 BLACK
#12 WHITE
#12 BLACK
#12 WHITE
(REAR VIEW)
#12 GREEN
#12 GREEN
EARTH
(NEUTRAL BONDED TO EARTH) (NOTE 4)
GENERATOR
CB1
10 AMP
CB2
10 AMP
#12 BLACK
#12 BLACK
#12 BLACK
#12 BLACK
(REAR VIEW)
T1 T4 T1 T4
NEU GND
#12 WHITE
(REAR VIEW)
10 INCHES OF #12 WHITE
10 INCHES OF #12 BLACK TAPE OR INSULATE TO PREVENT SHORTING
#12 GREEN
PANEL EARTH (NOTE 3)
RECEPTACLE PANEL
CONTROL BOX
SEE PAGE 11-33 FOR OPTIONAL CONTROL PANEL WIRING
300-3824-01
RECEPTACLE PANEL SHOWN
CADAM DWG
DO NOT SCALE PRINT
D. YOUNG 05-31-90
JEFF KRAGE 02-28-91
MINNEAPOLIS, MINNESOTA 55432
WIRING DIAGRAM
Onan
625-2333
D

625-2334 D



ER NO	LTR	NO	REVISION	ZONE	DR	CHKR	APPROVED	DATE
37,742	A	1	PRODUCTION RELEASE	-	DY	JFK	WMK	03-19-91

NOTES:

1. ALL WIRES MUST BE RATED 105°C UL/CSA APPROVED.
2. PANEL TERMINAL FOR USER CONNECTION TO EARTHING ROD.
3. FOR ISOLATED SYSTEM WITH NON-EARTHED CENTER TAP REMOVE T2-CHASSIS EARTH WIRE.

SEE PAGE 11-33 FOR OPTIONAL CONTROL PANEL WIRING

300-3824-01
RECEPTACLE PANEL SHOWN

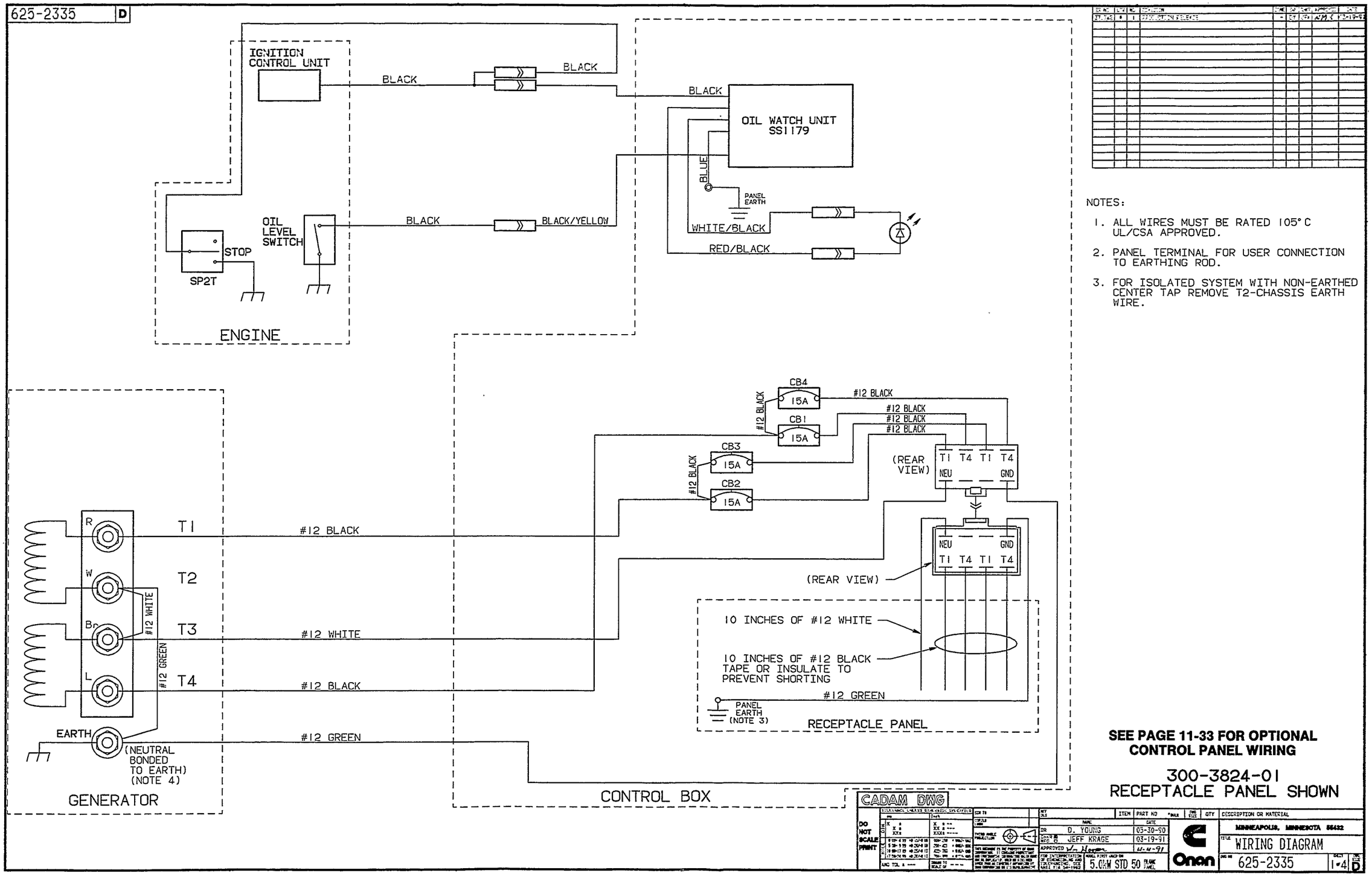
CADAM DWG

DO NOT SCALE PRINT

ITEM	PART NO	QTY	DESCRIPTION OR MATERIAL
DR	D. YOUNG	05-30-90	MINNEAPOLIS, MINNESOTA 55432
CHK'R MFR. G	JEFF KRAGE	03-19-91	
APPROVED	WMK	3-19-91	TITLE WIRING DIAGRAM
	3.5kW STD 50 BLANK PANEL		DWG NO 625-2334 SHEET 1-6 SIZE D

Onan

625-2335 D



NOTES:

1. ALL WIRES MUST BE RATED 105° C UL/CSA APPROVED.
2. PANEL TERMINAL FOR USER CONNECTION TO EARTHING ROD.
3. FOR ISOLATED SYSTEM WITH NON-EARTHED CENTER TAP REMOVE T2-CHASSIS EARTH WIRE.

SEE PAGE 11-33 FOR OPTIONAL CONTROL PANEL WIRING

300-3824-01
RECEPTACLE PANEL SHOWN

CADAM DWG

DO NOT SCALE PRINT

NAME	DATE
DR D. YOUNG	03-30-90
ENGR & MFG JEFF KRAGE	03-19-91
APPROVED	4-4-91

5.0KW STD 50 FRAME PANEL

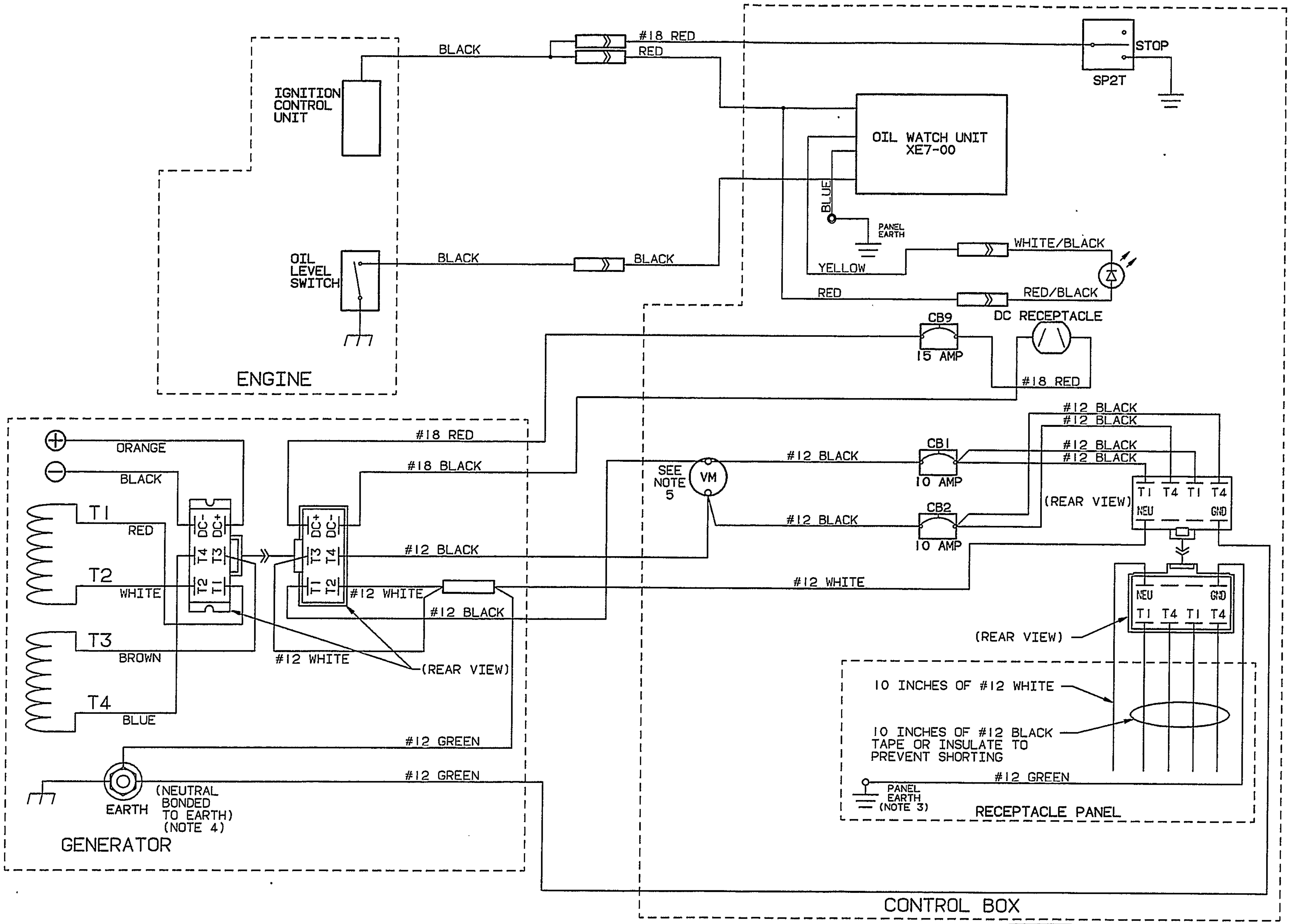
MINNEAPOLIS, MINNESOTA 55432

TITLE WIRING DIAGRAM

DWG NO 625-2335 SHEET 1-4 DWG REV D

625-2336 D

ER NO	LTR	NO	REVISION	ZONE	DR	CHKR	APPROVED	DATE
37742.	A	1	PRODUCTION RELEASE	-	DY	JFK	WH	02-28-91
3X,XXX	B	1	REVERSED T3 & T4 LEADS IN GEN CONNECTOR	-	JFK	JFK		06-06-91



NOTES:

1. ALL WIRES MUST BE RATED 105°C UL/CSA APPROVED.
2. PANEL TERMINAL FOR USER CONNECTION TO EARTHING ROD.
3. FOR ISOLATED SYSTEM WITH NON-EARTHED CENTER TAP REMOVE T2 & T3-CHASSIS EARTH WIRE.
4. DO NOT USE EXCESSIVE TORQUE ON VOLTMETER CONNECTIONS.

SEE PAGE 11-33 FOR OPTIONAL CONTROL PANEL WIRING

300-3824-01
RECEPTACLE PANEL SHOWN

CADAM DWG

DO NOT SCALE PRINT

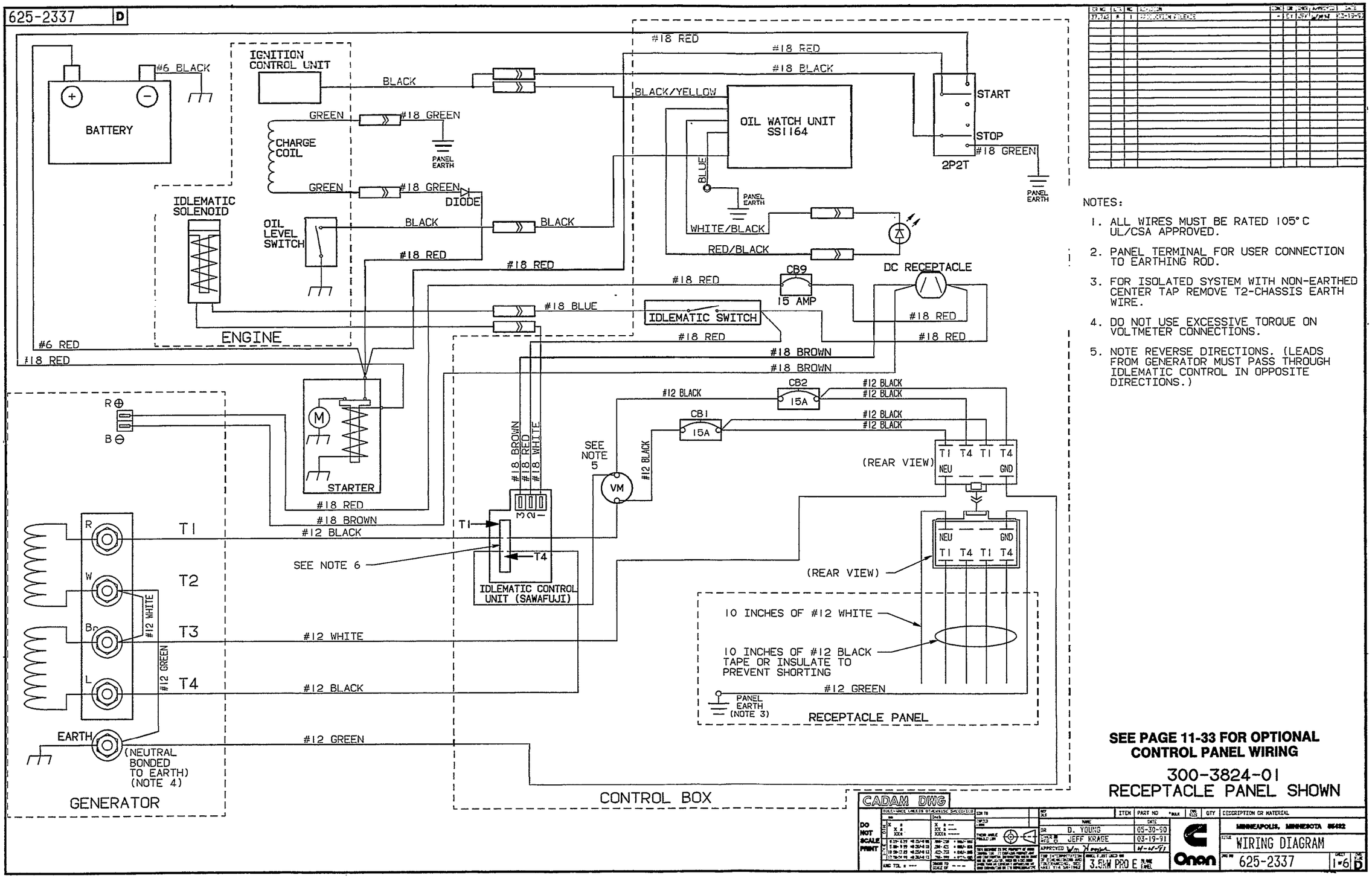
DR	D. YOUNG	05-31-90	
CHKR / MFG	JEFF KRAGE	02-28-91	
APPROVED			
MODEL FIRST USED ON	2.0 kW PRO BLANK PANEL		

Onan — MINNEAPOLIS, MINNESOTA

TITLE: WIRING DIAGRAM

DWG NO: 625-2336 — SHEET 1 of 4 — DWG SIZE D

625-2337 D



NOTES:

1. ALL WIRES MUST BE RATED 105°C UL/CSA APPROVED.
2. PANEL TERMINAL FOR USER CONNECTION TO EARTHING ROD.
3. FOR ISOLATED SYSTEM WITH NON-EARTHED CENTER TAP REMOVE T2-CHASSIS EARTH WIRE.
4. DO NOT USE EXCESSIVE TORQUE ON VOLTMETER CONNECTIONS.
5. NOTE REVERSE DIRECTIONS. (LEADS FROM GENERATOR MUST PASS THROUGH IDLEMATIC CONTROL IN OPPOSITE DIRECTIONS.)

SEE PAGE 11-33 FOR OPTIONAL CONTROL PANEL WIRING

300-3824-01
RECEPTACLE PANEL SHOWN

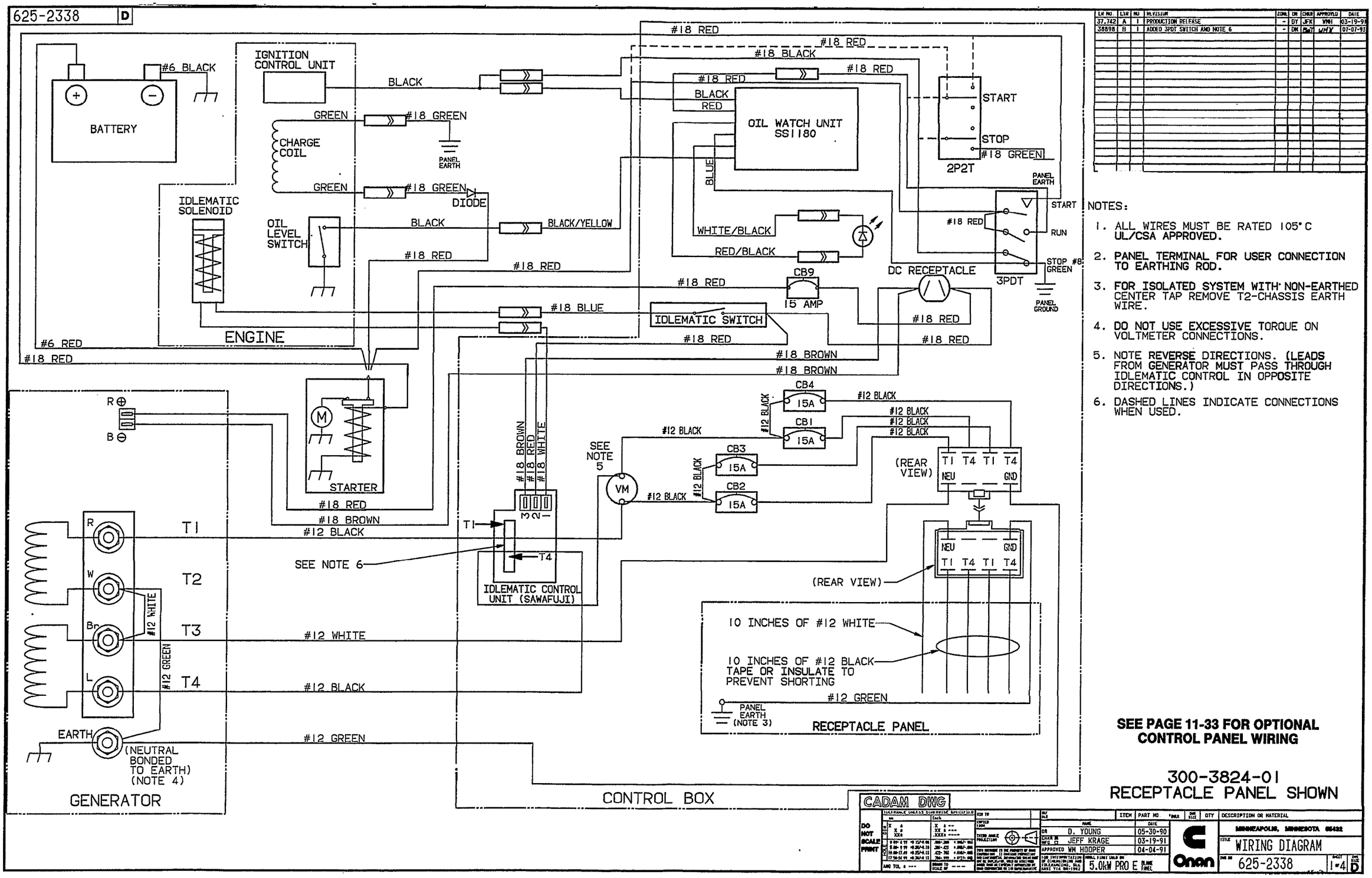
CADAM DWG

DO NOT SCALE PRINT

ITEM	PART NO	QTY	DESCRIPTION OR MATERIAL
DR	D. YOUNG	05-30-90	MINNEAPOLIS, MINNESOTA 55432
CHKD BY MFG. ENG.	JEFF KRAGE	03-19-91	WIRING DIAGRAM
APPROVED		4-4-91	625-2337 SHEET 1-6 REV D

3.5kW PRO E

625-2338 D



LW NO.	LTR	NO	REVISION	ZONE	DR	CHKR	APPROVED	DATE
37,742	A	1	PRODUCTION RELEASE	-	DY	JFK	WMH	03-19-91
38898	B	1	ADDED 3PDT SWITCH AND NOTE 6	-	DM	JFK	WMH	07-07-93

NOTES:

1. ALL WIRES MUST BE RATED 105°C UL/CSA APPROVED.
2. PANEL TERMINAL FOR USER CONNECTION TO EARTHING ROD.
3. FOR ISOLATED SYSTEM WITH NON-EARTHED CENTER TAP REMOVE T2-CHASSIS EARTH WIRE.
4. DO NOT USE EXCESSIVE TORQUE ON VOLTMETER CONNECTIONS.
5. NOTE REVERSE DIRECTIONS. (LEADS FROM GENERATOR MUST PASS THROUGH IDLEMATIC CONTROL IN OPPOSITE DIRECTIONS.)
6. DASHED LINES INDICATE CONNECTIONS WHEN USED.

SEE PAGE 11-33 FOR OPTIONAL CONTROL PANEL WIRING

300-3824-01
RECEPTACLE PANEL SHOWN

CADAM DWG

DO NOT SCALE PRINT

ITEM	PART NO.	QTY	DESCRIPTION OR MATERIAL
			MINNEAPOLIS, MINNESOTA 55432

	NAME	DATE
DR	D. YOUNG	05-30-90
CHKR	JEFF KRAGE	03-19-91
APPROVED	WM HOOPER	04-04-91

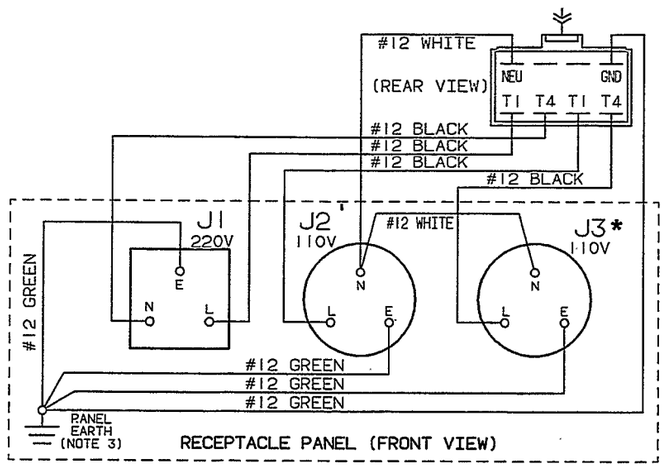
5.0kW PRO E

TITLE: WIRING DIAGRAM

DWG NO: 625-2338 SHT 1-4 REV D

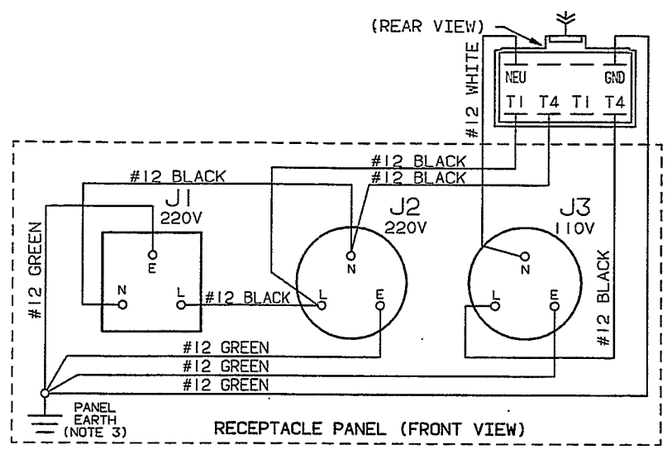
OPTIONAL CONTROL PANEL WIRING DIAGRAMS

OPTION - 11,12

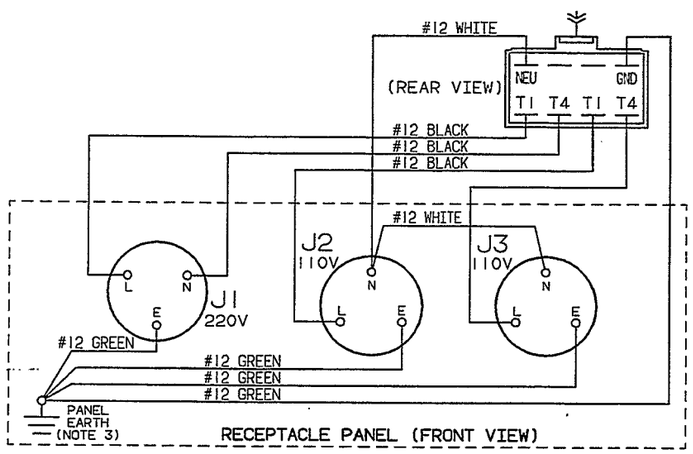


***DELETE ON 1.4 kW SETS**

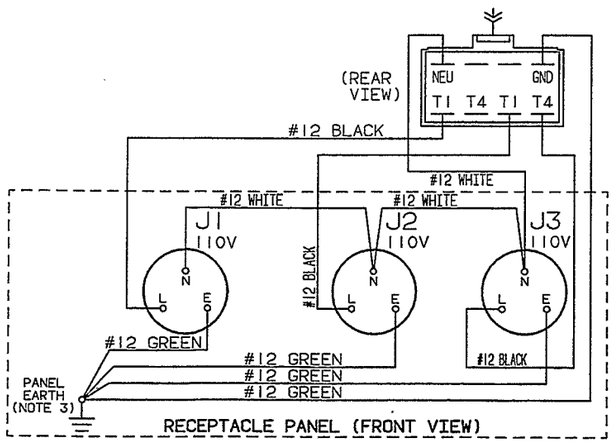
OPTION - 13



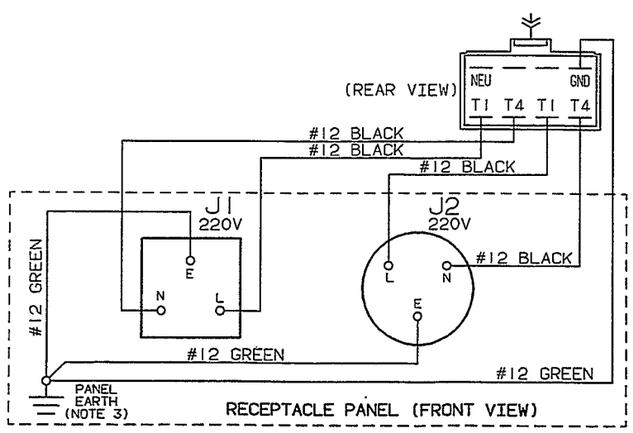
OPTION - 14



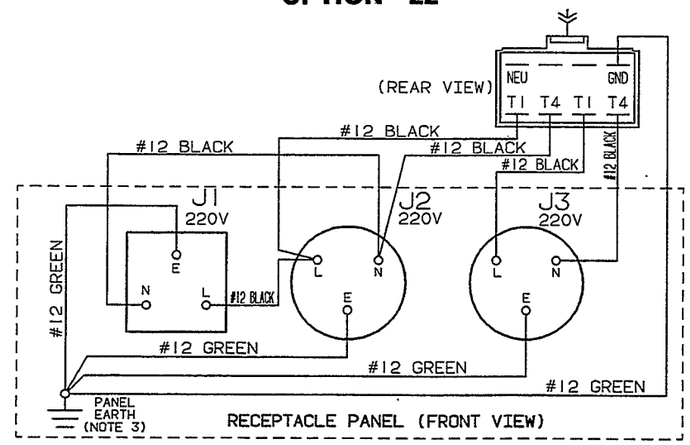
OPTION - 15



OPTION - 21



OPTION - 22



Onan

Cummins Power Generation
1400 73rd Avenue N.E.
Minneapolis, MN 55432
763-574-5000
Fax: 763-574-8087