Alcon Research, Ltd

Rule 13 Permit Modification Application
Alcon – Advanced Optic Device Center

Huntington, West Virginia

Prepared By:

ENVIRONMENTAL RESOURCES MANAGEMENT, Inc.
Hurricane, West Virginia

August 2015

Alcon Laboratories, Inc.
6065 Kyle Lane, Huntington, WV 25702
T: 304.733.1556
www.alcon.com

August 05, 2015

Mr. William F. Durham, Director
West Virginia Department of Environmental Protection
Division of Air Quality
601 57th Street, SE
Charleston, WV 25304

Subject: Rule 13 Permit Modification Application
Alcon Research, Ltd
Alcon – Advanced Optic Device Center (AODC) South

Dear Director Durham:

Alcon Research, Ltd (Alcon) is pleased to submit the enclosed Rule 13 Permit Modification Application for Alcon's Advanced Optic Device Center near Huntington in Cabell County, West Virginia. The original and two copies of the complete application package are enclosed.

A check for the application fee in the amount of $1,000.00 made payable to the *WVDEP – Division of Air Quality* is also included with this package.

A public notice for the proposed project will be published in *The Herald Dispatch* as soon as possible. Alcon will forward the original Affidavit of Publication to your attention once it is received from the publisher.

If you should have any questions, please contact Chad Stutler at (304) 733-7410.

Best Regards,

Chad Stutler
Sr. Health, Safety & Environmental Specialist

INTRODUCTION

Alcon Research, Ltd is submitting this Rule 13 Permit Modification to the WVDEP's Department of Air Quality for the Alcon Advanced Optic Device Center (AODC) South facility located in Cabell County, West Virginia. This application addresses support activities associated with the manufacture of ophthalmic products.

Per 45-13-2.17.a; the change in emission increase of more than 144 pounds per calendar day of any regulated pollutant requires a permit modification. Alcon's potential-to-emit is 177 lb/day CO and 447 lb/day NOx.

PROPOSED MODIFICATIONS

The applicant is currently authorized to operate the following pieces of equipment under R13-2518A-C:

- One (1) Caterpillar C15 compression ignition emergency generator rated at 619 bhp;
- One (1) 1,000 gallon #2 Fuel Oil Tank;
- Two (2) Ethylene Oxide Sterilizers designed for 3.2 lbs ethylene oxide per cycle;
- One (1) Ehtlyene Oxide Sterilizer designed for 12 lbs ethylene oxide per cycle.

With this application for permit modification, the applicant seeks the authority to make the following modifications:

Removed Equipment

- Three (3) Ethylene Oxide Sterilizers rated at 3.2 lbs/cycle and 12 lbs/cycle and all associated control devices (Removed 4/28/2014 - see attached letter).

Equipment Additions (After-the-fact)

- After-the-fact addition of four (4) boilers each rated at 2.0 MMBtu/hr heat input;
- After-the-fact addition of one (1) boiler rated at 1.3 MMBtu/hr heat input;
- One (1) 27 bhp Dayton 4W117H natural gas standby-power generator;
- One (1) 67 bhp Dayton 4LM43 natural gas standby-power generator;
- One (1) 201 bhp Caterpillar 3406 natural gas standby-power generator;
- One (1) 80 bhp Caterpillar G60F3 natural gas standby-power generator.

A process flow diagram is included in this application in Attachment F.

Alcon Research, Ltd.
6065 Kyle Lane, Huntington, WV 25702-9795
T: 304.733.1475
www.alcon.com

April 28, 2014

Director
WV Department of Environmental Protection
Division of Air Quality
601 57th Street, SE
Charleston, WV 25304-2345

Subject: Cease Operations of permitted (R13-2518C) Emissions Units

Dear Director:

As required per Section 2.14 of our Air Permit (R13-2518C), Alcon Research Ltd. is notifying you that we ceased operations of the permitted emission units listed below on 4/18/14.

1S – Ethylene Oxide Sterilizer
2S – Ethylene Oxide Sterilizer
3S – Ethylene Oxide Sterilizer

If you should have any questions, please contact Chad Stutler at (304) 733-7410.

Best Regards,

Chad Stutler
Sr. Health, Safety & Environmental Specialist

WEST VIRGINIA DEPARTMENT OF ENVIRONMENTAL PROTECTION

DIVISION OF AIR QUALITY

601 57th Street, SE
Charleston, WV 25304
(304) 926-0475
www.dep.wv.gov/daq

APPLICATION FOR NSR PERMIT

AND

TITLE V PERMIT REVISION

(OPTIONAL)

PLEASE CHECK ALL THAT APPLY TO **NSR (45CSR13)** (IF KNOWN):

☐ **CONSTRUCTION** ☒ **MODIFICATION** ☐ **RELOCATION**

☐ **CLASS I ADMINISTRATIVE UPDATE** ☐ **TEMPORARY**

☐ **CLASS II ADMINISTRATIVE UPDATE** ☒ **AFTER-THE-FACT**

PLEASE CHECK TYPE OF **45CSR30 (TITLE V)** REVISION (IF ANY):

☐ **ADMINISTRATIVE AMENDMENT** ☐ **MINOR MODIFICATION**

☐ **SIGNIFICANT MODIFICATION**

IF ANY BOX ABOVE IS CHECKED, INCLUDE TITLE V REVISION INFORMATION AS **ATTACHMENT S** TO THIS APPLICATION

FOR TITLE V FACILITIES ONLY: Please refer to "Title V Revision Guidance" in order to determine your Title V Revision options (Appendix A, "Title V Permit Revision Flowchart") and ability to operate with the changes requested in this Permit Application.

Section I. General

1. Name of applicant *(as registered with the WV Secretary of State's Office):*
Alcon Research, Ltd.

2. Federal Employer ID No. ***(FEIN):***
75-2824405

3. Name of facility *(if different from above):*
Alcon – Advanced Optic Device Center (AODC) South

4. The applicant is the:
☐ **OWNER** ☐ **OPERATOR** ☒ **BOTH**

5A. Applicant's mailing address:
6065 Kyle Lane
Huntington, WV 25702

5B. Facility's present physical address:
6065 Kyle Lane
Huntington, WV 25702

6. **West Virginia Business Registration.** Is the applicant a resident of the State of West Virginia? ☐ **YES** ☒ **NO**

- If **YES,** provide a copy of the **Certificate of Incorporation/Organization/Limited Partnership** (one page) including any name change amendments or other Business Registration Certificate as **Attachment A.**
- If **NO,** provide a copy of the **Certificate of Authority/Authority of L.L.C./Registration** (one page) including any name change amendments or other Business Certificate as **Attachment A.**

7. If applicant is a subsidiary corporation, please provide the name of parent corporation:

8. Does the applicant own, lease, have an option to buy or otherwise have control of the *proposed site?* ☒ **YES** ☐ **NO**

- If **YES,** please explain: Alcon Research, Ltd owns the site.
- If **NO,** you are not eligible for a permit for this source.

9. Type of plant or facility (stationary source) to be **constructed, modified, relocated, administratively updated** or **temporarily permitted** (e.g., coal preparation plant, primary crusher, etc.): **Emergency generators, boilers, ethylene oxide sterilizers.**

10. North American Industry Classification System **(NAICS)** code for the facility:
339113

11A. DAQ Plant ID No. (for existing facilities only):
11-00037

11B. List all current 45CSR13 and 45CSR30 (Title V) permit numbers associated with this process (for existing facilities only):
R13-2518A, R13-2518B, R13-2518C

All of the required forms and additional information can be found under the Permitting Section of DAQ's website, or requested by phone.

12A.

- For **Modifications, Administrative Updates** or **Temporary permits** at an existing facility, please provide directions to the *present location* of the facility from the nearest state road;
- For **Construction** or **Relocation permits,** please provide directions to the *proposed new site location* from the nearest state road. Include a **MAP** as **Attachment B**.

From I-64W, Take exit 18 towards US-60/WV-2, Turn Right at Merritts Creek Connector/WV-193 go 3.2 miles to Ohio River Rd/WV-2, turn left and go approx. 0.2 miles turn right onto Kyle Lane.

12.B. New site address (if applicable):	12C. Nearest city or town:	12D. County:
N/A	**Huntington**	**Cabell**
12.E. UTM Northing (KM): **4,257.6**	12F. UTM Easting (KM): **385.7**	12G. UTM Zone: **17**

13. Briefly describe the proposed change(s) at the facility:

Alcon Research, Ltd is proposing to permit four (4) after-the-fact back-up generators to provide emergency power supply. The emergency generators have the authority to operate for the purpose of maintenance checks and readiness testing for 500 hours per year. There will be no time limit on the use of the generator in emergency situations.

Alcon is also proposing to permit, after-the-fact, four (4) 2.0 mmBTU/hr boilers and one (1) 1.3 mmBTU/hr boiler for the use of generating steam.

Additionally, three (3) Ethylene Oxide Sterilizers and associated equipment were removed in 2014. Alcon would like this equipment and all permitted requirements be removed from the updated R13-2518 permit.

The Caterpillar C15 Diesel powered emergency generator contains an integrated 1,000 gallon #2 fuel oil tank listed in R13-2518C. Listing this tank as an emission point and emission source is not required under Table 45-13B-58.

14A. Provide the date of anticipated installation or change: – If this is an **After-The-Fact** permit application, provide the date upon which the proposed change did happen: **04/2014**	14B. Date of anticipated Start-Up if a permit is granted:

14C. Provide a **Schedule** of the planned **Installation** of/**Change** to and **Start-Up** of each of the units proposed in this permit application as **Attachment C** (if more than one unit is involved).

15. Provide maximum projected **Operating Schedule** of activity/activities outlined in this application:
Hours Per Day **24** Days Per Week **5** Weeks Per Year **52**

16. Is demolition or physical renovation at an existing facility involved? ☐ **YES** ☒ **NO**

17**. Risk Management Plans.** If this facility is subject to 112(r) of the 1990 CAAA, or will become subject due to proposed changes (for applicability help see www.epa.gov/ceppo), submit your **Risk Management Plan (RMP)** to U. S. EPA Region III.

18**. Regulatory Discussion.** List all Federal and State air pollution control regulations that you believe are applicable to the proposed process *(if known).* A list of possible applicable requirements is also included in Attachment S of this application (Title V Permit Revision Information). Discuss applicability and proposed demonstration(s) of compliance *(if known).* Provide this information as **Attachment D.**

Section II. Additional attachments and supporting documents.

19. Include a check payable to WVDEP – Division of Air Quality with the appropriate **application fee** (per 45CSR22 and 45CSR13).

20. Include a **Table of Contents** as the first page of your application package.

21. Provide a **Plot Plan,** e.g. scaled map(s) and/or sketch(es) showing the location of the property on which the stationary source(s) is or is to be located as **Attachment E** (Refer to ***Plot Plan Guidance***) **.**

– Indicate the location of the nearest occupied structure (e.g. church, school, business, residence).

22. Provide a **Detailed Process Flow Diagram(s)** showing each proposed or modified emissions unit, emission point and control device as **Attachment F.**

23. Provide a **Process Description** as **Attachment G.**

– Also describe and quantify to the extent possible all changes made to the facility since the last permit review (if applicable).

All of the required forms and additional information can be found under the Permitting Section of DAQ's website, or requested by phone.

24. Provide **Material Safety Data Sheets (MSDS)** for all materials processed, used or produced as **Attachment H.**

– For chemical processes, provide a MSDS for each compound emitted to the air.

25. Fill out the **Emission Units Table** and provide it as **Attachment I.**

26. Fill out the **Emission Points Data Summary Sheet (Table 1 and Table 2)** and provide it as **Attachment J.**

27. Fill out the **Fugitive Emissions Data Summary Sheet** and provide it as **Attachment K.**

28. Check all applicable **Emissions Unit Data Sheets** listed below:

☐ Bulk Liquid Transfer Operations	☐ Haul Road Emissions	☐ Quarry
☐ Chemical Processes	☐ Hot Mix Asphalt Plant	☐ Solid Materials Sizing, Handling and Storage Facilities
☐ Concrete Batch Plant	☐ Incinerator	
☐ Grey Iron and Steel Foundry	☒ Indirect Heat Exchanger	☐ Storage Tanks
☒ General Emission Unit, specify **Emergency Generator / Boiler**		

Fill out and provide the **Emissions Unit Data Sheet(s)** as **Attachment L.**

29. Check all applicable **Air Pollution Control Device Sheets** listed below:

☐ Absorption Systems	☐ Baghouse	☐ Flare
☐ Adsorption Systems	☐ Condenser	☐ Mechanical Collector
☐ Afterburner	☐ Electrostatic Precipitator	☐ Wet Collecting System

☐ Other Collectors, specify

Fill out and provide the **Air Pollution Control Device Sheet(s)** as **Attachment M.**

30. Provide all **Supporting Emissions Calculations** as **Attachment N,** or attach the calculations directly to the forms listed in Items 28 through 31.

31. **Monitoring, Recordkeeping, Reporting and Testing Plans.** Attach proposed monitoring, recordkeeping, reporting and testing plans in order to demonstrate compliance with the proposed emissions limits and operating parameters in this permit application. Provide this information as **Attachment O.**

➢ Please be aware that all permits must be practically enforceable whether or not the applicant chooses to propose such measures. Additionally, the DAQ may not be able to accept all measures proposed by the applicant. If none of these plans are proposed by the applicant, DAQ will develop such plans and include them in the permit.

32. **Public Notice.** At the time that the application is submitted, place a **Class I Legal Advertisement** in a newspaper of general circulation in the area where the source is or will be located (See 45CSR§13-8.3 through 45CSR§13-8.5 and ***Example Legal Advertisement*** for details). Please submit the **Affidavit of Publication** as **Attachment P** immediately upon receipt.

33**. Business Confidentiality Claims.** Does this application include confidential information (per 45CSR31)?

☐ **YES** ☒ **NO**

➢ If **YES,** identify each segment of information on each page that is submitted as confidential and provide justification for each segment claimed confidential, including the criteria under 45CSR§31-4.1, and in accordance with the DAQ's ***"Precautionary Notice – Claims of Confidentiality"*** guidance found in the ***General Instructions*** as **Attachment Q.**

Section III. Certification of Information

34. **Authority/Delegation of Authority.** Only required when someone other than the responsible official signs the application. Check applicable **Authority Form** below:

☐ Authority of Corporation or Other Business Entity ☐ Authority of Partnership

☐ Authority of Governmental Agency ☐ Authority of Limited Partnership

Submit completed and signed **Authority Form** as **Attachment R.**

All of the required forms and additional information can be found under the Permitting Section of DAQ's website, or requested by phone.

35A. **Certification of Information.** To certify this permit application, a Responsible Official (per 45CSR§13-2.22 and 45CSR§30-2.28) or Authorized Representative shall check the appropriate box and sign below.

Certification of Truth, Accuracy, and Completeness

I, the undersigned ☒ **Responsible Official** / ☐ **Authorized Representative,** hereby certify that all information contained in this application and any supporting documents appended hereto, is true, accurate, and complete based on information and belief after reasonable inquiry I further agree to assume responsibility for the construction, modification and/or relocation and operation of the stationary source described herein in accordance with this application and any amendments thereto, as well as the Department of Environmental Protection, Division of Air Quality permit issued in accordance with this application, along with all applicable rules and regulations of the West Virginia Division of Air Quality and W.Va. Code § 22-5-1 et seq. (State Air Pollution Control Act). If the business or agency changes its Responsible Official or Authorized Representative, the Director of the Division of Air Quality will be notified in writing within 30 days of the official change.

Compliance Certification

Except for requirements identified in the Title V Application for which compliance is not achieved, I, the undersigned hereby certify that, based on information and belief formed after reasonable inquiry, all air contaminant sources identified in this application are in compliance with all applicable requirements.

SIGNATURE _____ (Please use blue ink) DATE: 7.6.15 ~~07/23~~ 07/23/15 (Please use blue ink)

35B. Printed name of signee: Layne Webb		35C. Title: General Manager
35D. E-mail: Layne.Webb@alcon.com	36E. Phone: 304-733-8636	36F. FAX: 304-736-0688
36A. Printed name of contact person (if different from above): Chad Stutler		36B. Title: Facilities/HSE Manager
36C. E-mail: Chad.Stutler@alcon.com	36D. Phone: 304-733-7410	36E. FAX: 304-733-1593

PLEASE CHECK ALL APPLICABLE ATTACHMENTS INCLUDED WITH THIS PERMIT APPLICATION:

☒ **Attachment A: Business Certificate**
☒ **Attachment B: Map(s)**
☒ **Attachment C: Installation and Start Up Schedule**
☒ **Attachment D: Regulatory Discussion**
☒ **Attachment E: Plot Plan**
☒ **Attachment F: Detailed Process Flow Diagram(s)**
☒ **Attachment G: Process Description**
☐ **Attachment H: Material Safety Data Sheets (MSDS)**
☒ **Attachment I: Emission Units Table**
☒ **Attachment J: Emission Points Data Summary Sheet**
☐ **Attachment K: Fugitive Emissions Data Summary Sheet**
☒ **Attachment L: Emissions Unit Data Sheet(s)**
☐ **Attachment M: Air Pollution Control Device Sheet(s)**
☒ **Attachment N: Supporting Emissions Calculations**
☐ **Attachment O: Monitoring/Recordkeeping/Reporting/Testing Plans**
☒ **Attachment P: Public Notice**
☐ **Attachment Q: Business Confidential Claims**
☐ **Attachment R: Authority Forms**
☐ **Attachment S: Title V Permit Revision Information**
☒ **Application Fee**

Please mail an original and three (3) copies of the complete permit application with the signature(s) to the DAQ, Permitting Section, at the address listed on the first page of this application. Please DO NOT fax permit applications.

FOR AGENCY USE ONLY – IF THIS IS A TITLE V SOURCE:

☐ ***Forward 1 copy of the application to the Title V Permitting Group and:***

☐ ***For Title V Administrative Amendments:***

- ☐ ***NSR permit writer should notify Title V permit writer of draft permit,***

☐ ***For Title V Minor Modifications:***

- ☐ ***Title V permit writer should send appropriate notification to EPA and affected states within 5 days of receipt,***
- ☐ ***NSR permit writer should notify Title V permit writer of draft permit.***

☐ ***For Title V Significant Modifications processed in parallel with NSR Permit revision:***

- ☐ ***NSR permit writer should notify a Title V permit writer of draft permit,***
- ☐ ***Public notice should reference both 45CSR13 and Title V permits,***
- ☐ ***EPA has 45 day review period of a draft permit.***

All of the required forms and additional information can be found under the Permitting Section of DAQ's website, or requested by phone.

Table of Contents

ATTACHMENT A

BUSINESS CERTIFICATE

WEST VIRGINIA
STATE TAX DEPARTMENT
BUSINESS REGISTRATION CERTIFICATE

ISSUED TO:
ALCON RESEARCH, LTD.
6201 SOUTH FWY
FORT WORTH, TX 76134-2001

BUSINESS REGISTRATION ACCOUNT NUMBER: **2188-1558**

This certificate is issued on: 06/23/2011

This certificate is issued by
the West Virginia State Tax Commissioner
in accordance with Chapter 11, Article 12, of the West Virginia Code

The person or organization identified on this certificate is registered to conduct business in the State of West Virginia at the location above.

This certificate is not transferrable and must be displayed at the location for which issued.

ATTACHMENT B

LOCATION MAP


Alcon Research, Ltd.
Cox Landing Rd
Opal Rd
Big Seven Mile Rd
11
7
1149
1151
1148
1147
220
2/2
Molter Dr
1285
1196
Highland Dr
Peach St
Plum St
1140
1534
1139
1291
1137
1087
1135
107
1374
1375
411
10
1246
22
19/1
2/19
Marti Jo Dr
Amy Dr
2
2/18
19
Lucy Ln
193
Minerva Rd
© 2015 Google
Google earth

ATTACHMENT C

INSTALLATION SCHEDULE

SCHEDULE OF INSTALLATION

Equipment include in this permit application is existing and operational. Since this permit application does not include the installation of new equipment, a schedule of installation is not required and not being provided.

ATTACHMENT D

REGULATORY DISCUSSION

REGULATORY DISCUSSION

This section outlines the State air quality regulations that could be reasonably expected to apply to the Alcon AODC South facility and makes an applicability determination for each regulation based on activities conducted at the site and the emissions of regulated air pollutants. This review is presented to supplement and/or add clarification to the information provided in the WVDEP permit application forms.

The West Virginia State Regulations address applicable state (i.e. State Implementation Plan) rules as well as federal regulations, including Title I Prevention of Significant Deterioration Nonattainment New Source Review preconstruction permitting, Title V, New Source Performance Standards, and National Emission Standards for Hazardous Air Pollutants. The regulatory requirements in reference to Alcon AODC South are described in detail in the below section.

WEST VIRGINIA STATE AIR REGULATIONS

45 CSR 02 – To Prevent and Control Particulate Air Pollution From Combustion of Fuel in Indirect Heat Exchangers

The boilers are indirect heat exchangers that combust natural gas. These units are less than 10 mmBtu/hr. Such units are subject to 10% opacity as a six-minute block average limitation, but are exempt from most other requirements in the rule aside from discretionary testing requirements.

45 CSR 04 – To Prevent and Control the Discharge of Air Pollutants into the Air Which Causes or Contributes to an Objectionable Odor

Operations conducted at Alcon are subject to this requirement. Based on the nature of the process, the presence of objectionable odors is unlikely.

45 CSR 06 – Control of Air Pollution from the Combustion of Refuse

No on-site incinerators, flares, or open burning are associated with the processes at the Alcon facility.

45 CSR 10 – To Prevent and Control Air Pollution From the Emission of Sulfur Oxides

The boilers are indirect heat exchangers that combust natural gas but are exempt since the heat input capacities are less than 10 MMBtu/hr.

45 CSR 13 – Permits for Construction, Modification, Relocation, And Operation of Stationary Sources of Air Pollutants

This Rule 13 Permit Modification application is being submitted for the operational activities associated with Alcon's production of ophthalmic products. Per 45-13-2.17.a;

the change in an emission increase of more than 144 pounds per calendar day of any regulated pollutant trigger the need for this permit modification. Alcon's potential-to-emit is 177 lb/day CO and 447 lb/day NOx.

45 CSR 14 / 45 CSR 19 – Permits for Construction and Major Modification of Major Stationary Sources of Air Pollution for the Prevention of Significant Deterioration / Permits for Construction and Major Modification of Major Stationary Sources of Air Pollution which Cause or Contributed to Non-attainment.

Federally regulated construction permitting programs regulate new and modified major sources of regulated pollutants. Operation of equipment at the Alcon facility will not exceed major source emission thresholds. Alcon will monitor future construction and modification activities at the site closely and will compare any future increase in emissions with major source thresholds to ensure these activities will not trigger these programs.

45 CSR 16 - Standards of Performance for New Stationary Sources (NSPS)

45CSR 16 applies to all registrants with affected facilities that are subject to any of the NSPS requirements.

The following NSPS included in the Rule 13 Permit Modification are not applicable to the Alcon facility:

- 40CFR60 Subpart D (Standards of Performance for Fossil Fuel Fired Steam Generators*)*

  Boiler units are less than 10 mmBtu/hr.

- 40CFR60 Subpart Db (Standards of Performance for Industrial-Commercial-Institutional Steam Generating Units*)*

  Boiler units are less than 10 mmBtu/hr.

- 40CFR60 Subpart Dc (Standards of Performance for Small Industrial-Commercial-Institutional Steam Generating Units*)*

  Boiler units are less than 10 mmBtu/hr.

- *40 CFR 60, Subpart IIII (Standards of Performance for Stationary Compression Ignition Internal Combustion Engines.)*

  Subpart IIII establishes emission standards and compliance requirements for the control of criteria pollutants from stationary compression ignition emergency generator. The applicable provisions and requirements of Subpart IIII have been addressed for the diesel Caterpillar C15 emergency generator in R13-2518C and will not apply to the remaining reciprocating internal combustion engines.

- 40CFR60 Subpart JJJJ (Standards of Performance for Stationary Spark Ignition Internal Combustion Engines)

  Engine manufacture dates do not apply to this subpart.

No additional NSPS are currently applicable to this facility.

45 CSR 30 – Requirements for Operating Permits

45 CSR 30 applies to the requirements of the federal Title V operating permit program (40 CFR 70). The major source thresholds with respect to the West Virginia Title V operating permit program regulations are 10 tons per year (tpy) of a single HAP, 25 tpy of any combination of HAPs, and 100 tpy of all other regulated pollutants.

The potential emissions of all regulated pollutants are below the corresponding threshold(s) at this facility. The facility is not a major source with respect to the Title V operating permit program.

45 CSR 34 – National Emission Standards for Hazardous Air Pollutants (NESHAP)

45 CSR 34 applies to all registrants that are subject to any of the NESHAP requirements.

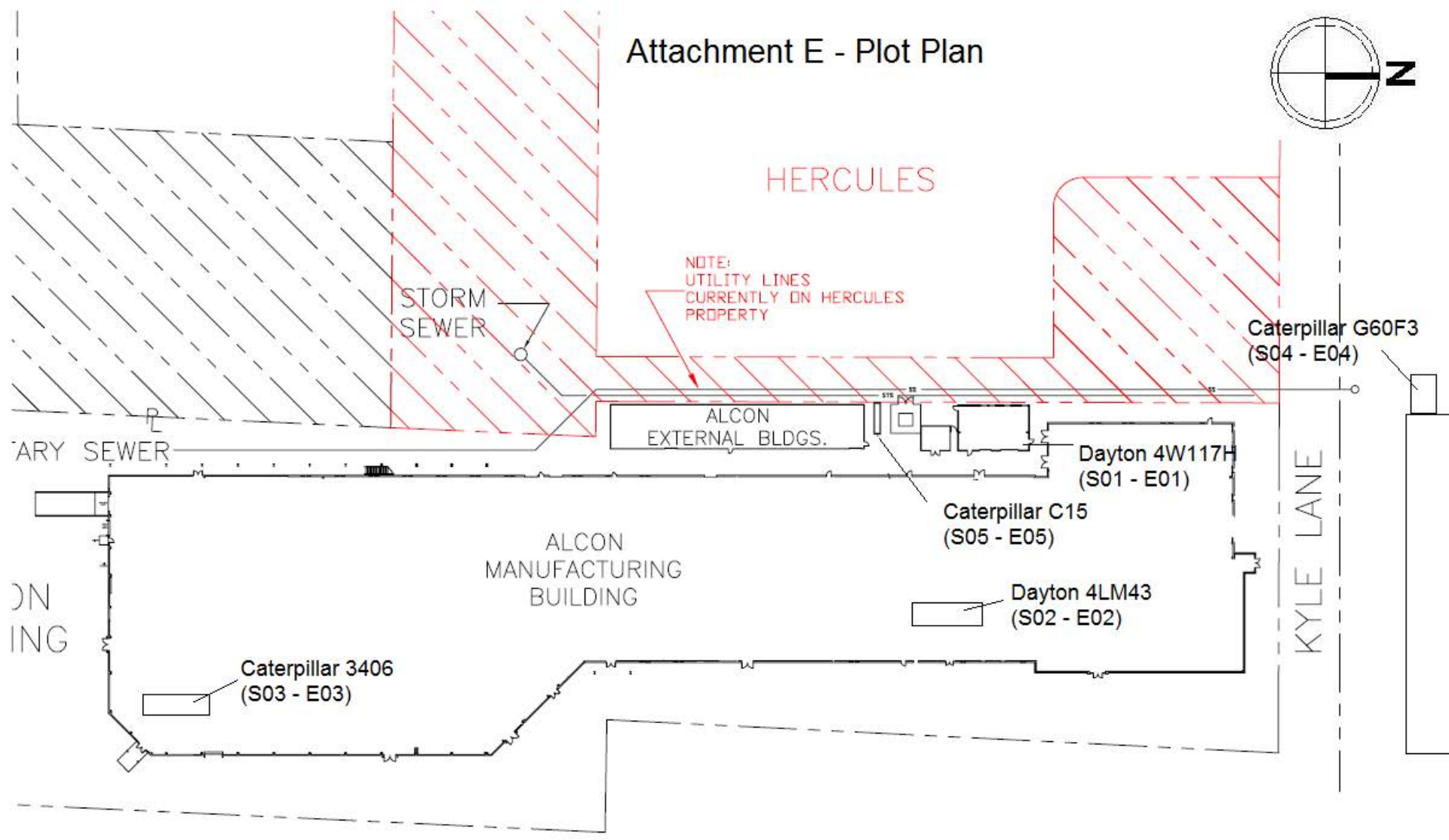
The following NESHAP included in the Rule 13 Permit Modification are not applicable to the Alcon facility:

- 40CFR63 Subpart ZZZZ (National Emission Standards for Hazardous Air Pollutants for Stationary Reciprocating Internal Combustion Engines*)*

  Installed emergency generators are not subject to the regulations listed in 40CFR63 Subpart ZZZZ.

ATTACHMENT E

PLOT PLAN


Attachment E - Plot Plan
N
HERCULES
NOTE:
UTILITY LINES
CURRENTLY ON HERCULES
PROPERTY
STORM
SEWER
Caterpillar G60F3
(S04 - E04)
ALCON
EXTERNAL BLDGS.
ARY SEWER
Dayton 4W117H
(S01 - E01)
Caterpillar C15
(S05 - E05)
ALCON
MANUFACTURING
BUILDING
Dayton 4LM43
(S02 - E02)
KYLE LANE
Caterpillar 3406
(S03 - E03)

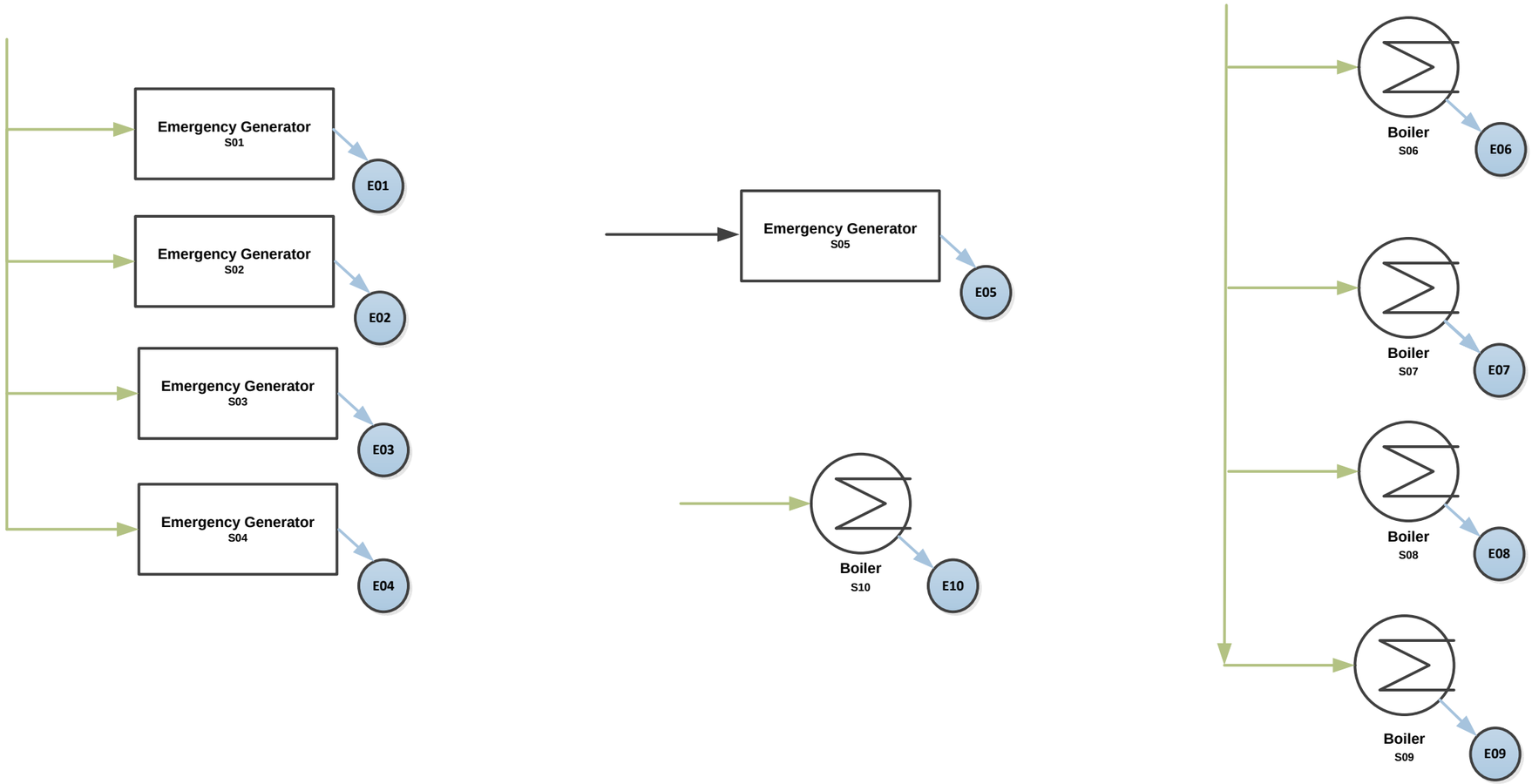
ATTACHMENT F

PROCESS FLOW DIAGRAM

Attachment F

Alcon Research (AODC) South

Process Flow Diagram



ATTACHMENT G

PROCESS DESCRIPTION

PROCESS DESCRIPTION

Alcon Research, LTD (Alcon) is an Advanced Optical Device Center that manufactures ophthalmic products; primarily intraocular lenses and surgical delivery system accessories.

The Emergency Generators (S01 – S05) will provide emergency backup power to the AODC facility. The Dayton 4W117H (S01), Dayton 4LM43 (S02), Caterpillar 3406 (S03), and Caterpillar G60F3 (S04) emergency generators are reciprocating internal combustion engines and powered by pipeline quality natural gas. The natural gas is supplied by the local utility. The Caterpillar C15 diesel generator (S05) is a compression ignition engine and combusts fuel oil from the integrated 1,000 gallon fuel oil tank.

The Plenum boilers (S06-S09) are 2.0 mmBtu/hr boilers which provide conditioning and comfort heating for manufacturing areas. The Govenair (S10) is a 1.3 mmBtu/hr boiler which provides additional conditioning and comfort heating for manufacturing areas.

A process flow diagram is included as Attachment F.

ATTACHMENT I

EQUIPMENT LIST FORM

Attachment I

Emission Units Table

(includes all emission units and air pollution control devices that will be part of this permit application review, regardless of permitting status)

Emission Unit ID[1]	Emission Point ID[2]	Emission Unit Description	Year Installed/ Modified	Design Capacity	Type[3] and Date of Change	Control Device[4]
S01	E01	Generator - Dayton 4W117H	2002	27 hp	Modification	None
S02	E02	Generator - Dayton 4LM43	2002	67 hp	Modification	None
S03	E03	Generator - Caterpillar 3406	2005	201 hp	Modification	None
S04	E04	Generator - Caterpillar G60F3	2006	80 hp	Modification	None
S05	E05	Generator (Diesel) - Caterpillar C15	2012	619 hp	Existing	None
S06	E06	Boiler - Plenum	2003	2.0 MMBtu/hr	Modification	None
S07	E07	Boiler - Plenum	2003	2.0 MMBtu/hr	Modification	None
S08	E08	Boiler - Plenum	2003	2.0 MMBtu/hr	Modification	None
S09	E09	Boiler - Plenum	2003	2.0 MMBtu/hr	Modification	None
S10	E10	Boiler - Govenair	1980	1.3 MMBtu/hr	Modification	None
1S	1E or 2E	Ethylene Oxide Sterilizer	1982	3.2 lbs Ethylene Oxide/cycle	Removal	1C or 2C
2S	1E or 2E	Ethylene Oxide Sterilizer	1997	3.2 lbs Ethylene Oxide/cycle	Removal	1C or 2C
3S	2E	Ethylene Oxide Sterilizer	2004	12 lbs Ethylene Oxide/cycle	Removal	2C

[1] For Emission Units (or Sources) use the following numbering system:1S, 2S, 3S,... or other appropriate designation.
[2] For Emission Points use the following numbering system:1E, 2E, 3E, ... or other appropriate designation.
[3] New, modification, removal
[4] For Control Devices use the following numbering system: 1C, 2C, 3C,... or other appropriate designation.

ATTACHMENT J

EMISSION POINTS DATA SUMMARY SHEET

Attachment J
EMISSION POINTS DATA SUMMARY SHEET

Table 1: Emissions Data

Emission Point ID No. *(Must match Emission Units Table & Plot Plan)*	Emission Point Type[1]	Emission Unit Vented Through This Point *(Must match Emission Units Table & Plot Plan)*		Air Pollution Control Device *(Must match Emission Units Table & Plot Plan)*		Vent Time for Emission Unit *(chemical processes only)*		All Regulated Pollutants - Chemical Name/CAS[3] *(Speciate VOCs & HAPS)*	Maximum Potential Uncontrolled Emissions [4]		Maximum Potential Controlled Emissions [5]		Emission Form or Phase *(At exit conditions, Solid, Liquid or Gas/Vapor)*	Est. Method Used [6]	Emission Concentration [7] (ppmv or mg/m^4)
		ID No.	Source	ID No.	Device Type	Short Term[2]	Max (hr/yr)		lb/hr	ton/yr	lb/hr	ton/yr			
E01	Upward Vertical Stack	S01	Emergency Generator	None	None	N/A	N/A	CO NOx PM VOCs HAPs – See Attachment N	0.13 1.72 <0.01 0.05 -	0.03 0.43 <0.01 0.01 -	N/A	N/A	Gas	EE	Varies
E02	Upward Vertical Stack	S02	Emergency Generator	None	None	N/A	N/A	CO NOx PM VOCs HAPs – See Attachment N	0.25 3.20 <0.01 0.09 -	0.06 0.80 <0.01 0.02 -	N/A	N/A	Gas	EE	Varies
E03	Upward Vertical Stack	S03	Emergency Generator	None	None	N/A	N/A	CO NOx PM VOCs HAPs – See Attachment N	5.54 5.01 0.02 0.24 -	1.39 1.25 <0.01 0.06 -	N/A	N/A	Gas	EE	Varies
E04	Upward Vertical Stack	S04	Emergency Generator	None	None	N/A	N/A	CO NOx PM VOCs HAPs – See Attachment N	0.23 2.99 <0.01 0.09 -	0.06 0.75 <0.01 0.02 -	N/A	N/A	Gas	EE	Varies
E05	Upward Vertical Stack	S05	Emergency Generator	None	None	N/A	N/A	CO NOx PM VOCs SO2 HAPs – See Attachment N	0.48 4.80 0.05 0.05 1.27 -	0.12 1.19 0.01 0.01 0.317 -	N/A	N/A	Gas	EE	Varies
E06	Upward Vertical Stack	S06	Boiler	None	None	N/A	N/A	CO NOx PM VOCs HAPs – See Attachment N	0.16 0.20 0.015 0.011 -	0.51 0.61 0.05 0.03 -	N/A	N/A	Gas	EE	See Attachment N

E07	Upward Vertical Stack	S07	Boiler	None	None	N/A	N/A	CO NOx PM VOCs HAPs – See Attachment N	0.16 0.20 0.015 0.011 -	0.51 0.61 0.05 0.03 -	N/A	N/A	Gas	EE	See Attachment N
E08	Upward Vertical Stack	S08	Boiler	None	None	N/A	N/A	CO NOx PM VOCs HAPs – See Attachment N	0.16 0.20 0.015 0.011 -	0.51 0.61 0.05 0.03 -	N/A	N/A	Gas	EE	See Attachment N
E09	Upward Vertical Stack	S09	Boiler	None	None	N/A	N/A	CO NOx PM VOCs HAPs – See Attachment N	0.16 0.20 0.015 0.011 -	0.51 0.61 0.05 0.03 -	N/A	N/A	Gas	EE	See Attachment N
E10	Upward Vertical Stack	S10	Boiler	None	None	N/A	N/A	CO NOx PM VOCs HAPs – See Attachment N	0.11 0.13 0.01 0.007 -	0.33 0.40 0.03 0.02 -	N/A	N/A	Gas	EE	See Attachment N

The EMISSION POINTS DATA SUMMARY SHEET provides a summation of emissions by emission unit. Note that uncaptured process emission unit emissions are not typically considered to be fugitive and must be accounted for on the appropriate EMISSIONS UNIT DATA SHEET and on the EMISSION POINTS DATA SUMMARY SHEET. Please note that total emissions from the source are equal to all vented emissions, all fugitive emissions, plus all other emissions (e.g. uncaptured emissions). Please complete the FUGITIVE EMISSIONS DATA SUMMARY SHEET for fugitive emission activities.

[1] Please add descriptors such as upward vertical stack, downward vertical stack, horizontal stack, relief vent, rain cap, etc.

[2] Indicate by "C" if venting is continuous. Otherwise, specify the average short-term venting rate with units, for intermittent venting (ie., 15 min/hr). Indicate as many rates as needed to clarify frequency of venting (e.g., 5 min/day, 2 days/wk).

[3] List all regulated air pollutants. Speciate VOCs, including all HAPs. Follow chemical name with Chemical Abstracts Service (CAS) number. **LIST** Acids, CO, CS_2, VOCs, H_2S, Inorganics, Lead, Organics, O_3, NO, NO_2, SO_2, SO_3, all applicable Greenhouse Gases (including CO_2 and methane), etc. **DO NOT LIST** H_2, H_2O, N_2, O_2, and Noble Gases.

[4] Give maximum potential emission rate with no control equipment operating. If emissions occur for less than 1 hr, then record emissions per batch in minutes (e.g. 5 lb VOC/20 minute batch).

[5] Give maximum potential emission rate with proposed control equipment operating. If emissions occur for less than 1 hr, then record emissions per batch in minutes (e.g. 5 lb VOC/20 minute batch).

[6] Indicate method used to determine emission rate as follows: MB = material balance; ST = stack test (give date of test); EE = engineering estimate; O = other (specify).

[7] Provide for all pollutant emissions. Typically, the units of parts per million by volume (ppmv) are used. If the emission is a mineral acid (sulfuric, nitric, hydrochloric or phosphoric) use units of milligram per dry cubic meter (mg/m^3) at standard conditions (68 °F and 29.92 inches Hg) (see 45CSR7). If the pollutant is SO_2, use units of ppmv (See 45CSR10).

Attachment J
EMISSION POINTS DATA SUMMARY SHEET

Table 2: Release Parameter Data								
Emission Point ID No. *(Must match Emission Units Table)*	Inner Diameter (ft.)	Exit Gas			Emission Point Elevation (ft)		UTM Coordinates (km)	
		Temp. (^{o}F)	Volumetric Flow [1] (acfm) *at operating conditions*	Velocity (fps)	Ground Level *(Height above mean sea level)*	Stack Height [2] *(Release height of emissions above ground level)*	Northing	Easting
E01	0.25	800	1,000	7.00	590 ft	20 ft	4,257.6	385.7
E02	0.25	800	1,000	7.00	590 ft	20 ft	4,257.6	385.7
E03	0.25	1,182	1,080	9.00	590 ft	20 ft	4,257.6	385.7
E04	0.25	800	1,162	8.25	590 ft	20 ft	4,257.6	385.7
E05	0.5	910	3,655.1	12.00	590 ft	8 ft	4,257.6	385.7
E06	0.25	500	300	5.00	590 ft	20 ft	4,257.6	385.7
E07	0.25	500	300	5.00	590 ft	20 ft	4,257.6	385.7
E08	0.25	500	300	5.00	590 ft	20 ft	4,257.6	385.7
E09	0.25	500	300	5.00	590 ft	20 ft	4,257.6	385.7
E10	0.25	500	300	5.00	590 ft	20 ft	4,257.6	385.7

[1] Give at operating conditions. Include inerts.
[2] Release height of emissions above ground level.

ATTACHMENT L

EMISSIONS UNIT DATA SHEET

NATURAL GAS-FIRED COMPRESSOR ENGINE (RICE)
EMISSION UNIT DATA SHEET

Complete this section for any natural gas-fired reciprocating internal combustion engine.

Emission Unit (Source) ID No.[1]		**S01**		**S02**		**S03**	
Emission Point ID No. [2]		**E01**		**E02**		**E03**	
Engine Manufacturer and Model		**Dayton 4W117H**		**Dayton 4LM43**		**Caterpillar 3406**	
Manufacturer's Rated bhp/rpm		**27 bhp / 1,800 rpm**		**67 bhp / 1,800 rpm**		**201 bhp / 1,800 rpm**	
Source Status[3]		**ES**		**ES**		**ES**	
Date Installed/Modified/Removed[4]		**2002**		**2002**		**2005**	
Engine Manufactured/Reconstruction Date[5]		**2002**		**2002**		**2005**	
Is this engine subject to 40CFR60, Subpart JJJJ?		**NO**		**NO**		**NO**	
Is this a Certified Stationary Spark Ignition Engine according to 40CFR60, Subpart JJJJ? (Yes or No)[6]		**NO**		**NO**		**NO**	
Is this engine subject to 40CFR63, Subpart ZZZZ? (yes or no)		**No**		**NO**		**NO**	
Engine, Fuel and Combustion Data	Engine Type[7]	**LB4S**		**LB4S**		**LB4S**	
	APCD Type[8]	**None**		**None**		**None**	
	Fuel Type[9]	**PQ**		**PQ**		**PQ**	
	H_2S (gr/100 scf)	**0.25**		**0.25**		**0.25**	
	Operating bhp/rpm	**27 bhp / 1,800 rpm**		**67 bhp / 1,800 rpm**		**201 bhp / 1,800 rpm**	
	BSFC (Btu/bhp-hr)	**15,640**		**11,707**		**9,915**	
	Fuel throughput (ft^3/hr)	**414**		**769**		**1,954**	
	Fuel throughput ($MMft^3$/yr)	**0.21**		**0.38**		**0.98**	
	Operation (hrs/yr)	**500**		**500**		**500**	
Reference[10]	Potential Emissions[11]	lbs/hr	tons/yr	lbs/hr	tons/yr	lbs/hr	tons/yr
AP-42 – Vendor Guarantee	NO_X	**1.72**	**0.43**	**3.20**	**0.80**	**5.01**	**1.25**
AP-42 – Vendor Guarantee	CO	**0.13**	**0.03**	**0.25**	**0.06**	**5.54**	**1.39**
AP-42	VOC	**0.05**	**0.01**	**0.09**	**0.02**	**0.24**	**0.06**
AP-42	SO_2	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**0.001**	**<0.001**
AP-42	PM_{10}	**0.004**	**0.001**	**0.01**	**0.001**	**0.02**	**0.005**
AP-42	Formaldehyde	**0.022**	**0.01**	**0.04**	**0.01**	**0.11**	**0.03**
MRR[12]	Proposed Monitoring:	**Alcon will comply with all monitoring requirements set forth in the issued permit.**					
	Proposed Recordkeeping:	**Alcon will comply with all recordkeeping requirements set forth in the issued permit.**					
	Proposed Reporting:	**Alcon will comply with all reporting requirements set forth in the issued permit.**					

NATURAL GAS-FIRED COMPRESSOR ENGINE (RICE)
EMISSION UNIT DATA SHEET

Complete this section for any natural gas-fired reciprocating internal combustion engine.

Emission Unit (Source) ID No.[1]		**S04**					
Emission Point ID No. [2]		**E04**					
Engine Manufacturer and Model		**Caterpillar G60F3**					
Manufacturer's Rated bhp/rpm		**80 bhp / 1,800**					
Source Status[3]		**ES**					
Date Installed/Modified/Removed[4]		**02/2006**					
Engine Manufactured/Reconstruction Date[5]		**2005**					
Is this engine subject to 40CFR60, Subpart JJJJ?		**No**					
Is this a Certified Stationary Spark Ignition Engine according to 40CFR60, Subpart JJJJ? (Yes or No)[6]		**No**					
Is this engine subject to 40CFR63, Subpart ZZZZ? (yes or no)		**NO**					
Engine, Fuel and Combustion Data	Engine Type[7]	**LB4S**					
	APCD Type[8]	**None**					
	Fuel Type[9]	**PQ**					
	H_2S (gr/100 scf)	**0.25**					
	Operating bhp/rpm	**80 bhp / 1,800**					
	BSFC (Btu/bhp-hr)	**9,167**					
	Fuel throughput (ft^3/hr)	**719**					
	Fuel throughput ($MMft^3$/yr)	**0.36**					
	Operation (hrs/yr)	**500**					
Reference[10]	Potential Emissions[11]	lbs/hr	tons/yr	lbs/hr	tons/yr	lbs/hr	tons/yr
AP-42	NO_X	**2.99**	**0.75**				
AP-42	CO	**0.23**	**0.06**				
AP-42	VOC	**0.09**	**0.02**				
AP-42	SO_2	**<0.001**	**<0.001**				
AP-42	PM_{10}	**0.01**	**0.002**				
Vendor Guarantee	Formaldehyde	**0.04**	**0.01**				
MRR[12]	Proposed Monitoring:	**Alcon will comply with all monitoring requirements set forth in the issued permit.**					
	Proposed Recordkeeping:	**Alcon will comply with all recordkeeping requirements set forth in the issued permit.**					
	Proposed Reporting:	**Alcon will comply with all reporting requirements set forth in the issued permit.**					

Attachment L
Emission Unit Data Sheet
(INDIRECT HEAT EXCHANGER)

Control Device ID No. (must match List Form): N/A

Equipment Information

1. Manufacturer: Govenair	2. Model No. 1.3 MMBtu/hr Serial No. FY33-11-35700
3. Number of units: 1	4. Use: Produces Steam
5. Rated Boiler Horsepower: hp	6. Boiler Serial No.: FY33-11-35700
7. Date constructed: 1980	8. Date of last modification and explain: None
9. Maximum design heat input per unit: 1.3 ×10^6 BTU/hr	10. Peak heat input per unit: 1.3 ×10^6 BTU/hr
11. Steam produced at maximum design output: LB/hr psig	12. Projected Operating Schedule: Hours/Day 24 Days/Week 5 Weeks/Year 52
13. Type of firing equipment to be used: ☐ Pulverized coal ☐ Spreader stoker ☐ Oil burners ☒ Natural Gas Burner ☐ Others, specify	14. Proposed type of burners and orientation: ☒ Vertical ☐ Front Wall ☐ Opposed ☐ Tangential ☐ Others, specify
15. Type of draft: ☐ Forced ☐ Induced	16. Percent of ash retained in furnace: %
17. Will flyash be reinjected? ☐ Yes ☐ No	18. Percent of carbon in flyash: %

Stack or Vent Data

19. Inside diameter or dimensions: 0.25 ft.	20. Gas exit temperature: 500 °F
21. Height: 20 ft.	22. Stack serves: ☒ This equipment only ☐ Other equipment also (submit type and rating of all other equipment exhausted through this stack or vent)
23. Gas flow rate: 300 ft^3/min	
24. Estimated percent of moisture: %	

Fuel Requirements

25.						
	Type	Fuel Oil No.	Natural Gas	Gas (other, specify)	Coal, Type:	Other:
	Quantity (at Design Output)	gph@60°F	1,275 ft^3/hr	ft^3/hr	TPH	
	Annually	$\times 10^3$ gal	7.95 $\times 10^6$ ft^3/hr	$\times 10^6$ ft^3/hr	tons	
	Sulfur	Maximum: wt. % Average: wt. %	0.25 gr/100 ft^3	gr/100 ft^3	Maximum: wt. %	
	Ash (%)				Maximum	
	BTU Content	BTU/Gal. Lbs/Gal.@60°F	1,020 BTU/ft^3	BTU/ft^3	BTU/lb	
	Source		Pipeline quality natural gas			
	Supplier		Local Utility			
	Halogens (Yes/No)		No			
	List and Identify Metals					

26. Gas burner mode of control:
☐ Manual ☐ Automatic hi-low
☐ Automatic full modulation ☐ Automatic on-off

27. Gas burner manufacture: Govenair

28. Oil burner manufacture:

29. If fuel oil is used, how is it atomized? ☐ Oil Pressure ☐ Steam Pressure ☐ Compressed Air ☐ Rotary Cup ☐ Other, specify

30. Fuel oil preheated: ☐ Yes ☐ No

31. If yes, indicate temperature: °F

32. Specify the calculated theoretical air requirements for combustion of the fuel or mixture of fuels described above actual cubic feet (ACF) per unit of fuel:
@ °F, PSIA, % moisture

33. Emission rate at rated capacity: lb/hr

34. Percent excess air actually required for combustion of the fuel described: %

Coal Characteristics

35. Seams:

36. Proximate analysis (dry basis): % of Fixed Carbon: % of Sulfur:
% of Moisture: % of Volatile Matter:
% of Ash:

Emissions Stream

37. What quantities of pollutants will be emitted from the boiler before controls?

Pollutant	Pounds per Hour lb/hr	grain/ACF	@ °F	PSIA
CO	0.11			
Hydrocarbons	-			
NO_x	0.13			
Pb	<0.001			
PM_{10}	0.01			
SO_2	0.001			
VOCs	0.007			
Other (specify)	See attachment N			

38. What quantities of pollutants will be emitted from the boiler after controls?

Pollutant	Pounds per Hour lb/hr	grain/ACF	@ °F	PSIA
CO	0.11			
Hydrocarbons	-			
NO_x	0.13			
Pb	<0.001			
PM_{10}	0.01			
SO_2	0.001			
VOCs	0.007			
Other (specify)	See attachment N			

39. How will waste material from the process and control equipment be disposed of?

40. Have you completed an *Air Pollution Control Device Sheet(s)* for the control(s) used on this Emission Unit.

41. Have you included the ***air pollution rates*** on the Emissions Points Data Summary Sheet? YES

42. **Proposed Monitoring, Recordkeeping, Reporting, and Testing**
Please propose monitoring, recordkeeping, and reporting in order to demonstrate compliance with the proposed operating parameters. Please propose testing in order to demonstrate compliance with the proposed emissions limits.

MONITORING PLAN: Please list (1) describe the process parameters and how they were chosen (2) the ranges and how they were established for monitoring to demonstrate compliance with the operation of this process equipment operation or air pollution control device.

TESTING PLAN: Please describe any proposed emissions testing for this process equipment or air pollution control device.

RECORDKEEPING: Please describe the proposed recordkeeping that will accompany the monitoring.

REPORTING: Please describe the proposed frequency of reporting of the recordkeeping.

43. Describe all operating ranges and maintenance procedures required by Manufacturer to maintain warranty.

The operation and maintenance manual will specify any required procedures.

Attachment L
Emission Unit Data Sheet
(INDIRECT HEAT EXCHANGER)

Control Device ID No. (must match List Form): N/A

Equipment Information

1. Manufacturer: Plenum	2. Model No. 2.0 MMBtu/hr Boiler Serial No. G-04-1042,G-04-1041,G-03-794,G-03-795
3. Number of units: 4	4. Use: Produces steam.
5. Rated Boiler Horsepower: hp	6. Boiler Serial No.: G-04-1042, G-04-1041, G-03-794, G-03-795
7. Date constructed: 2003, 2004	8. Date of last modification and explain: None
9. Maximum design heat input per unit: 2.0 ×10^6 BTU/hr	10. Peak heat input per unit: 2.0 ×10^6 BTU/hr
11. Steam produced at maximum design output: LB/hr 160 psig	12. Projected Operating Schedule: Hours/Day 24 Days/Week 5 Weeks/Year 52
13. Type of firing equipment to be used: ☐ Pulverized coal ☐ Spreader stoker ☐ Oil burners ☒ Natural Gas Burner ☐ Others, specify	14. Proposed type of burners and orientation: ☒ Vertical ☐ Front Wall ☐ Opposed ☐ Tangential ☐ Others, specify
15. Type of draft: ☐ Forced ☐ Induced	16. Percent of ash retained in furnace: %
17. Will flyash be reinjected? ☐ Yes ☐ No	18. Percent of carbon in flyash: %

Stack or Vent Data

19. Inside diameter or dimensions: 0.25 ft.	20. Gas exit temperature: 500 °F
21. Height: 20 ft.	22. Stack serves: ☒ This equipment only ☐ Other equipment also (submit type and rating of all other equipment exhausted through this stack or vent)
23. Gas flow rate: 300 ft^3/min	
24. Estimated percent of moisture: %	

Fuel Requirements

25.	Type	Fuel Oil No.	Natural Gas	Gas (other, specify)	Coal, Type:	Other:
	Quantity (at Design Output)	gph@60°F	1,960.8 ft^3/hr	ft^3/hr	TPH	
	Annually	$\times 10^3$ gal	12.23 $\times 10^6$ ft^3/hr	$\times 10^6$ ft^3/hr	tons	
	Sulfur	Maximum: wt. % Average: wt. %	0.25 gr/100 ft^3	gr/100 ft^3	Maximum: wt. %	
	Ash (%)				Maximum	
	BTU Content	BTU/Gal. Lbs/Gal.@60°F	1,020 BTU/ft^3	BTU/ft^3	BTU/lb	
	Source		Pipeline quality natural gas			
	Supplier		Local Utility			
	Halogens (Yes/No)		No			
	List and Identify Metals					

26. Gas burner mode of control:
☐ Manual ☐ Automatic hi-low
☐ Automatic full modulation ☐ Automatic on-off

27. Gas burner manufacture: Plenum

28. Oil burner manufacture:

29. If fuel oil is used, how is it atomized? ☐ Oil Pressure ☐ Steam Pressure ☐ Compressed Air ☐ Rotary Cup ☐ Other, specify

30. Fuel oil preheated: ☐ Yes ☐ No

31. If yes, indicate temperature: °F

32. Specify the calculated theoretical air requirements for combustion of the fuel or mixture of fuels described above actual cubic feet (ACF) per unit of fuel:
@ °F, PSIA, % moisture

33. Emission rate at rated capacity: lb/hr

34. Percent excess air actually required for combustion of the fuel described: %

Coal Characteristics

35. Seams:

36. Proximate analysis (dry basis): % of Fixed Carbon: % of Sulfur:
% of Moisture: % of Volatile Matter:
% of Ash:

Emissions Stream

37. What quantities of pollutants will be emitted from the boiler before controls?

Pollutant	Pounds per Hour lb/hr	grain/ACF	@ °F	PSIA
CO	0.16			
Hydrocarbons	-			
NO_x	0.20			
Pb	<0.001			
PM_{10}	0.015			
SO_2	0.001			
VOCs	0.011			
Other (specify)	See attachment N			

38. What quantities of pollutants will be emitted from the boiler after controls?

Pollutant	Pounds per Hour lb/hr	grain/ACF	@ °F	PSIA
CO	0.16			
Hydrocarbons	-			
NO_x	0.20			
Pb	<0.001			
PM_{10}	0.015			
SO_2	0.001			
VOCs	0.011			
Other (specify)	See attachment N			

39. How will waste material from the process and control equipment be disposed of?

40. Have you completed an *Air Pollution Control Device Sheet(s)* for the control(s) used on this Emission Unit.

41. Have you included the ***air pollution rates*** on the Emissions Points Data Summary Sheet? Yes

42. **Proposed Monitoring, Recordkeeping, Reporting, and Testing**

Please propose monitoring, recordkeeping, and reporting in order to demonstrate compliance with the proposed operating parameters. Please propose testing in order to demonstrate compliance with the proposed emissions limits.

MONITORING PLAN: Please list (1) describe the process parameters and how they were chosen (2) the ranges and how they were established for monitoring to demonstrate compliance with the operation of this process equipment operation or air pollution control device.

TESTING PLAN: Please describe any proposed emissions testing for this process equipment or air pollution control device.

RECORDKEEPING: Please describe the proposed recordkeeping that will accompany the monitoring.

REPORTING: Please describe the proposed frequency of reporting of the recordkeeping.

43. Describe all operating ranges and maintenance procedures required by Manufacturer to maintain warranty.

The operation and maintenance manual will specify any required procedures.

ATTACHMENT N

SUPPORTING EMISSIONS CALCULATIONS

Natural Gas Generator - Dayton 4W117H 20 kW - Prior to 2003 (S01)

Pollutant	Emission Factor	Emission Factor Units	Emission Factor Basis / Source	Engine Rating (bhp)	Fuel Consumption (Btu/bhp-hr)	Heat Value of Natural Gas (Btu/scf)	Annual Operating Hours	Max. Hourly Emissions. (lb/hr)	Max. Annual Emissions. (tpy)
VOC's	1.18E-01	lb/MMBtu	AP-42 Chapter 3.2	27	15,640	1,020	500	0.05	0.01
Hexane	1.11E-03	lb/MMBtu	AP-42 Chapter 3.2	27	15,640	1,020	500	<0.001	<0.001
Formaldehyde	5.28E-02	lb/MMBtu	AP-42 Chapter 3.2	27	15,640	1,020	500	0.02	0.01
Benzene	4.40E-04	lb/MMBtu	AP-42 Chapter 3.2	27	15,640	1,020	500	<0.001	<0.001
Toluene	4.08E-04	lb/MMBtu	AP-42 Chapter 3.2	27	15,640	1,020	500	<0.001	<0.001
Ethylbenze	3.97E-05	lb/MMBtu	AP-42 Chapter 3.2	27	15,640	1,020	500	<0.001	<0.001
Xylene	1.84E-04	lb/MMBtu	AP-42 Chapter 3.2	27	15,640	1,020	500	<0.001	<0.001
CO	0.32	lb/MMBtu	AP-42 Chapter 3.2	27	15,640	1,020	500	0.13	0.03
NOx	4.08	lb/MMBtu	AP-42 Chapter 3.2	27	15,640	1,020	500	1.72	0.43
PM_{10}	9.91E-03	lb/MMBtu	AP-42 Chapter 3.2	27	15,640	1,020	500	0.00	0.00
SO_2	5.88E-04	lb/MMBtu	AP-42 Chapter 3.2	27	15,640	1,020	500	<0.001	<0.001
CO_2	53.06	kg CO_2 / MMBtu	40 CFR Subpart C	27	15,640	1,020	500	59.79	14.95
CH_4	0.001	kg CH_4 / MMBtu	40 CFR Subpart C	27	15,640	1,020	500	0.001	<0.001
N_2O	0.0001	kg N_2O / MMBtu	40 CFR Subpart C	27	15,640	1,020	500	<0.001	<0.001
Total HAPs								0.02	0.01
Total CO_2e								59.85	14.96

Notes:

-Emission rates displayed above represent the max. hourly and max. annual emissions for one NG generator.

-Greenhouse Gas Emissions are calculated using 40 CFR 98 Subpart C Table C-1 and C-2 emission factors.

- AP-42, Chapter 3.2, Table 3.2-2 - Uncontrolled Emission Factors for 4-Stroke Lean Burn Engines

-Max. Annual Emissions based upon Max. Hourly Emissions @ 500 hr/yr.

-CO_2 equivalency solved for using Global Warming Potentials found in 40 CFR 98 Table A-1 (Updated January 2014). GWP CO_2=1, GWP CH_4=25, GWP N_2O=298

- Vendor Guarantee Emissions are converted from g/kW-hr to g/bhp-hr. 1 kW = 1.34 bhp

- Fuel consumption (Btu/bhp-hr) = Fuel Usage provided by manufacturer (414 scf/hr) * heating value (1020 btu/scf) / horsepower (27)

Example Equations:

Max. Hourly Emission Rate **(lb/hr) =** Emission Factor **(lb/10^6 scf)** ÷ Heating Value of Natural Gas **(Btu/scf)** x Boiler Rating (**MMBtu/hr)**

Natural Gas Generator - Dayton 4LM43 - 67 hp - Prior to 2003 (S02)

Pollutant	Emission Factor	Emission Factor Units	Emission Factor Basis / Source	Engine Rating (bhp)	Fuel Consumption (Btu/bhp-hr)	Heat Value of Natural Gas (Btu/scf)	Annual Operating Hours	Max. Hourly Emissions. (lb/hr)	Max. Annual Emissions. (tpy)
VOC's	1.18E-01	lb/MMBtu	AP-42 Chapter 3.2	67	11,707	1,020	500	0.09	0.02
Hexane	1.11E-03	lb/MMBtu	AP-42 Chapter 3.2	67	11,707	1,020	500	<0.001	<0.001
Formaldehyde	5.28E-02	lb/MMBtu	AP-42 Chapter 3.2	67	11,707	1,020	500	0.04	0.01
Benzene	4.40E-04	lb/MMBtu	AP-42 Chapter 3.2	67	11,707	1,020	500	<0.001	<0.001
Toluene	4.08E-04	lb/MMBtu	AP-42 Chapter 3.2	67	11,707	1,020	500	<0.001	<0.001
Ethylbenze	3.97E-05	lb/MMBtu	AP-42 Chapter 3.2	67	11,707	1,020	500	<0.001	<0.001
Xylene	1.84E-04	lb/MMBtu	AP-42 Chapter 3.2	67	11,707	1,020	500	<0.001	<0.001
CO	0.32	lb/MMBtu	AP-42 Chapter 3.2	67	11,707	1,020	500	0.25	0.06
NOx	4.08	lb/MMBtu	AP-42 Chapter 3.2	67	11,707	1,020	500	3.20	0.80
PM_{10}	9.91E-03	lb/MMBtu	AP-42 Chapter 3.2	67	11,707	1,020	500	0.01	0.00
SO_2	5.88E-04	lb/MMBtu	AP-42 Chapter 3.2	67	11,707	1,020	500	<0.001	<0.001
CO_2	53.06	kg CO_2 / MMBtu	40 CFR Subpart C	67	11,707	1,020	500	111.06	27.77
CH_4	0.001	kg CH_4 / MMBtu	40 CFR Subpart C	67	11,707	1,020	500	0.002	<0.001
N_2O	0.0001	kg N_2O / MMBtu	40 CFR Subpart C	67	11,707	1,020	500	<0.001	<0.001
Total HAPs								0.04	0.01
Total CO_2e								111.18	27.79

Notes:

-Emission rates displayed above represent the max. hourly and max. annual emissions for one NG generator.

-Greenhouse Gas Emissions are calculated using 40 CFR 98 Subpart C Table C-1 and C-2 emission factors.

- AP-42, Chapter 3.2, Table 3.2-2 - Uncontrolled Emission Factors for 4-Stroke Lean Burn Engines

-Max. Annual Emissions based upon Max. Hourly Emissions @ 500 hr/yr.

-CO_2 equivalency solved for using Global Warming Potentials found in 40 CFR 98 Table A-1 (Updated January 2014). GWP CO_2=1, GWP CH_4=25, GWP N_2O=298

- Vendor Guarantee Emissions are converted from g/kW-hr to g/bhp-hr. 1 kW = 1.34 bhp

- Fuel consumption (Btu/bhp-hr) = Fuel Usage provided by manufacturer (769 scf/hr) * heating value (1020 btu/scf) / horsepower (67)

Example Equations:

Max. Hourly Emission Rate **(lb/hr) =** Emission Factor **(lb/10^6 scf)** ÷ Heating Value of Natural Gas **(Btu/scf)** x Boiler Rating (**MMBtu/hr)**

Natural Gas Generator - Caterpillar 3406 - 150 kW - 2005 (S03)

Pollutant	Emission Factor	Emission Factor Units	Emission Factor Basis / Source	Engine Rating (bhp)	Fuel Consumption (Btu/bhp-hr)	Heat Value of Natural Gas (Btu/scf)	Annual Operating Hours	Max. Hourly Emissions. (lb/hr)	Max. Annual Emissions. (tpy)
VOC's	1.18E-01	lb/MMBtu	AP-42 Chapter 3.2	201	9,915	1,020	500	0.24	0.06
Hexane	1.11E-03	lb/MMBtu	AP-42 Chapter 3.2	201	9,915	1,020	500	0.00	<0.001
Formaldehyde	5.28E-02	lb/MMBtu	AP-42 Chapter 3.2	201	9,915	1,020	500	0.11	0.03
Benzene	4.40E-04	lb/MMBtu	AP-42 Chapter 3.2	201	9,915	1,020	500	<0.001	<0.001
Toluene	4.08E-04	lb/MMBtu	AP-42 Chapter 3.2	201	9,915	1,020	500	<0.001	<0.001
Ethylbenze	3.97E-05	lb/MMBtu	AP-42 Chapter 3.2	201	9,915	1,020	500	<0.001	<0.001
Xylene	1.84E-04	lb/MMBtu	AP-42 Chapter 3.2	201	9,915	1,020	500	<0.001	<0.001
CO	12.50	g/bhp-hr	Manfacture Spec Sheet	201	9,915	1,020	500	5.54	1.39
NOx	11.30	g/bhp-hr	Manfacture Spec Sheet	201	9,915	1,020	500	5.01	1.25
PM_{10}	9.91E-03	lb/MMBtu	AP-42 Chapter 3.2	201	9,915	1,020	500	0.02	0.00
SO_2	5.88E-04	lb/MMBtu	AP-42 Chapter 3.2	201	9,915	1,020	500	0.00	<0.001
CO_2	53.06	kg CO_2 / MMBtu	40 CFR Subpart C	201	9,915	1,020	500	282.19	70.55
CH_4	0.001	kg CH_4 / MMBtu	40 CFR Subpart C	201	9,915	1,020	500	0.005	0.001
N_2O	0.0001	kg N_2O / MMBtu	40 CFR Subpart C	201	9,915	1,020	500	<0.001	<0.001
Total HAPs								0.11	0.03
Total CO_2e								282.48	70.62

Notes:

-Emission rates displayed above represent the max. hourly and max. annual emissions for one NG generator.

-Greenhouse Gas Emissions are calculated using 40 CFR 98 Subpart C Table C-1 and C-2 emission factors.

- AP-42, Chapter 3.2, Table 3.2-2 - Uncontrolled Emission Factors for 4-Stroke Lean Burn Engines

-Max. Annual Emissions based upon Max. Hourly Emissions @ 500 hr/yr.

-CO_2 equivalency solved for using Global Warming Potentials found in 40 CFR 98 Table A-1 (Updated January 2014). GWP CO_2=1, GWP CH_4=25, GWP N_2O=298

- Vendor Guarantee Emissions are converted from g/kW-hr to g/bhp-hr. 1 kW = 1.34 bhp

- Vendor Guarantee Emissions are listed in Attachment I

- Fuel consumption (Btu/bhp-hr) = Fuel Usage provided by manufacturer (1954 scf/hr) * heating value (1020 btu/scf) / horsepower (201)

Example Equations:

Max. Hourly Emission Rate **(lb/hr) =** Emission Factor **(lb/10^6 scf)** ÷ Heating Value of Natural Gas **(Btu/scf)** x Boiler Rating (**MMBtu/hr)**

Natural Gas Generator - Caterpillar G60F3 - 60 kW - 02/2006 (S04)

Pollutant	Emission Factor	Emission Factor Units	Emission Factor Basis / Source	Engine Rating (bhp)	Fuel Consumption (Btu/bhp-hr)	Heat Value of Natural Gas (Btu/scf)	Annual Operating Hours	Max. Hourly Emissions. (lb/hr)	Max. Annual Emissions. (tpy)
VOC's	1.18E-01	lb/MMBtu	AP-42 Chapter 3.2	80	9,167	1,020	500	0.09	0.02
Hexane	1.11E-03	lb/MMBtu	AP-42 Chapter 3.2	80	9,167	1,020	500	<0.001	<0.001
Formaldehyde	5.28E-02	lb/MMBtu	AP-42 Chapter 3.2	80	9,167	1,020	500	0.04	0.01
Benzene	4.40E-04	lb/MMBtu	AP-42 Chapter 3.2	80	9,167	1,020	500	<0.001	<0.001
Toluene	4.08E-04	lb/MMBtu	AP-42 Chapter 3.2	80	9,167	1,020	500	<0.001	<0.001
Ethylbenze	3.97E-05	lb/MMBtu	AP-42 Chapter 3.2	80	9,167	1,020	500	<0.001	<0.001
Xylene	1.84E-04	lb/MMBtu	AP-42 Chapter 3.2	80	9,167	1,020	500	<0.001	<0.001
CO	0.32	lb/MMBtu	AP-42 Chapter 3.2	80	9,167	1,020	500	0.23	0.06
NOx	4.08	lb/MMBtu	AP-42 Chapter 3.2	80	9,167	1,020	500	2.99	0.75
PM_{10}	9.91E-03	lb/MMBtu	AP-42 Chapter 3.2	80	9,167	1,020	500	0.01	0.00
SO_2	5.88E-04	lb/MMBtu	AP-42 Chapter 3.2	80	9,167	1,020	500	<0.001	<0.001
CO_2	53.06	kg CO_2 / MMBtu	40 CFR Subpart C	80	9,167	1,020	500	103.84	25.96
CH_4	0.001	kg CH_4 / MMBtu	40 CFR Subpart C	80	9,167	1,020	500	0.002	<0.001
N_2O	0.0001	kg N_2O / MMBtu	40 CFR Subpart C	80	9,167	1,020	500	<0.001	<0.001
Total HAPs								0.04	0.01
Total CO_2e								103.95	25.99

Notes:

-Emission rates displayed above represent the max. hourly and max. annual emissions for one NG generator.

-Greenhouse Gas Emissions are calculated using 40 CFR 98 Subpart C Table C-1 and C-2 emission factors.

- AP-42, Chapter 3.2, Table 3.2-2 - Uncontrolled Emission Factors for 4-Stroke Lean Burn Engines

-Max. Annual Emissions based upon Max. Hourly Emissions @ 500 hr/yr.

-CO_2 equivalency solved for using Global Warming Potentials found in 40 CFR 98 Table A-1 (Updated January 2014). GWP CO_2=1, GWP CH_4=25, GWP N_2O=298

- Vendor Guarantee Emissions are converted from g/kW-hr to g/bhp-hr. 1 kW = 1.34 bhp

- Fuel consumption (Btu/bhp-hr) = Fuel Usage provided by manufacturer (719 scf/hr) * heating value (1020 btu/scf) / horsepower (80)

Example Equations:

Max. Hourly Emission Rate **(lb/hr) =** Emission Factor **(lb/10^6 scf)** ÷ Heating Value of Natural Gas **(Btu/scf)** x Boiler Rating (**MMBtu/hr)**

Boiler - Plenum - 2.0 MMBtu/hr (S06 - S09)

Pollutant	Emission Factor	Emission Factor Units	Emission Factor Basis / Source	Boiler Rating (MMBtu/hr)	Heat Value of Natural Gas (Btu/scf)	Annual Operating Hours	Max. Hourly Emissions. (lb/hr)	Max. Annual Emissions. (tpy)	Max. Annual Emissions. (tpy)
VOC's	5.5	$lb/10^6$ scf	AP-42 Chapter 1.4	2.00	1,020	6,240	0.011	0.03	0.03
Hexane	1.8	$lb/10^6$ scf	AP-42 Chapter 1.4	2.00	1,020	6,240	0.004	0.011	0.01
Formaldehyde	0.075	$lb/10^6$ scf	AP-42 Chapter 1.4	2.00	1,020	6,240	<0.001	0.000	<0.001
Benzene	0.0021	$lb/10^6$ scf	AP-42 Chapter 1.4	2.00	1,020	6,240	<0.001	0.000	<0.001
Toluene	0.0034	$lb/10^6$ scf	AP-42 Chapter 1.4	2.00	1,020	6,240	<0.001	0.000	<0.001
Pb	0.0005	$lb/10^6$ scf	AP-42 Chapter 1.4	2.00	1,020	6,240	<0.001	0.000	<0.001
CO	84	$lb/10^6$ scf	AP-42 Chapter 1.4	2.00	1,020	6,240	0.16	0.51	0.51
NOx	100	$lb/10^6$ scf	AP-42 Chapter 1.4	2.00	1,020	6,240	0.20	0.61	0.61
PM_{10}	7.6	$lb/10^6$ scf	AP-42 Chapter 1.4	2.00	1,020	6,240	0.01	0.05	0.05
SO_2	0.6	$lb/10^6$ scf	AP-42 Chapter 1.4	2.00	1,020	6,240	0.001	0.004	0.004
CO_2	53.06	kg CO_2 / MMBtu	40 CFR Subpart C	2.00	1,020	6,240	233.95	729.94	729.94
CH_4	0.001	kg CO_2 / MMBtu	40 CFR Subpart C	2.00	1,020	6,240	0.004	0.01	0.01
N_2O	0.0001	kg CO_2 / MMBtu	40 CFR Subpart C	2.00	1,020	6,240	<0.001	0.001	0.001
Total HAPs							0.004	0.012	0.01
Total CO_2e							234.20	730.69	730.69

Notes:

-Emission rates displayed above represent the max. hourly and max. annual emissions for one boiler. Cumulative emission rates for all 4 boilers are diplayed in the Total Site Emissions Table.
-Greenhouse Gas Emissions are calculated using 40 CFR 98 Subpart C Table C-1 and C-2 emission factors.
-AP-42, Chapter 1.4 references are from the July 1998 revision.
-Max. Annual Emissions based upon Max. Hourly Emissions @ 6240 hr/yr.
-CO_2 equivalency solved for using Global Warming Potentials found in 40CFR98 Table A-1 (Updated January 2014). GWP CO_2=1, GWP CH_4=25, GWP N_2O=298

Example Equations:

Max. Hourly Emission Rate **(lb/hr) =** Emission Factor **($lb/10^6$ scf) ÷** Heating Value of Natural Gas **(Btu/scf)** x Boiler Rating (**MMBtu/hr)**

Boiler - Govenair - 1.3 MMBtu/hr (S10)

Pollutant	Emission Factor	Emission Factor Units	Emission Factor Basis / Source	Boiler Rating (MMBtu/hr)	Heat Value of Natural Gas (Btu/scf)	Annual Operating Hours	Max. Hourly Emissions. (lb/hr)	Max. Annual Emissions. (tpy)
VOC's	5.5	$lb/10^6$ scf	AP-42 Chapter 1.4	1.30	1,020	6,240	0.007	0.02
Hexane	1.8	$lb/10^6$ scf	AP-42 Chapter 1.4	1.30	1,020	6,240	0.002	0.007
Formaldehyde	0.075	$lb/10^6$ scf	AP-42 Chapter 1.4	1.30	1,020	6,240	<0.001	<0.001
Benzene	0.0021	$lb/10^6$ scf	AP-42 Chapter 1.4	1.30	1,020	6,240	<0.001	<0.001
Toluene	0.0034	$lb/10^6$ scf	AP-42 Chapter 1.4	1.30	1,020	6,240	<0.001	<0.001
Pb	0.0005	$lb/10^6$ scf	AP-42 Chapter 1.4	1.30	1,020	6,240	<0.001	<0.001
CO	84	$lb/10^6$ scf	AP-42 Chapter 1.4	1.30	1,020	6,240	0.11	0.33
NOx	100	$lb/10^6$ scf	AP-42 Chapter 1.4	1.30	1,020	6,240	0.13	0.40
PM_{10}	7.6	$lb/10^6$ scf	AP-42 Chapter 1.4	1.30	1,020	6,240	0.010	0.03
SO_2	0.6	$lb/10^6$ scf	AP-42 Chapter 1.4	1.30	1,020	6,240	<0.001	0.002
CO_2	53.06	kg CO_2 / MMBtu	40 CFR Subpart C	1.30	1,020	6,240	152.07	474.46
CH_4	0.001	kg CO_2 / MMBtu	40 CFR Subpart C	1.30	1,020	6,240	0.003	0.01
N_2O	0.0001	kg CO_2 / MMBtu	40 CFR Subpart C	1.30	1,020	6,240	<0.001	<0.001
Total HAPs							0.002	0.007
Total CO_2e							152.23	474.95

Notes:

-Emission rates displayed above represent the max. hourly and max. annual emissions for one boiler.
-Greenhouse Gas Emissions are calculated using 40 CFR 98 Subpart C Table C-1 and C-2 emission factors.
-AP-42, Chapter 1.4 references are from the July 1998 revision.
-Max. Annual Emissions based upon Max. Hourly Emissions @ 6240 hr/yr.
-CO_2 equivalency solved for using Global Warming Potentials found in 40CFR98 Table A-1 (Updated January 2014). GWP CO_2=1, GWP CH_4=25, GWP N_2O=298

Example Equations:

Max. Hourly Emission Rate **(lb/hr) =** Emission Factor **($lb/10^6$ scf) ÷** Heating Value of Natural Gas **(Btu/scf)** x Boiler Rating (**MMBtu/hr)**

Total Alcon Research South Site Emission Levels

	VOCs		HAPs		CO			NO_x			PM		SO_2		CO_2		CH_4		N_2O		CO_2e	
Emission Sources	**lb/hr**	**tons/yr**	**lb/hr**	**tons/yr**	**lb/hr**	**lb/day**	**tons/yr**	**lb/hr**	**lb/day**	**tons/yr**	**lb/hr**	**tons/yr**	**lb/hr**	**tons/yr**	**lb/hr**	**tons/yr**	**lb/hr**	**tons/yr**	**lb/hr**	**tons/yr**	**lb/hr**	**tons/yr**
Generator - Dayton 4W117H (S01)	0.05	0.01	0.02	0.01	0.13	3.21	0.03	1.72	41.35	0.43	0.004	0.00	<0.001	<0.001	59.79	14.95	0.001	<0.001	<0.001	<0.001	59.85	14.96
Generator - Dayton (S02)	0.09	0.02	0.04	0.01	0.25	5.97	0.06	3.20	76.81	0.80	0.008	0.00	<0.001	<0.001	111.06	27.77	0.002	<0.001	<0.001	<0.001	111.18	27.79
Generator - Caterpillar 3406 (S03)	0.24	0.06	0.11	0.03	5.54	132.96	1.39	5.01	120.20	1.25	0.020	0.00	0.001	<0.001	282.19	70.55	0.005	0.00	<0.001	<0.001	282.48	70.62
Generator - Caterpillar G60F3 (S04)	0.09	0.02	0.04	0.01	0.23	5.58	0.06	2.99	71.81	0.75	0.007	0.00	<0.001	<0.001	103.84	25.96	0.002	<0.001	<0.001	<0.001	103.95	25.99
**Generator - Caterpillar C15 (S05) - Emissions from R13-2518C	0.05	0.01	0.02	0.00	0.48	11.52	0.12	4.80	115.20	1.19	0.050	0.01	1.270	0.317	717.00	179.00	0.014	0.00	<0.001	<0.001	717.70	179.18
Boiler - 2.0 MMBtu/hr (S06 - S09)	0.04	0.13	0.01	0.05	0.66	15.81	2.06	0.78	18.82	2.45	0.06	0.19	0.005	0.015	935.82	2919.75	0.018	0.06	0.002	0.006	936.78	2,922.76
Boiler - 1.3 MMBtu/hr (S10)	0.01	0.02	0.00	0.01	0.11	2.57	0.33	0.13	3.06	0.40	0.010	0.03	0.001	0.002	152.07	474.46	0.003	0.01	0.000	0.001	152.23	474.95
Totals	**0.56**	**0.29**	**0.25**	**0.11**	**7.40**	**177.62**	**4.05**	**18.64**	**447.25**	**7.27**	**0.16**	**0.24**	**1.28**	**0.33**	**2,361.77**	**3,712.43**	**0.04**	**0.07**	**0.00**	**0.01**	**2,364.17**	**3,716.26**

Please read and save these instructions. Read carefully before attempting to assemble, install, operate or maintain the product described. Protect yourself and others by observing all safety information. Failure to comply with instructions could result in personal injury and/or property damage! Retain instructions for future reference.

Dayton® Standby Generator

Rec'd 6-1-00
Installed 7-3-00
Technical Support
847-535-5400
#2726
Mel
744-4949
Ser# 3110252 1-800-323-0620

Description

Model 4LM43 is a liquid-cooled, engine-driven generator set that produces 40,000 watts (40.0 kW) using either natural or Liquid Propane (LP) gas as fuel. The generator is designed for supplying electrical power that operates critical electrical loads during a utility power failure. The unit has been factory-installed in a weather resistant, all metal enclosure and is INTENDED FOR OUTDOOR INSTALLATION ONLY.

FEATURES

- Automatic System Operation
- Automatic Voltage Regulator
- Overcrank Protection
- Overspeed Protection
- Low Oil Pressure Shutdown
- High Temp./Low Level Coolant Shutdown
- Low Coolant Level Shutdown
- Automatic 7-Day Exerciser
- 12 VDC Generator Battery Charger
- Run Time Hourmeter
- Fault Indicator Light
- Engine Coolant Heater
- Battery Charger Ammeter
- RPM Sensor Loss

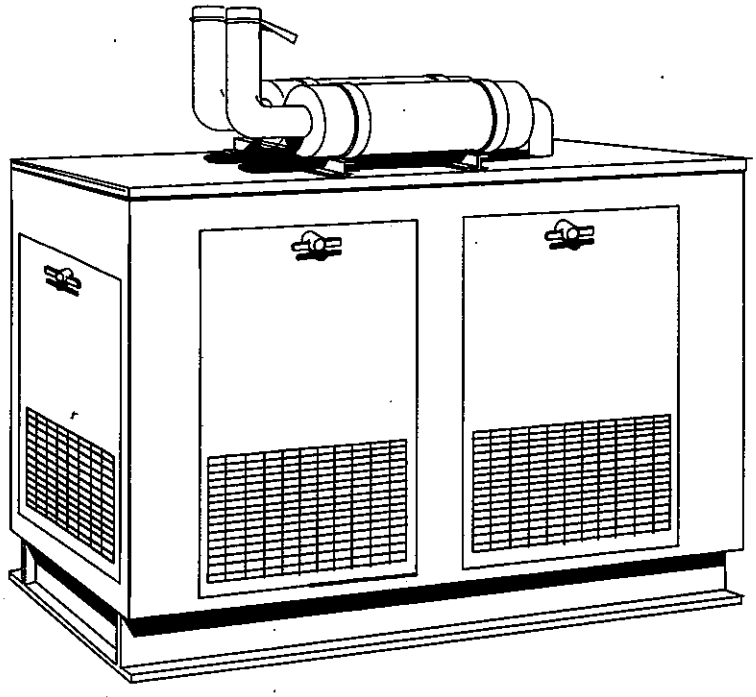


Figure 1 — Standby Generator

Table of Contents

Form 5S4171

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04348
0298/008/VCPVP

Dayton®

Dayton® Standby Generator

Specifications

Generator

Rated Maximum Power Capacity	+40,000 watts (40 kW)			
Rated AC Voltage	120/240 volts	120/240 volts	120/208 volts	277/480 volts
Phase	1Ø	3Ø	3Ø	3Ø
Rated Maximum Load Amperage	333/166 amps	240/120 amps	—/139 amps	—/60 amps
Stator Connection	12 lead			
Number of Rotor Poles	4			
Driven Speed of Rotor	1800 RPM			
Rotor Excitation	Brushless Type			
Rotor and Stator Insulation	Class "F"			
Rated AC Frequency	60 Hz at 1800 RPM			
Recommended Transfer Switch, 240 volts 1-phase				
Model Number	4W126			
Switch Amperage Rating	150 amps, 250 volts			

(+) Minimum wattage and current are subject to and limited by such factors as fuel BTU content, ambient temperature, altitude, engine power, condition, etc. Maximum power decreases about 3.5% for each 1000 feet above sea level; and will also decrease about 1% for each 10°F above 72°F.

Engine

Type of Engine	V-6, liquid-cooled
Number of Cylinders	6
Rated Horsepower	67 at 1800 RPM
Displacement	4.3 liters
Cylinder Block	Iron
Valve Arrangement	Overhead Valves
Ignition System	Electronic
Spark Plugs	AC 41-932 or equivalent
Spark Plug Gap	0.045" (1.1mm)
Compression Ratio	9.2 to 1
Starter	12 volt DC
Oil Filter	Full Flow Cartridge
Crankcase Oil Capacity	4.5 U.S. quarts, API rating 10W-30
Coolant Capacity	4.5 U.S. Gallons (17 Liters)
Air Filter	Pleated Paper

DIMENSIONS

Generator

Length	76 inches
Width	34.5 inches
Height (muffler installed)	54 inches
Height (muffler removed)	45 inches
Weight	2088 pounds

NOTE: See Figures23 and 24 for Installation Drawing

FUEL CONSUMPTION

Generator

Using Natural Gas	769 cubic ft. per hour
Using LP Gas	306 cubic ft. per hour

NOTE: Fuel consumption is listed at the approximate amount of fuel the unit consumes at 100% rated load. Actual fuel consumption may vary depending on BTU content of fuel, applied load, ambient conditions, engine condition, etc.

Model 4LM43

Unpacking

Handle shipping cartons and crates with care. Use care to avoid damage from dropping, bumping, collision, etc. Store and unpack cartons with the proper side up as noted on the shipping carton.

INSPECTION

After unpacking, carefully inspect generator and transfer switch for any damage that may have occurred during shipment. If loss or damage is noted at time of delivery, have person(s) making delivery note all damage on freight bill or affix his or her signature under consignor's memo of loss or damage.

If you note loss or damage after delivery, separate the damaged materials and contact the carrier for claim procedure.

"Concealed damage" is understood to mean damage to the contents of a package which is not in evidence at the time of delivery, but is discovered later. The carrier or carriers are responsible for merchandise lost or damaged in transit. The title to goods rests with the consignee when generators are shipped FOB factory and only the consignee can legally file claims.

NOTE: Critical grade muffler and flexible exhaust pipe are included with this unit, packed in a separate carton, which has been banded to the frame.

LIFTING THE GENERATOR

⚠WARNING ***If lifting the generator or hoisting equipment, be careful not to touch overhead power lines. Proper tools and equipment and qualified personnel should be used in all phases of handling and unpacking.***

General Safety Information

Watch for specific safety rules and symbols. Each area of the manual has related safety information.

⚠ DANGER ***Indicates an immediately hazardous situation which, if not avoided, will result in death or serious injury. Danger is limited to the most extreme situations.***

⚠WARNING ***Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.***

⚠ CAUTION ***Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. Caution may also be used to alert against unsafe practices.***

NOTE: Indicates a statement of company policy as the message relates directly or indirectly to the safety of personnel or protection of property.

Dayton recommends fastening a copy of the following general safety "rules" in a conspicuous place near the generator or transfer switch or both.

Every possible circumstance that might involve a hazard cannot be anticipated. The warnings in this manual and on tags and decals affixed to the unit are, therefore, not all-inclusive. If using a procedure, work method, or operating technique not specifically recommended, satisfy yourself that it is safe for you and others. Also satisfy yourself that the procedure, work method, or techniques chosen will not render the equipment unsafe.

⚠WARNING ***Connecting this unit to an electrical system normally supplied by an electric utility shall be by means of a double throw switch (such as the Dayton Automatic Transfer Switch). The transfer switch will isolate the generator electric system from the electric utility distribution system when the generator is operating (NEC 701). Failure to isolate the two electric system power sources from each other by such means may result in damage to the generator and may also result in injury or death to utility power workers due to backfeed of electrical energy.***

1. Installing a standby electric system is not a "do-it-yourself" project. Only qualified installation contractors or electricians who are familiar with applicable codes, standards, regulations and procedures should install the system. Improper or unauthorized installation, operation, or service of this equipment is extremely hazardous and may result in serious personal injury or death.
2. DO NOT permit anyone to operate the standby electric system without proper instruction.
3. Comply with regulations of the United States National Electric Code (NEC) as well as state and local codes and Occupational Safety and Health Administration (OSHA) established in the United States.
4. This equipment, when installed as part of a standby electric power system, must be installed in conjunction with an approved transfer switch.

Dayton®

Dayton® Standby Generator

General Safety Information (Continued)

a. The transfer switch serves to prevent both generator and utility power from being connected to the load circuits at the same time.

b. A properly connected transfer switch helps to prevent backfeed of generator power into commercial lines while the standby generator is operating.

5. This equipment supplies extremely high and dangerous power voltages. Any contact with high electrically "hot" components will result in extremely hazardous, and possibly LETHAL, electrical shock. Use care to avoid contact with live terminals, bare connectors, bare wires, etc.
6. Never handle any kind of electrical device while standing in water, while barefoot, or while hands or feet are wet. Dangerous electrical shock can result.
7. Do not wear any kind of jewelry (such as rings, watches, bracelets, etc.) while operating this equipment. Jewelry conducts electricity which can cause dangerous electrical shock.
8. Keep the area clean and uncluttered. Remove all materials that might become a fire hazard. Remove all slippery materials such as grease, oil, snow, water, or ice.
9. Be very careful and remain alert at all times when working on or around this equipment. Never work on or around the equipment when physically or mentally tired.
10. When installed and interconnected with the transfer switch, the generator may crank and start at anytime without warning. To prevent possible injury if such a start and transfer occurs, always set the generator's AUTO-MANUAL-OFF Switch to its OFF position before working on equipment. Then place a "DO NOT OPERATE" tag on the generator Control Console.
11. Keep a fire extinguisher on hand near the generator set and know how to use it. Extinguishers rated "ABC" by the National Fire Protection Association are the appropriate kind.
12. This generator is designed for installing out of doors only. Never install this unit inside any room, enclosure or basement. The generator needs adequate cooling and ventilation for continued proper and safe operation.
13. The United States National Electrical Code requires the frame and external electrically conductive parts of the generator be connected to an approved earth ground. Review local electrical codes that may also require proper grounding of the generator.

⚠ WARNING ***Storage batteries give off explosive hydrogen gas while charging. The gas can form an explosive mixture around the battery for several hours after charging. Any spark, heat or flames can ignite the gas and cause an explosion which can shatter the battery, causing blindness or other serious injury.***

⚠ WARNING ***Battery electrolyte fluid is an extremely caustic sulfuric solution that can cause severe burns. DO NOT permit fluid to contact eyes, skin, clothing, painted surfaces, wiring insulation, etc. If spilled, flush the affected area with clear water immediately.***

⚠ WARNING ***Gaseous fuels such as natural gas and LP gas are highly explosive. Even the slightest spark can ignite such fuels and cause an explosion. No leakage of fuel is permitted. Natural gas, which is lighter than air, tends to collect in high areas. LP gas is heavier than air and tends to settle in low areas. Consult with local fire marshal for safety requirements.***

Preinstallation

PLANNING

Installers should plan the installation of this equipment carefully. When planning, consider the following factors:

1. Size of the generator and space required.
2. Weight of the generator.
3. Best outdoor location for generator. Best indoor location for transfer switch, options and accessories.
4. Adequate mounting and support.
5. Adequate flow of air for cooling, ventilation, and combustion.
6. Fuel supply must be free of leaks, and must be in compliance with applicable codes.
7. Fuel and exhaust piping runs, as well as wiring and conduit runs, should be as short as possible.

Model 4LM43

Preinstallation (Continued)

8. Transfer switch ampere rating must be adequate to handle system current flow.
9. Transfer switch voltage and phase ratings must be compatible with utility supply and load circuit ratings.
10. Generator's voltage and phase ratings must be compatible with utility supply and load circuit voltage and phase ratings.
11. The site must allow engine exhaust gases to be piped safely away, to an area where they will not endanger people or animals.
12. The proposed site must be clean, dry and not subject to flooding.
13. Decide on the circuit isolation method to power critical (essential) electrical loads.

VOLTAGE-PHASE SELECTOR BOARD

The Voltage-Phase Selector board (Figure 2) in the generator's AC connection panel permits the installer to select the proper AC output voltage and phase. By changing the board position on a "stud board," the installer may change generator AC power output to any of the following:

- 120/240 Volts, 1-Phase
- 120/240 Volts, 3-Phase
- 120/208 Volts, 3-Phase
- 277/480 Volts, 3-Phase

⚠ CAUTION ***The "voltage phase selector board" has been factory installed for the low WYE output mode.Do NOT connect electrical loads to generator AC output until you have determined the load is fully compatible with the CAUTION phase and voltage output. Consult with a qualified electrician when in doubt about generator and load compatibility. Some electrical loads may be severely damaged if connected to incorrect (incompatible) power source voltage, phase or frequency.***

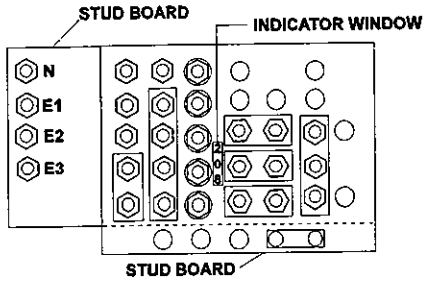

Figure 2 — Voltage Phase Selector Board Positions

Board Positions and wiring connections for each voltage and phase selection are shown in Figures 8-10.

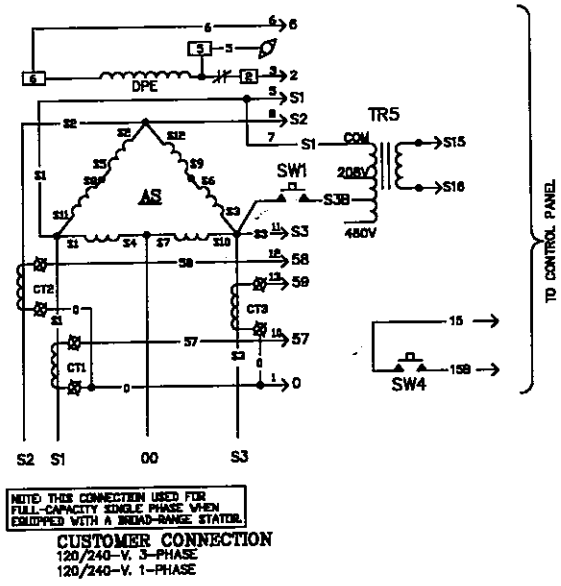

Figure 3 — Delta Connected Stator

The 12-stator output leads connect to studs on the stud board. By positioning strapping board over the studs in a certain way, the electrician can change the stator to (a) delta connected type, (b) a "Low-Wye" connected type, or (c) a "Hi-Wye" connected type.

Delta Connected: With strapping board positioned over stud board the stator is Delta connected for both 120/240 volts, 1-phase and 120/240 volts, 3-phase output (Figure 3).

Low-Wye Connected: With strapping board positioned over stud board the stator is "Low-Wye" connected for 120/208 volts, 3-phase output (Figure 4).

Hi-Wye Connected: With strapping board positioned over stud board the stator is "Hi-Wye" connected for 277/480 volts, 3-phase output (Figure 5).

Dayton® Standby Generator

Preinstallation (Continued)

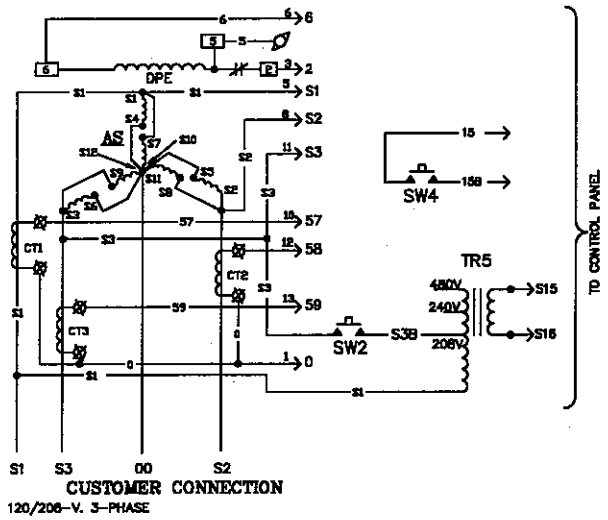

Figure 4 — "Low Wye" Connected Stator

N1, N2, and N3 = NORMAL (utility) power source
S11, S2, and S3 = EMERGENCY (standby) power source
T1, T2, and T3 = LOAD terminals
00 or Neutral = NEUTRAL terminal

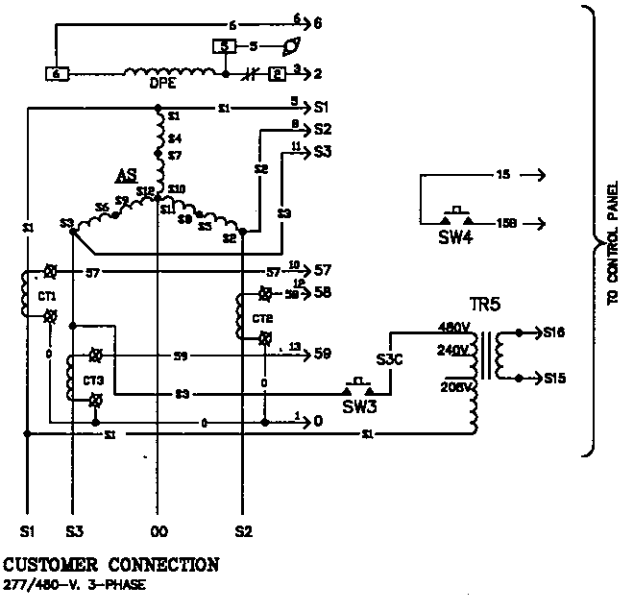

Figure 5 — "Hi Wye"Connected Stator

NOTE: If the position of the voltage-phase selector board is changed, also reconnect wiring at generator and transfer switch terminals E1, E2 and E3.

COOLING AND VENTILATING AIR

The engine-generator needs an adequate supply of air for cooling and ventilating, as well as ample air for engine combustion. The installer must make sure that sufficient air flow is available to (a) cool the engine-generator, (b) support engine combustion, and (c) remove toxic fumes and explosive gases.

The generator is equipped with a "pusher type" cooling fan. This type of fan draws air in and circulates it within the generator enclosure, then expels the air forward through the engine radiator and to the outdoors. Thus, the radiator end of the unit is its air outlet end; the Control Console end is the air inlet end.

AIR FLOW FOR OUTDOOR INSTALLATIONS

For outdoor installations, the design of the protective enclosure should provide adequate cooling and ventilating air provided the following general rules are followed:

1. If strong prevailing winds are a factor, face the generator's air inlet end into the prevailing wind.
2. The owner/operator must maintain air inlet and outlet openings in the compartment. Keep them free of obstructions such as leaves, grass, snow or ice.
3. Where leaves, grass, snow or ice might tend to obstruct air openings, consider using a windbreak or fence.

Model 4LM43

Preinstallation (Continued)

GENERATOR LOCATION

The generator should be installed outdoors on the ground or on the roof of a structure. In all cases, the unit must be installed with safety, reliability and economy in mind.

Figure 6, illustrates a typical outdoor installation. The transfer switch is installed indoors and as close as possible to the electrical load circuits. The generator is installed out-of-doors on a cement slab. Models are equipped with compartment enclosures that protect the unit from bad weather.

When planning the installation, be sure to allow about three feet of clearance around the entire generator set for maintenance and servicing.

GENERATOR SUPPORT

It is recommended that the generator be mounted on a cement slab. Install the slab on a firm surface that is not likely to shift or settle. The slab should extend past the generator to a distance of at least 12" on all sides. The slab must be level within ±5°. Use masonry type anchor bolts to retain the unit to the slab.

If the generator is to be installed on any combustible floor or roof, install a layer of non-combustible insulation under the unit, followed by a layer of sheet metal. Both insulation and the sheet metal must extend beyond the generator base, to a distance of at least 12 inches on all sides.

⚠ DANGER ***Considerations for proper rooftop placement and weight distribution must be designed by a qualified engineer or architect.***

EXHAUST SYSTEM — OUTDOOR INSTALLATION

The installer must do whatever is required to make sure that people or animals are not endangered by exhaust gases and temperatures.

⚠ WARNING ***Engine exhaust gives off DEADLY carbon monoxide gas. This dangerous gas, if breathed in sufficient concentrations, can cause unconsciousness or even death. The danger of carbon monoxide poisoning is greatly reduced when the generator is installed outdoors in a well-ventilated area.***

⚠ WARNING ***Engine exhaust and muffler temperatures are extremely high and can cause severe burns. Keep hands, all body parts and any combustible materials away from engine muffler and exhaust gases.***

CIRCUIT ISOLATION METHODS

Read Emergency Circuit Isolation Method and Total Circuit Isolation Method in the "Installation" section carefully.

The generator's rated wattage/ amperage capacity must be adequate to handle all electrical loads that the unit will power. Group the critical (essential) electrical loads together and wire them into a separate "emergency distribution panel."

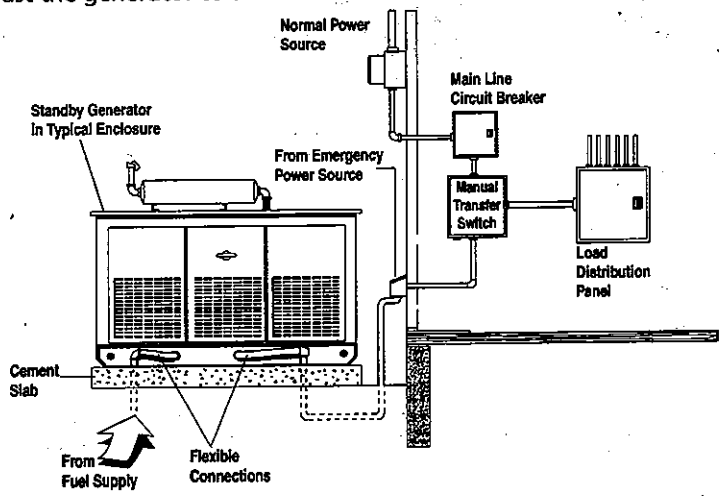

Figure 6 — Typical Outdoor Installation

Dayton® Standby Generator

Installation

⚠ DANGER ***It is not intended that the information in this manual should be used by any unqualified persons for the purpose of installing a standby electric power systems. Only qualified personnel should install, inspect, test and adjust such equipment. These people should be familiar with the equipment and installation requirements.***

⚠ WARNING ***Before proceeding with the installation, be sure the generator AUTO-MANUAL-OFF switch is set to OFF position. Place the safety disconnect switch (inside transfer switch enclosure) to the MANUAL position. The preceding will prevent accidental starting of the generator engine.***

NOTE: It would be extremely difficult, if not impractical, to attempt a detailed coverage of every installation possibility. For that reason, much of the information is general in nature. Plan the installation carefully. Information in this manual is provided as a guide only and is not meant to serve as a detailed installation plan. Illustrations provided in the manual must not be construed as installation blueprints.

Dayton could not possibly know of and advise the standby generator trade of all conceivable procedures and methods by which installation of this equipment might be achieved. Neither could all possible hazards and/or results of each method or procedure be known.

GASEOUS FUEL SYSTEMS

The generator's fuel system consists of a fuel shutoff valve, pressure reducing valve, and carburetor.

The engine was factory tested and adjusted using natural gas as a fuel.

Liquid propane (LP) gas as a fuel is acceptable, but will require fuel system reconfiguration (see page 9). No modifications to the system are required when natural gas is used as the fuel.

With LP gas, use only the vapor withdrawal type system. This type of system uses the vapors formed above the liquid fuel in the storage tank.

Recommended fuel should have a BTU content of at least 1000 BTUs per cubic foot for natural gas; or at least 2520 BTUs per cubic foot for LP gas. Ask your fuel supplier for the BTU content of your fuel.

Local gaseous fuel codes may vary widely. It is recommended that a local gas system installer should install and connect the gaseous fuel lines.

⚠ WARNING ***Gaseous fuels are highly explosive. Even the slightest spark can cause an explosion. The fuel system must be properly installed and maintained. Comply strictly with all codes, standards and regulations.***

Use leak detectors in any structure that houses a gaseous fuel system. Natural gas is lighter than air, so install detectors high in the room. LP gas is heavier than air, install detectors for LP gas low in the room.

If LP gas is used, modify the fuel system as outlined in Figure 9, (CONVERSION TO LP GAS).

Gas pressure at the inlet of the fuel shutoff valve (see Figure 7 and 8) should not exceed 14 inches water column (0.5 psi). Optimum supply pressure at the shutoff valve inlet is 11 inches water column. Depending on the characteristics of specific shutoff valves, they may or may not open in excess of 14 inches water column (0.5 psi).

Flexible fuel line, approved for use with gaseous fuels, is required between the fuel connection on the generator mounting base and rigid fuel supply lines, to prevent line breakage in the event generator shifts, settles or vibrates.

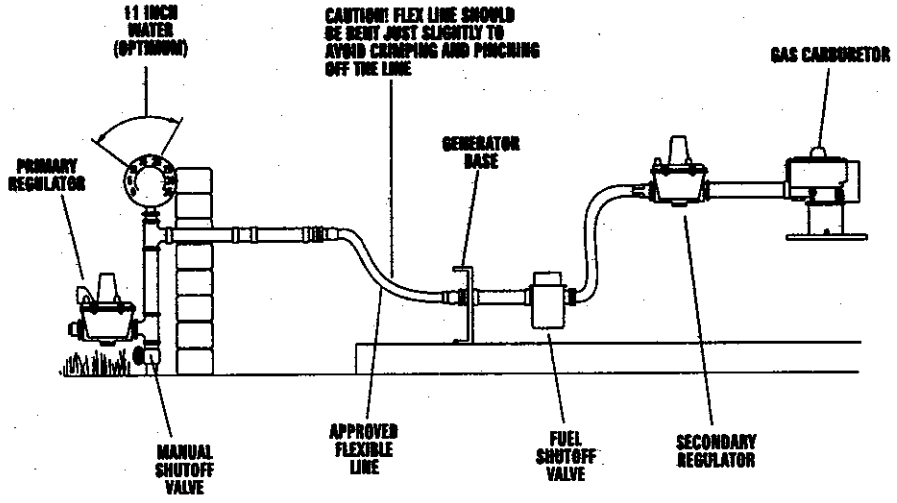

Figure 7 — Typical Natural Gas System

Model 4LM43

Installation (Continued)

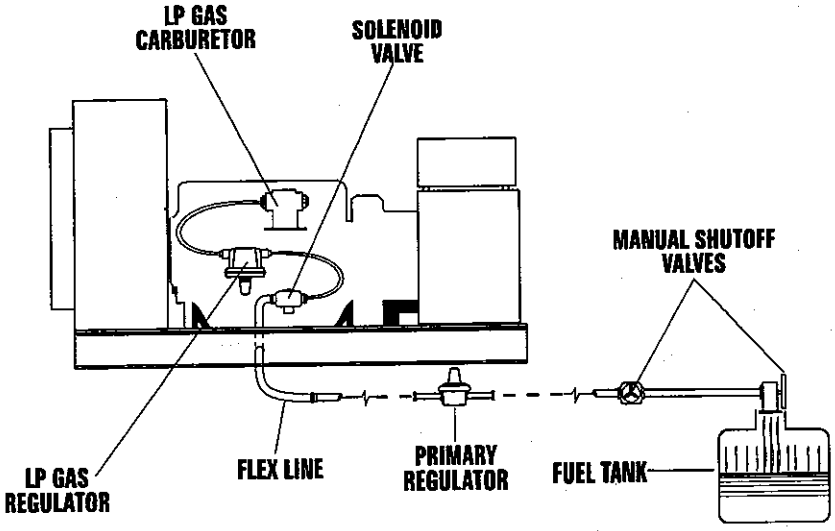

Figure 8 — Typical LP (Propane) Gas System

NATURAL GAS SYSTEM

The fuel system connection is a 3/4" NPT located on the generator mounting base.

The maximum pressure at which gas is allowed to enter a building is established by code and may vary from one area to another. A primary regulator may be required to reduce gas pressure to the required safe level. The primary regulator may or may not be furnished by the gas supplier. The gas company usually supplies piping from the main distribution line to the generator site. The supplier is responsible to be sure that sufficient gas pressure is available for primary regulator operation (see Figure 4).

LP GAS (PROPANE) SYSTEM

LP gas is supplied in pressure tanks as a liquid. The generator requires a "vapor withdrawal" type system. This type of system uses the gas vapors that form above the liquid in the tank (see Figure 5).

CONVERSION TO LP GAS VAPOR

The generator is shipped from the factory, configured for using natural gas as fuel. To convert the fuel system to LP gas, proceed as follows, Figure 6:

1. Remove END CAP from PRESSURE REDUCER VALVE.
2. Turn TENSION SCREW counterclockwise until all tension is removed from INNER SPRING.
3. Invert the PRESSURE REDUCER VALVE. In other words, turn it upside down (END CAP facing downward).
4. Install and tighten END CAP.
5. Purge and leak test the entire fuel system according to gaseous fuel codes. NO LEAKS must be allowed at any point in the system.

GASEOUS FUEL PIPING

The following general rules apply to gaseous fuel piping:

1. Use only piping that complies with applicable fuel-gas codes.
2. Do NOT use any galvanized piping. The galvanized coating can flake off and cause serious problems.
3. Determine fuel piping diameter by (a) the length of the pipe, and (b) the engine fuel consumption. This is determined by a gas system installer. The longer the piping run and the greater the engine fuel consumption, the greater the diameter of the pipe required.

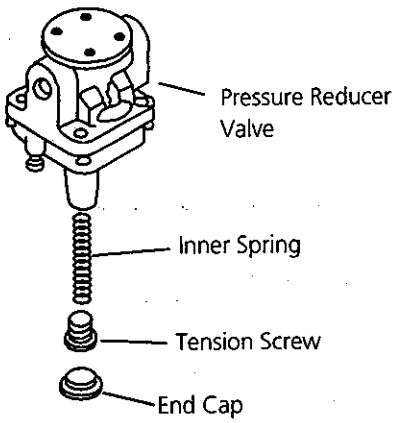

Figure 9 — Conversion to LP Gas Vapor

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Installation (Continued)

GROUNDING THE GENERATOR

The United States National Electrical Code requires that the frame and external electrically conductive parts of the generator be properly connected to an approved earth ground. Local electrical codes may also require proper grounding of the unit. For that purpose, a grounding lug is provided on the mounting base rails (see Figure 10).

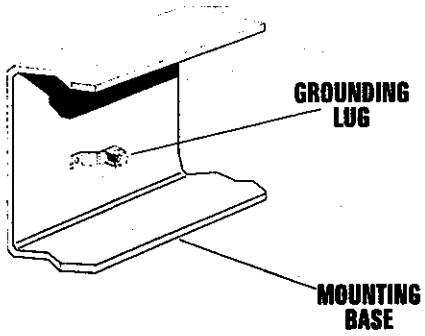

Figure 10 — Generator Grounding Lug

Connect a minimum #12 AWG stranded copper wire to the grounding lug and to an earth-driven copper or brass grounding rod (electrode).

However, local codes may vary widely. Consult with a local electrician for grounding requirements in your area. Proper grounding helps reduce the chance of electrical shock if a ground fault condition occurs in the generator or connected electrical devices. Grounding also helps to dissipate static electricity, which often builds up in ungrounded devices. Static electricity can cause very painful shock and may cause you to believe the equipment has a short.

POWER SOURCE AND LOAD CONNECTIONS

⚠WARNING ***Extremely high and dangerous electrical voltages are present in utility power source lines and in generator load leads when the unit is running. Therefore, be sure to turn OFF all power voltage supplies at their source before attempting to complete electrical connections. A competent electrician must wire the generator system. Contact with "live" wires or terminals can cause extremely hazardous and possibly lethal electrical shock.***

Leads from both the utility power source and from the generator must be connected to the proper transfer switch terminal lugs (see Figure 15). In addition, load leads must be connected from the correct transfer switch terminal lugs and routed to a load distribution panel. Use an approved main line circuit breaker in the utility power supply lines to the transfer switch.

It is recommend that this generator is connected to an automatic transfer switch.

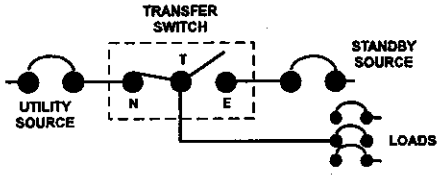

Figure 11 — Typical Standby Electric System

IMPORTANT: READ THE TRANSFER SWITCH MANUAL CAREFULLY. COMPLY WITH ALL INSTRUCTIONS IN THAT MANUAL, AS WELL AS INSTRUCTIONS AND INFORMATION ON TAGS AND DECALS AFFIXED TO THE TRANSFER SWITCH.

1. Connect NORMAL (utility), EMERGENCY (standby) and LOAD leads to the transfer switch terminal lugs as shown (Figure 11 on page 12). The transfer switch is a 3-pole type with terminal lugs identifies as follows:

N1, N2, and N3 = NORMAL (utility) power source

E1, E2, and E3 = EMERGENCY (standby) power source

T1, T2, and T3 = LOAD terminals

00 or Neutral = Neutral terminal

2. All wires that carry current must be of adequate size to handle the full rated capacity of the main line circuit breaker (or fuse) in the entrance (or sub-panel) protecting the transfer switch.
3. Because of the many different types of service, feeder and distribution equipment, no specific wiring instructions can be provided. When properly connected, the transfer switch must prevent any electrical feedback between the different power sources.
4. The standby generator set uses an ungrounded neutral line indicated by "00". When completing wiring connections, it is recommended that neutral be grounded only at the main service entrance.
5. Follow the installation instructions for the transfer switch (supplied separately).

Model 4LM43

Installation (Continued)

GENERATOR MAIN CIRCUIT BREAKER

This generator does not include a main circuit breaker for generator AC output. The installer is responsible for selecting and installing a generator main circuit breaker having a rated voltage, amperage and phase that meets system requirements.

For rated maximum continuous load current at each voltage-phase selection, see Page 2 for "Specifications."

⚠ WARNING ***If the generator's neutral line is grounded and one of the phase leads becomes grounded, the resulting excessive current flow will collapse the generator field or open the main circuit breaker (CB2). The actual result depends on the electrical characteristics of the generator, the type of fault, and the main circuit breaker (CB2) trip rating.***

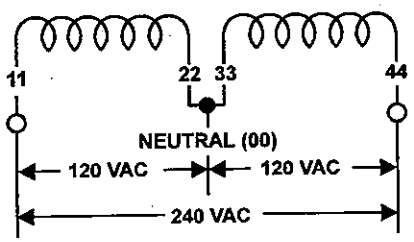

Figure 12 — Connections for 120/240 Volts, 1-Phase

POWER SOURCE ISOLATION METHODS

Generator and utility power supplies must be positively isolated from one another in the standby electric system. Never connect the generator to any circuit that might become electrically hot when utility power is suddenly restored. A suitably rated, double pole, double throw transfer switch is required.

TOTAL CIRCUIT ISOLATION METHOD

The generator set may not be rated at sufficient wattage/amperage capacity to handle the entire load in a building. If key electrical circuits are not wired into a separate emergency distribution panel, select the loads to be turned ON during a utility power outage. Only one distribution panel is used in this type of system, Figure 13. Consider the following factors when using this isolation method:

1. The transfer switch is located between the main utility service entrance and the load distribution panel.
2. The transfer switch ampere rating must equal the ampere rating of the normal incoming utility service.
3. Take care to avoid exceeding the generator's wattage/amperage capacity.

EMERGENCY CIRCUIT ISOLATION METHOD

An isolation method used to prevent overloading the generator is to group critical electrical loads into a separate emergency distribution panel. Load circuits powered by the emergency distribution panel must not exceed the rated wattage/amperage capacity of the generator, Figure 14. The following applies to this type of isolation system:

1. The transfer switch is installed between the main distribution panel and the emergency distribution panel as shown.
2. The transfer switch must then have an ampere rating equal to or greater than the ampere rating of the emergency circuit.

⚠ WARNING ***The following hazards exist, which require the isolation of power supply circuits:***

1. ***A utility power company worker trying to restore electrical power opens a switch between the main power supply and the spot where working. If the building circuits are not isolated, generator AC output backfeeds into the utility power lines. The worker may be electrocuted when attempting repairs.***
2. ***If utility and generator circuits are not isolated and utility power is suddenly restored while the generator is powering building circuits, the generator or building circuits could be damaged or it could cause an electrical fire.***

⚠ WARNING ***When this generator is installed along with an automatic transfer switch, the engine can crank and start suddenly as soon as battery cables are connected. For that reason, it is recommended servicing the engine properly before installing the battery. To also help prevent such automatic starts, the installer should set the AUTO-MANUAL-OFF switch to OFF, set the maintenance disconnect switch on the transfer switch set to MANUAL and pull the 15 amp fuse on the Control Console.***

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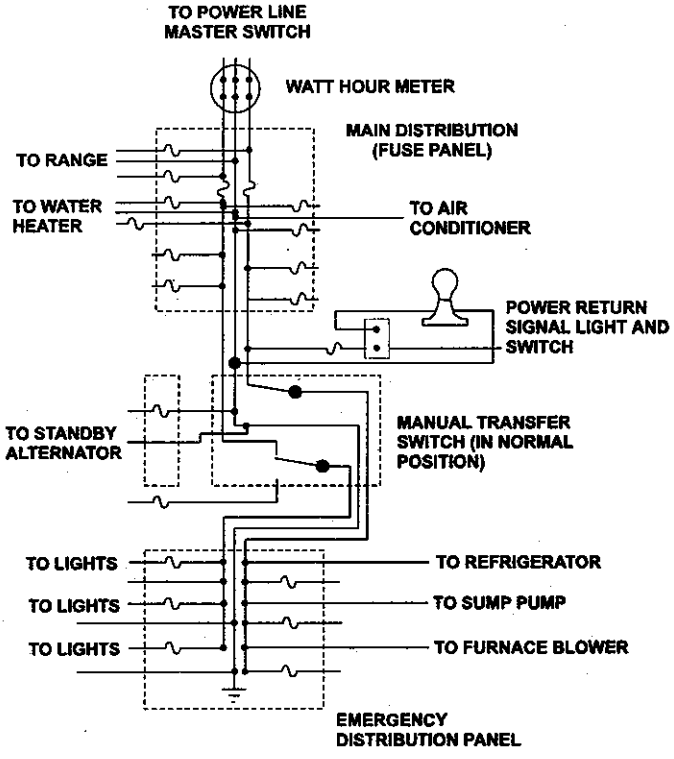
Dayton® Standby Generator

Installation (Continued)



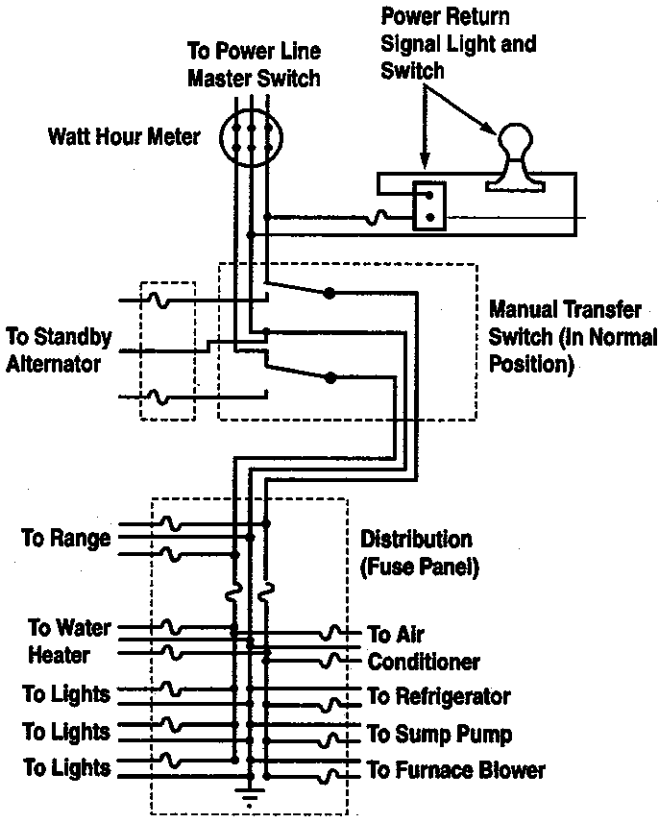
Ampere rating must be equal to or greater than the main (normal) utility entrance service.

With this system take care to prevent overloading the generator. During utility power failure, turn OFF individually all load items to distribution panel. Only certain items can be turned back on during generator operation. Have the electrician specify these items so as not overload the generator.

All wiring must conform to the United States National Electrical Code (NEC) and all state and local codes. Consult a qualified licensed electrician.

The above illustration assumes the utility is supplying 120/240 volt single phase electric service.

Figure 13 — Total Circuit Isolation Method



Ampere rating must be equal to or greater than the ampere rating of the emergency distribution panels.

Ampere capacity not to exceed the generator rating. Only these items will be powered by the standby generator. If the electrician sizes the load properly, the generator cannot be overloaded.

All wiring must conform to the United States National Electrical Code (NEC) and all state and local codes. Consult a qualified licensed electrician.

the illustration assumes the utility is supplying 120/240 volt single phase electric service.

Figure 14 — Emergency Circuit Isolation Method

Model 4LM43

Installation (Continued)

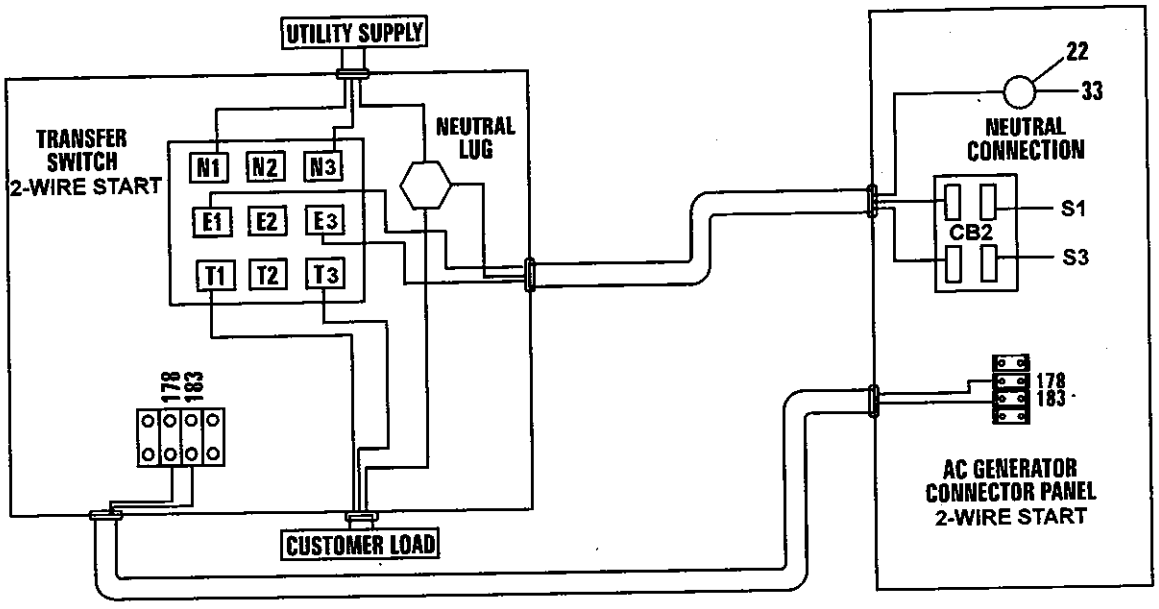


Figure 15 — Connection Diagram for 1-Phase Standby System with 4W126 Transfer Switch
NOTE: Example of typical 40 kW Dayton Generator with **4W126** Transfer Switch. Use electrical schematic and wiring diagrams for the Generator and Transfer Switch selected.

PREPARING THE ENGINE BEFORE USE

⚠ CAUTION ***Any attempt to crank or start the engine before it has been properly serviced with the recommended oil will result in an engine failure. The engine crankcase must be properly filled with the recommended oil.***

Check the engine fluid levels before installing the battery. If the correct rated utility power source voltage is NOT available to the automatic transfer switch, the engine cranks and starts as soon as the battery is installed and connected. Such automatic starting is a normal function of the automatic transfer switch as discussed in the "Operation" section. Before installing and connecting the battery, be sure the engine is ready to run by checking the following:

1. Check engine crankcase oil level and add oil, if necessary.
2. Check engine coolant level in the radiator and in the coolant recovery bottle. Add the recommended 50-50 coolant mixture as necessary.
3. Inspect engine fan belts for condition and proper tension.

Refer to "Maintenance" section for procedures.

CONNECTING STARTING AIDS

This generator is equipped with a battery charger, rated 2 amperes at 12 volts DC. This battery charger, when properly connected to a 120 volt s AC utility power source, helps prevent battery self-discharge when the engine is not running. The battery charger cannot be used to recharge a discharged or dead battery.

The unit also includes an engine coolant heater, which is powered by a 120 volts AC utility power supply. The engine coolant heater, as its name implies, keeps the engine coolant

Dayton® Standby Generator

Installation (Continued)

warm during non-operating periods. A warm engine will crank and start more readily than a cold engine.

Connect suitable wiring to the 2-amp battery charger and to a 120 volts AC utility power source as shown (Figure 16). When this is done, both the battery charger and the coolant heater will be powered by the utility source. Install a circuit breaker in the circuit, so the starting aids can be turned off for maintenance.

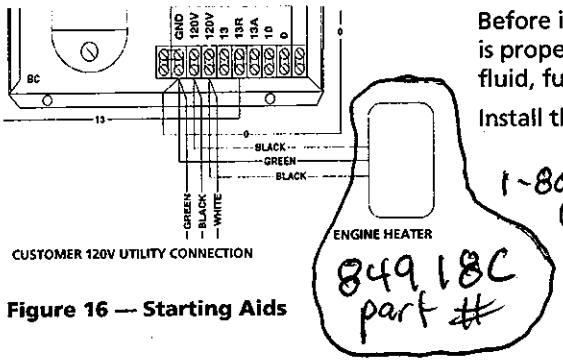


Figure 16 — Starting Aids

An internal thermostat controls engine coolant heater operation, by turning the heater circuit off at a preset temperature.

Also see REPLACEMENT PARTS, which includes an exploded view of the battery charger as well as the engine coolant heater.

INSTALLING THE BATTERY

A battery tray is provided on generator mounting base, Figure 17.

Recommended is a 12-volt automotive type storage battery (Group 27F) rated 90 amp-hours or more and capable of at least 600 cold cranking amperes.

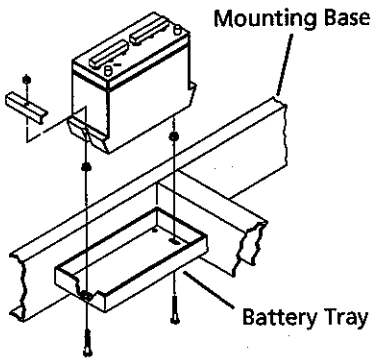


Figure 17 — Battery Tray

NOTE: A Group 27F battery is 11.75" long by 8" wide by 6.25" high.

Before installing the battery, be sure it is properly serviced with electrolyte fluid, fully charged and ready for use.

Install the battery as follows, Figure 18:

1. Install the battery into the battery tray.
2. Connect the red battery cable (from starter) to the battery post indicated by a positive, POS or (+).
3. Connect the black battery cable (from frame ground) to the battery post indicated by a negative, NEG or (-).
4. Tighten battery cable clamps securely.

TRANSFER SWITCH ADJUSTMENTS AND SETUP

The installer must be sure the transfer switch has been properly installed, mounted, connected and tested before the installation is complete.

Carefully read the instructions in the transfer switch manual. Check that the following tasks have been completed:

1-800-323-0620
Grainger Parts

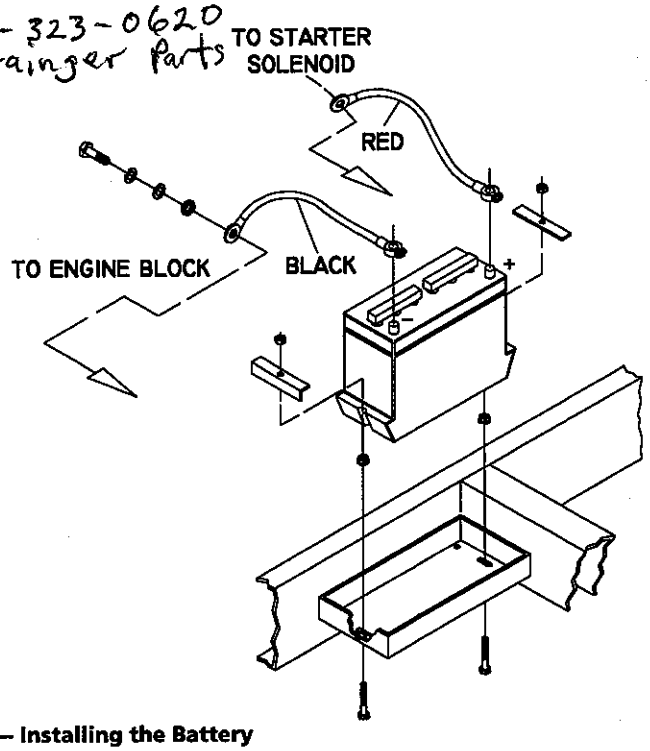


Figure 18 — Installing the Battery

Model 4LM43

Installation (Continued)

1. Transfer switch is properly mounted.
2. Power source and load line connections are correct.
3. Wiring runs and connections are in compliance with applicable codes.
4. If the transfer switch is equipped with a multi-voltage interface panel, the selected phase and voltage must match the utility power source phase and voltage.
5. Properly connect, route and support the engine START/STOP control circuit wires.
6. If the transfer switch has auxiliary contacts, properly connect a device that is compatible with the contacts rated voltage and current.
7. Test and verify proper MANUAL operation of the transfer switch main contacts.
8. Test and verify correct electrical operation of the transfer switch.
9. Complete any required adjustments.

POST INSTALLATION TESTS

The generator was factory tested and adjusted, no additional adjustments should be required. However, the installer is responsible for the readiness of the unit in all respects. The installer or generator service technician should complete the following inspection:

1. Installation must comply with applicable codes, standards and regulations.
2. Installation must comply with recommendations in this manual.
3. Some areas may require that a building inspector and/or electrical inspector examine the installation.
4. Recheck levels of engine fluids.
5. Check that proper fuel is available to the engine.
6. Fuel lines must be properly purged and leak tested, according to applicable fuel-gas codes.
7. OPEN any manually operated shutoff valves in the fuel system.

Conduct manual start and transfer, and manual retransfer and shutdown, as described in the "Operation" section.

Operation

CONTROL CONSOLE COMPONENTS

Refer to Figure 19 to locate the Control Console Components, which are as follows:

1. AC Voltmeter: The voltmeter displays generator AC output voltage during operation. Voltage is regulated by a solid state voltage regulator to ±1% and is proportional to AC frequency. Output voltage is selected by means of a voltage phase selector board. Refer to the "Specifications" for rated AC voltage.
2. AC Ammeter: Indicates current draw of connected electrical loads during operation. DO NOT EXCEED the UNIT'S RATED MAXIMUM CURRENT, refer to the "Specifications" for rated maximum load current.
3. AC Frequency Meter: Indicates generator AC output frequency in "Hertz" (cycles per second). Frequency is proportional to engine speed. Units with a 4-pole rotor supplies 60 Hertz at 1800 RPM. Frequency reading with or without electrical loads connected should be between 59-61 Hertz.
4. DC Voltmeter: The generator is equipped with a belt-driven DC alternator, which maintains the

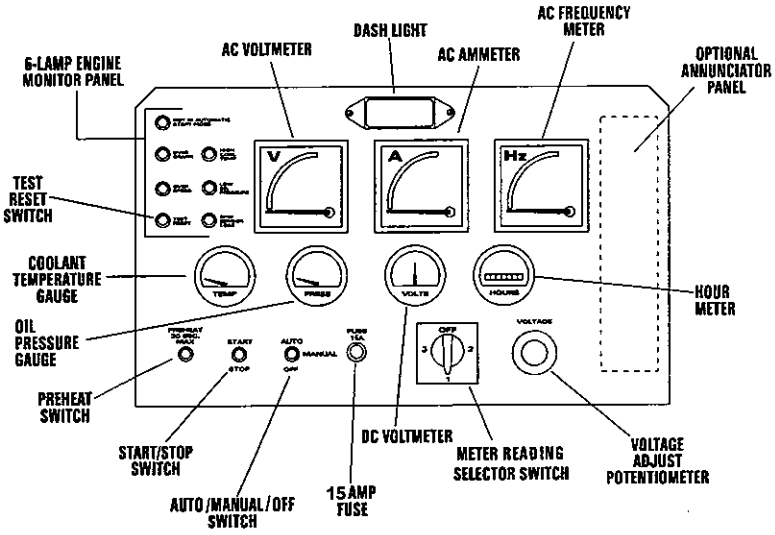


Figure 19 — Main Components of Control Console

Dayton® Standby Generator

Operation (Continued)

engine battery charge when operating. The 2 amperes 12 volts DC battery charger connected to 120 volts AC utility power source, helps prevent battery discharge when the engine is not running. Battery voltage should read about 12.5 to 14.5 volts DC. A low battery voltage indicates the battery is discharging.

5. Hourmeter: Indicates engine operating time, in hours and tenths of hours. Use the hourmeter to guide in performing periodic maintenance.
6. Start/Stop Switch:
   a. To crank and start the engine manually, hold this switch at START until engine starts, then release it.
   b. To shut down an operating engine, set the switch to STOP.
7. Auto-Manual-Off Switch:

   Set switch to AUTO for automatic operation, the following applies:

   a. When utility voltage drops below a preset level, the Transfer Switch signals the engine to crank and start.
   b. Automatic starting occurs when the transfer switch closes the 178/183 circuit between the Transfer Switch and generator.

   Set the switch to MANUAL before attempting to crank and start the engine with Start/Stop switch, the following applies:

   a. Selecting MANUAL prevents automatic operation.
   b. Dayton Automatic Transfer Switches may have a Safety Disconnect Switch that must also be set to MANUAL before starting the unit in MANUAL. See the appropriate Transfer Switch Instructions.

   Set switch to OFF to prevent BOTH AUTO and MANUAL starting. When the switch is set to either MANUAL or OFF, a "Not in Automatic Start Mode" lamp will go ON. See "Engine Monitor Panel."

⚠ DANGER ***With this switch set to AUTO, engine can crank and start suddenly without warning. Such automatic start up normally occurs when utility source voltage drops below a preset level. To prevent possible injury that might be caused by such sudden starts, set switch to OFF before working on or around the unit. Then, place a "DO NOT OPERATE" tag on Control Console.***

8. 15 Amp Fuse: Fuse protects the Control Console's DC control circuit against electrical overload. If fuse has failed open due to an overload, the engine cannot crank and start. When replacing the fuse, use only an identical 15 amp replacement fuse.
9. Temperature Gauge: Indicates engine coolant temperature. Typical operating, temperature range is 200-225° F (111-125°C). The actual temperature may vary depending on such variables as ambient temperature, applied load, cooling system condition, etc. If the coolant temperature should exceed 256° F (142°C), the engine automatically shuts down.
10. Oil Pressure Gauge: Indicates engine oil pressure.After engine warms up, oil pressure should be stable at approximately 25-60 psi.
11. DC Ammeter: The engine is equipped with a belt-driven DC alternator which maintains the engine battery charge during engine operation. The ammeter indicates the rate of charge to the battery:
    a. Meter needle should be at zero or to the right of zero indicating battery is charging during operation.
    b. If needle swings to the left of zero,this indicates the battery is discharging. Investigate and correct as required.
12. Meter Reading Selector Switch: This 4-position rotary switch permits the operator to select line-to-line voltmeter and ammeter readings as follows:

a. With 120-240 Volts, 1-phase selected.

Note: When the Voltage Phase Selector Board is set-up for 120/240 volts, 1-phase output, Line E2 is NOT connected. Meter will NOT read line-to-neutral, therefore the meter will NOT indicate the 120 volt value.

1. Switch Position "1" - Voltmeter and ammeter indicate line E1 to E3 voltage (240 volts) and current.
2. Switch Position "2" - No Reading.
3. Switch Position "3" - No Reading.
4. Switch Position "OFF" - No Reading.

b. With LO or HI-Wye connection, 3-phase output selected:

1. Switch Position "1" - Voltmeter and ammeter indicate line E1 to E2 voltage and current.
2. Switch Position "2" - Voltmeter and ammeter indicate line E2 to

Operation (Continued)

E3 voltage and current.

3. Switch Position "3" - Voltmeter and ammeter indicate line E3 to E1 voltage and current.
4. Switch Position "OFF" - No Reading.

13. Voltage Adjust Potentiometer: Permits the operator to fine tune the generator AC output voltage within +/- 5 %. Turning the knob clockwise increases voltage and counterclockwise decreases voltage.

ENGINE MONITOR PANEL

The generator control console includes an Engine Monitor Panel which consists of (a) five engine fault advisory lamps, (b) "Not in Automatic Start Mode" lamp and (c) a TEST-RESET Switch (see Figures 19 and 20).

The engine will not crank while one or more of the five engine fault lamps are ON). The following facts apply to the five engine fault lamps:

a. When one or more of the five engine faults occur, the engine automatically shuts down.

b. A "LAMP ON" condition indicates that shutdown has occurred and which fault condition was the source that caused the lamp to "latch" ON.

c. To "unlatch" a fault condition (turn lamp OFF) press the TEST-RESET Switch.

Once the lamp is OFF, the engine can be cranked. However, if fault/s still exist, the engine shuts down and the specific lamp/s go ON.

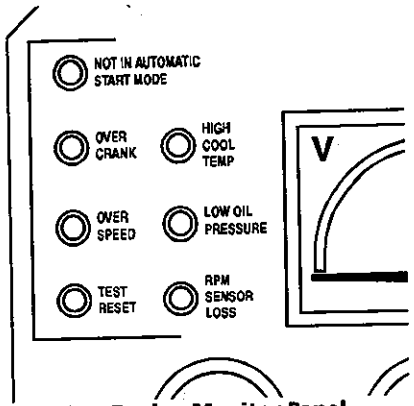


Figure 20 — Engine Monitor Panel

1. Overcrank Lamp: During AUTO the following sequence of events occurs:

   a. Transfer switch senses that utility voltage has dropped below a preset level.

   b. The Transfer Switch CLOSES the 178/183 circuit, to initiate engine cranking.

   c. The DC Control/Latch-Crank Circuit Board in the generator's Control Console incorporates a "Crank Limiter" circuit which controls cranking as follows:

   The engine cranks for Five seconds, rests for Five seconds, and repeats the cycle until the engine starts OR the "Overcrank" lamp goes ON at the completion of the eight cycle.

2. High Temperature / Low Coolant Level Lamp: When coolant temperature is too HIGH or level is too LOW, the engine shuts down and the lamp goes ON under the following conditions:

   a. If engine is cranked and started while HIGH temperature or LOW coolant level exists, the engine will shut down and the lamp goes ON when the engine speed reaches approximately 1000 RPM.

   b. If the engine starts normally and a HIGH temperature or LOW coolant level occurs while operating, the engine will shut down immediately and the lamp goes ON.

3. Overspeed Lamp: When the engine RPM reaches 2070-2340 (69-78 Hz) for approximately four seconds or longer, the engine shuts down and the lamp goes ON.

4. Low Oil Pressure Lamp: If oil pressure never reaches or drops below approximately 15 psi, the engine shuts down and the lamp goes ON under the following conditions:

   a. During cranking and after the engine has reached 800-1000 RPM, a timer in the DC Control/Latch-Crank Circuit Board turns ON, allowing four seconds for the oil pressure to build.

   b. If the oil pressure does not reach 15 psi within four seconds, the engine shuts down, but the lamp does NOT go ON.

   c. The engine attempts to start and raise the oil pressure to 15 psi five times. If unsuccessful after the fifth attemp, the engine shuts down and the lamp goes ON.

5. RPM Sensor Loss Lamp: The generator is equipped with an RPM Sensor mounted over the engine flywheel gear teeth.(Figure 21). The sensor is a magnetic pickup

Dayton® Standby Generator

Operation (Continued)

that emits an electrical "pulse" as each tooth of the flywheel passes.

The pulses are used by the DC Control/Latch-Crank Circuit Board to (1) cutout the starter at a preset speed during cranking and (2) shut down the engine if an overspeed condition exists.

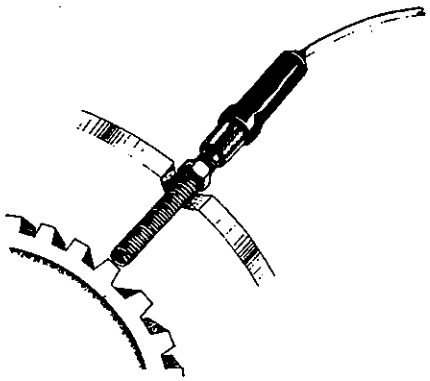


Figure 21 — RPM Sensor

The engine will shut down and the lamp goes ON when there is a loss of the sensor signals under the following conditions:

a. During a MANUAL start, if the engine starts within two seconds after cranking begins, but shuts down as soon as the START/STOP Switch is released. However, the lamp does NOT go ON.

b. During a MANUAL start, if the engine takes longer than two seconds to start after cranking begins, the cranking ceases, and the lamp goes ON.

c. During an AUTO start, if the sensor signal is lost the engine shuts down. The engine re-cranks within one second after it stopped. If the loss of signal persists during the re-cranking, the engine shuts down and the lamp goes ON within two seconds after the start of the re-crank.

d. During an AUTO start, if the engine starts within two seconds after re-crank begins, the starter remains engaged until the two second time delay is over.

6. "Not in Automatic Start Mode" Lamp: The lamp indicates that the generator cannot be operated automatically. The lamp ON condition occurs whenever the AUTO/MANUAL/OFF Switch is set to either MANUAL or OFF.

7. Test-Reset Switch: Used to test all lamps when the switch is depressed and released. The lamps remain ON until the switch is pressed a second time.

   Engine cranking is inhibited while any lamp is ON. To reset the system and permit cranking, press the switch. All lamps should go OFF.

   If the switch is actuated while the engine is running, ONLY the lamps will be tested. The engine will not shut down.

MANUAL START AND TRANSFER

To start the engine manually and transfer LOAD circuits to the EMERGENCY (standby) power source manually, proceed as follows:

1. Check for proper MANUAL operation of the automatic transfer switch, using the manual handle supplied with the switch.

⚠ WARNING ***Do not try MANUAL operation of the transfer switch until all power supplied to the switch has been positively turned OFF. Failure to turn OFF power supplied may result in extremely dangerous and possibly lethal electrical shock.***

2. After verification that transfer switch operates manually, actuate the transfer switch main contacts to the UTILITY position, i.e., LOAD terminals connected to the utility power supply.
3. Turn ON the utility power supply to the transfer switch with whatever means provided. With an accurate AC voltmeter, verify that correct load voltage is available at transfer switch main contact, terminal lugs N1nd N2.
4. If so equipped set Maintenance Disconnect switch (inside Transfer Switch) to the MANUAL position.
5. On the generator Control Console, set the AUTO-MANUAL-OFF switch to the OFF position.
6. Turn OFF the utility power supply to the transfer switch, with whatever means provided.
7. Set the generator's main circuit breaker (CB2) to the OFF or OPEN position.
8. Turn off all electrical loads. Initial testing and adjustment should be conducted with the generator at "no-load."

Model 4LM43

Operation (Continued)

9. To start the generator engine manually, set the AUTO-MANUAL-OFF switch to the MANUAL position. Hold the START/STOP switch to crank and start the engine, then release the switch. Let the unit stabilize and warm up for a few minutes.
10. Set the main circuit breaker (CB2) on the generator to the ON or CLOSED position.
11. With an accurate AC voltmeter, verify that correct rated voltage and frequency are being supplied to transfer switch terminals E1, E2, and neutral.
    a. Do not proceed until generator output frequency and voltage are correct.
    b. If AC frequency is not within 59-61 Hz contact 1-800-333-1322 for authorized generator service.

⚠ DANGER ***DO NOT attempt to adjust the governor. Only qualified service facilities should adjust the governor. Excessively HIGH operating speeds are dangerous and increase the risk of personal injury. LOW speeds impose a heavy load on the engine when adequate engine power is not available and may shorten engine life. Correct rated frequency and AC voltage are supplied only at the proper governed speed. Some connected electrical load devices may be damaged by incorrect AC frequency and/or voltage. IT IS RECOMMENDED THAT ONLY QUALIFIED SERVICE TECHNICIANS ADJUST THE ENGINE GOVERNOR.***

    c. If the AC voltage is not at the stated voltage found in the "Specifications", adjust the "Voltage Adjust Potentiometer" clockwise to increase or counterclockwise to decrease output voltage.

NOTE: On units connected for 240 volts, 1-phase output, line-to-line voltage at 60 Hz should be 240 volts. Take these initial readings with the generator running at no-load.

IMPORTANT: DO NOT PROCEED UNTIL NO-LOAD FREQUENCY AND VOLTAGE ARE CORRECT.

12. Verify that all power voltage supplies have been turned OFF to the transfer switch with whatever means provided. Then, manually actuate the transfer switch main contacts to the STANDBY position, i.e., LOAD connected to the GENERATOR.
13. Turn ON electrical loads that almost equal the generator's wattage/amperage capacity. With an accurate AC frequency meter, check frequency at transfer switch terminals E1, E2, and E3. With generator under load, frequency should not drop below 59 Hz.
    a. Do not proceed until generator output frequency and voltage are correct.
    b. If AC frequency is not within 59-61 Hz contact 1-800-333-1322 for authorized generator service.
    c. If the AC voltage is not at the stated voltage found in the "Specifications", adjust the "Voltage Adjust Potentiometer" clockwise to increase or counterclockwise to decrease output voltage.
14. Let the generator run under load for at least 20-30 minutes. During this time, check for unusual vibration, noise, high temperature, other indications of abnormal operation.

MANUAL RETRANSFER AND SHUT DOWN

Electrical loads may be retransferred back to UTILITY and the generator can be shut down as follows:

1. Verify that utility power supply to the Transfer Switch has been positively turned OFF, using whatever means provided (such as the utility main line circuit breaker).
2. Set the generator's main circuit breaker (CB2) to its OFF or OPEN position.
3. Let the generator engine run at no-load for a few minutes to stabilize internal unit temperatures.
4. On the generator Control Console, set the AUTO-MANUAL-OFF switch to OFF. Wait for engine to come to a complete stop.
5. With the manual transfer handle, move the switch's main contact back to the UTILITY position, i.e., connected to utility power supply.
6. Turn ON the utility power supply to the Transfer Switch, using whatever means provided (such as a utility main line circuit breaker). The utility power source now powers the loads.

SELECTING AUTOMATIC OPERATION

To set the system for fully automatic operation, proceed as follows:

1. Check that load circuits are connected to the UTILITY power supply.

Dayton® Standby Generator

Operation (Continued)

2. On the transfer switch, set the AUTO-MANUAL-OFF switch to the AUTO position.
3. On the generator control console, set the AUTO-MANUAL-OFF switch to the AUTO position.
4 Set the generator main circuit breaker (CB2) to its ON or CLOSED position.

AUTOMATIC OPERATING SEQUENCE

For a description of automatic operating sequence, see Transfer Switch Instruction Manual. The sequence of automatic operation is briefly described as follows:

1. Should utility source voltage drop below about 60% of the nominal supply voltage, a 15-second delay timer starts timing.
2. After the 15-second delay,circuit 178/183 closes, and the engine cranks and starts.

NOTE: Engine cranking, starting and operating are controlled by a DC Control/Latch/Crank circuit board housed in the generator's control console.

NOTE: The 15-second time delay is required to prevent false starts that might otherwise be caused by transient voltage dips.

3. An engine warm up time delay lets the engine warm up for about 15 seconds.
4. After 15 seconds, a standby voltage sensor checks the generator AC output voltage. If generator voltage is more than about 50% of nominal, the transfer switch transfers load circuits to STANDBY (GENERATOR) power.
5. If utility source voltage is restored above about 80% of the nominal source voltage a "retransfer time delay" starts timing.
6. If UTILITY source voltage is still above 80% of nominal after 15 seconds, the switch retransfers load circuits back to the utility power source.
7. After the retransfer opens the 178/183 circuit, the generator engine shuts down.
8. After load circuits retransfer, an engine cool down timer allows engine to cool for one minute before shutting down.

WEEKLY EXERCISE CYCLE

Exercise the generator set at least once each week. The unit should run at least 30 minutes during this weekly exercise.

NOTE: The transfer switch houses an EXERCISER circuit board which initiates an automatic startup at the time selected.

To select day and time of exerciser cycle, on that day and time, proceed as instructed in the transfer switch manual.

Place a sign on the generator Control Console and the transfer switch, indicating the day and time the generator will be exercising.

ENGINE COOLANT HEATER

The unit also includes an engine coolant heater, which is powered by a 120 volts AC utility power supply. The engine coolant heater, as its name implies, keeps the engine coolant warm during non-operating periods. A warm engine will crank and start more readily than a cold engine.

ALARM RELAY DRIVER

.1 When any one or more of the engine shutdown faults indicated by the engine monitor panel lamps occur, the DC control/latch/crank circuit board completes the 229 wire circuit to ground. The optional relay energizes, its normally open (N.O.) contacts will CLOSE and normally closed (N.C.) contacts will OPEN.

2. Connecting any remotely installed alarm device (such as a horn, warning light, telephone dialer, etc.) across the optional relays N.O. and common contacts will provide an alarm.

NOTE: A separate power supply must be provided to oiperate the alarm signal device.

Maintenance

It is the owner/operator's responsibility to:

1. Make sure that all safety checks have been performed;
2. Make sure all required maintenance for safe operation is performed;
3. Have the equipment checked by a qualified technician periodically.
4. Repair or replace all damaged or defective parts immediately. Never operate the generator with damaged or defective parts.
5. When replacing parts, always use factory approved parts.

Normal maintenance service and replacement parts are the responsibility of the owner/operator and, as such, are not considered defects in material or workmanship within the terms of the warranty. Proper installation and use of this equipment will affect the need for maintenance service. Proper maintenance and care of the standby

Model 4LM43

Maintenance (Continued)

generator helps reduce problems and also keeps overall operating expenses low.

15 HOUR BREAK-IN PERIOD

The first 15 hours of operation is called the break-in period for a standby generator. Correctly breaking-in the generator is essential to minimize oil consumption and maximize engine performance. During the break-in period, observe the following rules:

1. Run the unit at varying electrical loads, to help seat the engine piston rings properly.

NOTE:. Repeated light loads during the break-in period can cause improper seating of engine piston rings, which could cause blowby and high oil consumption.

2. During the break-in period, check engine oil level every two to three hours of operation. It is normal for oil consumption to be high during the break in period.
3. Check coolant level in coolant recovery bottle frequently and maintain at half full.
4. After the 15 hour break-in period, complete the tasks recommended under "15 Hour Check-Up."

15 HOUR CHECK-UP

After the first 15 hours of operation, contact an authorized service facility for the following maintenance.

1. Change engine crankcase oil and oil filter.
2. Check all fluid levels.
3. Check hose condition and all hose clamps for tightness.
4. Check for proper engine operation.
5. Check for correct rated AC frequency and voltage output.
6. Inspect engine exhaust system for damage, deterioration, leaks, etc.
7. Inspect drive belts for proper tension and condition.
8. Inspect entire electrical system for proper condition of connections, and compliance with all codes.
9. Retorque the engine cylinder head as described in "Retorque Engine Cylinder Head" in "Maintenance" section.
10. Retorque engine manifold bolts to 18 Ft-Lbs.

PERIODIC MAINTENANCE SCHEDULE

⚠ WARNING ***When performing maintenance on this equipment, nothing should be done that might render the equipment or its installation in non-compliance with applicable codes, standards and regulation.***

This schedule lists the minimum recommended maintenance for most applications. Each unit may need additional or more frequent maintenance, depending on its exposure to weather and atmospheric conditions.

Some maintenance tasks are beyond the capability of the owner/operator and should be performed by an engine-generator service facility.

When maintenance frequency is given in both "hours of operation" and "calendar months", perform the recommended tasks at either the stated number of hours or after the recommended time interval — WHICHEVER OCCURS FIRST.

1. Once Each Month or Every Ten Hours
   a. Check engine oil level.
   b. Check coolant level with engine cold.
2. Every Three Months
   a. Inspect battery.
   b. Inspect fuel system.
   c. Check exhaust system for leaks.
3. Once every 100 operating hours or Six months.
   a. Change engine oil.
   b. Change oil filter.
4. Every Six Months
   a. Test engine protective devices.
   b. Inspect hoses.
   c. Test Battery.
   d. Inspect transfer switch.
   e. Conduct operational Test.
5. Once every 250 hours or Annually
   a. Check V-belts.
6. Once Annually
   a. Have an authorized generator techician inspect and adjust the engine governor. Call 1-800-333-1322 to find an authorized generator technician.

⚠ DANGER ***DO NOT attempt to adjust the governor. Only qualified service facilities should adjust the governor. Excessively HIGH operating speeds are dangerous and increase the risk of personal injury. LOW speeds impose a heavy load on the engine when adequate engine power is not available and may shorten engine life. Correct rated frequency and AC voltage are supplied only at the proper governed speed. Some connected electrical load devices may***

Dayton® Standby Generator

Maintenance (Continued)

be damaged by incorrect AC frequency and/or voltage. IT IS RECOMMENDED THAT ONLY QUALIFIED SERVICE TECHNICIANS ADJUST THE ENGINE GOVERNOR.

b. Clean and inspect generator.

c. Flush cooling system.

7. Once every Two years.

a. Check stator and rotor windings.

8. Once every 500 operating hours.

a. Check valve clearance.

b. Check engine DC alternator.

c. Change engine air cleaner.

d. Check ignition system (or every Three months).

e. Change spark plugs and torque to 27 Ft-Lbs.

f. Check engine compression.

INSPECT THE TRANSFER SWITCH

Inspect transfer switch once every six months. Switch interior should be clean and free of foreign matter. During transfer, you should hear no unusual sounds. All switch terminals and connectors should be normal color. Check condition of all wiring insulation. When inspection is completed, close and lock the enclosure door.

Check battery state of charge and condition every 3 months (quarterly). Use an automatic type battery hydrometer to test battery electrolyte fluid specific gravity. Follow the hydrometer manufacturer's instructions carefully. Check specific gravity of fluid in all battery cells. Return the electrolyte fluid in all battery cells. Return the electrolyte fluid to the cell from which it was taken before continuing to the next cell. Write down the specific gravity of each cell as the reading is taken.

CHECKING ENGINE OIL LEVEL

During the first 15 hours of operation on a new units break-in-period, check oil level every two to three hours of operation. After the break-in period, check the engine oil every 10 operating hours or at least once monthly (whichever comes first). For recommended oil, see "Specifications," Page 2.

CHANGE ENGINE OIL/OIL FILTER

Change the engine oil and the oil filter every six months or every 100 hours. Let engine run and warm up, then shut down the engine and immediately drain the oil completely. Remove oil filter while oil is draining into suitable container. Clean the filter mating surface on engine with a lint free cloth. Apply small amount of clean engine oil to new filter seal. Install filter and hand tighten plus about 1/2 to 3/4 turn. Install and tighten oil drain plug when all oil has drained.

CLEAN/REPLACE AIR CLEANER

Clean and inspect the engine air cleaner after 500 hours of operation. Replace air cleaner element if torn, perforated, damaged, or excessively dirty. Element may be cleaned with low pressure air. For replacement element, use FRAM # CA-326.

ENGINE COMPRESSION

Test the compression with engine warm, all spark plugs removed and, throttle and choke valves wide open. Crank the engine through at least four compression strokes. The compression pressure should read between 180 to 200 psi, with a maximum variation of 30% between cylinders.

RETORQUE ENGINE CYLINDER HEAD

Retorque cylinder head annually or when valve clearance is checked. Tighten bolts to an initial torque of 30 Ft-Lbs in the order shown in Figure 22. Continue torqueing bolt 90 ° from existing position in the order shown to complete tightening. Iin order shown, final torqueing of bolt 90° from existing position is neede to complete tightening.

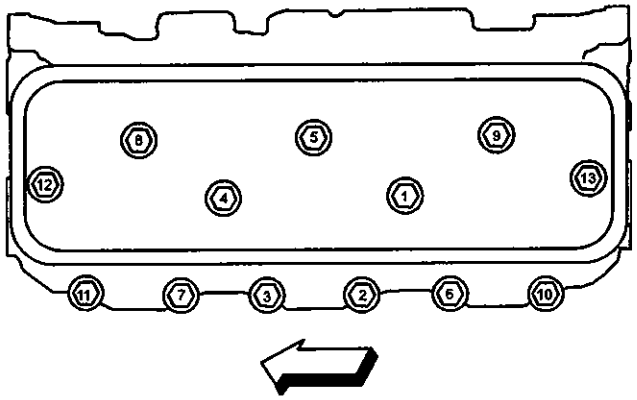


Figure 22 — Retorque Engine Cylinder Head

Model 4LM43

Maintenance (Continued)

CHECK COOLANT LEVEL

Fill the engine cooling system with a 50-50 mixture of ethylene glycol base anti-freeze and soft water. When replenishing coolant, always add the recommended mixture. Use only soft water. Never mix different types of anti-freeze. A high quality rust inhibitor can be added to the cooling system.

⚠ CAUTION ***When adding coolant or when refilling after flushing, always use ethylene glycol base anti-freeze, and SOFT WATER only. Do NOT use any chromate base rust inhibitor with ethylene glycol base anti-freeze. When these two chemicals mix, they can form "green slime" (chromium hydroxide), which reduces heat transfer rate and may result in overheating. Also, "green slime" forms when high silicate anti-freeze boosters or additives, hard water, or a high ratio of anti-freeze to water (60% or more) are used. During the 15 hour break in period, check the level frequently and maintain it half full.***

Inspect the engine cooling system at least once monthly, as follows:

1. Maintain the recovery bottle level at half-full while the engine is cold.
2. If coolant level is low, check radiator cap for leaks. Replace the cap if necessary.
3. Check that the cooling air outlet opening is unobstructed.
4. Check condition of cooling system hoses and connections. Make sure hose clamps are tight.
5. Check cooling system for leaks.
6. Make sure the engine block heater is functioning properly.
7. When adding coolant, always use the recommended 50-50 mixture.

FLUSH COOLING SYSTEM

Drain, flush and refill the engine cooling system every 12 months. Use standard automotive draing, flushing and refilling procedures.

OPERATIONAL TEST

Conduct an operational test of the standby generator system at least once every six months. Manually test the generator set and transfer switch under load and operating temperature conditions. Conduct test in accordance with Manual Start and Transfer and Manual Retransfer and Shutdown in the "Operation" section. After test, set generator back to AUTO operation in accordance with Selecting Automatic Operation in the "Operation" section

CHECK ENGINE V-BELTS

Check engine drive belts prior to initial use and at least once annually thereafter. Replace any damaged, worn, cracked, or deteriorated belt. Check for proper belt tension. Tension is correct when a force of about 20 pounds, applied midway between pulleys, causes a belt deflection of 1/4 to 1/2 inch.

CLEANING THE GENERATOR

Keep generator as clean and dry as possible. Dirt and moisture that is allowed to accumulate on external surfaces cause rust and corrosion.

Use a soft brush or cloth to loosen caked on dirt. When cleaning exterior surfaces, do not allow water to enter the generator interior. Washing or rinsing the unit with a forceful spray is NOT recommended.

When moisture is allowed to remain in contact with windings, some of the moisture will be retained in voids and cracks in the insulation. This causes a reduced insulation resistance and will eventually cause problems. Dirt will make the problem worse, since dirt tends to hold moisture in contact with windings. Salt (as from sea air) will also worsen the problem since it tends to absorb moisture from the air. Salt and moisture, when combined, form a good electrical conductor, potentially shorting the windings to ground.

It is recommended that an authorized service facility check the insulation resistance of stator and rotor windings every Two years.

BATTERY MAINTENANCE

Keep the battery as close as possible to 100% charge if standby electric system is to operate satisfactorily. The generator will not start when the utility power source fails if the battery is dead. All lead-acid storage batteries discharge when not in use. Refer to specific instructions and warnings that accompany the battery.

Periodically inspect the battery cables and battery posts. Keep battery posts clean and cable clamps clean and tight. Check for proper electrolyte fluid level in battery cells. Add distilled water as needed.

IMPORTANT: NEVER USE TAP WATER IN BATTERY.

Every Six months have the battery tested by an authorized service facility.

Be sure to comply with the following precautions when handling a battery:

1. Do not connect or disconnect

Dayton® Standby Generator

Maintenance (Continued)

battery cables until AFTER the utility power supply to the unit battery charger has been turned OFF. The battery can spark, which could cause an explosion.

2. DO NOT use jumper cables and a booster battery to crank or start the generator engine.
3. DO NOT attempt to recharge a discharged battery while it is attached to the generator. Disconnect the battery cables and remove battery, then recharge it in a well-ventilated area.

⚠WARNING ***Storage batteries give off explosive hydrogen gas while charging. The gas can form an explosive mixture around the battery for several hours after charging. Any spark, heat, or flames can ignite the gas and cause an explosion which can shatter the battery, causing blindness or other serious injury.***

4. Always wear safety glasses, rubber apron, and rubber gloves when handling a battery.

⚠WARNING ***Battery electrolyte fluid is an extremely caustic sulfuric solution that can cause severe burns. DO NOT permit fluid to contact eyes, skin, clothing, painted surfaces, wiring insulation, etc. If spilled, flush the affected area with clear water immediately.***

5. Never store a battery on a cement floor. Place battery on a wooden block for storage. Batteries discharge when resting on a cement floor.

ENGINE PROTECTIVE DEVICES

The generator set may be required to run unattended for relatively long periods of time. Because an operator may not be nearby to monitor engine operation, the Control Console provides fault protection that shuts down the engine if something fails. See Engine Panel in the "Operation" section for details.

ELECTRICAL OVERLOAD PROTECTION

1. Main Circuit Breaker (CB2)
   a. Used to protect generator from voltage/amperage overload.
2. 15 Amp Fuse — See Control Console component in the "Operation" section.
3. Field Circuit Breaker (CB1)
   a. Protects AC voltage regulator against electrical overload.
   b. Located inside Control Console.
   c. Wire #2 from stator excitation winding connects breaker.
   d. Wire #162 to voltage regulator connects to breaker.
   e. Circuit breaker is self-resetting. Breaker CANNOT be manually actuated.

THERMAL PROTECTOR

The generator is equipped with a thermal protector which is physically imbedded in the generator stator windings and electrically connected in series with the stator excitation winding output of the voltage regulator (Wire #2). This device is a temperature sensitive switch having normally closed (N.C.) contacts. Should stator temperature increase above a safe value, the switch contacts open. Opening the contacts results in the following:

1. Excitation current flow to the voltage regulator is lost.
2. Without excitation current, the generator output voltage drops to nearly zero (about 5-12 volts AC).

If the thermal protector fails in the OPEN position, it is possible for a service technician to bypass the switch.

1. Before bypassing the thermal protector, be sure to test the field circuit breaker for open condition as well as excitation winding leads 2 and 6. DO NOT bypass the thermal protector until certain it has failed (OPEN).
2. To bypass a failed thermal protector, disconnect Wire #2 from field circuit breaker (CB1) and connect Wire #5 to field circuit breaker terminal from which Wire #2 was disconnected.

NOTE: When BOTH the thermal protector and field circuit breaker (CB1) are OPEN, the AC output voltage is lost. If the contacts of either component open, excitation current is lost, then the output voltage is only produced by the residual magnetism in the rotor (5-12 volts).

A FEW WORDS ABOUT SAFETY

PLEASE THINK SAFETY AT ALL TIMES. If you are not sure of instructions or procedures, seek qualified help before continuing.

This manual emphasizes the safety precautions required during assembly, installation, operation, and maintenance of this generator set. Each section of the manual has WARNING and CAUTION messages. THESE MESSAGES ARE FOR YOUR SAFETY AND FOR THE SAFETY OF THE EQUIPMENT.

If you do not understand a CAUTION or WARNING message, seek clarification from qualified personnel before proceeding.

Model 4LM43

A FEW WORDS ABOUT SAFETY (CONTINUED)

Before any service work is done, disconnect or turn OFF all power sources and, where appropriate, turn OFF automatic START/STOP and transfer controls. You can receive extremely dangerous electrical shock from the generator and utility power source if **A** the system is misused. IF AUTOMATIC START/STOP CONTROLS ARE NOT TURNED OFF OR OTHERWISE DISABLED, THE GENERATOR CAN CRANK AND START AT ANY TIME WITHOUT WARNING.

Local electrical codes require that the generator be grounded. See "Grounding the Generator" on page 10.

Complying with ALL SAFETY PRECAUTIONS is necessary to prevent serious injury or even death.

Whenever the generator is running, always assume that DANGEROUS VOLTAGE is present and then proceed as if such DANGEROUS VOLTAGE is present at the generator leads and at the Control Console connections. Be careful to prevent serious injury or even death from electrical shock.

When solvents, cleaners, or flammable liquids are near the generator, provide adequate ventilation to avoid fire, explosion, or health hazards. Avoid breathing vapors and use suitable protective equipment to prevent personal injury.

This manual is NOT INTENDED to be a substitute for properly trained personnel. Only competent, qualified people should attempt repairs and some periodic maintenance. Each installation will create its own unique set of circumstances. No manual can cover every possible situation.

WARNINGS and CAUTIONS in the manual and on tags and decals affixed to equipment cannot eliminate the hazards they depict.

Stay alert at all times. The best safety rule is to use COMMON SENSE in all circumstances. Strict compliance with WARNINGS and CAUTIONS plus practicing common sense are major accident prevention measures.

Dayton® Standby Generator

Troubleshooting

Symptom	Possible Causes	Corrective Action
Engine won't crank	1. Blown 15-amp fuse 2. Loose, dirty, or corroded battery cable(s) 3. Weak battery 4. Open or shorted control wires 5. Bad Control/Latch/Crank Circuit Board 6. Bad starter motor. 7. Defective Start/Stop switch	1. Replace 15-amp fuse 2. Tighten, clean, or replace cable(s) 3. Recharge or replace battery 4. Repair or replace bad wires 5. Replace Circuit Board 6. Replace bad starter 7. Replace switch
Upon loss of UTILITY power supply to transfer switch, engine does not crank	1. Faulty actuating coil 2. Open 178/183 circuit between generator and transfer switch 3. Problem in automatic Transfer Switch 4. Bad Control/Latch/Crank PCB	1. Test/replace actuating coil 2. Repair/ replace bad wiring 3. Test/replace transfer relay 4. Replace circuit board
Engine cranks, will not start	1. Out of fuel 2. Manually operated fuel valves are CLOSED 3. Failure of one or more components in fuel supply system 4. Wire 14 to fuel solenoid is open 5. Defective fuel solenoid 6. Failure in engine fuel system 7. Failure in ignition system 8. Engine mechanical failure	1. Replenish fuel supply 2. OPEN all shutoff valves 3. Replace bad fuel solenoid or faulty component(s) 4. Close circuit between Wire 14 and solenoid 5. Replace defective solenoid 6. Have fuel system check by qualified engine mechanic 7. Have ignition system checked by qualified engine mechanic 8. Have engine checked by qualified engine mechanic
Low or no AC output voltage	1. OPEN main circuit breaker (CB2) 2. Failure in generator electrical systems	1. Reset (CLOSE) main breaker 2. Have unit tested and repaired by authorized service facility
Engine shuts down, fault indicator lamp comes ON	Engine shutdown occurred	Correct the fault
AC voltage and frequency are both high or low	Incorrect governor speed	Have electronic governor serviced by authorized service facility
Frequency is good but AC voltage is high or low	Voltage regulator problem	Have voltage regulator checked and adjusted by authorized service facility

Notes

Installation Dimensions and Features

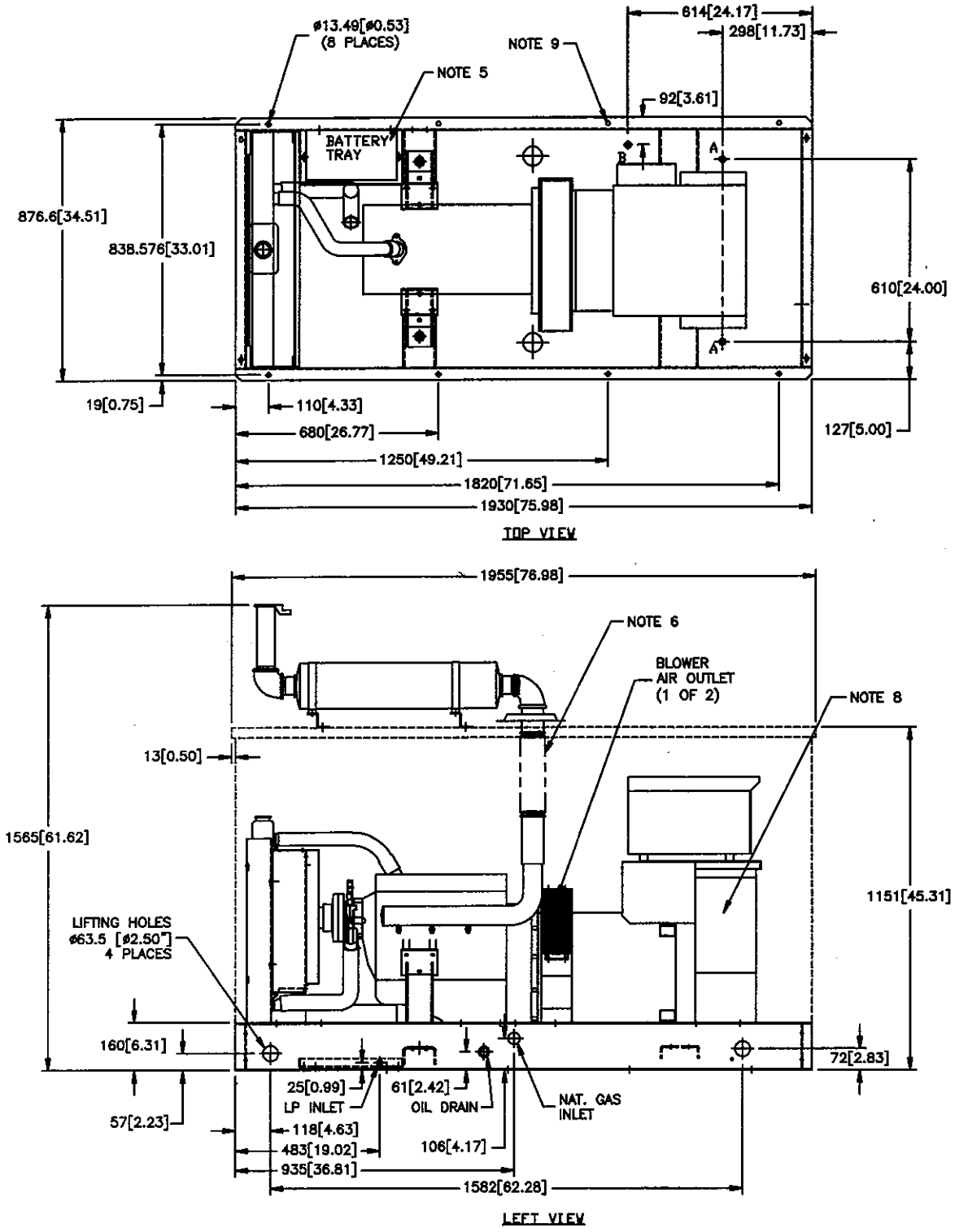
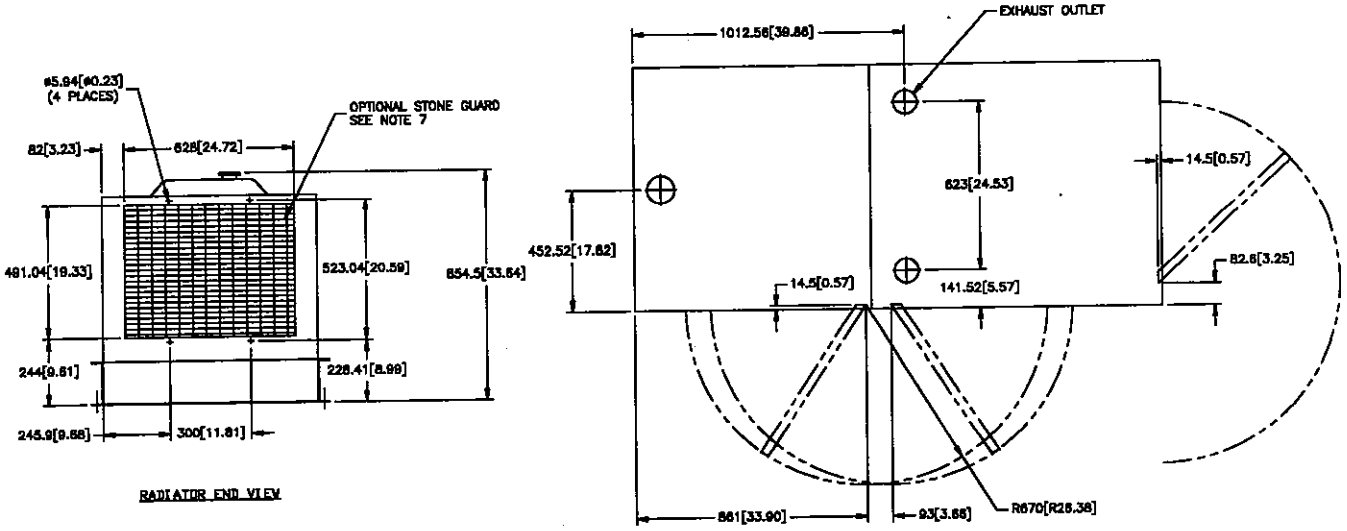
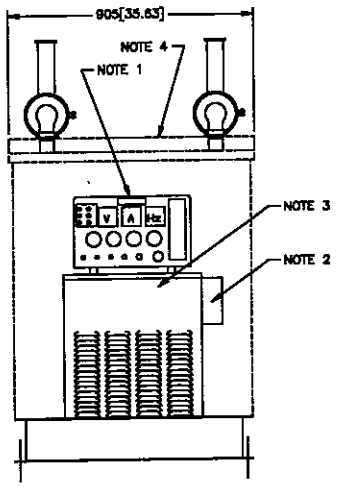


Figure 23 – Installation Dimensions and Features

Installation Dimensions and Features





ENGINE SERVICE CONNECTIONS (N.A. AND TURBO)

LPG LIQUID/GASOLINE	=	1/4" NPT
NATURAL GAS/LPG VAPOR	=	3/4" NPT
OIL DRAIN	=	1/2" NPT

NOTES:

1. METER & CONTROL PANEL MAY BE ROTATED 90° IN EITHER DIRECTION
2. OPTIONAL BATTERY CHARGER REQUIRES 120V AC CONNECTION (ALSO OPTIONAL BLOCK HEATER/BATTERY HEATER)
3. CONNECTION POINTS FOR AC LOAD LEADS AND ENGINE AUTOMATIC START/STOP CONTROL WIRES PROVIDED IN AC CONNECTION PANEL
4. EXHAUST MUFFLER MOUNTS SUPPLIED WITH OPTIONAL COMPARTMENT
5. 12 VOLT NEGATIVE GROUND SYSTEM
6. BATTERY TRAY INSIDE DIMENSIONS = 7.00(178mm)WIDE x 13.50(343mm)LONG
7. OPTIONAL FLEX EXHAUST PIPE (DUAL EXHAUST-2" NPT, SINGLE-2-1/2" NPT)
8. OPTIONAL AIR OUTLET DUCT ADAPTER AND STONE GUARD FOR NON COMPARTMENT UNITS
9. OPTIONAL MAIN LINE CIRCUIT BREAKER
10. DIMENSIONED HOLES ARE ON BOTTOM OF BASE FOR MOUNTING TO STATIONARY PLATFORM
11. THIS UNIT IS DESIGNED FOR STATIONARY OPERATIONS ONLY. UNIT MAY NOT COMPLY WITH FEDERAL, STATE, OR LOCAL EMISSIONS REGULATIONS WHEN MOUNTED ON A TRAILER OR OTHER MOBIL DEVICE. CONTACT GENERAC FOR FURTHER DETAILS.
11. OPTIONAL COMPARTMENT LENGTH = 73.00" (1854 mm)
    WIDTH = 35.62" (905 mm)
    HEIGHT = 36.31" (922 mm)
12. FUEL SYSTEM COMES SET UP FOR OUTSIDE STUBUPS, FUEL SYSTEM MODIFICATIONS REQUIRED FOR INSIDE STUBUPS

RECOMMENDED FUEL/ELECTRICAL STUBUPS
(SEE TOP OR PLAN VIEW)

DESCRIPTION	INSIDE BASE
AC LOAD LEAD CONDUIT	A
120V AC FOR OPT. BATTERY CHARGER, BLOCK HEATER, BATTERY HEATER	B

Figure 24 – Installation Dimensions and Features

Electrical Schematic

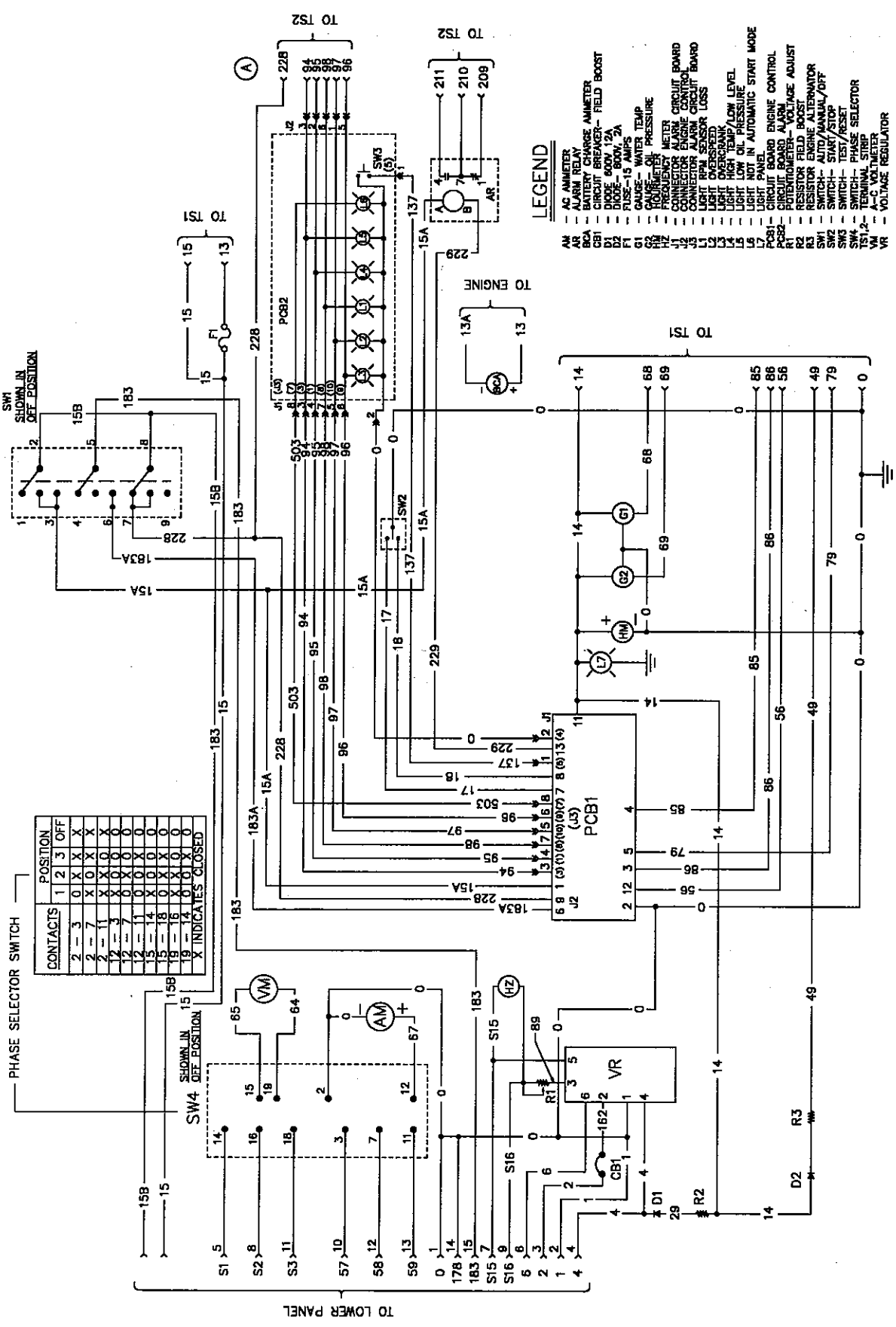


Figure 25 – Electrical Schematic

Wiring Diagram

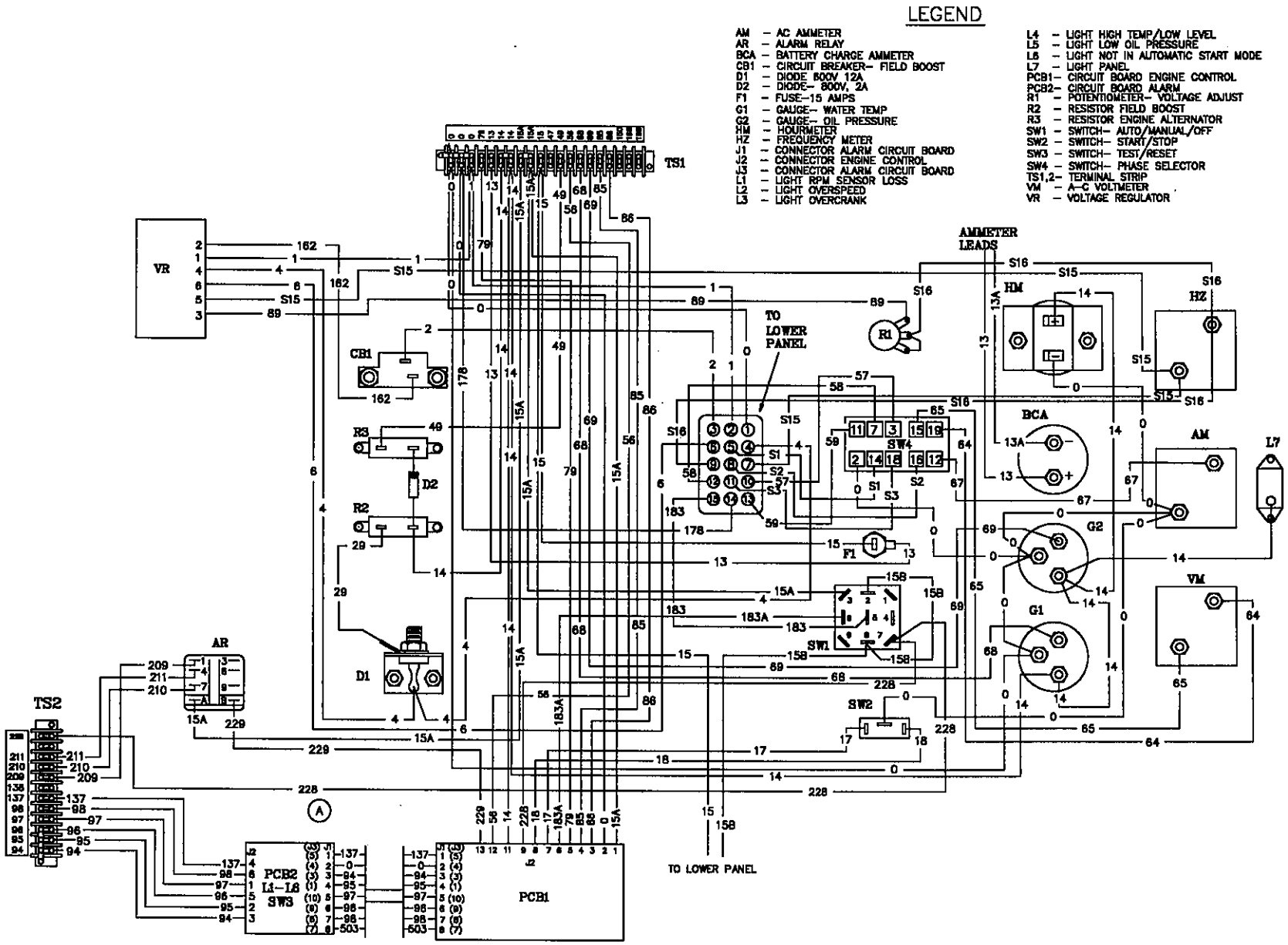


Figure 26 – Wiring Diagram for Control Panel

Wiring Diagram

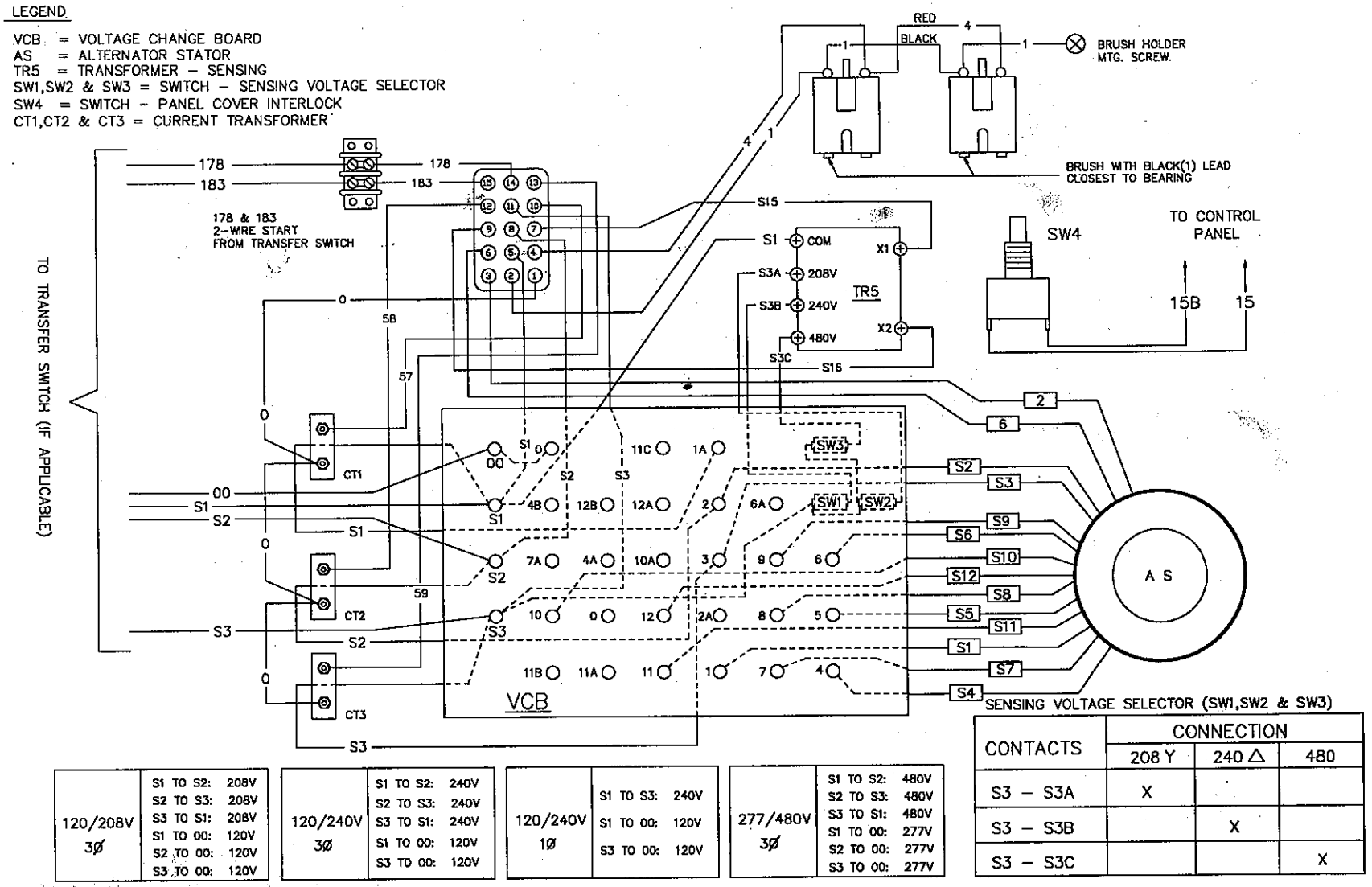
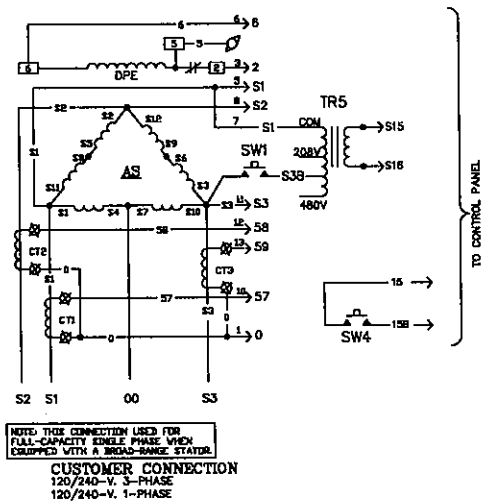


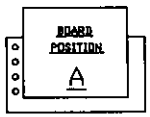
Figure 27 — Wiring Diagram for Lower Panel

Electrical Schematic

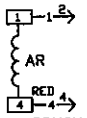


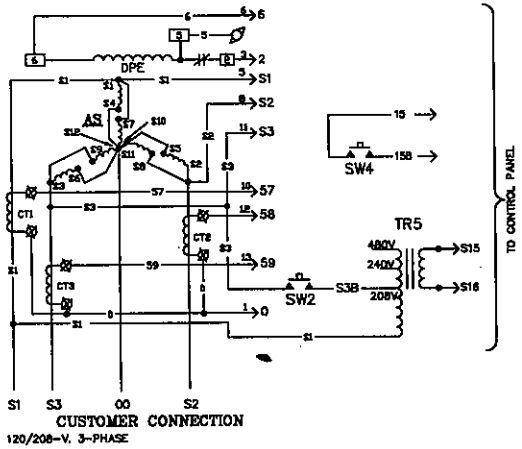
120/240V 1Ø	S1 TO S3: 240V S1 TO 00: 120V S3 TO 00: 120V S2: NOT CONNECTED

VOLTAGE CHANGEOVER



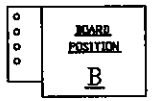
120/240V 3Ø	S1 TO S2: 240V S2 TO S3: 240V S3 TO S1: 240V S1 TO 00: 120V S3 TO 00: 120V

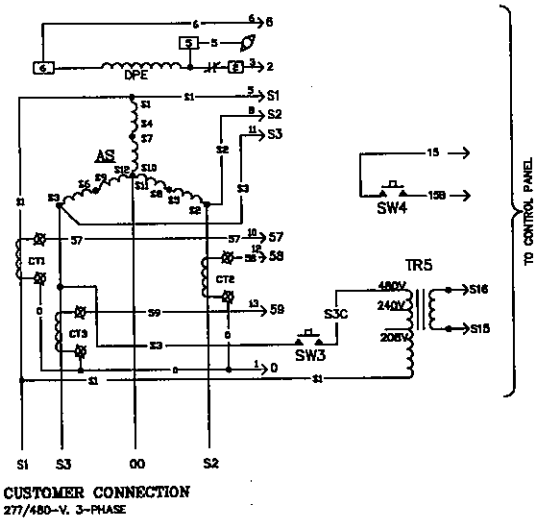




120/208V 3Ø	S1 TO S2: 208V S2 TO S3: 208V S3 TO S1: 208V S1 TO 00: 120V S2 TO 00: 120V S3 TO 00: 120V

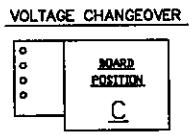
VOLTAGE CHANGEOVER





277/480V 3Ø	S1 TO S2: 480V S2 TO S3: 480V S3 TO S1: 480V S1 TO 00: 277V S2 TO 00: 277V S3 TO 00: 277V

VOLTAGE CHANGEOVER



LEGEND
AR – ALTERNATOR ROTOR
AS – ALTERNATOR STATOR
CT – CURRENT TRANSFORMER
DPE – EXCITATION WINDING
SW1 – SWITCH, VOLTAGE SENSING SELECTOR– 240VΔ
SW2 – SWITCH, VOLTAGE SENSING SELECTOR– 208VY
SW3 – SWITCH, VOLTAGE SENSING SELECTOR– 480VY
SW4 – SWITCH, PANEL COVER INTERLOCK
TR5 – TRANSFORMER, SENSING

Figure 28 – Electrical Schematic for Lower Panel

Electrical Schematic

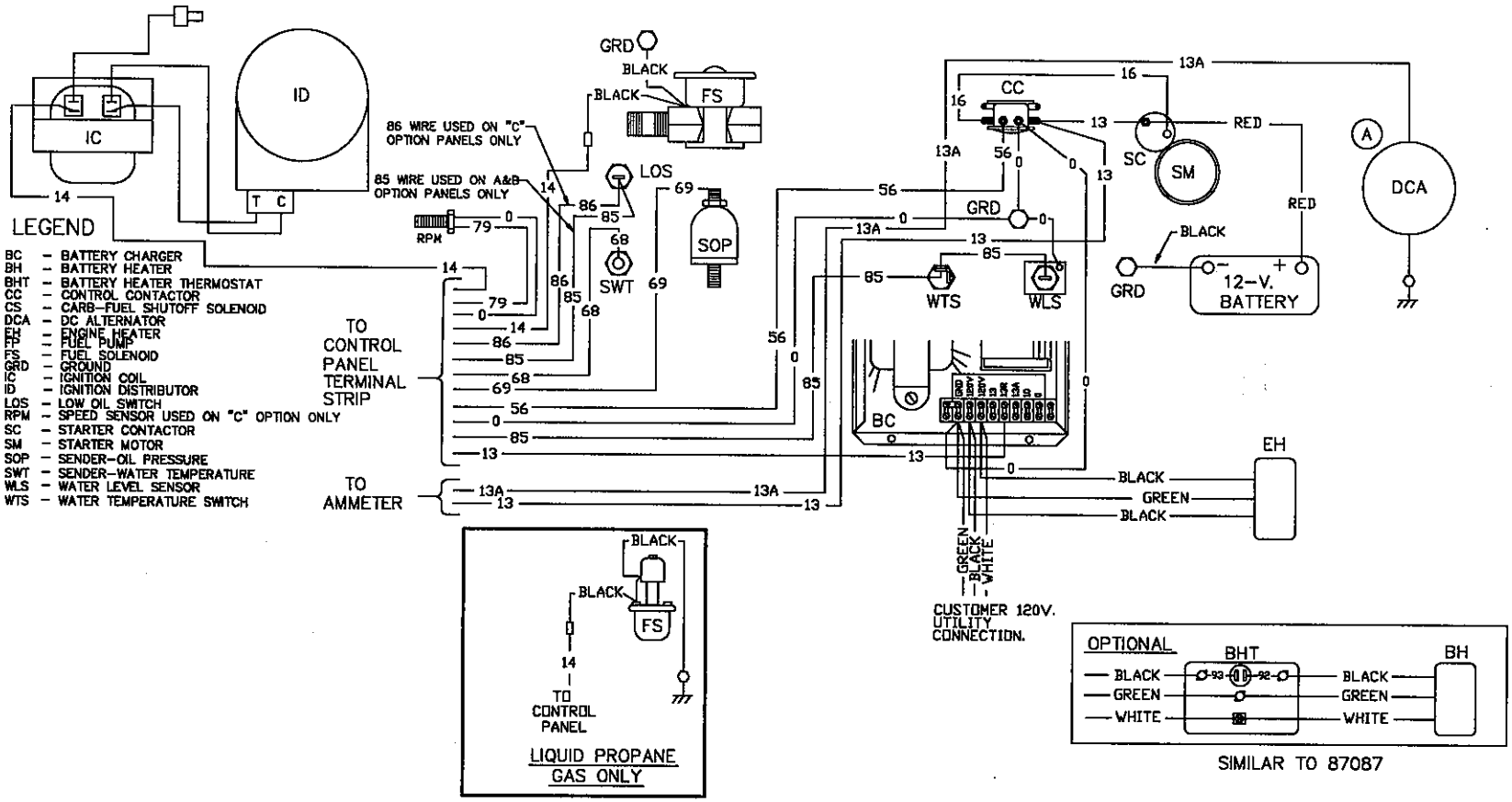
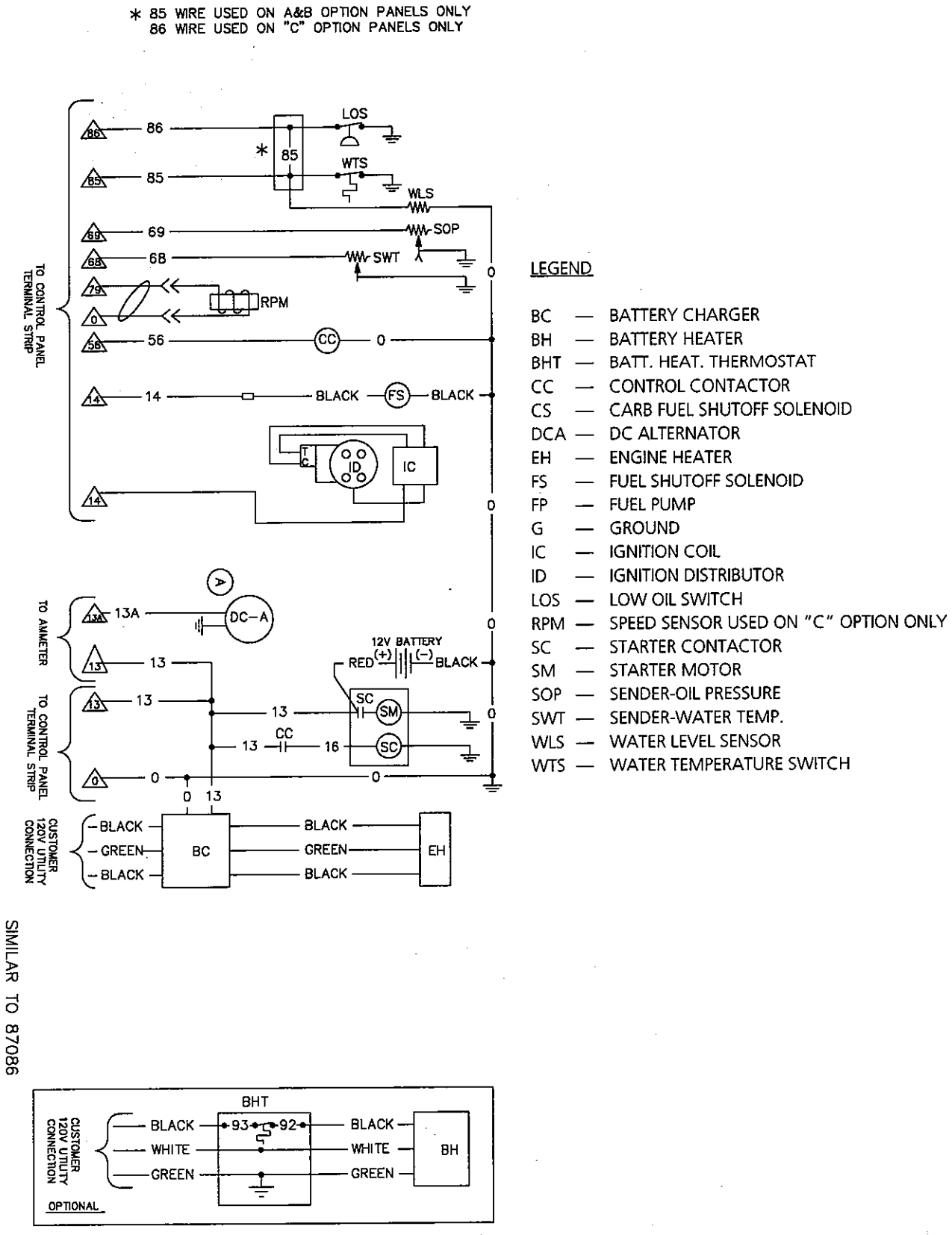


Figure 29 – Electrical Schematic for 4.3 Liter Engine

Wiring Diagram



LEGEND

BC	—	BATTERY CHARGER
BH	—	BATTERY HEATER
BHT	—	BATT. HEAT. THERMOSTAT
CC	—	CONTROL CONTACTOR
CS	—	CARB FUEL SHUTOFF SOLENOID
DCA	—	DC ALTERNATOR
EH	—	ENGINE HEATER
FS	—	FUEL SHUTOFF SOLENOID
FP	—	FUEL PUMP
G	—	GROUND
IC	—	IGNITION COIL
ID	—	IGNITION DISTRIBUTOR
LOS	—	LOW OIL SWITCH
RPM	—	SPEED SENSOR USED ON "C" OPTION ONLY
SC	—	STARTER CONTACTOR
SM	—	STARTER MOTOR
SOP	—	SENDER-OIL PRESSURE
SWT	—	SENDER-WATER TEMP.
WLS	—	WATER LEVEL SENSOR
WTS	—	WATER TEMPERATURE SWITCH

Figure 30 – Wiring Diagram for 4.3 Liter Engine

Interconnection Diagram

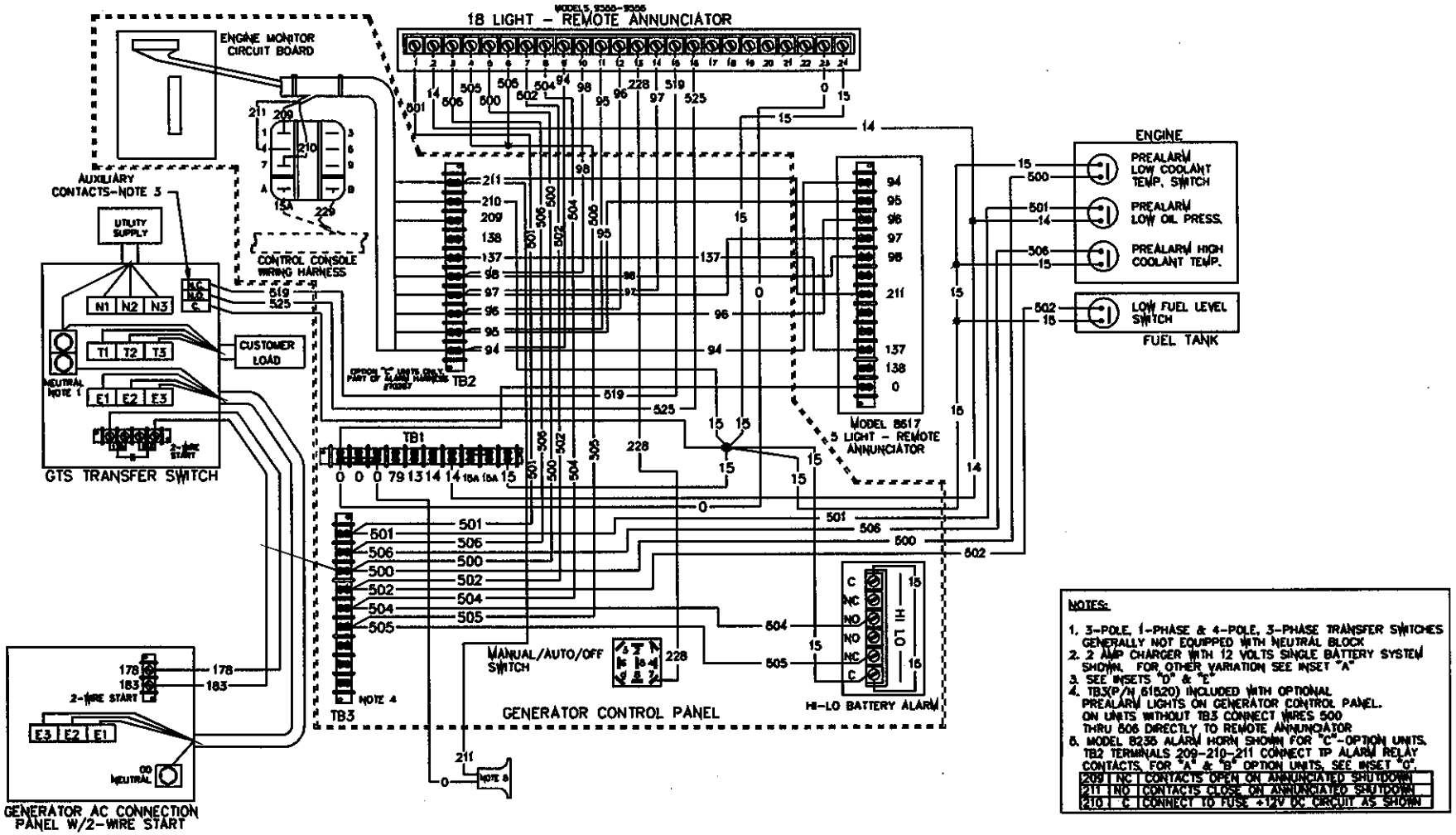


Figure 31 – Replacement Parts Illustration

Interconnection Diagram

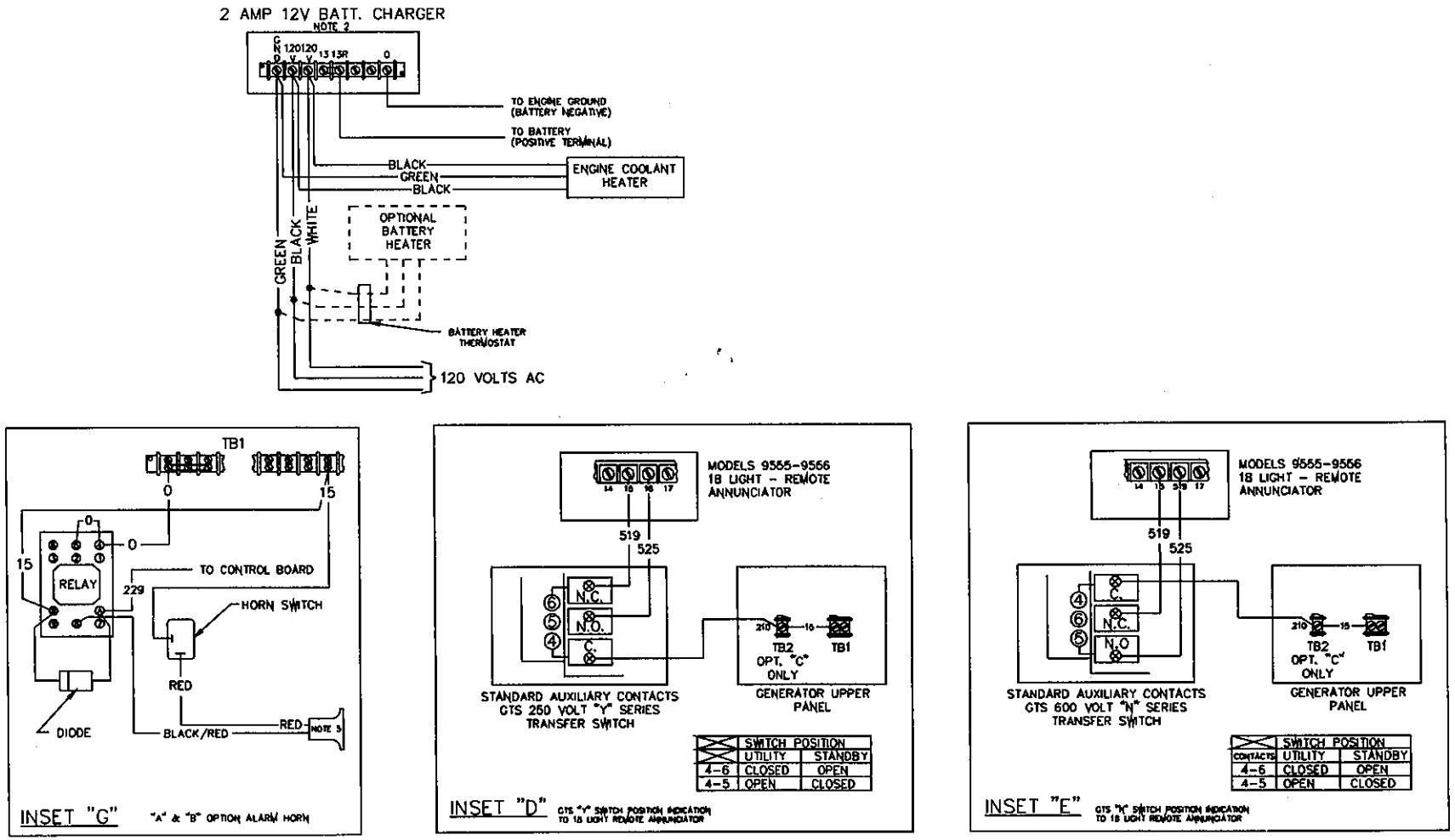


Figure 32 – Interconnection Diagram

For Replacement Parts, call 1-800-323-0620

24 hours a day - 365 days a year

Please provide the following information:
-Model number
-Serial number (if any)
-Part description and number as shown in parts list

Address parts correspondence to:
Grainger Parts Operations
P. O. Box 3074
1657 Shermer Road
Northbrook, IL 60065-3074 U.S.A.

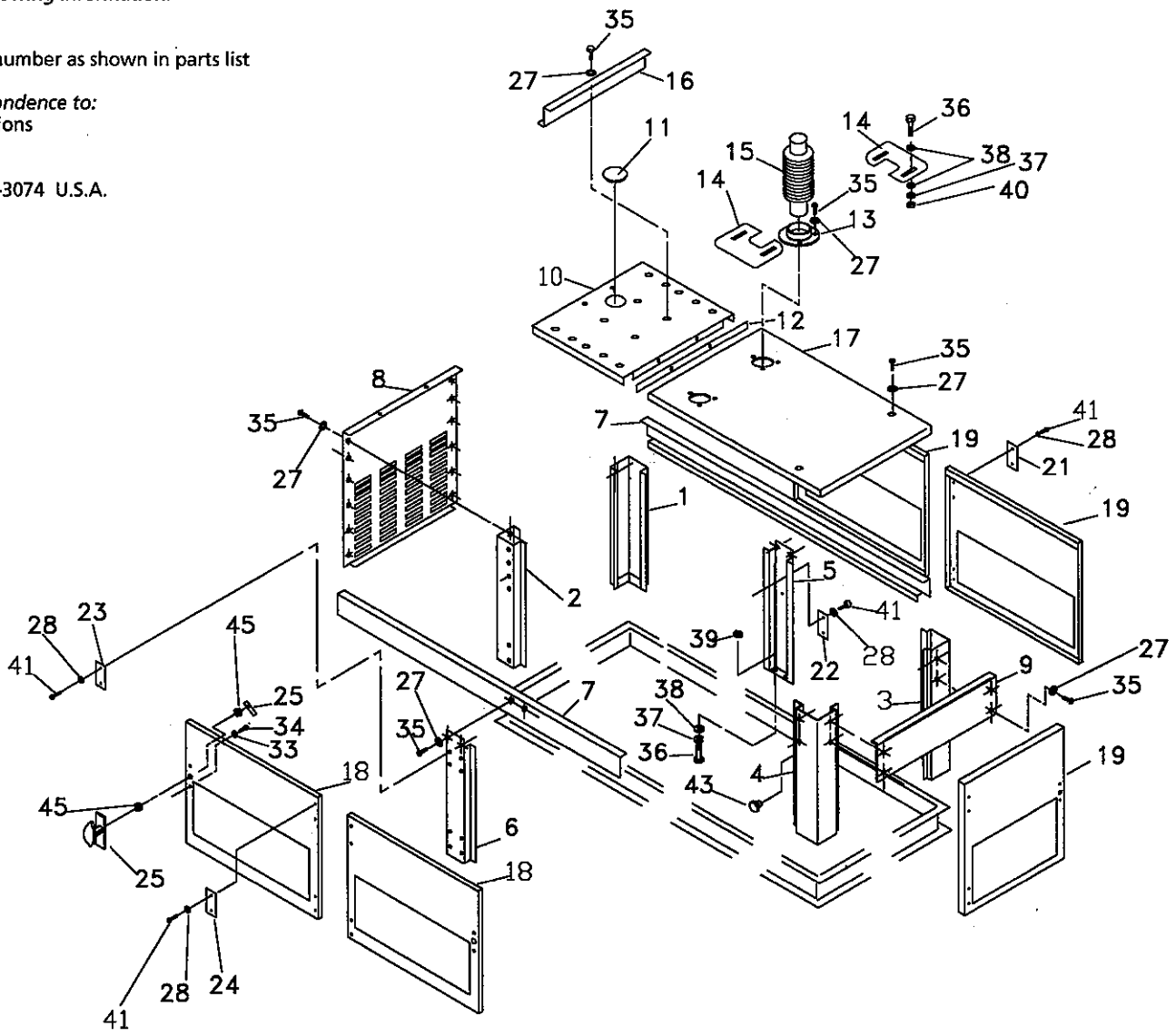


Figure 33 – Replacement Parts Illustration

Replacement Parts List

Ref. No.	Description	Part No. for Model:4LM43	Qty.
1	POST, CORNER-FRONT	A5673A	1
2	POST, CORNER-FRONT	A5673	1
3	POST, CORNER-REAR	A1202	1
4	POST, CORNER-REAR	A1202A	1
5	SUPPORT, CENTER	A5672	1
6	SUPPORT, CENTER	A5672A	1
7	BRACE, SIDE	69557	2
8	SCREEN-FRONT	A3136	1
9	BRACE, REAR	68422	1
10	TOP, ENGINE END	A4137	1
11	COVER, ACCESS 4"	82570	1
2	STRIP, SEALANT-1/8" x 1"	66760	35.5"
13	RING, INLET	47993A	2
14	SHIELD, RAIN	66071D	1
15	PIPE, FLEXIBLE EXHAUST-4.3L GAS	A4621A	2
16	SUPPORT, MUFFLER	68932	2
17	TOP, GENERATOR END	A4982	1
18	DOOR, LEFT SIDE	70379	2
19	DOOR, RIGHT SIDE	70379A	3

Ref. No.	Description	Part No. for Model:4LM43	Qty.
21	HINGE, SLIP-LH (FM)	A3133A	4
22	HINGE, SLIP-LH (M)	A3133B	4
23	HINGE, SLIP-RH (M)	A3133C	6
24	HINGE, SLIP-RH (FM)	A3133D	6
25	LATCH	67042	5
27	WASHER, NYLON	A2115	47
28	WASHER, SS SHAKEPROOF M6	A3360	40
33	WASHER, LOCK-NO.8	22264	10
34	SCREW, PAN HEAD MACH.-NO.8-32 x 5/16"	67035	10
35	SWAGEFORM FASTENER 1/4-20 x 5/8"	A2437	47
36	CAPSCREW, HEX HEAD-1/4"-20 xz 3/4"	22287	14
37	WASHER, LOCK-1/4"	22097	56
38	WASHER, FLAT-1/4"	22473	58
39	NUT, SPEED-1/4"-20	67577	12
40	NUT, HEX-1/4"-20	49813	4
41	CAPSCREW, HEX HEAD-M6-1.00 x 20MM SS	A3359	40
43	BUMPER	32990	10
45	HEX NUT-JAM, 3/8-24	37337	10
46	CAPSCREW, HEX HEAD-M6 x 10MM	43146	2

For Replacement Parts, call 1-800-323-0620

24 hours a day - 365 days a year

Please provide the following information:
-Model number
-Serial number (if any)
-Part description and number as shown in parts list

Address parts correspondence to:
Grainger Parts Operations
P.O. Box 3074
1657 Shermer Road
Northbrook, IL 60065-3074 U.S.A.

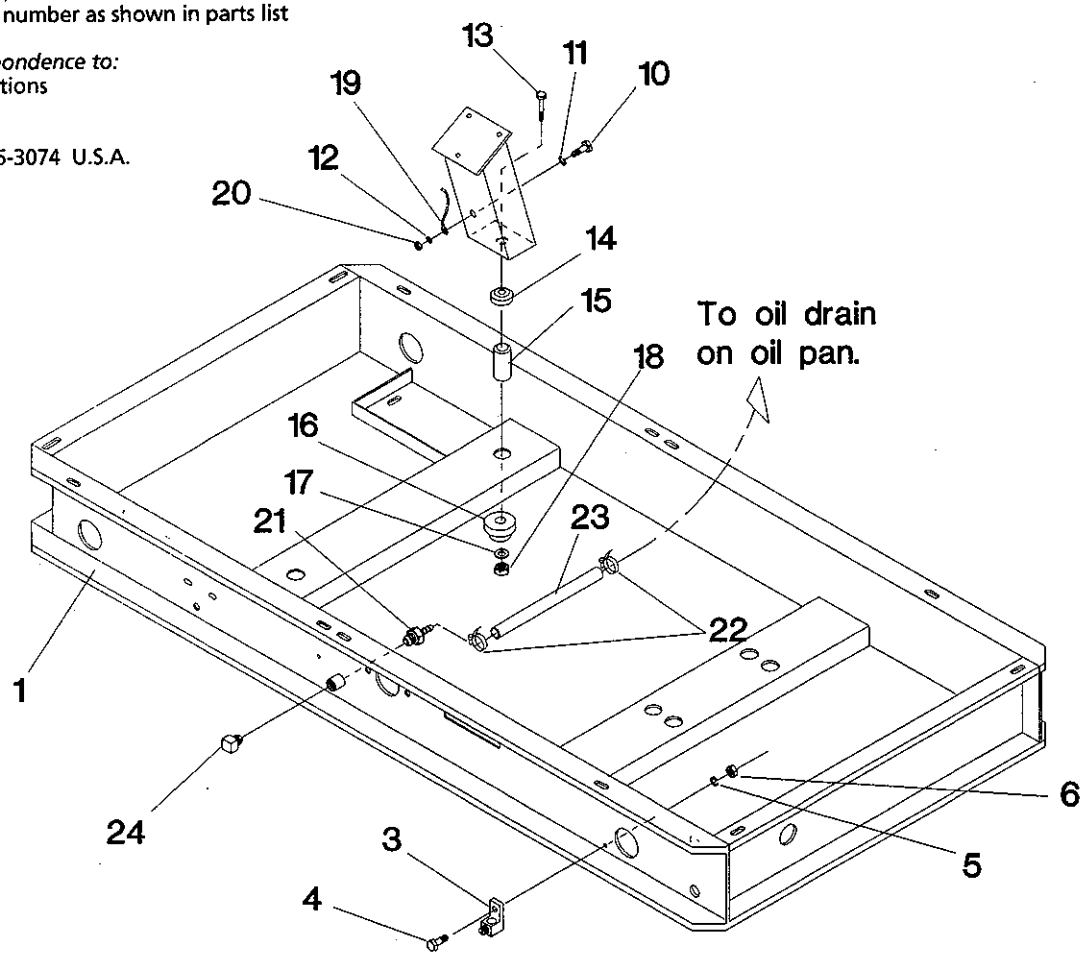


Figure 34 – Replacement Parts Illustration for Mounting Base

Replacement Parts List

Ref. No.	Description	Part No. For Models: 4LM43	Qty.
1	BASE, MNT. (DIRECT-COUPLED)	A3684	1
	BASE, MNT. (GEARBOX)	A3688	1
3	LUG, GROUNDING	55414	1
4	CAPSCR., HEX HD. M6-1.00x16MM	47411	1
5	LOCK WASHER-M6	22097	1
6	NUT, HEX-M6-1.00	49813	1
10	CAPSCREW, HEX HEAD 3/8"-16 x 3/4"	23152	1
11	LOCK WASHER-3/8"	22237	1
12	WASHER, SHAKE PROOF	25507	1
13	CAPSC. HEX HD. M12-1.75 X 80	52891	2

Ref. No.	Description	Part No. For Models: 4LM43	Qty.
14	DAMPENER, VIBRATION-BLUE	52251	2
15	SPACER - 1-7/8" LONG	52257	2
16	DAMPENER, VIBRATION	52252	2
17	FLAT WASHER	52259	2
18	NUT, LOCK - M12-1.75	52860	2
19	WIRE ASSY. - GROUNDING	98-53621	1
20	NUT, HEX - 3/8" - 16	22241	1
21	BARBED, STR. 3/4" NPT . 5/8"	84033	1
22	CLAMP, HOSE NO. 10	57823	2
23	HOSE, 5/8" I.D. X 11" LONG	57448	1
24	PLUG, PIPE - 3/4"NPT	25655	1

For Replacement Parts, call 1-800-323-0620

24 hours a day – 365 days a year

Please provide the following information:
-Model number
-Serial number (if any)
-Part description and number as shown in parts list

Address parts correspondence to:
Grainger Parts Operations
P.O. Box 3074
1657 Shermer Road
Northbrook, IL 60065-3074 U.S.A.

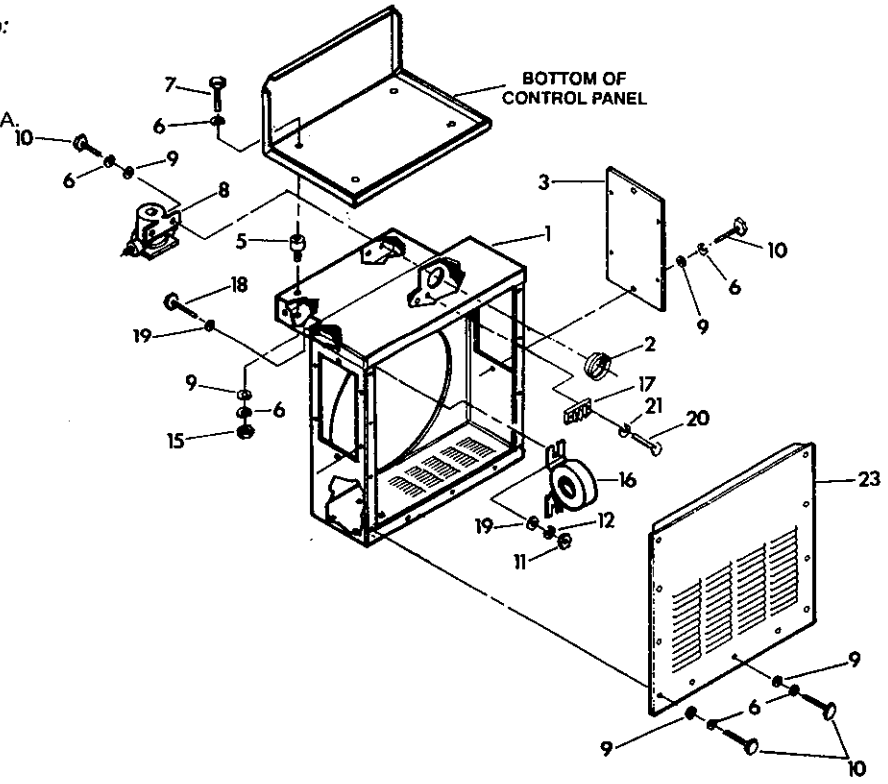


Figure 35 – Replacement Parts Illustration for Connection Panel

Replacement Parts List

Reference Number	Description	Part Number For Models: 4LM43	Quantity
1	PANEL, LOWER	68115	1
2	BUSHING, SNAP	23484-N	1
3	COVER, LOWER PANEL BLANK	68147	2
5	DAMPENER, VIBRATION	40479	4
6	WASHER, LOCK-1/4"	22097	33
7	CAPSCR., HEX HD.-1/4"-20 x 1/2"	22507	4
8	SOLENOID (SILVER)	56739	1
9	WASHER, FLAT-1/4"	22473	29
10	CAPSCR., HEX HD.-1/4"-20 x 3/4"	22287	25
11	NUT, HEX-M8-1.25	45771	6
15	NUT, HEX-1/4"-20	22127	4
16	TRANSFORMER, CURRENT-200/5	58710	3
17	BLOCK, TERMINAL	48766	1
18	CAPSC., HEX HEAD-M8-1.25 x 16 LONG	42907	6
19	WASHER, FLAT-M8	22145	12
20	SCREW, HEX HEAD MACH.-NO. 6-32 x 5/8"	33136	2
21	WASHER, LOCK-NO. 8	22264	2
23	COVER, LOWER PANEL	71665	1

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Northbrook, IL 60065-3074 U.S.A.

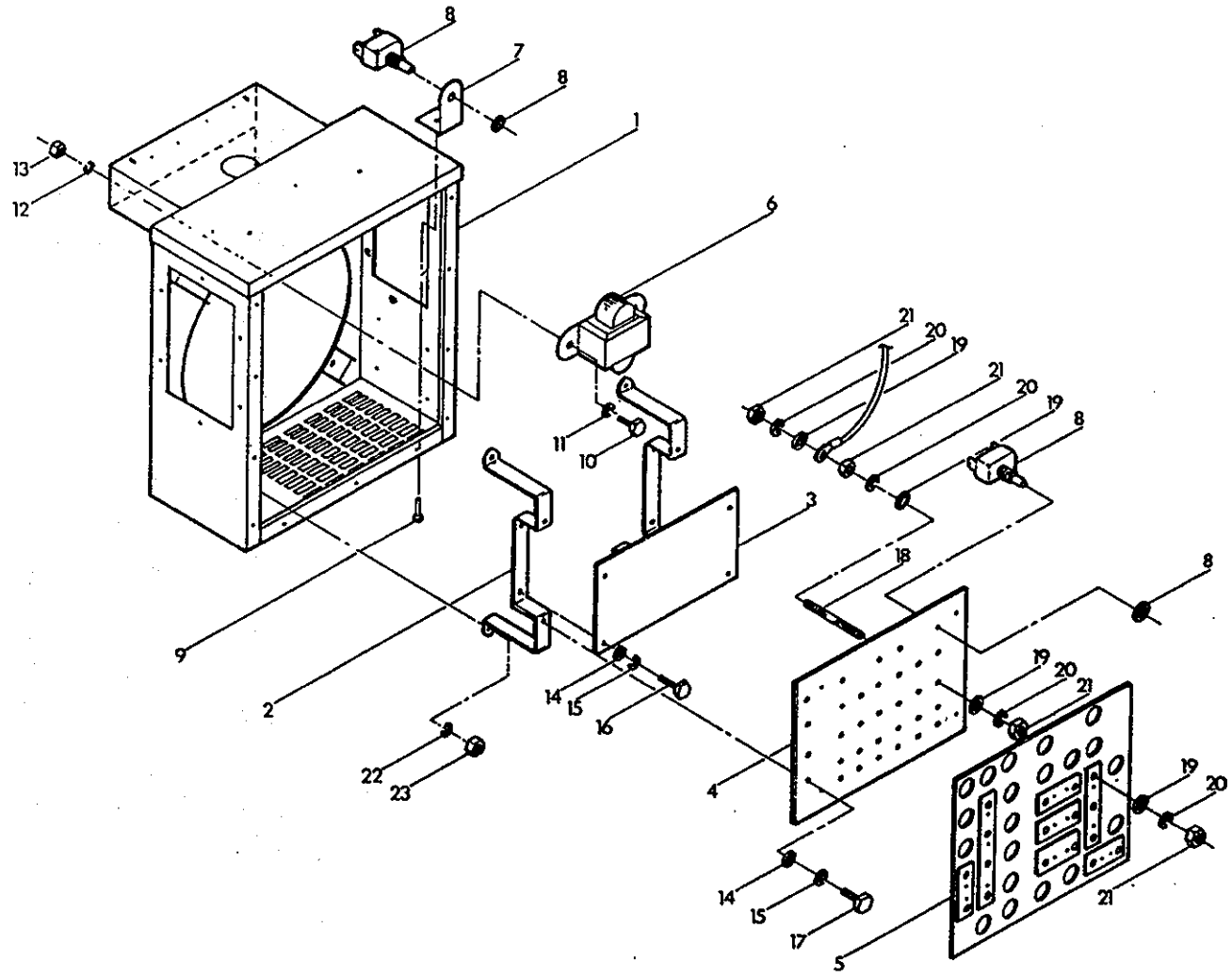

Figure 36 – Replacement Parts Illustration for Lower Panel

Replacement Parts List

Reference Number	Description	Part Number for Model: 4LM43	Quantity
1	Lower panel	68115	1
2	Stub board bracket	72401	2
3	Stator wire shields	72402	1
4	Stud board	72430	1
5	Strapping board	72434	1
6	Transformer	71643	1
7	Bracket	71656	1
8	Switch	71671	4
9	Pop rivet	71670	2
10	#8-32 x 3/8" Capscrew	*	2
11	#8 Flatwasher	*	2
12	#8 Lock washer	*	2
13	#8 -32 Hex nut	*	2
14	1/4" Flat washer	*	8
15	1/4" Lock washer	*	8
16	1/4"-20 x 3/4" Capscrew	*	4
17	1/4" x 1" Capscrew	*	4
18	M10-1.50 x 65mm Stud	72426	30
19	M10 Flat washer	22131	105
20	M10 Lock washer	46526	105
21	M10-1.50 Hex nut	45772	105
22	M14 Lock washer	43123	4
23	M14-2.00 Hex nut	51779	4
§	#10-32 x " Capscrew	*	1
§	#10 Flat washer	*	1
§	#10-32 Hex nut	*	1
§	#10 Lock washer	*	1

(§) NOT SHOWN
(*) Standard hardware item. Available locally.

For Replacement Parts, call 1-800-323-0620

24 hours a day - 365 days a year

Please provide the following information:
-Model number
-Serial number (if any)
-Part description and number as shown in parts list

Address parts correspondence to:
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Northbrook, IL 60065-3074 U.S.A.

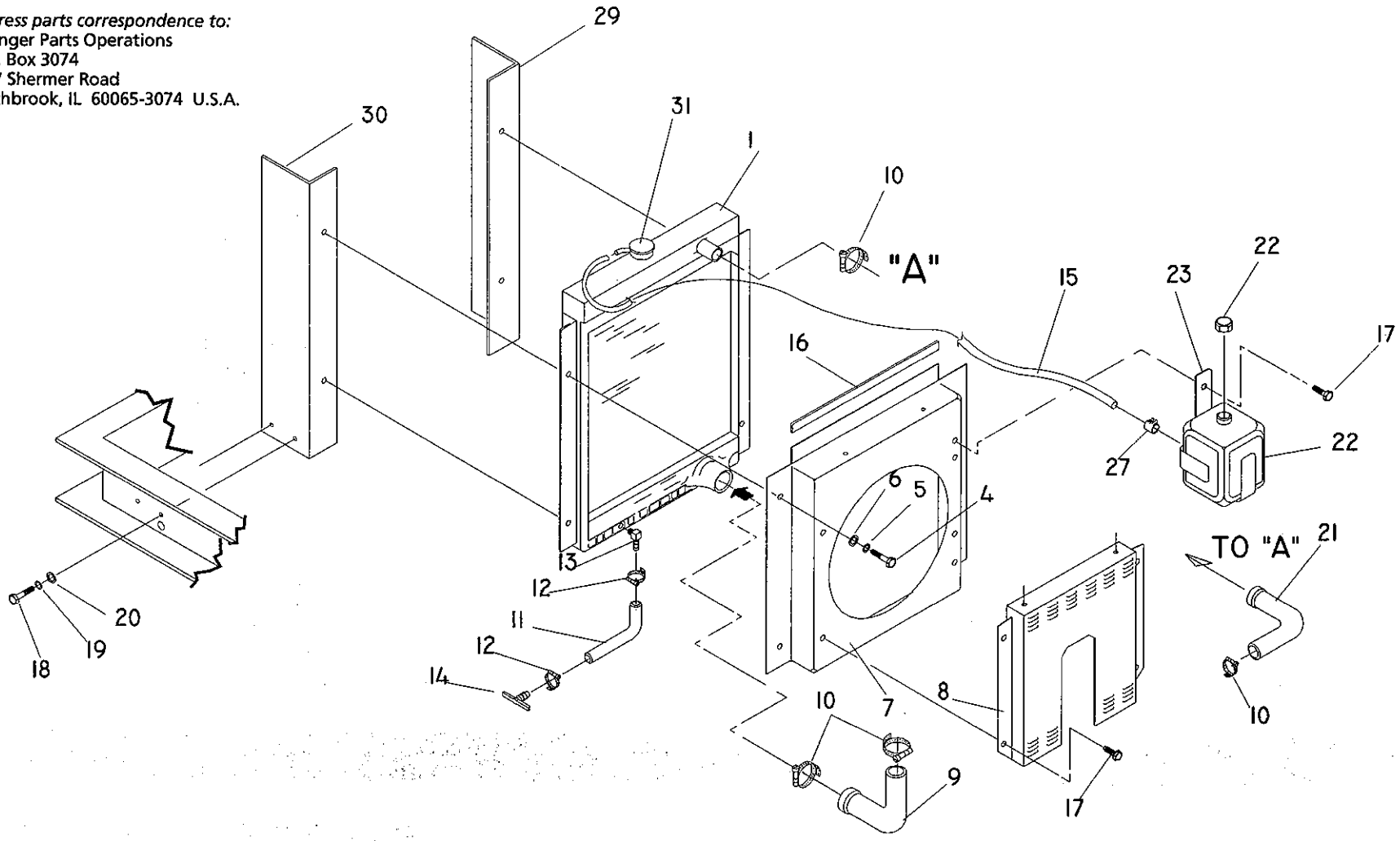

Figure 37 – Replacement Parts Illustration for Radiator

Replacement Parts List

Reference Number	Description	Part Number for Model: 4LM43	Quantity
1	RADIATOR-14 FIN PER INCH	68928	1
4	CAPSCR., HEX HD.-1/4-20 x 1"	22413	4
5	LOCKWASHER-1/4"	22097	4
6	FLATWASHER-1/4"	22473	4
7	VENTURI-35KW	97246A	1
	VENTURI-45KW	97246B	1
8	GUARD, FAN	A5397	1
9	HOSE, RADIATOR LOWER	A4375	1
10	CLAMP, HOSE-NO. 28	35685	4
11	HOSE-3/8" I.D. x 16" LONG	47290	1
12	CLAMP, HOSE-NO. 5	40173	2
13	FITTING, BARBED 90 DEG.-1/4" x 3/8"	49340	1
14	PETCOCK	36865	1
15	HOSE 9/32" I.D. x 46" LONG	29032	1
16	TAPE, FOAM-1" SQ. x 2.4' LONG	52250	2
17	SCREW(CRIMPTITE)-1/4"-20 x 5/8"	58443	10
18	CAPSCR., HEX HD.-3/8"-16 x 1"	29745	4
19	LOCKWASHER-3/8"	22237	4
20	FLAT WASHER-3/8"	22131	4
21	HOSE, RADIATOR UPPER	A4374	1
22	BOTTLE, COOLANT RECOVERY	76749	1
23	BRACKET, COOLANT RECOVERY	80712	1
27	SPRING CLAMP, HOSE #9	83709	1
29	SUPPORT-RADIATOR LT	A3187A	1
30	SUPPORT-RADIATOR RT	A3187B	1
31	RADIATOR CAP	46627	1

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-Serial number (if any)
-Part description and number as shown in parts list

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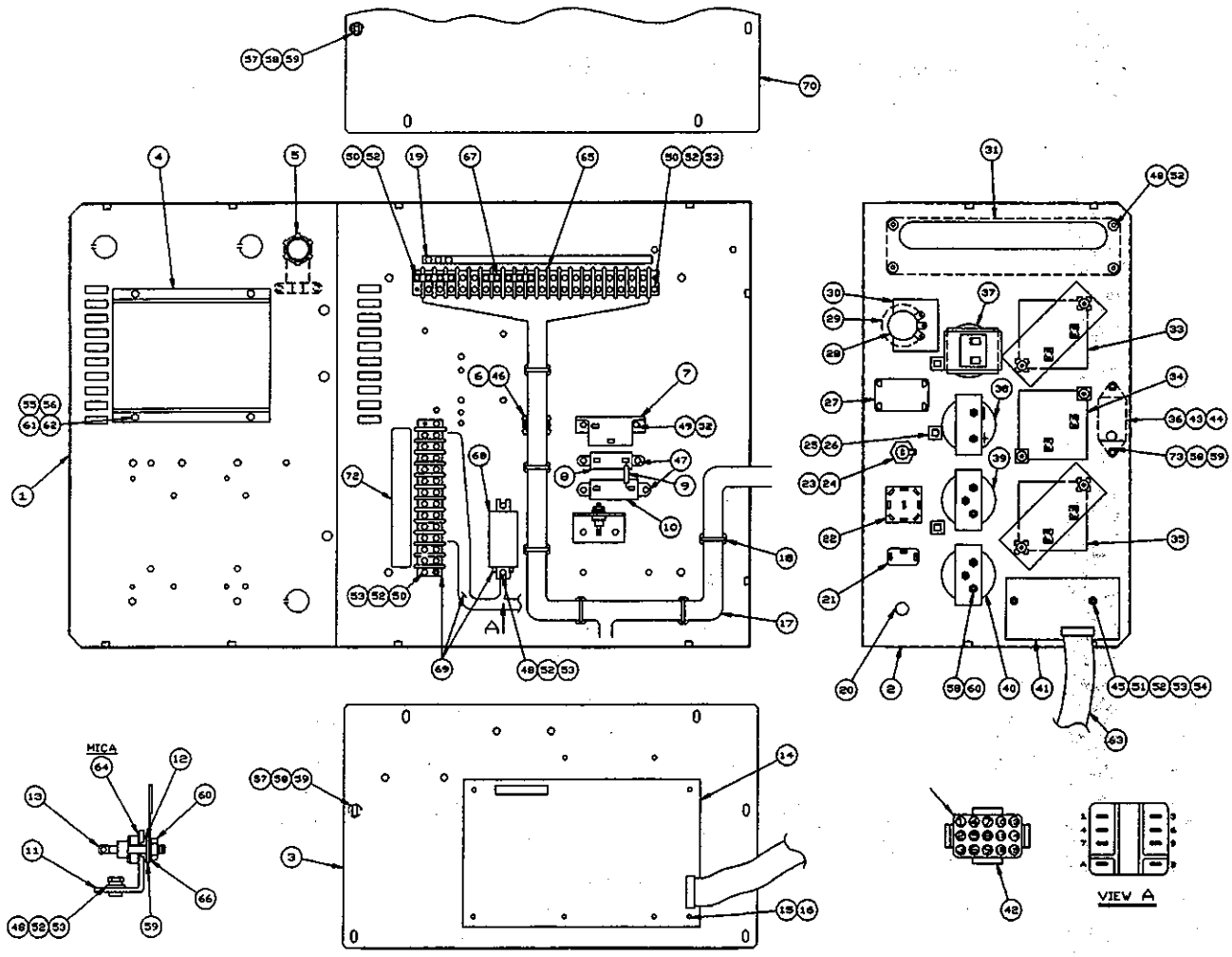

Figure 38 – Replacement Parts Illustration for Control Panel

Replacement Parts List

Ref. No.	Description	Part No. For Models: 4LM43	Qty.
1	BOTTOM, CONTROL PANEL	70023	1
2	FRONT, CONTROL PANEL	70026	1
3	SIDE, CONTROL PANEL	70028	1
4	REGULATOR, VOLT.	67680	1
5	CONNECTOR, 90DEG.-3/4"	39271	1
6	CONNECTOR, STRAIGHT-3/4"	34616	1
7	BREAKER, CIRCUIT-8AMP.	48468	1
8	RESISTER-10 OHM, 12 WATT	44213	1
9	DIODE-600 VOLTS, 2 AMP.	25192	1
10	RESISTER-5 OHM	48352	1
11	SINK, HEAT	55444	1
12	WASHER, STEP (NYLON)	30468	1
13	RECTIFIER	49939	1
14	BOARD, CIR.-ENG. CONTROL	83089	1
15	STANDOFF, CIR./BOARD SUPT.	64525	4
16	SCREW, SELF TAPPING-NO. 6-32	64526	8
17	HARNESS-12 VOLTS GAS	87047	1
18	TIE WRAP-7" LONG	29333	6
19	DECAL, TERMINAL STRIP	70097	1
20	BUTTON, PLUG	64001	1
21	SWITCH, START/STOP	55867	1
22	SWITCH, 3-POS.(AUTO/MAN./OFF)	67625	1
23	HOLDER, FUSE	32300	1
24	FUSE-15AMP.	22676	1
25	MOUNT, CABLE TIE	57593	3
26	TIE WRAP-4" LONG	28739	3
27	SWITCH	61945	1
28	POTENTIOMETER	71361	1
29	KNOB	50123	1
30	INSULATOR	55349	1
31	COVER-GENERAC	70030	1
32	MACH. SCR., #10-32 x 5/8-LONG HEX HEAD	33138	2
33	METER, FREQUENCY (HERTZ)	70042	1
34	A-C AMMETER-0 TO 200	70045	1
35	A-C VOLTMETER-0 TO 500	71668	1
36	LIGHT, PANEL	70202	1
37	HOUR METER	70081	1
38	D-C AMMETER	62304	1
39	GAUGE, OIL PRESSURE	55405	1
40	GAUGE, WATER TEMP.	55406	1
41	BOARD, CIR.-ENG. MONITOR	70083	1
42	HOUSING, SOCKET-15 CKT.	55089	1
43	BLOCKER, LIGHT	70082	1
44	LUG-NO. 10	53247	1
45	SPACER	29187	2
46	FLEX-GARD-5/8" I.D.	77043-D	16"
47	SC., RD. HD. MACH. NO. 6-32x1/4"	25105	4
48	SC., HEX HD. MACH. NO. 6-32x3/8"	33132	8
49	SC., PAN HD. MACH. NO. 6-32x3/8"	33500	2
50	SC., HEX HD. MACH. NO. 6-32x3/8"	36904	4
51	SC., HEX HD. MACH. NO. 6-32x7/8"	33142	2
52	WASHER, LOCK-NO. 6	22155	16
53	WASHER, FLAT-NO. 6	22985	9
54	NUT, HEX-NO. 6-32	22188	2
55	SCR., HEX HD. MACH. NO. 8-32x1/2"	33135	4
56	WASHER, LOCK-NO. 8	22264	4
57	SC., HEX HD. MACH. NO. 10-32x1/2"	33121	14
58	WASHER, LOCK-NO. 10	22152	24
59	WASHER, FLAT-NO. 10	23897	17
60	NUT, HEX-NO. 10-32	22158	9
61	WASHER, FLAT-NO. 9	38150	4
62	NUT, HEX NO. 8-32	22471	4
63	CABLE, RIBBON-16"	84787	1
64	MICA WASHER	70370	1
65	BLOCK, TERMINAL	57335	1
66	WASHER, EXT. SHAKEPROOF	23762	1
67	JUMPER, TERMINAL BLOCK	46669	5
68	RELAY (DPDT) 12V. DC, 10A.	63617	1
69	HARNESS, ASSEM.-ALARMS	70287	1
70	SIDE, CONTROL PANEL	64000	1
71	COVER, TOP (NOT SHOWN)	64008	1
72	DECAL, TERMINAL STRIP	66040	1

For Replacement Parts, call 1-800-323-0620

24 hours a day - 365 days a year

Please provide the following information:
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-Serial number (if any)
-Part description and number as shown in parts list

Address parts correspondence to:
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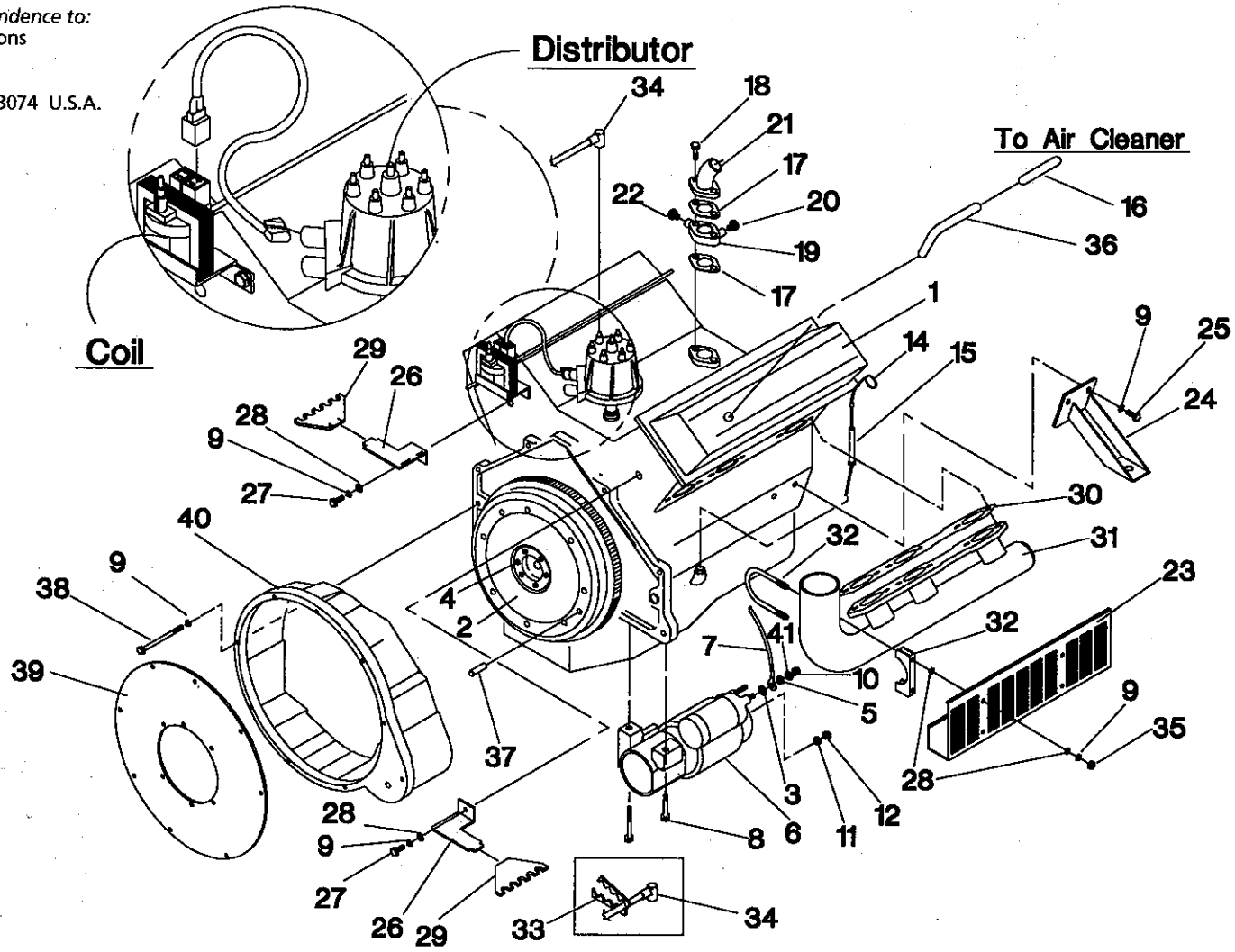

Figure 39 – Replacement Parts Illustration for Engine Parts

Replacement Parts List

Ref. No.	Description	Part No. for Model:4LM43	Qty.
1	ENGINE-4.3 LITER V6	A3797	1
2	FLYWHEEL	A3849A	1
3	WASHER, LOCK-EXTERNAL M12	70022	1
4	BOLT (FLYWHEEL)	A6021	6
6	STARTER	59056A	1
7	CABLE, BATTERY (RED)-15" LONG		1
8	BOLT, STARTER	58385A	2
9	WASHER, LOCK-3/8"	22237	17
10	NUT, HEX-M10-1.50	45772	1
11	WASHER, LOCK-M5	49226	1
12	NUT, HEX-M5-0.80	51716	1
13	CONNECTOR, COIL DISTRIBUTOR	A4244	1
14	DIPSTICK, OIL LEVEL	A4215	1
15	TUBE, OIL DIPSTICK	A4231	1
16	TUBING, 3/4" I.D. x 10" LONG	59057	1
17	GASKET, THERMOSET	A2440	2
18	CAPSCREW, HEX HD.-3/8-16 x 2-3/4	26568	2
19	HOUSING, SENSOR/THERMOSTAT	99729	1
20	SENDER, TEMPERATURE	53667	1
21	HOUSING, THERMOSTAT/WATER INLET	69939	1
22	SWITCH, HIGH COOLANT	35606	1
23	HEATSHIELD	A4930B	1
24	ENGINE MOUNT	A4084	1
25	CAPSCR., HEX HD. - 3/8"-16 X 1"	29745	3
26	SUPPORT, SPARK PLUG WIRE	44101	2
27	CAPSCR., HEX HD. - 3/8"-16 X 3/4"	23152	2
28	WASHER, FLAT - 3/8"	22131	2
29	GROMMET, SPARK PLUG WIRE	58030	2
30	GASKET, EXHAUST	A3928	1
31	MANIFOLD, EXHAUST	A3928	1
32	U-BOLT & SADDLE	80762	2
33	RETAINER, SPARK PLUG WIRES	57794	2
34	SET-SPARK PLUG WIRE	A4277	1
35	NUT, HEX 3/8-16	22241	4
36	CONNECTOR	57795	1
37	DOWEL PIN-M10 X 24	489191	2
38	CAPSCR., HEX HD. - 3/8"-16 X 3.5"	32303	6
39	FLEX PLATE	A3852	3
40	ADAPTER CASTING, SAE3	98239	1
*	ENGINE HARNESS (NOT SHOWN)	A4308	1

For Replacement Parts, call 1-800-323-0620

24 hours a day - 365 days a year

Please provide the following information:
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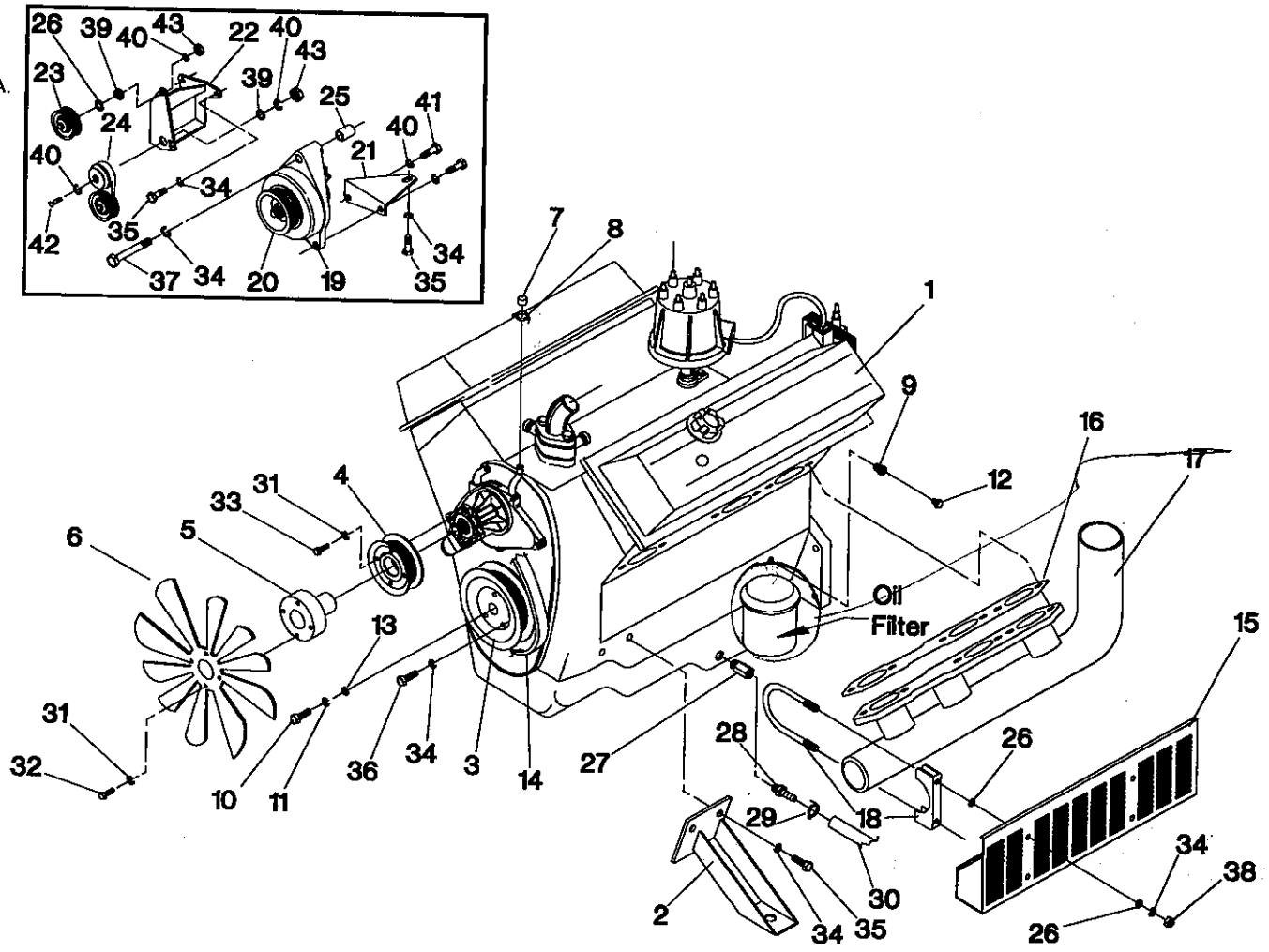

Figure 40 – Replacement Parts Illustration for Engine Parts

Replacement Parts List

Ref. No.	Description	Part No. for Model:4LM43	Qty.
1	ENGINE, 4.3L VORTEC	A3797	1
2	ENGINE MOUNT	A4084	1
3	PULLEY, CRANKSHAFT	A4239	1
4	PULLEY, WATERPUMP	A4240	1
5	FAN SPACER, 45KW UNITS ONLY	A5640	1
6	FAN, 17"-45KW UNITS ONLY	A5639	1
7	CAP, ANTI-FREEZE	77996	1
8	CLAMP, HOSE #10	57823	1
9	REDUCER, 1/4 NPT-1/8 NPT	35579	1
10	CAPSCR.,-HEX HD.-7/16-20 x 2-1/4	37065	1
11	LOCK WASHER-7/16	22302	1
12	SWITCH, OIL PRESSURE	60108	1
13	SPACER,- .50-1.50	52644	1
14	SERPENTINE BELT,72-1/2"	A4278A	1
15	HEAT SHIELD	A4930A	1
16	GASKET, EXHAUST	A4085	1
17	MANIFOLD, EXHAUST	A3927	1
18	U-BOLT & SADDLE	80762	2
19	DC ALTERNATOR	A1232	1
20	PULLEY, ALTERNATOR	A4777	1
21	BRACKET, ALT. SUPPORT	21928	1
22	BRACKET, ALT. MOUNTING	A4187	1
23	PULLEY, IDLER	A4241	1
24	PULLEY, TENSIONER	A4242	1
25	SPACER	A4100G	1
26	FLAT WASHER, 3/8-M10	22131	9
27	ADAPTOR, M12-1.75 - 3/8 NPT	77456	1
28	BARB, 3/8 NPT-5/8 BARB	44117	1
29	CLAMP, HOSE #10	57823	1
30	HOSE, 5/8"-12" LONG	57448	1
31	LOCK WASHER, 5/16"	22129	8
32	HEX HD. CAPSCR. -5/16-18 x 3/4(45KW)	22142	4
33	HEX HD. CAPSCR.-5/16-24 x 3/4	48614	4
34	LOCK WASHER, 3/8"	22237	15
35	HEX HD. CAPSCR.-3/8-16 x 1	29745	7
36	HEX HD. CAPSCR.-3/8-24 x 1	42633	3
37	HEX HD. CAPSCR.-3/8-16 x 4	33819	1
38	HEX NUT, 3/8-16	22241	4
39	FLAT WASHER, M10 HEAVY	A5768	2
40	LOCK WASHER, M10	46526	5
41	HEX HD. CAPSCR.-M10-1.5 x 25	49814	2
42	HEX HD. CAPSCR.-M10-1.5 x 70	51735	1
43	HEX NUT, M10	45772	2
*	OIL FILTER	001-A3797	1

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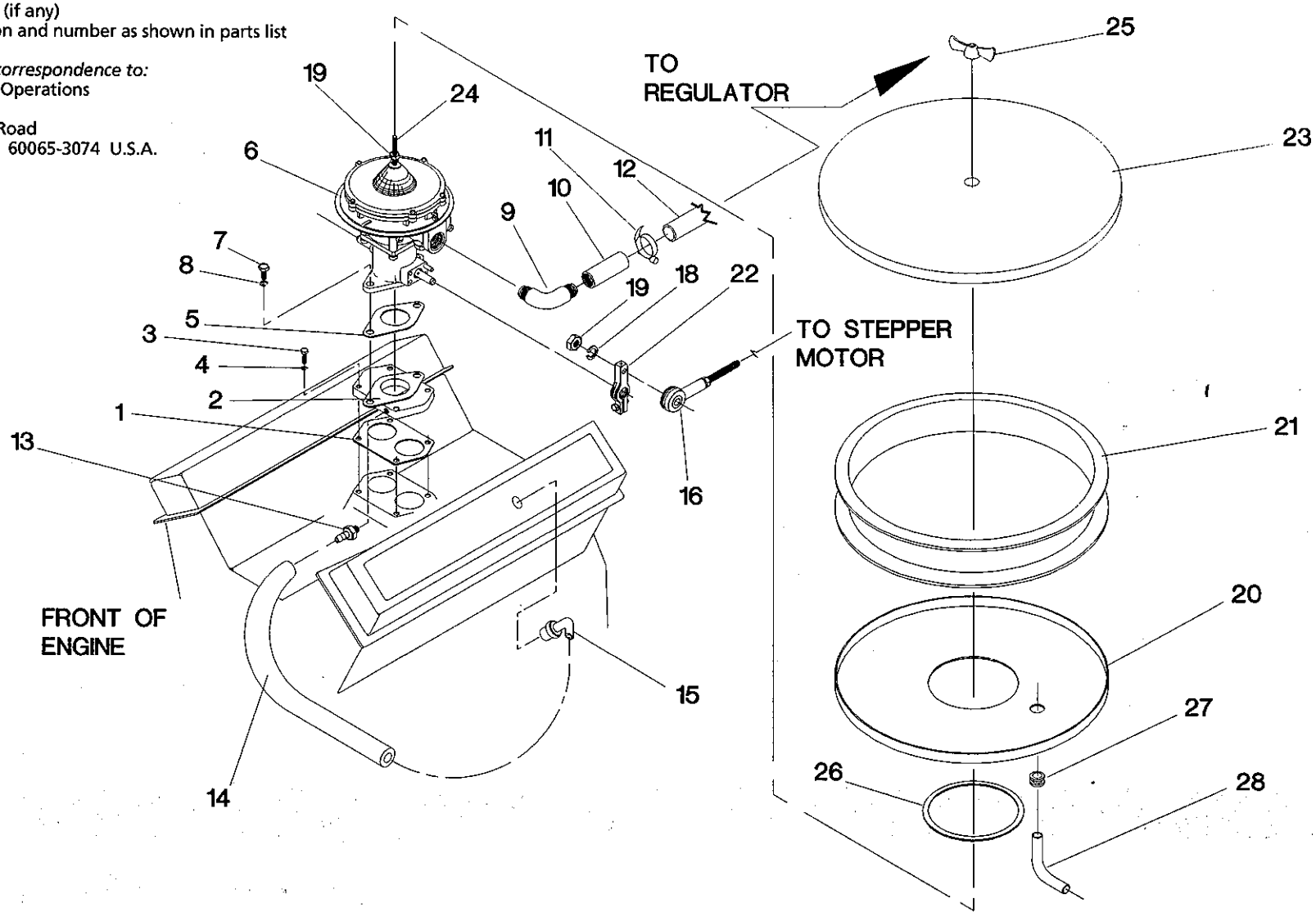

Figure 41 – Replacement Parts Illustration for Carburetor

Replacement Parts List

Reference Number	Description	Part Number for Model: 4LM43	Quantity
1	GASKET	64945	1
2	ADAPTOR, CARBURETOR	A4120	1
3	CAPSCREW, HEX HEAD-5/16"-18 x 1-1/4"	33212	4
4	WASHER, LOCK-5/16"	22129	4
5	GASKET	52865	1
6	CARBURETOR, (NATURAL GAS + VAPOR)	57306	1
	CARBURETOR (LPG LIQUID)	55492	1
7	CAPSCREW, HEX HEAD-3/8"-16 x 1"	29745	2
8	WASHER, LOCK-3/8"	22237	2
9	ELL, STREET-3/4" NPT	26307	1
10	NIPPLE, PIPE (THREADED ONE END)-3/4" NPTx2" LG.	28641	1
11	CLAMP, HOSE-#16	57824	1
12	HOSE, 1" I.D. x 44" LONG(NATURAL GAS + VAPOR)	57422	1
	HOSE, 1" I.D. x 12" (LPG LIQUID)	57422	1
13	BARB, 1/8 NPT-3/8 BARB	44074	1
14	HOSE, 3/8-9" LONG	47290	1
15	PVC VALVE	A4121	1
16	BALL JOINT	82508	1
18	WASHER, LOCK-1/4"	22097	1
19	NUT, HEX-1/4"-28	36409	2
20	BOTTOM, AIR CLEANER	A4632B	1
21	ELEMENT, AIR CLEANER	A4637	1
22	ARM, THROTTLE	A5763	1
23	COVER, AIR CLEANER	A4632A	1
24	STUD-1/4"-20 x 3" LONG	62522	1
25	NUT, WING-1/4"-20	37561	1
26	GASKET	61258	1
27	GROMMET	57796	1
28	CONNECTOR	57795	1

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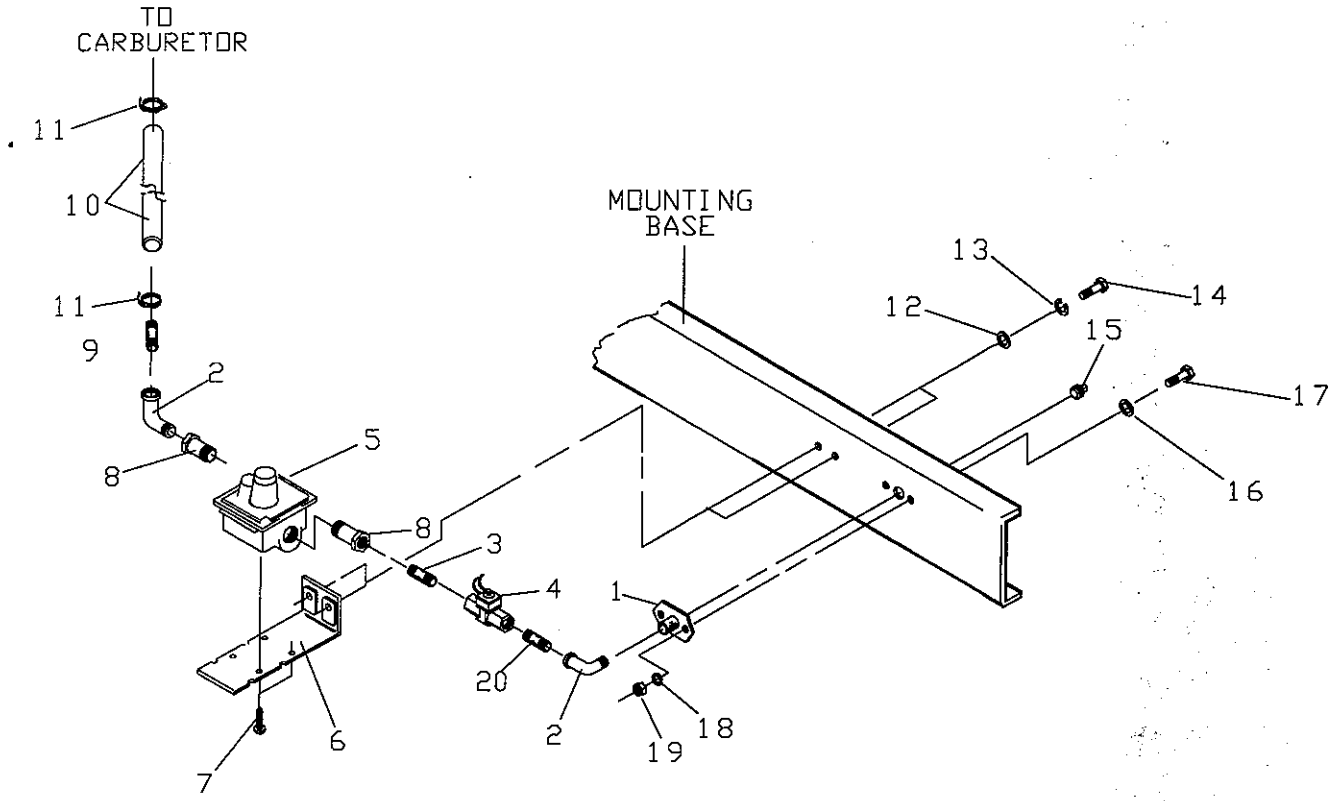

Figure 42 – Replacement Parts Illustration for Natural Gas Regulator

Replacement Parts List

Ref. No.	Description	Part No. For Models: 4LM43	Qty.
1	SUPPORT, SOLENOID	65907	1
2	STREET ELL, 3/4" NPT	26307	2
3	NIPPLE, 3/4" NPT x 2" LONG	26490	1
4	SOLENOID	43768-A	1
5	REGULATOR	55944	1
6	SUPPORT, REGULATOR	67018	1
7	TAPTITE #10-24 x 3/4 LONG	61910	4
8	REDUCER, 1" TO 3/4" NPT	26577	2
9	TOE NIPPLE-3/4" NPT x 2" LONG	28641	1
10	HOSE 1" I.D. X 44" LONG	57422	1

Ref. No.	Description	Part No. For Models: 4LM43	Qty.
11	CLAMP, HOSE #16	57824	2
12	FLAT WASHER - 5/6"	22145	2
13	LOCK WASHER - 5/16"	22129	2
14	CAPSC., HEX HD. 5/16-18 X 1"	30795	2
15	PLUG PIPE	25655	1
16	FLAT WASHER - M14	22132	2
17	CAPSC., HEX HD. M14-2.00 X 25	51778	2
18	LOCK WASHER - M14	43123	2
19	NUT, HEX - M14-2.00	51779	2
20	CLOSE NIPPLE 3/4"	26915	1

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-Model number
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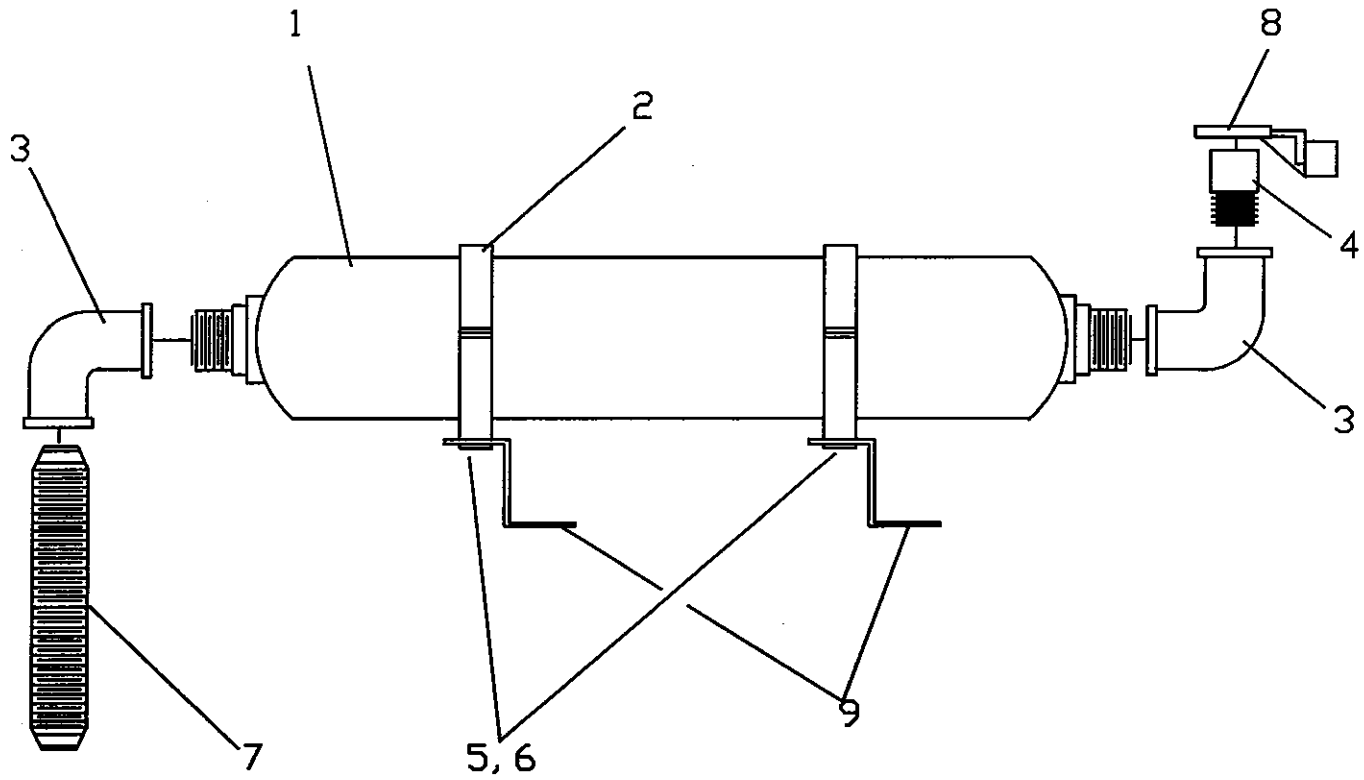


Figure 43 – Replacement Parts Illustration for Muffler

Replacement Parts List

Reference Number	Description	Part Number For Models: 4LM43	Quantity
1	MUFFLER, EXHAUST	59937	2
2	STRAP, MUFFLER MOUNTING	60366	4
3	ELBOW-2" NPT	59933	2
4	NIPPLE-2" NPT x 9" LONG	59109	2
5	CAPSCR., HEX HEAD-M8-1.25 x 20	39253	8
6	NUT, LOCKING M8-1.25	52858	8
7	PIPE, FLEXIBLE EXHAUST-2" NPT(DIRECT COUPLED)	A4621A	1
	PIPE, FLEXIBLE EXHAUST-2" NPT(GEARBOX)	A4621B	1
8	CAP, RAIN	59939	2
9	MUFFLER, SUPPORT	68932	4

For Replacement Parts, call 1-800-323-0620

24 hours a day - 365 days a year

Please provide the following information:
-Model number
-Serial number (if any)
-Part description and number as shown in parts list

Address parts correspondence to:
Grainger Parts Operations
P.O. Box 3074
1657 Shermer Road
Northbrook, IL 60065-3074 U.S.A.

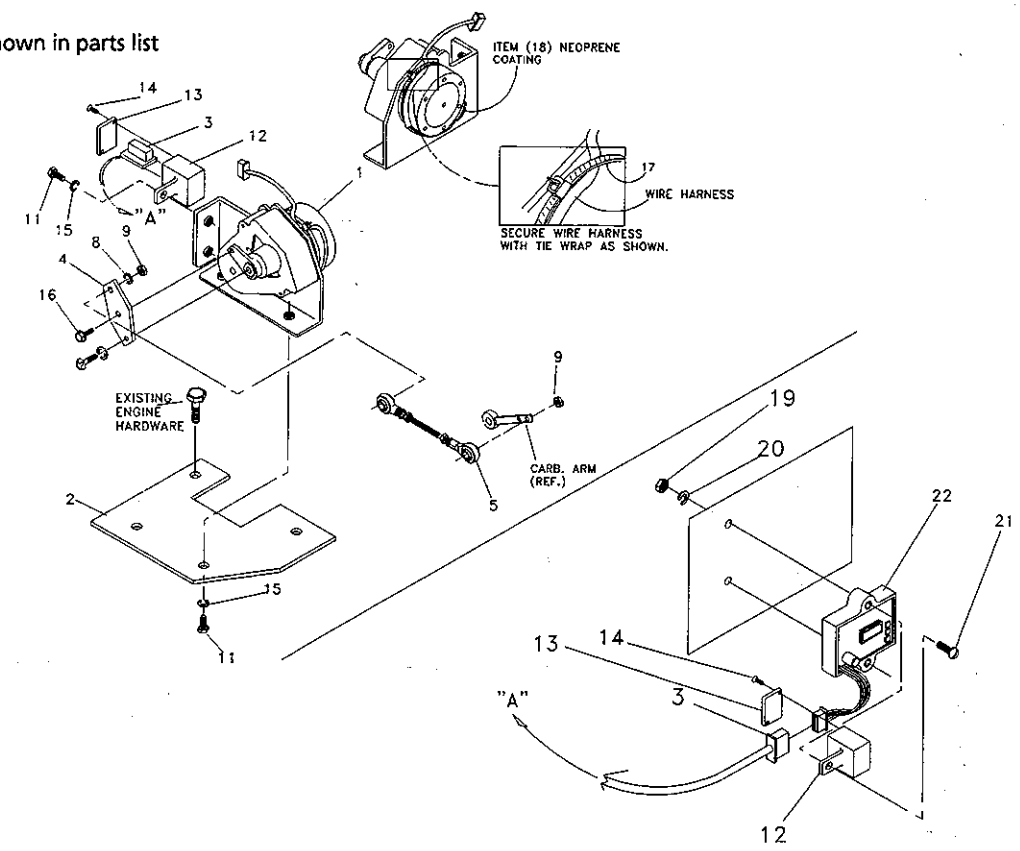
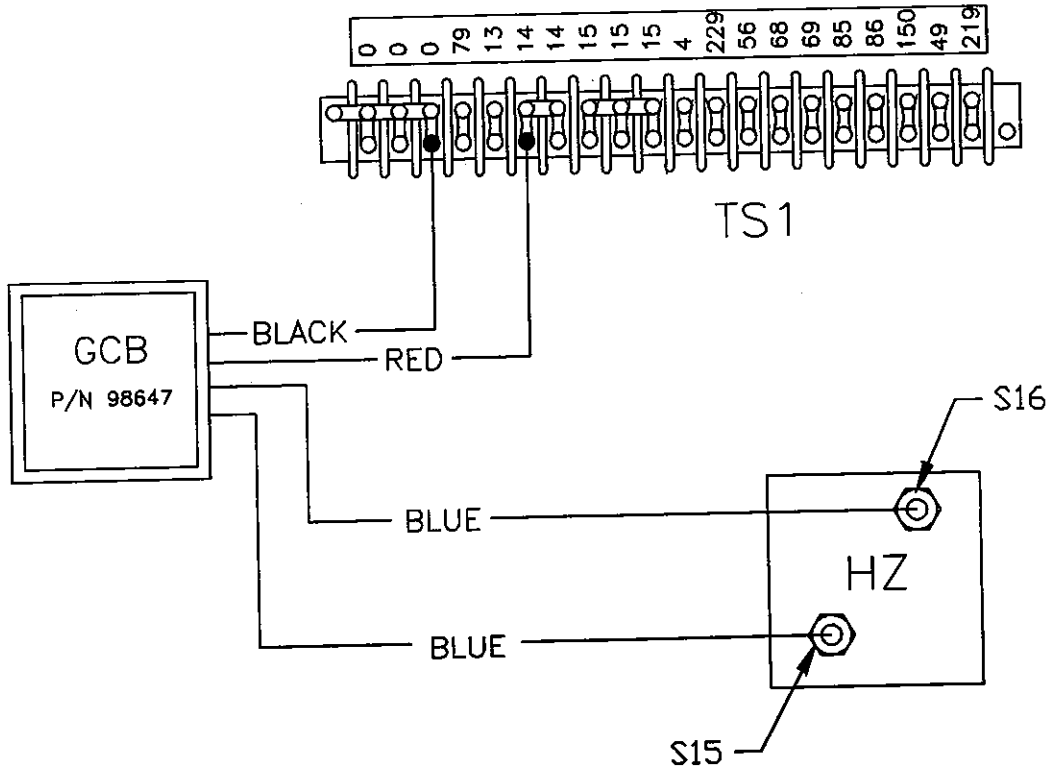


Figure 44 – Replacement Parts Illustration for Electronic Governor

Replacement Parts List

Reference Number	Description	Part Number For Models: 4LM43	Quantity
1	STEPPER MOTOR ASSEMBLY	98290	1
2	BRACKET-MOTOR MOUNT	A3439	1
3	CONNECTOR INTERFACE ASSEMBLY	98958A	1
4	LEVER-STEPPER MOTOR	21888	1
5	CARB. LINKAGE ASSEMBLY	98275	1
9	HEX NUT-1/4-28	36409	2
11	HHMS-M6-1.0 x 10 LONG	43146	3
12	HOUSING-CONNECTOR INTERFACE	98941A	2
13	COVER-INTERFACE HOUSING	98942A	2
14	FHMS-#2 x 5/8 SELF TAP	98225	4
15	LOCKWASHER-M6	22097	3
16	HHMS-#6-32 x 3/8 SELF TAP	64526	1
17	TIE WRAP 7" BLACK	29333A	1
18	NEOPRENE COATING	74031	-
19	NUT, HEX-M5-0.8	51716	2
20	LOCK WASHER M5	49226	2
21	PPHMS, M5-0.8 x 16	76040	2
22	CONTROLLER	98647	1

Electrical Schematic



LEGEND

GCB – GOVERNOR CONTROL BOARD
HZ – FREQUENCY METER
TB1 – TERMINAL BLOCKS

Figure 45 – Electrical Schematic for Stepper Motor

For Replacement Parts, call 1-800-323-0620

24 hours a day - 365 days a year

Please provide the following information:
-Model number
-Serial number (if any)
-Part description and number as shown in parts list

Address parts correspondence to:
Grainger Parts Operations
P.O. Box 3074
1657 Shermer Road
Northbrook, IL 60065-3074 U.S.A.

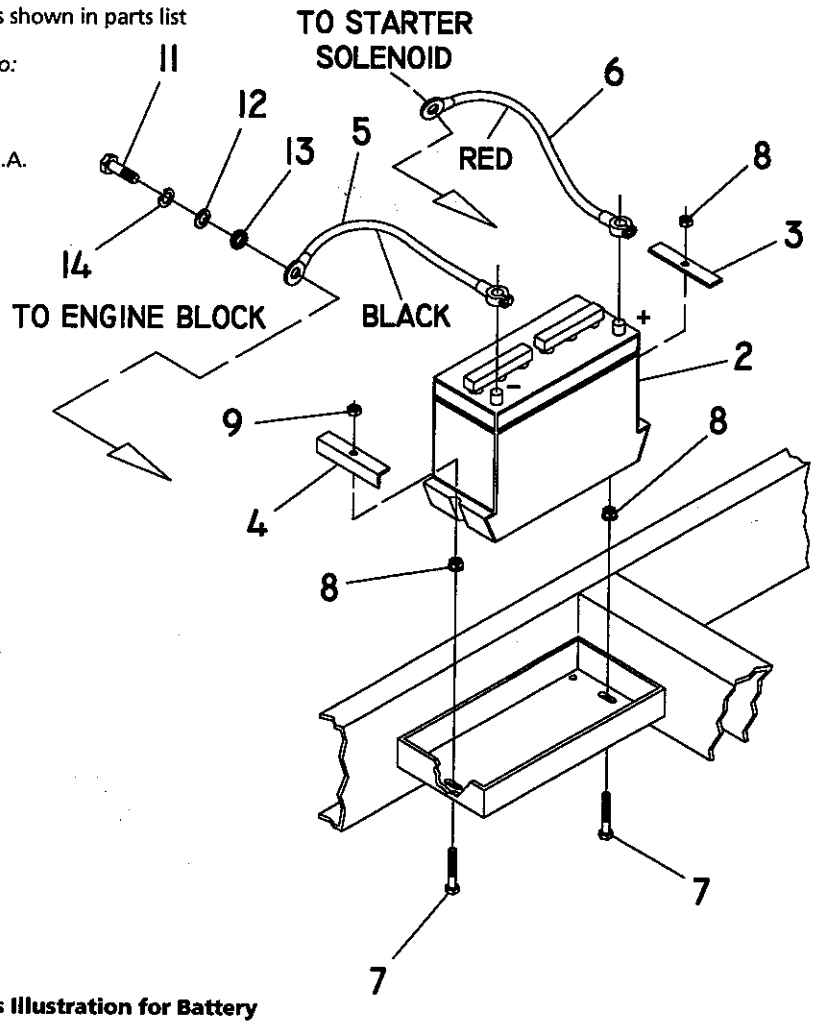


Figure 46 – Replacement Parts Illustration for Battery

Replacement Parts List

Reference Number	Description	Part Number For Model:	Quantity
2	BATTERY-TYPE 27F (OPTIONAL)	58665	1
3	HOLD-DOWN, BATTERY	61902	1
4	HOLD-DOWN, BATTERY	59473	1
5	CABLE, BATTERY (BLACK)-23" LONG	38805-H	1
6	CABLE, BATTERY (RED)-15" LONG	38804-N	1
7	CAPSCREW, HEX HEAD-M8-1.25 x 50MM	51731	2
8	NUT, HEX LOCK-M8-1.25	52858	2
9	NUT, HEX LOCK-(NYLON INSERT)-M8-1.25	49820	2
11	CAPSCREW, HEX HEAD-3/8"-16 x 1" LONG	29745	1
12	WASHER, FLAT-3/8"	22131	1
13	WASHER, SHAKE-PROOF-3/8"	25507	1
14	WASER, LOCK-3/8"	22237	1

For Replacement Parts, call 1-800-323-0620

24 hours a day – 365 days a year

Please provide the following information:
-Model number
-Serial number (if any)
-Part description and number as shown in parts list

Address parts correspondence to:
Grainger Parts Operations
P.O. Box 3074
1657 Shermer Road
Northbrook, IL 60065-3074 U.S.A.

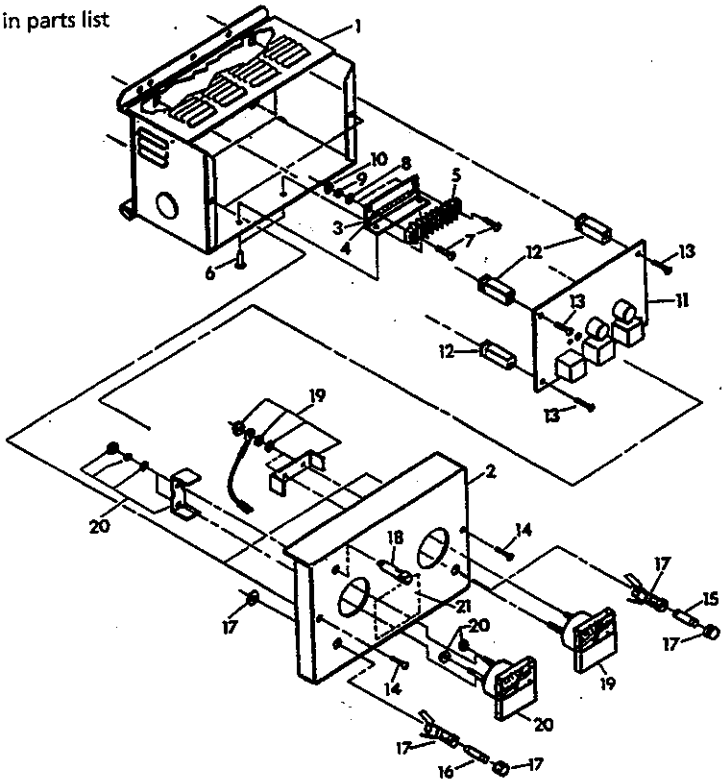


Figure 47 – Replacement Parts Illustration for Battery Charger

Replacement Parts List

Reference Number	Description	Part Number For Models: 4LM43	Quantity
1	BATTERY CHARGER ENCLOSURE	79517	1
2	BATTERY CHARGER COVER-12V.	79522	1
3	TERMINAL BLOCK BRACKET	79523	1
4	TERMINAL BLOCK DECAL	79527	1
5	TERMINAL BLOCK 7-PLACE	79524	1
6	RIVET	29357	2
7	#10 PPHMS.-5/8" LONG	36934	2
8	FLAT WASHER #10	23897	2
9	LOCK WASHER-#10	22152	2
10	HEX NUT #10	22158	2
11	CIRCUIT BOARD ASSEM.-12V.	67666B	1
13	SCREW-P.P. HD. THREAD CUTTING-M4.2 x 16	79529	5
14	MACHINE SCREW-(COVER)-#8, 3/8"	36917	2
15	FUSE, 12AMP.	67683	1
16	FUSE, 4AMP.	67682B	1
17	FUSE HOLDER	32300	2
18	LAMP	61525	1
19	AMETER	61526	1
20	VOLTMETER, 0-15V.	61527	1
21	WIRING DECAL	79528	1

For Replacement Parts, call 1-800-323-0620

24 hours a day - 365 days a year

Please provide the following information:
-Model number
-Serial number (if any)
-Part description and number as shown in parts list

Address parts correspondence to:
Grainger Parts Operations
P. O. Box 3074
1657 Shermer Road
Northbrook, IL 60065-3074 U.S.A.

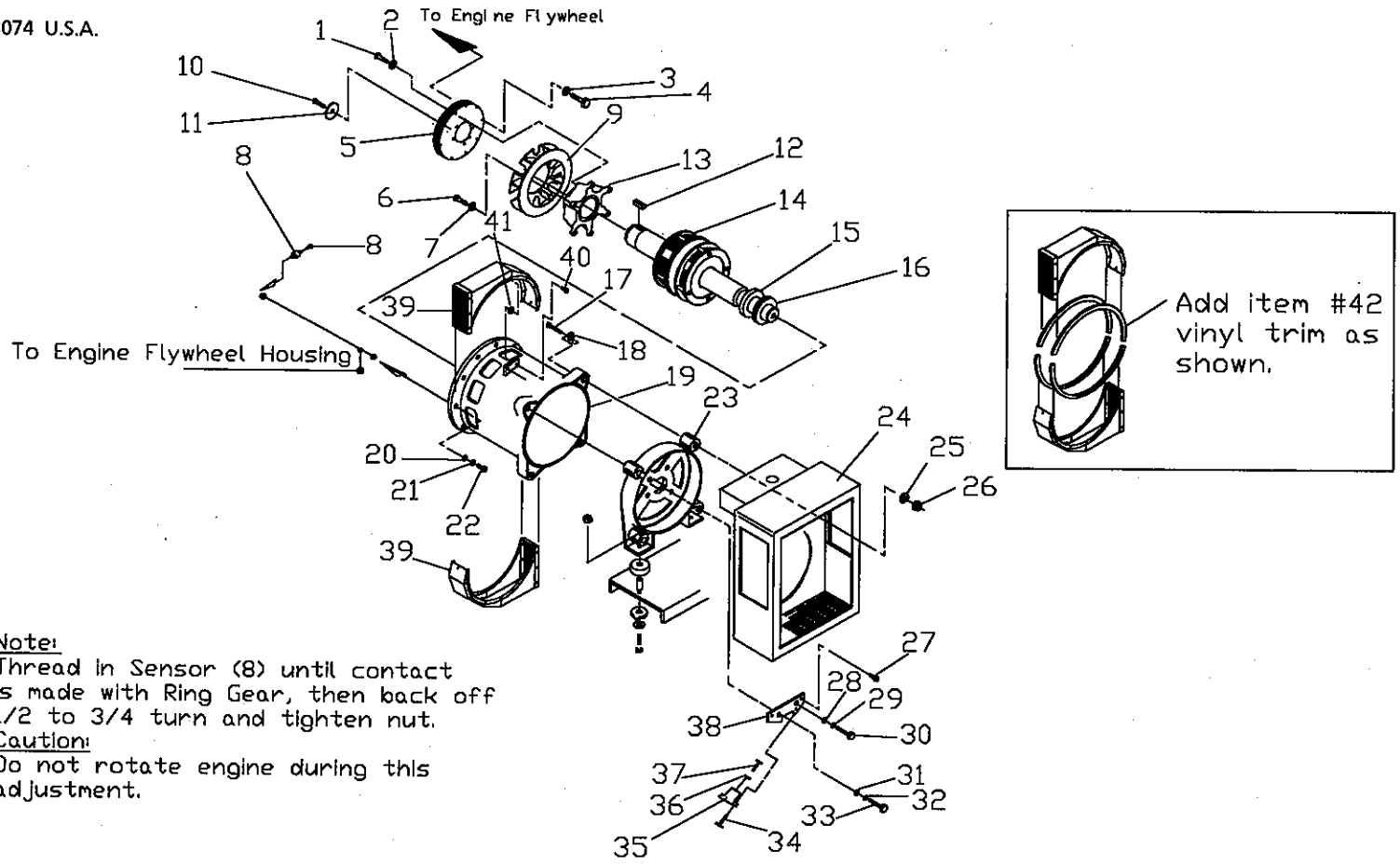


Figure 48 — Replacement Parts Illustration for Alternator

Replacement Parts List

Ref. No.	Description	Part No. for Model:4LM43	Qty.
1	CAPSCR. HEX HD.-1.75 x 25	51268	6
2	LOCK WASHER-M12	51769	6
3	LOCK WASHER-3/8"	22237	8
4	CAPSCR. SOCKET HD.-3/8"-16 x 1"	43097	8
5	FLEX PLATE GM 4.3L, 5.7L & 7.4L	A3852	3
6	CAPSCR. HEX HD.-M8-1.25 x 20	39253	6
7	LOCL WASHER-5/16"-M8	22129	6
8	RPM SENSOR-72"	82130D	1
9	FAN ASSEMBLY	A5526	1
10	CAPSCR. HEX HD.-M6-2.0 x 45	A2601	1
11	WASHER 3.25" O.D. x .69" I.D.	A2602	1
12	KEY 3/8" SQ. x 2.50" LONG	A1138	1
13	DRIVE HUB	21941	1
14	ROTOR, 390, 50KW, 3P, LV, DIR	20813A	1
15	BEARING	52624	1
16	SLIP RING	70892	1
17	CAPSCR., HEX HD.-M14-2.0 x 150	65477	4
18	WASHER, 390 SAE ALT.	A1633	4
19	STATOR, 390, 40KW, DIRECT	A5856	1
20	FLAT WASHER 3/8"-M10	22131	12
21	LOCK WASHER M10	46526	12
22	CAPSCR., HEX HD.-M10-1.5 x 40	57642	12
23	REAR BEARING CARRIER	68113	1
24	LOWER CONTROL PANEL	68115	1
25	LOCK WASHER M14	43123	4
26	HEX NUT M14-2.0	51779	4
27	TAPTITE #10-32 x 1/4" LONG	46852	1
28	FLAT WASHER M12	22250	1
29	LOCK WASHER M12	51769	1
30	CAPSCR., HEX HD.-M12-1.75 x 25	57821	1
31	FLAT WASHER M8	22145	1
32	LOCK WASHER M8	22129	1
33	CAPSCR., HEX HD.-M8-1.25 x 40	57821	4
34	BRUSH	A24044A	2
35	BRUSH HOLDER	23877D	4
36	LOCK WASHER #6	22155	4
37	ROUND HD. SCREW #6-32 x 1/4"	25105	4
38	BRUSH HOLDER SUPPORT	71639	1
39	SCROLL ASSEMBLY	A4089	1
40	1/4-20 x 5/8" FASTENER	A2437	2
41	FLAT WASHER 1/4-M6	22473	2
42	VINYL TRIM 1/8" GP	56326	8.4'

Notes

Notes

Dayton® Standby Generator

Limited Warranty

Dayton Two-Year, 1500 Hour Limited Warranty. *Standby Generator Model 4LM43 is warranted by Dayton to the original user against defects in workmanship or materials under normal use for two years or 1500 hours of operation, whichever occurs first, after date of purchase. Any part which is determined to be defective in material or workmanship and returned to an authorized service location, as Dayton designates, shipping costs prepaid, will be, as the exclusive remedy, repaired or replaced at Dayton's option. For limited warranty claim procedures, see PROMPT DISPOSITION below. This limited warranty gives purchasers specific legal rights which vary from state to state.*

Limitation of Liability. *To the extent allowable under applicable law, Dayton's liability for consequenatial and incidental damages is expressly diclaimed. Dayton's liability in all events is limited to and shall not exceed the purchase price paid.*

Warranty Disclaimer. *Dayton has made a diligent effort to illustrate and describe the product in this literature accuratelyl however such illustrations and descriptions are for the sole purpose of identification, and do not express or imply a warranty that the product id merchantable, or fits a particular purpose, or that the product will necessarily conform to the illustrations or descriptions.*

Except as provided below, no warranty or affirmation of fact, expressed or implied, other than as stated in the "LIMITED WARRANTY" above is made or authorized by Dayton.

Product Suitability. *Many states and localities have dodes and regulations governing sales, construction, installation, and/or use of products for certain purposes, which may vary from those in neighboring areas. While Dayton Industries attempts to assure that its products comply with such codes, it cannot guarantee compliance, and cannot be responsible for how the product is installed or used. Before purchase and use of a product, please review the product application, and national and local codes and regulations, and be sure that the product, installation, and use will comply with them.*

Certain aspects of disclaimers are not applicable to consure products; e.g., (a) some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you; (b) also, some states do not allow a limitation on how long an implied warranty lasts, consequentially the above limitation may not apply to you; and (c) by law, during the period of this limited warranty, any implied warranty of implied merchantability or fitness for a particular purpose applicable to consumer products purchased by consumers may not be excluded or otherwise disclaimed.

Promp Disposition. *Dayton will make a good faith effort for prompt correction or other adjustment with respect to any product which proves to be defective within limited warranty. For any product believed to be defective within limited warranty, first write or call dealer from whom the product was purchased. Dealer will give additional directions. If unable to resolve satisfactorily, write to Dayton at address below, giving dealer's name, address, date, and number of dealer's imvoice, and describing the nature of the defect. Title and risk of loss pass to buyer on delivery to common carrier. If product was damabed in transit to you, file claim with carrier.*

Manufactured for Dayton Electric Mfg. Co.
Niles, Illinois 60714 U.S.A.

A5708
3/6/98 Rev. A

Dayton®

Please read and save these instructions. Read carefully before attempting to assemble, install, operate or maintain the product described. Protect yourself and others by observing all safety information. Failure to comply with instructions could result in personal injury and/or property damage! Retain instructions for future reference.

EQUIP # 2461

Dayton® Standby Generators

Description

This equipment is a revolving field, alternating current generator set. The unit is designed for supplying electrical power to operate critical electrical loads if the utility power supply has failed or has dropped below an acceptable level.

Dayton standby generators are rugged, compact and are designed for dependable, trouble-free operation. Models 4W117H and 4W118H are driven by a 1.6 liter gas-fueled engine, using either natural or LP gas as fuel. The generator's revolving field is connected to the engine shaft by means of durable flexible discs and turns at the same speed as the engine. Both models incorporate a direct excited (brush type) field excitation system.

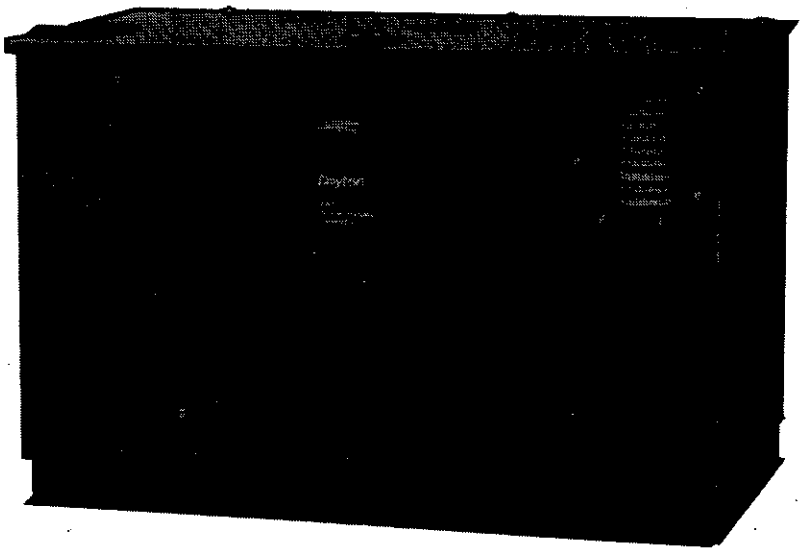


Figure 1

Table of Contents

Dayton®

Dayton® Standby Generators

Description (Continued)

GENERATOR OPERATING SPEED

The engine-generator operates at a fixed speed. Operating speed is maintained under load conditions by a mechanical, fixed speed, centrifugal, flyweight type engine governor.

1. Generator Model 4W117H is equipped with a 2-pole revolving field (rotor) and is rated at 3600 rpm. Operating speed at no-load has been factory set to about 3720 rpm.
2. Model 4W118H is equipped with a 4-pole rotor, and is rated at 1800 rpm. Operating speed has been factory set to about 1860 rpm at no-load.

⚠WARNING ***Do not attempt to change engine-generator governed speed without proper equipment and knowledge. Excessively high speeds are dangerous and increase the risk of personal injury or damage of equipment. Correct rated a-c frequency and voltage are provided only at the correct governed speed. Some connected electrical devices may be damaged by incorrect frequency and/or voltage. Operation at excessively low speeds imposes a heavy load on the engine when sufficient engine power is not available and may shorten engine life.***

GENERATOR A-C CONNECTION SYSTEM

Both generator models are equipped with a 12-lead, reconnectable type stator a-c power winding. Units have been factory connected to supply 120/240 volts, one or three-phase output. If required, the installing electrician may reconnect the units to provide 120/208 volts, 3-phase a-c output. See "Assembly" section of this manual for reconnection information.

TRANSFER SWITCH

A transfer switch, required by electrical code in standby electric power systems, must be purchased separately. See "Installation" section.

Unpacking

Remove all packing material from the generator. Then, inspect the entire generator carefully before installing and using. Check for damage that may have occurred during shipment. Never install or attempt to use any damaged or defective generator. If you find any damage, contact the carrier for claim procedures.

Units were properly serviced with engine oil and coolant before they were shipped from the factory. However, you are responsible for checking engine oil and coolant levels before using generator and to add oil and coolant as needed. Refer to "Maintenance" section for servicing procedures and for recommended oil and coolant.

⚠CAUTION ***Check and replenish oil and coolant levels as necessary before initial starting and use of the generator. Any attempt to start the engine before it has been properly filled with the recommended oil and coolant results in an engine failure.***

The following parts are shipped loose with your new standby generator:

1. Black battery post cover (see "Installation" section).
2. Replacement fuse kit: Consists of a 30 amp, 10 amp, 14 amp and 9 amp fuse kit in a plastic bag. Keep fuses in a safe place. See "Maintenance" section for location of fuses.

Specifications

Generator	Model 4W117H	Model 4W118H
Rated Max. Continuous a-c Power Output	Δ20,000 watts (20 kW)	Δ10,000 watts (20 kW)
Rated Voltage & Phase (selectable)		
As Shipped from Factory	120/240 volt, 1 or 3Ø	120/240 volt, 1 or 3Ø
Reconnectable to	120/208 volts, 3Ø	120/208 volts, 3Ø
Rated Maximum Continuous Load Current		
At 240 Volts, 1-Phase	83 amps	41.5 amps
At 240 Volts, 3-Phase	60 amps	30 amps
At 208 Volts, 3-Phase	69 amps	35 amps
Stator Connection	12 lead reconnectable	12 lead reconnectable
No. of Rotor Poles	2	2
Driven Speed of Rotor	3720 rpm at no-load	1860 rpm at no-load
Rotor Excitation	Brush Type	Brush Type
Rotor and Stator Insulation	Class "F"	Class "F"
Rated a-c Frequency	60 Hz at 1800 rpm	60 Hz at 1800 rpm
Recommended Transfer Switch Model Number	100 amp, 250 volts 1Ø 1ZC00 or 3Ø 5W961	1Ø 1ZC00 or 3Ø 5W961
Switch Amperate Rating	100 amp, 250 volts	100 amp, 250 volts

Δ Wattage and current are subject to and limited by such factors as fuel Btu content, ambient temperature, altitude, engine power and condition, etc. Maximum power decreases about 3.5% for each 1,000 feet above sea level; and will also decrease about 1% for each 10°F above 60°F.

Models 4W117H and 4W118H

Specifications (Continued)

3. Type BQ2 and BQ3 mounting brackets for main circuit breaker, for reconnection to 1-phase or 3-phase output.
4. Muffler parts.

ENGINE

Type of Engine	Fiat
Displacement	1.6 liters (98 inches^3)
Cylinder Arrangement	4, in-line
Valve Arrangement	Overhead Cam
Firing Order	1-3-4-2
No. of Main Bearings	5
No. of Piston Rings	
Compression	2
Oil	1
Compression Ratio	9 to 1
Distributor Point Gap	0.018-0.022 inch
Distributor Condensor	0.20-0.24 micro-farad
Spark Plug Gap	0.031-0.035 inch
Recommended Spark Plugs	
Champion	R49YC
AC	R42XLS
NGK	BPR6ES
Oil Pressure	30-50 psi
Crankcase Oil Capacity	4.5 U.S. quarts
Recommended Engine Oil	SAE 15W-40
Type of Cooling System	Pressurized, closed recovery
Cooling Fan	Pusher Type
Cooling System Capacity	2 U.S. gallons (8.5 liters)
Recommended Coolant	50-50 mixture of silicate ethylene glycol base anti-freeze & soft water

FUEL CONSUMPTION
(CUBIC FEET PER HOUR)

Generator	Model 4W117H	Model 4W118E
Using Natural Gas	414 cubic ft. per hour	230 cubic ft. per hour
Using LP Gas	18 pounds per hour	10 pounds per hour

NOTE: Fuel consumption is given at rated maximum continuous power output when using natural gas rated at 1000 Btus per cubic foot; or LP gas rated 2520 Btus per cubic foot. Actual fuel consumption obtained may vary, depending on such variables as applied load, ambient temperature, engine condition, etc.

DIMENSIONS

Length	44.5"
Width	24.75"
Height (Muffler Installed)	38.6"
Height (Muffler Removed)	29.15"

General Safety Information

Dayton recommends that you copy the following general safety rules and post them in a conspicuous place near the generator or transfer switch.

Every possible circumstance that might involve a hazard cannot be anticipated. The warnings in this manual and on tags or decals affixed to the equipment are, therefore, not all inclusive. If you use a procedure, work method, or operating technique not specifically recommended by Dayton, you must satisfy yourself that it is safe for you and others. You must also satisfy yourself that such a procedure, work method or technique will not damage equipment or render it unsafe.

⚠WARNING ***Connecting this generator to an electrical system normally supplied by an electric utility shall be by means of a double throw switch (such as a Dayton Automatic Transfer Switch), so as to isolate the electric system from the utility distribution system when generator is operating (NEC 701). Failure to isolate the electric system by such means will result in damage to the generator and may also result in injury or death to utility power workers, due to backfeed of electrical energy.***

1. This equipment, when installed as part of a standby electric power system, must be installed in conjunction with an approved transfer switch.
   a. The transfer switch serves to prevent both generator and utility power from being connected to the load circuits at the same time.
   b. A properly connected transfer switch helps to prevent backfeed of generator power into commercial lines while the standby generator is operating.
2. DO NOT permit anyone to operate the standby electric system without proper instruction.
3. When using this equipment, comply with regulations the United States National Electric Code (NEC) and the Occupational Safety and Health Administration (OSHA) established.
4. Installing a standby electric system is not a "do it yourself" project. Only qualified installation contractors or electricians who are familiar with applicable codes, standards, regulations and procedures should install the system. Improper or unauthorized installation, operation or service of

Dayton® Standby Generators

General Safety Information (Continued)

this equipment is extremely hazardous and may result in serious personal injury or death.

5. This equipment supplies extremely high and dangerous power voltages. Any contact with high electrically "hot" components will result in extremely hazardous, and possibly LETHAL, electrical shock. Use care to avoid contact with live terminals, bare connectors, bare wires, etc.
6. Never handle any kind of electrical device while standing in water, while barefoot, or while hands or feet are wet. Dangerous electrical shock will result.
7. Do not wear any kind of jewelry (such as rings, watches, bracelets, etc.) while operating this equipment. Jewelry conducts electricity which can cause dangerous electrical shock.
8. Keep the area clean and uncluttered. Remove all materials that might become a fire hazard. Remove all slippery materials such as grease, oil, snow, water, or ice.
9. Repair or replace all damaged or defective parts immediately. Never operate the generator with damaged or defective parts.
10. When replacing parts, always use factory approved parts.
11. The frame and external electrically conductive parts of this equipment must be properly connected to an approved earth ground in accordance with applicable code. Your generator should have been properly grounded. Never disconnect ground wire.
12. When this generator is installed along with an automatic transfer switch, its engine can crank and start at any time without warning. To prevent possible injuries that might be caused by such a sudden startup, disable the generator's automatic start circuit before working on or around the unit. To disarm the automatic start system, complete one or more of the following:
    a. On the generator control console, set the Auto-Off-Start switch to "Off".
    b. Remove the 30 amp fuse from the generator's control console.
    c. Disconnect the negative (–) cable from the unit battery.
    d. On the Dayton automatic transfer switch, set the Maintenance Disconnect switch to "Manual" (if so equipped).
    e. After the circuit is disabled, place a "Do Not Operate" tag on the generator control console and on the transfer switch.
13. Installing this standby generator must be done in strict compliance with applicable codes, standards and regulations. Following installation, nothing must be done that might render the unit in non-compliance with such codes, standards, and regulations.
14. Natural and LP gas and their vapors are highly EXPLOSIVE. Even the slightest spark can ignite these dangerous fuels and cause fire or an explosion.
    a. After installing the generator and before using it, the installer must be sure the gaseous fuel system has been properly purged and leak tested according to applicable codes.
    b. Have the entire fuel system periodically tested for leaks. No leaks should be permitted.
    c. If the unit is installed inside any structure, Dayton recommends the following: (a) install natural gas detectors high in the room because natural gas is lighter than air; (b) install LP gas detectors low in the room because LP gas is heavier than air.
    d. Properly ventilate the structure housing the generator to prevent any explosive gas from accumulating.
    e. Keep a fire extinguisher nearby and know how to use it. Extinguishers rated A-B-C by the National Fire Protection Association are appropriate for such use. Do not use any carbon tetra-chloride extinguisher; its fumes are toxic and the liquid can deteriorate wiring insulation.
15. The generator engine consumes oxygen and gives off DEADLY carbon monoxide gas through its exhaust system. This dangerous gas, if breathed in sufficient concentrations, can cause unconsciousness or even death. The danger of carbon monoxide poisoning is greatly reduced when the generator is installed outdoors

Models 4W117H and 4W118H

General Safety Information (Continued)

in a well-ventilated area. If the generator is installed inside a structure or in a room of a structure, pipe exhaust gases safely away from such a structure and to an area where they will not endanger people or animals.

Assembly

The generator was shipped from the factory completely assembled and ready for use, except for the following, which must be done by competent, qualified personnel:

1. The unit was shipped from the factory with its stator a-c output leads connected for 120/240 volts, 1 or 3-phase output. If you require 120/208 volts, 3-phase output, the installing electrician must reconnect stator leads to obtain that output.
2. You must install the correct 1 or 3-phase main circuit breaker on the generator. Both 1-phase (BQ2) and a 3-phase (BQ3) mounting brackets are included with the generators. Only the BQ2 type of bracket requires the circuit breaker cover.
3. If you plan to use LP gas as fuel, modify the engine's pressure reducer valve.
4. If you reconnect the unit for 120/208 volts, 3-phase output, adjust the a-c voltage regulator of the generator.

⚠WARNING ***Assembly tasks, including reconnecting for 120/208 volts, 3-phase output and converting to LP gas should only be performed by qualified personnel who have been trained in such tasks. Improper or unauthorized installation, assembly or adjustment are extremely dangerous and may result in death, serious injury or damage to equipment and/or property.***

STEPS IN THE CONNECTION PROCESS

1. Determine the required load voltage and phase.
2. Install the correct main circuit breaker with the proper rating. They should be as follows:

MODEL 4W117H

a. At 240 Volts, 1-phase rated current is 83.3 amperes.
b. At 240 Volts, 3-phase rated current is 60.2 amperes.
c. At 208 volts, 3-phase rated current is 69.5 amperes

MODEL 4W118H

a. At 240 Volts, 1-phase rated current is 41.7 amperes.
b. At 240 Volts, 3-phase rated current is 30.1 amperes.
c. At 208 volts, 3-phase rated current is 34.7 amperes

3. Reconnect the 12 stator leads (S1 through S12), if required.
   a. If required load voltage is 120/240 volts, (single or 3-phase), you do not need to reconnect stator leads.
   b. If required load voltage is 120/208 volts, 3-phase, reconnect the stator leads.
4. Connect leads E1, E2 and E3 from the stator lead junctions to the main circuit breaker.
5. Connecting customer load leads at the main circuit breaker and the neutral block is discussed in the "Installation" section.

DETERMINING LOAD VOLTAGE AND PHASE

The installing electrician must be sure electrical loads the generator will power are fully compatible with the generator's rated a-c voltage output and phase. The Models 4W117H and 4W118H generators are shipped from the factory with their stator leads connected for 120/240 volts, single or 3-phase output. If that output is compatible with the load, the electrician does not need to reconnect the generator. If the load voltage is 120/208 volts, 3-phase, the electrician must reconnect the leads.

INSTALLING THE MAIN CIRCUIT BREAKER

The generator's main circuit breaker is not included with the unit as shipped from the factory and must be purchased and installed separately.

1. Two different circuit breaker mounting brackets are shipped with the generator as follows (Figure 2).

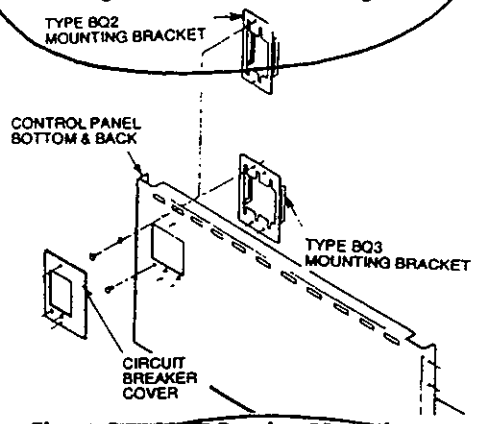


Figure 2 — Main Breaker Mounting Brackets/Cover

   a. Type BQ2 bracket is to be used with single phase (2-pole) main circuit breaker.

Dayton® Standby Generators

Assembly (continued)

b. Type BQ3 bracket is for 3-phase (3-pole) main circuit breakers.

2. Circuit breaker cover is required only with the single phase (2-pole) main circuit breakers.

3. Mounting bracket and cover (if used) are retained by No. 8-32 x 1/4 inch long machine screws and lock washers.

FACTORY INSTALLED STATOR CONNECTIONS

This generator was shipped from the factory with its stator a-c output leads connected in "Delta" configuration, as shown in Figure 3. This type of connection system supplies a 120 and/or 240 volts, 1 or 3-phase output as shown in Figure 3.

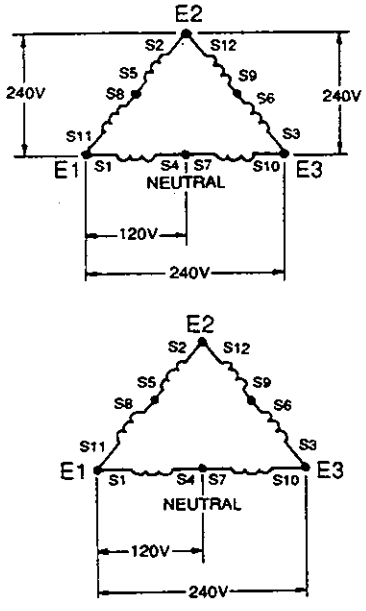


Figure 3 — The Delta Connection System

RECONNECTION TO 120/208 VOLTS, 3-PHASE

Figure 4 shows the reconnection for 120 and/or 208 volts, 3-phase output.

The reconnection results in a "Wye" connected system.

"Heat shrink" type insulation is used to cover the bolted wiring junctions. When reconnecting to 120/208 volts, 3-phase, remove the heat shrink tubing.

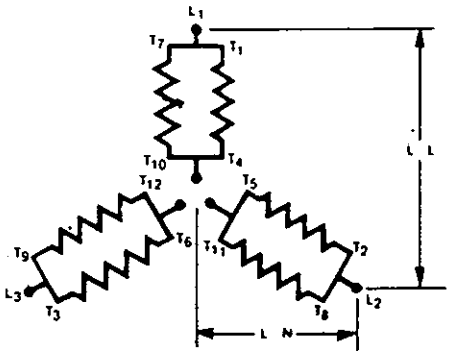


Figure 4 — The "Wye" Reconnection System

Remove bolts, nuts and washers that retain the wire junctions and reconnect in the way shown in Figure 5.

Wire junctions must be connected and insulated properly according to applicable codes and standards.

Figure 5 — Bolted Stator Lead Junctions

⚠WARNING ***Only qualified electricians should perform all wiring connections and reconnections. Improper or unauthorized wiring connections may result in personal injury or damage of equipment and/or property.***

ADJUSTMENT OF VOLTAGE REGULATOR

When the stator a-c leads are reconnected for 120/208 volts, 3-phase output, the generator's a-c voltage regulator must be readjusted to the correct voltage settings. Adjusting the voltage regulator is discussed in the "Maintenance" section, as well as adjusting the engine governor.

⚠WARNING ***Before adjusting the voltage regulator, make sure engine governed speed and generator a-c frequency are correct. Only qualified service technicians who have been properly trained should adjust engine governor and voltage regulator.***

CONVERSION TO LP GAS

Generator Models 4W117H and 4W118H are shipped from the factory configured for using natural gas as fuel. You can also convert the system to burn LP (propane) gas. To convert the fuel system to LP gas, proceed as follows (See Figure 6, page 7):

1. Remove END CAP from PRESSURE REDUCER VALVE.
2. Remove the SPRING and the SPRING SEAT.
3. Install and tighten END CAP.
4. Invert the PRESSURE REDUCER VALVE. In other words, turn it upside down (END CAP facing upward).
5. Purge and leak test the entire fuel system according to gaseous fuel codes. No leaks must be allowed at any point in the system.

Models 4W117H and 4W118H

Assembly (continued)

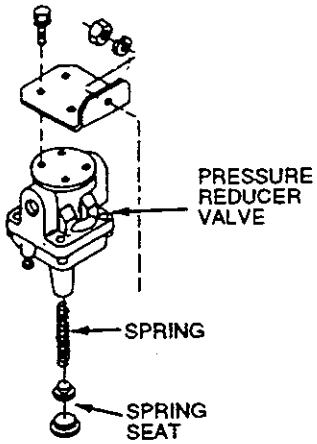


Figure 6 — Conversion to LP Gas

Installation

Before installing this equipment, recheck the generator and transfer switch ratings, Be sure those ratings can handle the intended electrical load and are fully compatible with service entrance voltage, phase and current ratings.

⚠WARNING ***Before proceeding with the installation, be sure the generator auto-off-start switch is set to "off" position. Also place the safety disconnect switch (inside transfer switch enclosure) to the "manual" position. The proceeding will prevent accidental starting of the generator engine.***

NOTE: It would be extremely difficult, if not impractical, to attempt a detailed coverage of every installation possibility. For that reason, much of the information is general in nature. Plan the installation carefully. Information in this manual is provided as a guide only and is not meant to serve as a detailed installation plan. Illustrations provided in the Manual must not be construed as installation blueprints. The installation must comply fully with national, state and local electrical and building codes. You must also comply with codes established by the Occupational Safety and Health Administration.

⚠ DANGER ***It is not intended that the information in this manual should be used by any unqualified persons for the purpose of installing a standby electric power system. Only qualified personnel should install, inspect, test and adjust such equipment. These people should be familiar with the equipment and installation requirements.***

PLANNING THE INSTALLATION

Installers should plan the installation of this equipment carefully. When planning, they should consider the following factors:

1. Size of the generator and space required.
2. Weight of the generator.
3. Best location for generator, transfer switch and other options and accessories.
4. Adequate mounting and support.

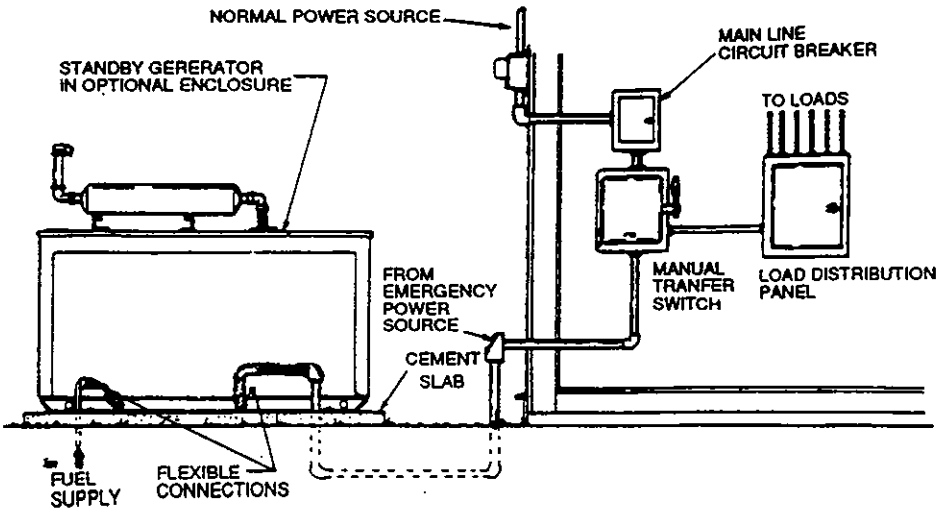


Figure 7 — A Typical Outdoor Installation

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Installation (Continued)

5. Generator must have adequate flow of air for cooling, ventilation and combustion.
6. The fuel supply system must be free of leaks, and in compliance with codes.
7. Economy , keep fuel and exhaust piping runs, as well as wiring and conduit runs, as short as possible.
8. Be sure transfer switch ampere rating is adequate to handle system current flow.
9. Be sure the transfer switch voltage and phase ratings are compatible with utility supply and load circuit ratings.
10. Be sure the generator's voltage and phase ratings are compatible with utility supply and load circuit voltage and phase ratings.

GENERATOR LOCATION

The generator may be installed outdoors, outdoors on the roof of a structure, inside a detached structure, or in a room within or attached to a structure. In all cases, the unit must be installed with safety, reliability and economy in mind.

Figure 7 on page 7 illustrates a typical outdoor installation. The generator is installed out-of-doors on a cement slab. The transfer switch is installed indoors and as close as possible to the electrical load circuits. Models 4W117H and 4W118H are equipped with compartment enclosures that protect the engine from bad weather.

Figure 8 shows a typical indoor installation (detached structure shown). Note the air inlet and outlet openings in the building. An adequate supply of air must be brought into the building for cooling, ventilation and engine combustion. An air outlet opening must be provided to duct heated air out of the building. An exhaust fan may be required on some installations to provide adequate ventilation.

When planning the installation, be sure to allow about three feet of clearance around the entire generator set for maintenance and servicing.

GENERATOR SUPPORT

Dayton recommends that the generator be mounted on a cement slab. Install the slab on a firm surface that is not likely to shift or settle. The slab should extend past the generator, to a distance of at least 12 inches on all sides. Use masonry type anchor bolts to retain the unit to the slab.

EXHAUST SYSTEM – OUTDOOR INSTALLATIONS

For outdoor installations, the factory supplied exhaust system should be

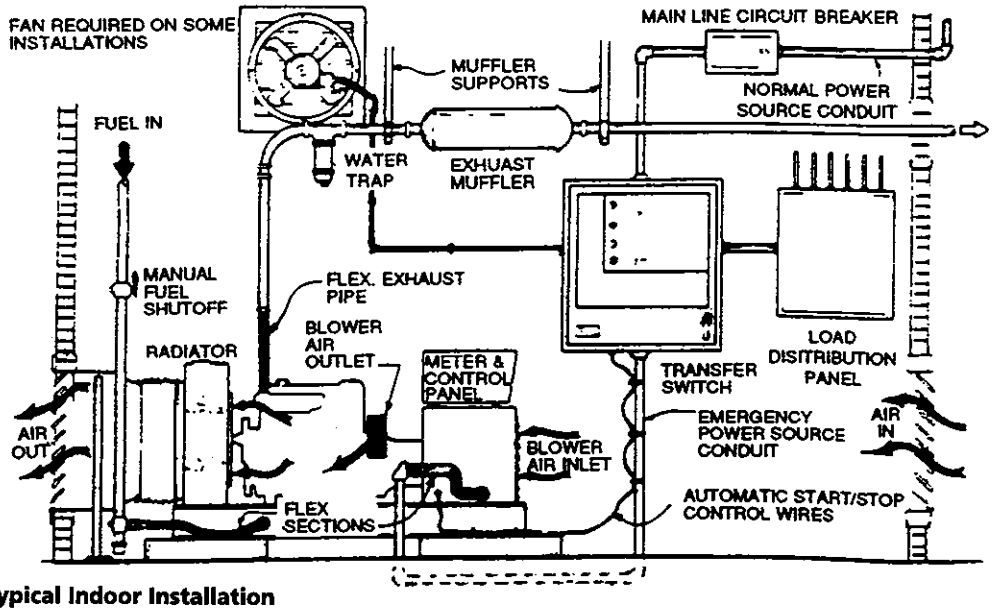

Figure 8 — A Typical Indoor Installation

Models 4W117H and 4W118H

Installation (Continued)

adequate. The installer must do whatever is required to make sure that people or animals are not endangered by exhaust gases. Install the exhaust system as shown in Figure 9.

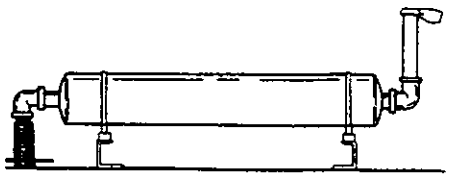

Figure 9 — Factory Supplied Exhaust System

EXHAUST SYSTEM – INDOOR INSTALLATIONS

When the generator is installed inside a structure, engine exhaust gases must be piped safely to the outdoors and to an area where people or animals will not be endangered. Exhaust system installation must comply strictly with applicable codes, standards and regulations.

⚠WARNING ***Engine exhaust gives off deadly carbon monoxide gas. This dangerous gas, if breathed in sufficient concentrations, can cause unconsciousness or even death. Exhaust gases must be piped safely out of any building or structure that houses the generator and to an area where people or animals will not be endangered.***

The following general rules apply to installation of exhaust systems:

1. Piping runs should be made of black iron.
2. Piping runs should be adequately supported.
3. An approved, flexible length of pipe is required between the engine and rigid piping.
4. Install a water trap. Drain the trap at regular intervals.
5. Slope the exhaust piping downward away from the engine to prevent condensation from draining back into the engine.
6. Keep bends and turns in piping at a minimum. Where you must install turns, use 45-degree elbow.

Length of Piping	Pipe Size
0-5 ft	1.5 in.
5-25	2
25-50	2.5

7. Engine exhaust outlet is 1-1/2 inch NPT female fitting. For piping runs over 5 feet long, increase exhaust pipe diameter as shown in chart below:
8. Where exhaust piping must pass through a combustible wall or partition, use a ventilated metal thimble (Figure 10) to isolate the piping from the combustible material.

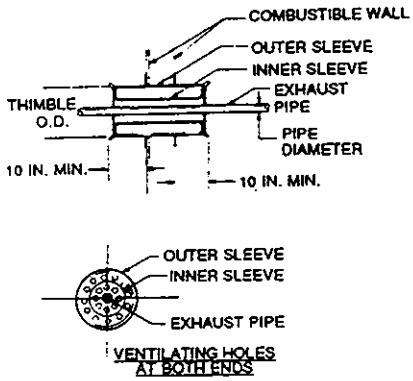

Figure 10 — Exhaust Piping Through a Wall

9. Use ventilated metal thimble (Figure 11) where exhaust piping must pass through combustible ceiling.

⚠WARNING ***Exhaust mufflers and piping become extremely hot during operation and remain hot for a long time after shutdown. Contact with hot exhaust system parts causes severe burns. Hot exhaust system parts may also be a fire hazard. All building and safety codes pertaining to the installation and use of exhaust system must be complied with.***

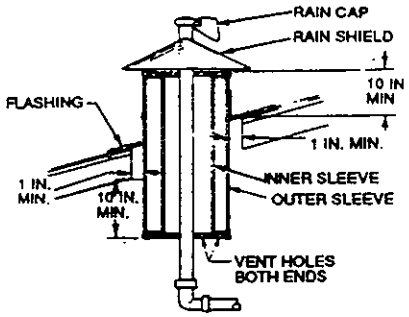

Figure 11 — Exhaust Piping Through a Ceiling

GASEOUS FUEL SYSTEMS

Generators Models 4W117H and 4W118H are shipped from the factory with a natural gas fuel system. No modifications to the system are required when natural gas is used as the fuel.

Local gaseous fuel codes may vary widely. Dayton recommends that a local gas system installer should install and connect the gaseous fuel lines.

⚠WARNING ***Gaseous fuels are highly explosive. Even the slightest spark can cause an explosion. The fuel system must be properly installed and maintained. Comply strictly with all codes, standards and regulations.***

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Dayton® Standby Generators

Installation (Continued)

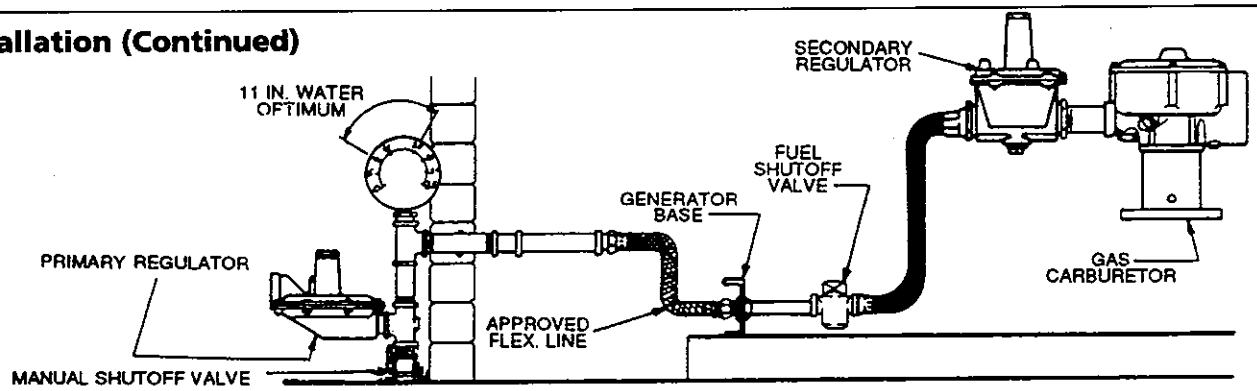

Figure 12 — Typical Natural Gas Fuel System

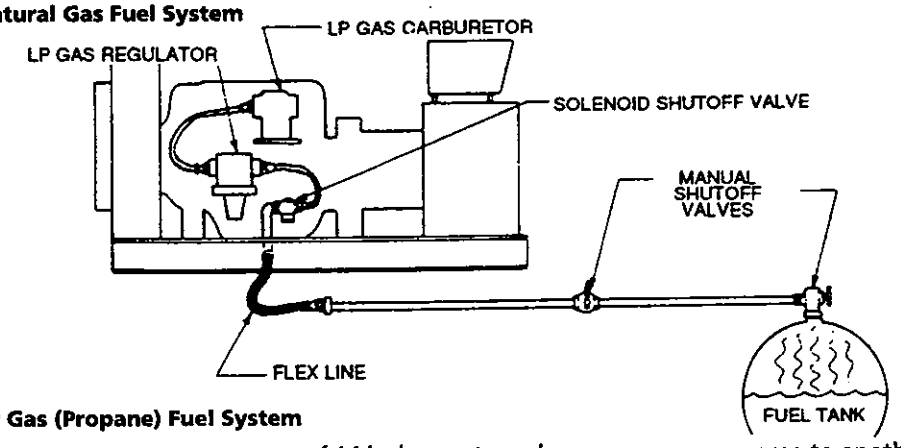

Figure 13 — Typical LP Gas (Propane) Fuel System

Use leak detectors in any structure that houses a gaseous fuel system. Natural gas is lighter than air, so install detectors high in the room. Likewise, LP gas is heavier than air. Install detectors for LP gas low in the room.

If LP gas is your fuel, modify the fuel system as outlined on Pages 6 and 7 (CONVERSION TO LP GAS).

Gas pressure at the inlet of the fuel shutoff valve (Figures 12 and 13) should not exceed 20 inches water column (0.75 psi). Optimum supply pressure at the shutoff valve inlet is 11 inches water column. Depending on the characteristics of specific shutoff valves, they may or may not open in excess of 14 inches water column (0.5 psi).

Flexible fuel line, approved for use with gaseous fuels, is required between the fuel connection on the generator mounting base and rigid fuel supply lines.

NATURAL GAS SYSTEM

Fuel system components installed at the factory are (a) a 3/4 inch gas connection on the generator mounting base, (b) a solenoid operated shutoff valve, (c) a pressure reducer valve, and (d) the carburetor.

The maximum pressure at which gas is allowed to enter a building is established by code and may vary from one area to another. A primary regulator may be required, to reduce gas pressure to the required safe level. The primary regulator may or may not be furnished by the gas supplier. The gas company usually supplies piping from the main distribution line to the generator site. The supplier is responsible to be sure that sufficient gas pressure is available for primary regulator operation.

LP GAS (PROPANE) SYSTEM

LP gas is supplied in pressure tanks as a liquid. Generator Models 4W117H and 4W118H require a "vapor withdrawal" type system. This type of system uses the gas vapors that form above the liquid in the tank.

Models 4W117H and 4W118H

Installation (Continued)

GASEOUS FUEL PIPING

The following general rules apply to gaseous fuel piping:

1. Use only piping that complies with applicable fuel-gas codes.
2. Do NOT use any galvanized piping. The galvanized coating can flake off and cause serious problems.
3. Determine fuel piping diameter by (a) the length of the pipe, and (b) the engine fuel consumption. This is determined by a gas system installer. The longer the piping run and the greater the engine fuel consumption, the greater the diameter of the pipe.

COOLING AND VENTILATING AIR

The engine-generator needs an adequate supply of air for cooling and ventilating, as well as ample air for engine combustion. The installer must make sure that sufficient air flow is available to (a) cool the engine-generator, (b) support engine combustion, and (c) remove toxic fumes and explosive gases.

The generator is equipped with a "pusher type" cooling fan. That type of fan draws air in and circulates it around the engine-generator, then expels the air forward through the engine radiator and to the outdoors. Thus, the radiator end of the unit is its air outlet end; the control console end is the air inlet end.

AIR FLOW FOR OUTDOOR INSTALLATIONS

For installations out-of-doors, the design of the protective enclosure should provide adequate cooling and ventilating air. The following general rules apply to outdoor installations:

1. If strong prevailing winds are a factor, face the generator's air inlet end into the prevailing wind.
2. The owner/operator must maintain air inlet and outlet openings in the compartment. Keep them free of obstructions such as leaves, grass, snow or ice.
3. Where leaves, grass, snow or ice might tend to obstruct air openings, consider using a windbreak or fence.

AIR FLOW FOR INDOOR OPENINGS

If you install the generator inside a structure, provide air openings in the structure. The following general rules apply:

1. Whenever possible, position the generator so that radiator air outlet air is expelled directly and horizontally to the building exterior.
2. The unobstructed free air opening of the air outlet in the structure must be at least as large as the radiator air outlet duct.
3. If you must install ductwork to exhaust air from the building, keep such ductwork as short as possible and with a minimum number of bends.
4. If ductwork must have bends, make gradual sweeping bends rather than sharp bends in ductwork.
5. Air inlet opening for the structure housing the generator must be at least as large as the air outlet opening and preferably larger.
6. Louvers, screening and expanded metal used to cover air openings offer an obstruction to the free flow of air. Compensate for this obstruction by making the size of the air opening proportionately larger.
7. Some installations require using ventilation openings and exhaust fans.

COMPENSATING FOR RESTRICTIONS

Screening, expanded metal and louvers restrict the free flow of air into or out of a building. Such restrictions must be compensated for by making the actual opening size proportionately larger. The restriction offered by different materials is usually given as a percentage of the free air inlet area. This "percentage of free air inlet area" is obtainable from the manufacturer of the screening or other material. To compensate for the restriction to air flow offered by the material, first find the radiator duct area. Then, divide the radiator air duct area by the "percentage of free air inlet area" of the screening to be used.

For example, if the radiator air duct area measures 17.49 inches by 21.74 inches, multiply 17.49 by 21.74 to obtain 380.2 square inches.
If screening having a 70 percent free air inlet area is to be used, divide 380.2 by 0.70 to obtain 543 square inches. The actual air opening size to be provided should be at least 543 square inches.

Dayton® Standby Generators

Installation (Continued)

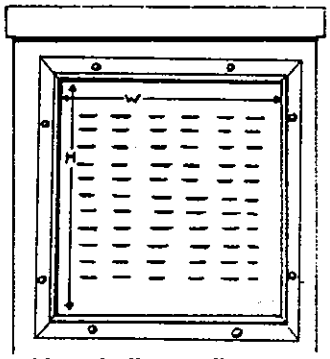

Figure 14 — Finding Radiator Duct Area

GROUNDING THE GENERATOR

The National Electric Code requires that the frame and external electrically conductive parts of the generator be properly connected to an approved earth ground. Local electrical codes may also require proper grounding of the unit. For that purpose, a grounding lug is provided on the mounting base rails (Figure 15). Connect a stranded copper wire of approved size to the grounding lug and to an earth-driven copper or brass grounding rod (electrode). Consult with a local electrician for grounding requirements in your area.

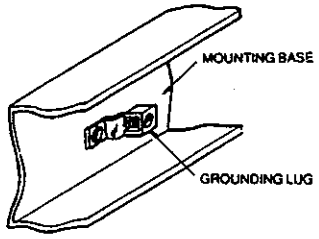

Figure 15 — Generator Grounding Lug

Proper grounding helps reduce the chance of electrical shock if a ground fault condition occurs in the generator or connected electrical devices. Grounding also helps to dissipate static electricity, which often builds up in ungrounded devices. Static electricity can cause very painful shock and may cause you to believe the equipment has a shorted condition.

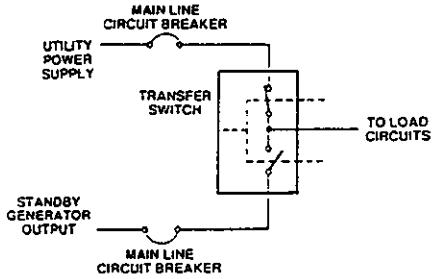

Figure 16 — Simple Standby Electric System

POWER SOURCE AND LOAD CONNECTIONS

Leads from both the utility power source and from the generator must be connected to the proper transfer switch terminal lugs (Figure 16). In addition, load leads must be connected from the correct transfer switch terminal lugs and routed to a load distribution panel. Use an approved main line circuit breaker in the utility power supply lines

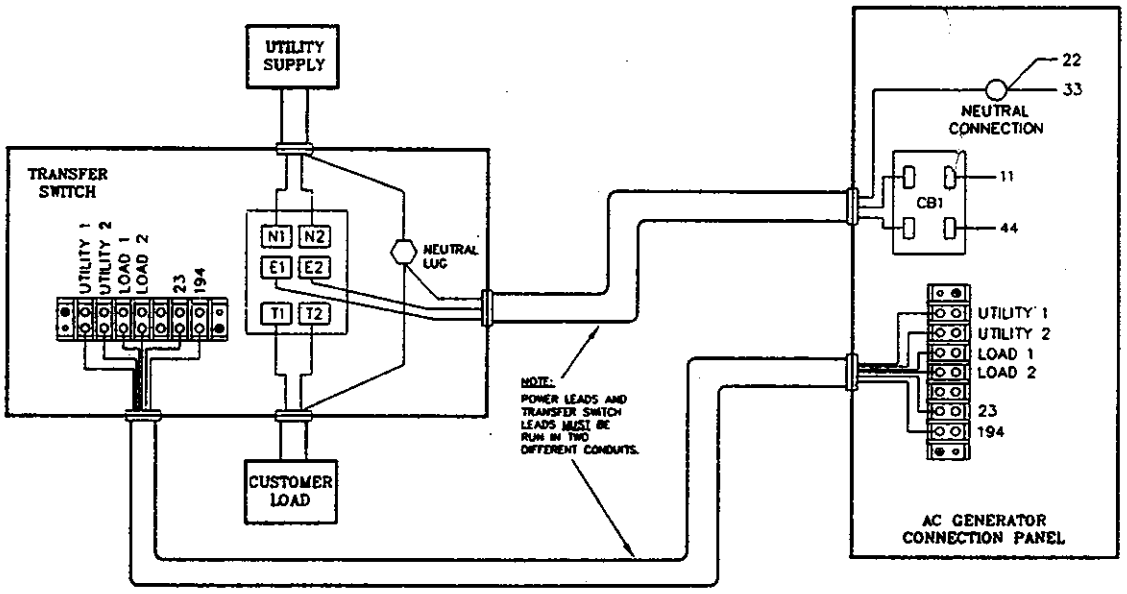

Figure 17 — Standby Interconnection Diagram

Models 4W117H and 4W118H

Installation (Continued)

to the transfer switch. Also see "Installing the Main Circuit Breaker" on Page 5.

Dayton recommends that you connect this generator to an automatic transfer switch, such as Dayton Model 1ZC00. That transfer switch model is rated 100 amperes at 250 volts maximum.

IMPORTANT: Read the transfer switch manual carefully. Comply with all instructions in that manual, as well as instructions and information on tags and decals affixed to the transfer switch.

⚠WARNING ***Extremely high and dangerous electrical voltages are present in utility power source lines and in generator load leads when the unit is running. The installing electrician must positively be sure that all power voltage supplies are turned off before attempting connections.***

Figure 17 on Page 12 is an electrical interconnection diagram for a typical standby electric power system when using a Dayton automatic transfer switch (such as Dayton Model 1ZC00).

Connect a-c wiring as follows:

1. Connect suitable approved wiring to generator leads E1, E2, E3 and 00 (neutral) and to identically numbered terminal lugs inside the transfer switch.
2. Connect utility power source supply leads to transfer switch terminal lugs N1, N2, N3 and 00 (neutral).
3. Connect approved wiring between transfer switch terminal lugs T1, T2, T3 and 00 (neutral) and the load distribution panel.
4. Figure 18 shows the wiring wiring connections at the generator's a-c output leads for 120/240 volts, 1-phase power supply.

Figure 19 shows the wiring wiring connections at the generator's a-c output leads for 120, 1-phase and 240 volts, 3-phase power supply.

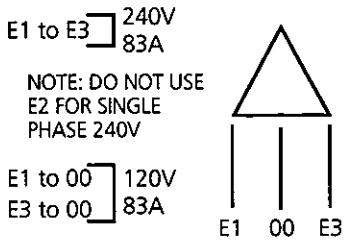

Figure 18 — Connections for 120/240 Volts, 1-Phase

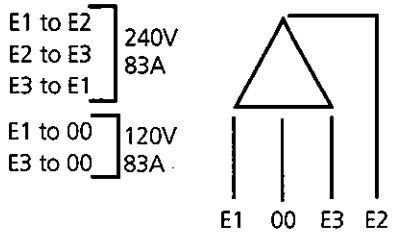

Figure 19 — Connections for 240 Volts, 3-Phase

Figure 20 shows the wiring wiring connections at the generator's a-c output leads for 120/208 volts, 3-phase power supply.

IMPORTANT: Generator models 4W117H and 4W118H are shipped from the factory connected for 120/240 volts, 1 or 3-phase. If your configuration requires 120/208 volts, 3-phase output, you must reconnect the 12 stator leads. See "assembly" section.

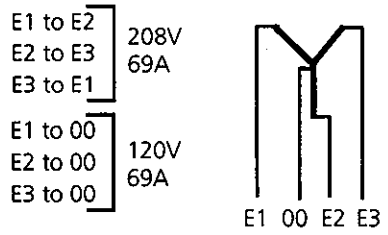

Figure 20 — Connections for 120/208 Volts, 3-Phase

⚠WARNING ***Installing a standby electric system is not a "do it yourself" project. Only qualified installation contractors or electricians who are familiar with applicable codes, standards, regulations and procedures should install the system. Improper or unauthorized installation, operation or service of this equipment is extremely hazardous and may result in serious personal injury or death.***

NEUTRAL CONNECTIONS

The standby generator uses an "ungrounded" neutral line, indicated by "00". When completing electrical connections, the neutral line should be grounded at the electrical service entrance only.

⚠CAUTION ***If the generator neutral line is grounded and one of the phase leads becomes grounded, the resulting excessive current flow will collapse the generator field or open the main circuit breaker. The actual result depends on the electrical characteristics of the generator, the type of fault, and the main circuit breaker trip rating.***

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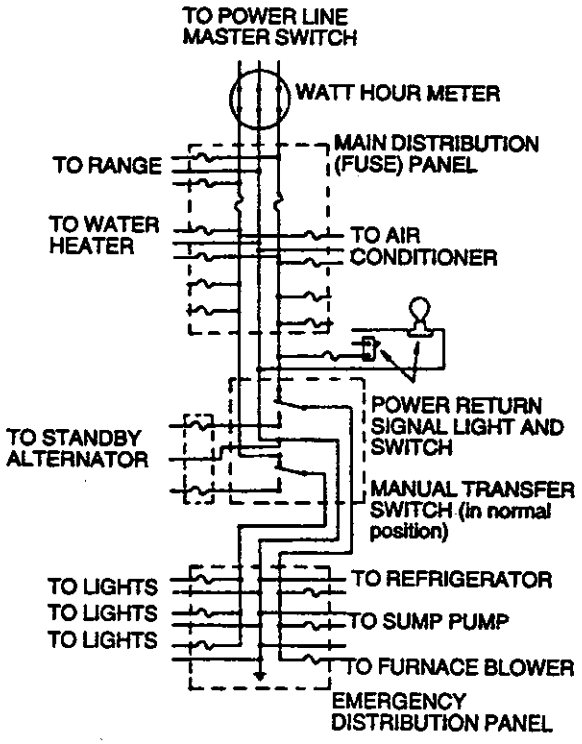
Installation (Continued)

Total Circuit Isolation Method



* Ampere rating equal to or larger than main (normal) utility entrance service.

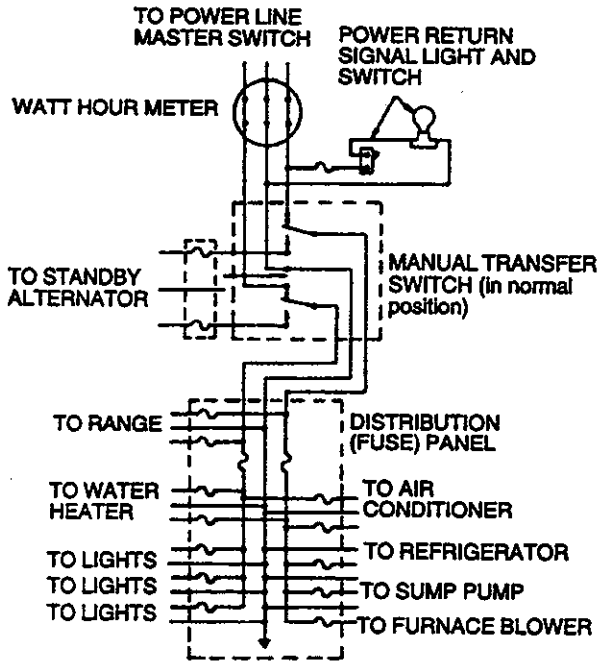
** With this system, take care to prevent overloading the alternator. During utility power failure, turn OFF individually all load items to distribution panel. Only certain items can be turned back on during alternator operation. Have your electrician specify these items so you do not overload the alternator.

All wiring must conform to the National Electric Code and all state and local codes. Consult a qualified licensed electrician.

The above illustration assumes the utility is supplying 120/240 volt single phase electric service.

Figure 21 — Total Circuit Isolation Method

Emergency Circuit Isolation Method



* Ampere rating must be equal to or exceed the ampere rating of the emergency distribution panel.

** Ampere capacity not to exceed the alternator rating. Only these items will be powered by the standby alternator. If the electrician sizes the load properly, the alternator cannot be overloaded.

All wiring must conform to the National Electric Code and all state and local codes. Consult a qualified licensed electrician.

The above illustration assumes the utility is supplying 120/240 volt single phase electric service.

Figure 22 — Emergency Circuit Isolation Method

Models 4W117H and 4W118H

Installation (Continued)

POWER SOURCE ISOLATION METHODS

Generator and utility power supplies must be positively isolated from one another in the standby electric system. Never connect the generator to any live building circuit or to any circuit that might become electrically hot when utility power is suddenly restored. A suitably rated, double pole, double throw transfer switch is required. The following hazards exist, which require the isolation of power supply circuits:

1. A utility power company worker trying to restore electrical power opens a switch between the main power supply and the spot where he is working. If the building circuits are not isolated, generator a-c output power backfeeds into the utility power lines. The worker may be electrocuted when he attempts repairs.
2. If utility and generator circuits are not isolated and utility power is suddenly restored while the generator is powering building circuits, the generator or building circuits could be damaged or it could cause an electrical fire.

TOTAL CIRCUIT ISOLATION METHOD

The generator set may not be rated at sufficient wattage/amperage capacity to handle the entire load in a home or other building. If key electrical circuits are not wired into a separate emergency distribution panel, you will have to select the loads you want turned ON during a utility power outage. Only one distribution panel is used in this type of system (Figure 21 on page 14). Consider the following factors when using this isolation method:

1. The transfer switch is located between the main utility service entrance and the load distribution panel.
2. The transfer switch ampere rating must equal the ampere rating of the normal incoming utility service.
3. Take care to avoid exceeding the generator's wattage/amperage capacity.

EMERGENCY CIRCUIT ISOLATION METHOD

One isolation method used to prevent overloading the generator is to group critical electrical loads into a separate emergency distribution panel. Load circuits powered by the emergency distribution panel must not exceed the rated wattage/amperage capacity of the generator (Figure 22 on Page 14).

When using the emergency isolation method, the transfer switch is installed between the main distribution panel and the emergency distribution panel. The transfer switch must then have an ampere rating equal to the ampere rating of the emergency circuit.

CONTROL CIRCUIT INTERCONNECTIONS

⚠WARNING ***Do not connect generator's battery cables until after the control circuit wires have been properly connected. If battery cables are connected, generator cranks and starts as soon as control circuit wires are attached.***

These interconnections consist of "Utility" and "Load" leads, plus leads 23 and 194. These six leads must be routed in conduit that is separate from the generator a-c power leads. Control lead functions may be described as follows:

N1A and N2: Deliver utility source power to the generator's logic circuit board. By attaching these leads you also connect the battery to the trickle charger.

T1 and T2: Used to operate the 7-day exerciser circuit on generator's logic board.

Leads 23 and 194: When logic circuit board closes the circuit, the transfer switch main contacts actuate to their "standby" position (load connected to generator output). When logic board opens this circuit, load circuits are transferred back to Utility power source.

COOLANT HEATER

The generator is equipped with an engine coolant heater (Figure 23). You must connect the coolant heater to 120 volts a-c circuit that is powered by a utility power source. Protect the 120 volts circuit with a circuit breaker or fuse.

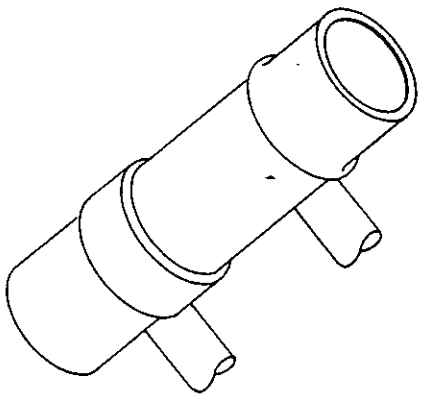


Figure 23 — Engine Coolant Heater

Dayton® Standby Generators

Installation (Continued)

⚠WARNING ***When this generator is installed along with an automatic transfer switch (such as Dayton Model 1ZC00), the engine can crank and start suddenly as soon as battery cables are connected. For that reason, Dayton recommends you service engine properly before installing the battery. To also help prevent such automatic starts, the installer should set the "auto-off-start" switch to "off" and the transfer switch's maintenance disconnect switch to "manual".***

PREPARING THE ENGINE BEFORE USE

Check the engine fluid levels before installing the battery. If correct rated utility power source voltage is NOT available to the automatic transfer switch, the engine cranks and starts as soon as the battery is installed and connected. Such automatic starting is a normal function of the automatic transfer switch as discussed in the "Operation" section. Before installing and connecting the battery, be sure the engine is ready to run by checking the following:

1. Check engine crankcase oil level and add oil, if necessary.
2. Check engine coolant level in the radiator and in the coolant recovery bottle. Add the recommended coolant mixture as necessary.
3. Check oil level in engine governor.
4. Inspect engine fan belts for condition and proper tension.

Refer to "Maintenance" section for procedures.

INSTALLING THE BATTERY

A battery tray is provided on the generator mounting base (Figure 24).

Recommended is a 12 volts automotive type storage battery (Group 26) rated 90 amp-hours or more and capable of at least 450 cold cranking amperes.

NOTE: A Group 26 battery is 8-1/8 inches long by 6-3/4 inches wide by 8 inches high.

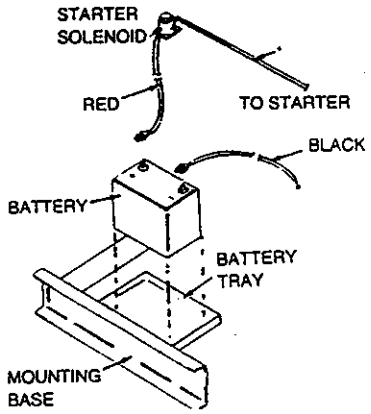


Figure 24 — Installing the Battery

Before installing the battery, be sure it is properly serviced with electrolyte fluid, fully charged and ready for use. Install the battery as follows (Figure 24):

1. Install the battery into the battery tray.
2. Connect the black battery cable (from frame ground) to the battery post indicated by a negative, NEG or (–).
3. Connect the red battery cable (from starter) to the battery post indicated by a positive, POS or (+).
4. Tighten battery cable clamps securely.

NOTE: By attaching leads N1A and N2 you also connect the battery to the trickle charger.

TRANSFER SWITCH ADJUSTMENTS & SETUP

The installer must be sure the transfer switch has been properly installed, mounted, connected and tested before the installation is complete. Recommended single phase transfer switch is Dayton Model 1ZC00, but you can also use other Dayton transfer switches. Carefully read the instructions in the transfer switch manual. Check that you have properly completed the following tasks:

1. Transfer switch is properly mounted and retained.
2. Power source and load line connections are correct.
3. Wiring runs and connections are in strict compliance with applicable codes.
4. If the transfer switch is equipped with a multi-voltage interface panel, the selected phase and voltage must match the utility power source phase and voltage.
5. Properly connect, route and support the engine start/stop control circuit wires.
6. If the transfer switch auxiliary contacts are used, properly connect a device that is compatible with the contacts rated voltage and current.
7. Test and verify proper manual operation of the transfer switch main contacts.
8. Test and verify correct electrical operation of the transfer switch.
9. Complete any required adjustments.
10. Select a day and time of day to start and exercise the equipment.

Models 4W117H and 4W118H

Installation (Continued)

POST INSTALLATION TESTS

The generator was factory tested and adjusted. No additional adjustments should be required. However, the installer is responsible for the readiness of the unit in all respects. The installer or generator service technician should complete the following tests:

1. Inspect the entire installation carefully.
   a. Installation must comply with applicable codes, standards and regulations.
   b. Installation must comply with recommendations in this manual.
   c. Some areas may require that a building inspector and/or electrical inspector examine the installation.
   d. Recheck engine fluid levels.
   e. Check that proper fuel is available to engine.
   f. Fuel lines must be properly purged and leak tested, according to applicable fuel-gas codes.
   g. Open any manually operated shutoff valves in the fuel system.
2. Check for proper manual operation of the automatic transfer switch, using the manual handle supplied with the switch.

⚠WARNING ***Do not try manual operation of the transfer switch until all power voltage supplied to the switch has been positively turned off. Failure to turn off power voltage supplied may result in extremely dangerous and possibly lethal electrical shock.***

3. When you are certain transfer switch operates manually, actuate the transfer switch main contacts to the "Utility" position, i.e. LOAD terminals connected to the UTILITY power supply.
4. Turn ON the utility power supply to the transfer switch with whatever means provided. With an accurate a-c voltmeter, verify that correct load voltage is available at transfer switch main contacts (Terminal lugs N1, N2, N3).
5. If so equipped, set the Maintenance Disconnect switch (inside transfer switch) to the "Manual" position.
6. On the generator control console, set the Auto-Off-Start switch to the "Off" position.
7. Turn OFF the utility power supply to the transfer switch, with whatever means provided.
8. Set the generator's main circuit breaker to the "Off" or "Open" position.
9. Turn off all electrical loads. Initial testing and adjustment is done with the generator at "no-load".
10. Start the generator engine manually, using the generator start/stop switch on the control console. Let the unit stabilize and warm up for a few minutes.
11. Set the generator's main circuit breaker to the "On" or "Closed" position.
12. With an accurate a-c voltmeter, verify that correct rated voltage and frequency are being supplied to transfer switch terminals E1, E2, E3 and neutral.
    a. Do not proceed until generator output frequency and voltage are correct.
    b. If a-c frequency is not within 61-63 Hz at no-load, adjust the engine governed speed. See "Maintenance" section.
    c. If frequency is correct but voltage is not, you may need to adjust the voltage regulator. See "Maintenance" section.

NOTE: On units connected for 240 volts, 1 or 3-phase output, line-to-line voltage at 61-63 Hz should be 244-252 volts. On units reconnected to 208 volts, 3-phase, line-to-line voltage at 61-63 Hz should be 211-218 volts. Take these initial readings with the generator running at no-load.

IMPORTANT: Do not proceed until no-load frequency and voltage are correct.

13. Verify that you have positively turned OFF all power voltage supplies to the transfer switch, with whatever means provided. Then, manually actuate the transfer switch main contacts to the "Standby" position, i.e., LOAD connected to generator output.

⚠WARNING ***Do not attempt manual operation of the transfer switch until after all power voltage supplied has been positively turned off. Failure to turn off power voltage supplies to the switch may result in extremely hazardous and possibly lethal electrical shock.***

14. With the generator running, set the unit's main circuit breaker to its "On" or "Closed" position. The generator is now operating load circuits.

Dayton® Standby Generators

Installation (Continued)

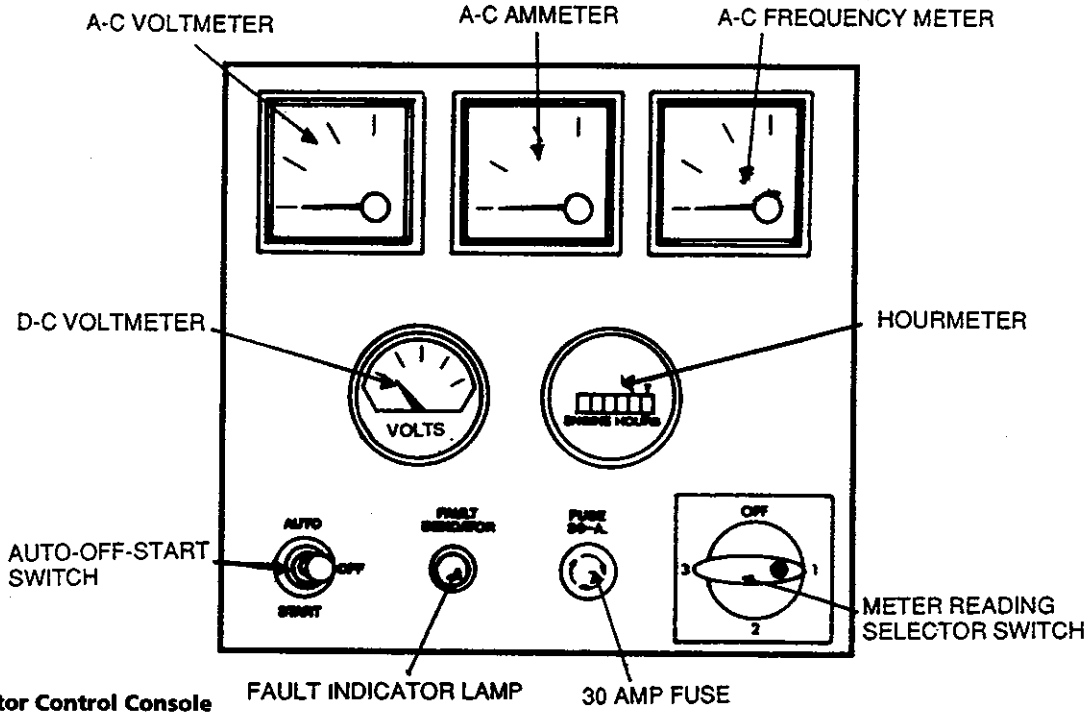


Figure 25 — Generator Control Console

15. Turn ON electrical loads that almost equal generator's wattage/amperage capacity. With an accurate a-c frequency meter, check frequency at transfer switch terminals E1, E2, E3. With generator under load, frequency should not droop below 58 Hz.
16. Let the generator run under load for at least 20-30 minutes. During this time, check for unusual vibration, noise, high temperature, other indications of abnormal operation.
17. When checkout under load is completed, proceed as follows:
    a. Set generator main circuit breaker to "Off" or "Open."
    b. Let the engine run at no-load for several minutes to stabilize internal generator temperatures.
    c. Shut down engine by pressing start/stop switch on control console.
    d. Verify all power voltage supplies to transfer switch have been turned OFF. Then manually actuate switch main contacts to the "Utility" position, i.e., LOAD connected to UTILITY power.
    e. Turn ON the utility power supply to the transfer switch with whatever means provided.
    f. Set the system for normal automatic operation, as outlined in "Operation" section.
18. Perform a "Normal Test" of system as outlined in appropriate transfer switch manual. If transfer switch is so equipped, also perform a "Fast Test."
19. Refer to appropriate transfer switch manual and set timers and sensors on transfer switch to the desired values. Test automatic operation as required.

Operation

When properly installed and interconnected with an automatic transfer switch (such as Dayton Model 1ZC00), this generator can be started and stopped either manually or automatically. Automatic operation is briefly described at follows:

1. Circuit boards in the generator constantly sense for preset utility power source voltage.
2. Should utility source voltage drop below a preset level and remain at such a low level for a preset time,

Models 4W117H and 4W118H

Operation (Continued)

transfer switch closes the terminals for the start/stop circuit.

3. Once this circuit closes, the generator cranks and starts.
4. After the generator starts and when the generator output voltage and frequency have reached a preset level, the switch transfers load circuits to the generator output.
5. The transfer switch circuit boards continue to monitor utility power source voltage. When that voltage is restored above a preset level and remains at such an acceptable level for preset time, the switch transfers load circuits back to the utility power source.
6. After the loads are transferred back to utility power, the switch opens terminals 178/183 circuit, which shuts down the generator.

For a more complete description of automatic operation, refer to the appropriate transfer switch manual.

CONTROL CONSOLE COMPONENTS

Refer to Figure 25 on page 18 to locate the control console components, which are as follows:

1. A-C Voltmeter
   a. Indicates generator a-c output voltage during operation.
   b. For units connected at 240 volts, 1 or 3-phase, no load voltage at 62 Hz is about 248 volts.
   c. For units connected at 208 volts, 3-phase, no load voltage at 62 Hz is about 215 volts.
   d. See also "Meter Reading Selector Switch."
2. A-C Ammeter
   a. Indicates current draw of connected electrical loads in amperes.
   b. Rated maximum continuous current flow for Model 4W117H is as follows:
      1. At 240 volts, 1-phase – 83 a-c amperes
      2. At 240 volts, 3-phase – 60 a-c amperes.
      3. At 208 volts, 3-phase – 69 a-c amperes.
   c. Rated maximum continuous current flow for Model 4W118H is as follows:
      1. At 240 volts, 1-phase – 41.5 a-c amperes
      2. At 240 volts, 3-phase – 30 a-c amperes.
      3. At 208 volts, 3-phase – 35 a-c amperes.
3. A-C Frequency Meter
   a. Indicates generator a-c output frequency, in "Hertz" (cycles per second).
   b. Generator Model 4W117H is rated 60 Hz at 3600 rpm.
      1. Engine governors are factory set to about 3720 rpm at no-load.
      2. Frequency at no-load speed of 3720 rpm will be about 62 Hz.
   c. Generator Model 4W118H is rated 60 Hz at 1800 rpm.
      1. Engine governors are factory set to about 1860 rpm at no-load.
      2. Frequency at no-load speed of 1860 rpm will be about 62 Hz.
   d. With electrical loads applied, frequency should not drop below about 58 Hz.
4. D-C Voltmeter
   a. The generator is equipped with a belt-driven d-c alternator, which maintains battery state-of-charge when the engine operates.
      1. The Control Module assembly also incorporates a trickle charge circuit which maintains battery state-of-charge during non-operating periods.
      2. Battery voltage should read about 12.5 to 14.5 volts d-c. A low battery voltage indicates the battery is discharging.
5. Hourmeter
   a. Indicates engine-generator operating time, in hours and tenths of hours.
   b. Use the hourmeter to guide you in performing periodic maintenance. See MAINTENANCE section.
6. Auto-Off-Start Switch
   a. Set switch to AUTO for automatic operation.
      1. With AUTO selected, when utility supply voltage drops below a preset level, the engine automatically cranks and starts.
      2. Automatic starting occurs when transfer switch closes Wires 178/183 circuit between the transfer switch and generator.
   b. Set switch to START to crank and start the engine.

Dayton® Standby Generators

Operation (Continued)

c. Set switch to OFF to shut down an operating engine. With "Off" selected, automatic operation is not possible.

⚠WARNING ***When this unit is installed in conjunction with a Dayton Automatic Transfer Switch, the engine can crank and start suddenly, at any time without warning. Such automatic starts usually occur when the transfer switch intelligence circuit has sensed that utility power source voltage has dropped below a preset value. To prevent such automatic starting and to prevent possible injuries, always set the auto-manual-off switch to "off" before working on or around the generator set.***

7. Fault Indicator Lamp
   a. Lamp goes ON when one or more of the following engine faults occurs and when engine shuts down:
      1. Low oil pressure
      2. High coolant temperature
      3. Overcrank
      4. Overspeed
8. 30 amp Fuse
   a. Fuse protects the control console's d-c control circuit against electrical overload.
   b. If fuse has failed open due to an overload, the engine cannot crank and start.
   c. Should you need to replace the fuse, use only an identical 30 amp replacement fuse.
9. Meter Reading Selector Switch
   a. Permits the operator to select either line-to-line or line-to-neutral readings on the a-c voltmeter and ammeter.
   b. With unit connected for 120/240 volts, 1-phase:
      1. Switch Position "1" displays Line E1 to Neutral (120 volts nominal) voltage and amperage readings.
      2. Switch Position "2" displays Line E2 to Neutral (120 volts nominal) readings for voltage and current.
      3. Switch Position "3" displays Line E1 to E3 (240 volts nominal) readings.
   c. With unit connected for 120/240 volts, 3-phase:
      1. Switch Position "1" displays Line E1 to E2 (240 volts nominal) voltage and amperage readings.
      2. Switch Position "2" displays Line E2 to E3 (240 volts nominal) readings for voltage and current.
      3. Switch Position "3" displays Line E3 to E1 (240 volts nominal) readings.
   d. With unit connected for 120/208 volts, 3-phase:
      1. Switch Position "1" displays Line E1 to E2 (208 volts nominal) voltage and amperage readings.
      2. Switch Position "2" displays Line E2 to E3 (208 volts nominal) readings for voltage and current.
      3. Switch Position "3" displays Line E3 to E1 (208 volts nominal) readings.
   e. With switch set to "Off", no voltage or amperage readings are displayed.

OPERATING INSTRUCTIONS — MANUAL START

When the generator set is installed along with a Dayton automatic transfer switch, you can manually start the generator and transfer of load circuits to generator a-c output as follows:

IMPORTANT: The following procedure applies when the Dayton Model 1ZC00 automatic transfer switch is used. It does not apply if you have installed any other transfer switch. Refer to the instrucions of the specific transfer switch before trying to start the generator and transfer loads manually.

1. On the generator control console, set the Auto-Off-Start switch to its "Off" position.
2. Turn off the utility power supply to the transfer switch, using whatever means provided (such as a utility main line circuit breaker).
3. Actuate the generator's main circuit breaker to its "Off" or "Open" position.

⚠ DANGER ***Do not attempt manual transfer switch operation until all power voltage supplies of the switch have been positively turned off. Failure to turn off power voltage supplies may result in extremely dangerous and possibly lethal electrical shock.***

4. In the prepackaged transfer switch, remove the manual transfer handle.
5. Attach the manual transfer switch handle to the transfer switch

Models 4W117H and 4W118H

Operation (Continued)

operating lever. Move the handle downward and then back to its original position. If the handle is DOWN, load is connected to the utility power supply. If handle is UP, load is connected to generator output.

6. On the generator control console, set the Auto-Off-Start switch to its "Start" position. Engine should crank and start.
7. Let the engine stabilize and warm up for a few minutes.
8. Set the generator's main circuit breaker to its "On" or "Closed" position. Loads are now powered by generator output.

RETRANSFER AND SHUTDOWN

When utility power source voltage has been restored, electrical loads may be retransferred back to that source and the generator can be shut down as follows:

1. Verify that utility power supply voltage to the transfer switch has been positively turned OFF, using whatever means provided (such as utility main line circuit breaker).
2. Set the generator's main circuit breaker to its "Off" or "Open" position.
3. Let the generator engine run at no-load for a few minutes, to stabilize internal unit temperatures.
4. On the generator console, set the Auto-Off-Start switch to "Off". Wait for engine to come to a complete stop.
5. With the manual transfer handle, move the switch's main contacts back to their utility position, i.e., load connected to utility power supply. Handle and operating lever of transfer switch should be in down position.
6. Turn on the utility power supply to the transfer switch, using whatever means provided (such as a utility main line circuit breaker). The utility power source now powers the loads.

SELECTING AUTOMATIC OPERATION

To set the system for fully automatic operation, proceed as follows:

1. Check that load circuits are connected to the utility power supply (transfer switch operating lever is down).
2. Set the Auto-Off-Start switch to its "Auto" position.
3. Set the generator main circuit breaker to its "On" or "Closed" position.

AUTOMATIC OPERATING SEQUENCES

A solid state circuit board in the control panel controls automatic operation. For a more exact description of automatic operating sequences see transfer switch instruction manual. The sequences of automatic operation are briefly described as follows:

1. Should utility source voltage drop below about 60% of the nominal supply voltage, a 6-second delay timer starts timing.
2. After the 6-second delay, the engine cranks and starts.

NOTE: The 6-second time delay is required to prevent false starts that might otherwise be caused by transient voltage dips.

3. An engine warmup time delay lets the engine warm up for about 15 seconds.
4. After 15 seconds, a standby voltage sensor checks the generator a-c output voltage. If generator voltage is more than about 50% of nominal, the pre-packaged transfer switch transfers load circuits to "standby" power supply.
5. If utility source voltage is restored above about 80% of the nominal source voltage, a "re-transfer time delay" starts timing.
6. If utility source voltage is still above 80% of nominal after six seconds, the switch re-transfers load circuits back to that power source.
7. After load circuits re-transfer, an engine cooldown timer allows engine to cool for a minute before shutting down.

NOTE: The control panel has a terminal strip that allows you to connect other types of automatic transfer switches (such as Dayton Model No. 4W123).

Maintenance

It is the owner/operator's responsibility to make sure that all safety checks have been performed; to make sure all required maintenance for safe operation is performed; and to have the equipment checked by a qualified technician periodically.

Normal maintenance service and replacement parts are the responsibility of the owner/operator and, as such, are not considered defects in material or workmanship within the terms of the warranty. Proper installation and use of this equipment will affect the need

Dayton® Standby Generators

Maintenance (Continued)

for maintenance service. Proper maintenance and care of your standby electric system helps reduce problems and also keeps overall operating expenses low.

RECOMMENDED ENGINE OIL

Used a high quality detergent oil with API classification "For Service SF" and having an SAE viscosity rating dependent of 15W-40. The oil needs no additives.

You need about 3.0 U.S. quarts (2.8 liters) of oil to fill the engine crankcase; about 3.5 U.S. quarts (3.3 liters) if oil filter is changed when you change the oil.

ENGINE COOLANT

Fill the engine cooling system with a mixture of half ethylene glycol base anti-freeze and soft water.
When replenishing coolant, always add the recommended mixture. Use only soft water. Never mix different types of anti-freeze. You can add a high quality rust inhibitor to the cooling system.

⚠CAUTION ***When adding coolant or when refilling after flushing, always use LOW SILICATE ethylene glycol base anti-freeze. Use SOFT WATER only. Do NOT use any chromate base rust inhibitor with ethylene glycol base anti-freeze. When these two chemicals mix, they can form "green slime" (chromium hydroxide), which reduces heat transfer rate and may result in overheating. Also, "green slime" forms when (a) you use high silicate anti-freeze boosters or additives, (b) you use hard water, or (c) you use a high ratio of anti-freeze to water (60% or more).***

15 HOUR BREAK IN PERIOD

The first 15 hours of operation is called the "break in" period for your new standby generator. Correctly breaking in the generator is essential to minimize oil consumption and maximize engine performance. During the break in period, observe the following rules:

1. Run generator at varying electrical loads for first 15 operating hours, to help seat engine piston rings properly.
2. For the next 75 operating hours, avoid light electrical loads. Load the generator at 50% (or more) of its rated capacity during this period. Repeated light loads during the break in period can cause engine piston rings to seat incorrectly, which results in blowby and high oil consumption.
3. Check engine oil level frequently during the break in. Add oil as necessary. It is normal for oil consumption to be high during the break in.
4. After the 15 hour break in period, complete the tasks recommended under "15 Hour Check Up".

15 HOUR CHECK UP

After first 15 hours of operation, contact an authorized service facility for the following maintenance tasks. The standby system owner is responsible for any charges.

1. Change engine crankcase oil and oil filter.
2. Check all fluid levels.
3. Inspect all cooling system hoses for damage, deterioration. Check all hose clamps for tightness.
4. Check for proper engine operation.
5. Check for correct rated a-c frequency and voltage output.
6. Inspect engine exhaust system for damage, deterioration, leaks, etc.
7. Inspect drive belts for proper tension and condition.
8. Inspect entire electrical system for proper connections, compliance with code, condition, etc.

PERIODIC MAINTENANCE SCHEDULE

This schedule lists the minimum recommended maintenance for most applications. Your particular unit may need additional or more frequent maintenance, depending on its exposure to weather and atmospheric conditions.

Some maintenance tasks are beyond the capability of the owner/operator and should be performed at an engine-generator service facility.

Where maintenance frequency is given in both "hours of operation" and "calender months", perform the recommended tasks at either the stated number of hours or after the recommended time interval WHICHEVER OCCURS FIRST.

1. Every three months
   - a. Check battery.
   - b. Inspect fuel system.
   - c. Check transfer switch.
   - d. Check exhaust system for leaks.
   - e. Check ignition system.
   - f. Check fan belt.
2. Every six months
   - a. Test engine safety devices.
3. Once annually
   - a. Test engine governor; adjust or repair.
   - b. Clean and inspect generator.

Models 4W117H and 4W118H

Maintenance (Continued)

c. Flush cooling system.

d. Grease the generator.

4. Once every 100 operating hours
   a. Change engine oil.
   b. Change oil filter.
5. Once every 200 operating hours
   a. Change air cleaner.
6. Once every 500 operating hours
   a. Check valve clearance.
   b. Check ignition system.
   c. Check engine DC alternator.

CHECKING ENGINE OIL LEVEL

During the first 15 hours of operation on a new unit (break in period), check oil level every two to three hours of operation. After the break in period, check engine oil level every 10 operating hours or at least once monthly (whichever comes first). For recommended oil, see "Specifications" on Page 2.

CHECKING COOLANT LEVEL

During the break in period (first 15 hours), check coolant level in coolant recovery bottle frequently. After break in, check coolant level in bottle at least once each week with the engine cold. Maintain the bottle about half full.

Periodically check coolant level in radiator, to make sure the coolant recovery system is functioning properly. If radiator coolant level is low, inspect gasket in radiator pressure cap for damage or wear. Replace pressure cap if necessary. The pressure cap may be tested by an automotive repair facility. Also inspect cooling system for leaks.

When adding coolant to the radiator or to the coolant recovery bottle, always add the recommended half-and-half mixture. See "Engine Coolant".

CLEANING THE GENERATOR

Keep the generator as clean as possible. Moisture and dirt that are allowed to accumulate on exterior surfaces causes rust and corrosion. Automotive type cleaners and waxes may be used on exterior surfaces, to clean the unit and help prevent corrosion.

Use a soft cloth or brush to clean exterior surfaces. When cleaning exterior surfaces, do not allow water to enter generator interior. Washing or rinsing the unit with a forceful spray is NOT recommended.

If moisture is allowed to remain in contact with generator windings, some of it will be trapped in voids and cracks of the winding insulation. This trapped moisture can eventually reduce the resistance of winding insulation and may cause serious problems. Dirt can worsen the problem since it tends to hold moisture into contact with the windings. Salt (as from sea air) can also worsen the problem, because it can absorb the moisture from the air. The combination of salt and moisture make a good electrical conductor.

Dayton recommends that an authorized service facility check the insulation resistance of your generator windings every 2 years.

BATTERY MAINTENANCE

Keep the generator battery as close as possible to 100% state-of-charge, if the standby electric system is to operate satisfactorily. The generator will not start when utility power source fails if the battery is dead. All lead-acid storage batteries discharge when not used. Refer to specific warnings that come with your battery.

Periodically inspect the battery cables and battery posts for condition. Keep battery posts clean and cable clamps clean and tight. Also, check for proper electrolyte fluid level in battery cells. Add distilled water as needed. Never use tap water in a battery.

Every 6 months have the battery tested by an authorized service facility.

Be sure to comply with the following rules when handling any battery:

1. Do not connect or disconnect battery cables until AFTER the utility power supply to the unit battery charger has been turned OFF. The battery can spark, which could cause an explosion.
2. Do not use jumper cables and a booster battery to crank the generator engine.
3. Do NOT attempt to recharge a discharged battery while it is attached to the generator. Disconnect the battery cables and remove battery, then recharge it in a well-ventilated area.
4. Wear safety goggles, rubber apron and gloves while handling a storage battery.
5. Never store a battery on a cement floor. Place battery on a wooden block for storage. Batteries self-discharge when resting on a cement floor.

Dayton® Standby Generators

Maintenance (Continued)

⚠WARNING ***Storage batteries give off explosive hydrogen gas while charging. An explosive mixture will remain around the battery for a long time after it has been charged. The slightest spark can ignite the gas and cause an explosion. Such an explosion can shatter the battery and cause blindness or other serious injury. Adequate ventilation is required to prevent explosive gas from accumulating around the battery.***

⚠WARNING ***Battery electrolyte fluid is an extremely caustic sulfuric acid solution that can cause severe burns. Do not permit fluid to contract eyes, skin, clothing, etc. If you spill the fluid, flush with clear water immediately. Wear safety glasses, rubber gloves and rubber apron while handling a battery.***

ENGINE PROTECTIVE DEVICES

The generator set may be required to run unattended for relatively long periods of time. Because an operator may not be nearby to monitor engine operation, the pre-packaged control panel provides fault protection that shuts down the engine if something fails.

A fault indicator lamp on the control panel lights up when one or more of the following engine fault shutdowns occurs: (1) low oil pressure: (2) high coolant temperature; (3) overcrank and (4) overspeed.

ELECTRICAL OVERLOAD PROTECTION

1. Main Circuit Breaker
   a. The generator's main circuit breaker must be installed when you assemble the generator. Refer to "Installation" section on Page 16.
   b. Current rating of main circuit breaker will be different depending on whether the unit is connected for 240 volts, 3-phase, 240 volts, 1-phase or 208 volts, 3-phase. See "Steps in the Connection Process" on Page 5.
2. 30 Amp Fuse – see "Operation" section on Page 19.
3. Field Circuit Breaker
   a. Protects the a-c voltage regulator against electrical overload.
   b. Located inside control console.
   c. Wire #2 from stator excitation winding connects to circuit breaker Terminal 2.
   d. Wire #162 to voltage regulator connects to breaker.
   e. Circuit breaker is self-resetting. You cannot manually actuate the breaker.

ENGINE GOVERNOR ADJUSTMENT

The generator supplies its correct rated a-c frequency and voltage only if the governed speed is correct. The engine governor was factory adjusted to deliver about 62 Hz with no electrical loads connected to the generator (no-load). Model 4W117H operates at about 3720 rpm to supply that frequency. Model 4W118H operates at about 1860 rpm to supply that frequency. Setting the no-load slightly high helps to prevent excessive rpm, frequency and voltage droop under heavy electrical loading.

NOTE: Generally, if frequency is correct (61-63 Hz) at no-load but voltage is incorrect, the a-c voltage regulator requires adjustment. Conversely, if a-c frequency is incorrect, the engine governor requires adjustment.

⚠WARNING ***Do not adjust the engine governor unnecessarily. Factory settings are correct for most applications. Excessively high operating speeds are dangerous and increase the risk of personal injury or damage to equipment. Excessively low speeds impose a heavy load on the engine when adequate engine power is not available which may shorten engine life. Correct a-c voltage and frequency are supplied only at the proper governed speed. Some connected electrical devices may be damaged by incorrect a-c frequency and voltage. Dayton recommends that only qualified service technicians adjust the governor.***

To adjust the governor, proceed as follows (Figure 26):

1. Connect an accurate a-c frequency meter and voltmeter across the generator a-c output leads, to read line-to-line frequency and voltage.
2. Set the generator's main circuit breaker to its "OFF" or "OPEN" position. Check and adjust the governor first at no-load.

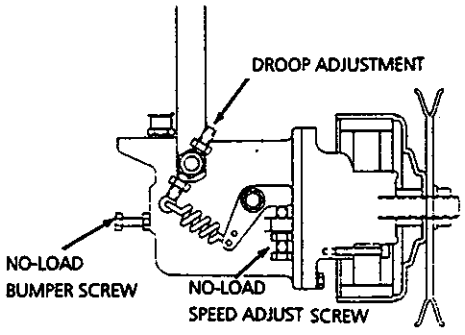


Figure 26 — Engine Governor Adjustments

3. Start the generator; let it stabilize and warm up. Then check the no-load frequency and voltage.

Models 4W117H and 4W118H

Maintenance (Continued)

a. For units connected for 120/240 volts, 1-phase or 3-phase, readings should be 244-252 volts at 61-63 Hz.

b. Units connected for 120/208 volts, 3-phase, should have readings of 211-218 volts at 61-63 Hz.

4. Analyze the frequency and voltage readings obtained in Step 3 as follows:
   a. If both frequency and voltage are within stated limits, no additional adjustment is required.
   b. If a-c frequency is not within the stated limits, go to Step 5.
   c. If frequency is good, but voltages not, try bringing the voltage within limits with the control console's voltage adjust potentiometer. If voltage is still not within limits, you may need to adjust the voltage regulator.
5. If frequency is not within limits, adjust the governor as follows:
   a. Adjust the NO-LOAD SPEED ADJUST SCREW to obtain a frequency reading as close as possible to 61.5 Hz.
   b. Adjust the NO-LOAD BUMPER SCREW to obtain frequency reading of 62 Hz.
   c. Apply electrical load to generator as close as possible to unit's full rated wattage/amperage capacity. (1) If frequency droops below 58 Hz, adjust the DROOP ADJUSTMENT downward; (2) Adjust the DROOP ADJUSTMENT until applying load causes the smallest possible frequency droop.

NOTE: If surging occurs when electrical loads are removed, adjust the NO-LOAD BUMPER SCREW inward. If BUMPER SCREW adjustment changes the frequency, back out the BUMPER SCREW until frequency is again 62 Hz.

6. When a-c frequency (at no-load and with load applied) is correct, check the a-c voltage reading. If necessary, adjust the a-c voltage regulator to obtain correct voltage reading.

VOLTAGE REGULATOR ADJUSTMENT

The a-c voltage regulator is housed inside the generator control console. You may have to adjust the regulator under the following circumstances:

a. If you have installed a new voltage regulator

b. After reconnecting the stator output leads to 120/208 volts, 3-phase configuration

c. When frequency is correct but voltage is not

To adjust the voltage regulator, proceed as follows (Figure 27 on page 26):

1. Connect an accurate a-c voltmeter and frequency meter across generator a-c output leads.
2. On the voltage regulator, set the following slotted adjustment potentiometers to their center position:
   - Voltage Adjust
   - Gain
   - Stability
   - Underfrequency Adjust
3. Actuate the generator's main circuit breaker to its "Off" or "Open" position. Make initial adjustments at no-load.
4. Start the generator, let it stabilize and warm up at no-load.
5. Check frequency reading. If frequency is not within 61-63 Hz at no-load, adjust the engine governor to correct frequency.
6. With engine stable and frequency at 61-63 Hz, analyze the condition of the excitement circuit as follows:
   a. All lights ON – Condition is normal.
   b. Green and yellow lights ON – Voltage regulator has a fault with accompanying low or no voltage.
   c. Green and red lights ON – Loss of regulator sensing with little or no output voltage.
   d. No lights are ON – Loss of excitation or reduced excitation current flow.
7. If red light is flashing, turn "Stability" adjustment counterclockwise until flashing stops. TURN SLOWLY.
8. With governed no-load speed at 61-63 Hz, turn the "Voltage Adjust" potentiometer to obtain the desired voltage.
   a. Adjust units connected for 240 volts, 1 or 3-phase to obtain 248 volts (line-to-line).
   b. Adjust units connected for 208 volts, 3-phase to obtain 215 volts (line-to-line).
9. Turn ON electrical loads to at least 75% of the generator's rated wattage capacity and check engine speed recovery.

Dayton® Standby Generators

Maintenance (Continued)

a. Turn the "Underfrequency Adjust" potentiometer counterclockwise to unload generator while engine recovers. Set this potentiometer full clockwise for flat regulation.

b. Adjustment range of potentiometer is 62 Hz (counterclockwise) to 52 Hz (clockwise).

ENGINE SERVICE DATA

Ignition System
- Timing ..... 21° BTDC at 1860 rpm no-load condition
- Distributor Point Gap ..... 0.018-0.022 inch
- Dwell Angle ..... 49°-55°
- Condensor Capacity ..... 0.20-0.24 micro-farad

Recommended Spark Plugs
- Champion RN9YC
- AC R42XLS
- NGK BPR6ES
- Spark Plug Gap ..... 0.031-0.035 inch

Compression Pressure at 350 rpm
- Standard ..... 192 PSI
- Minimum ..... 165 PSI
- Limit Between Cylinders .. 14 PSI

Valve Clearance (Hot)
- Intake ..... 0.0098 inch
- Exhaust ..... 0.0118 inch

Valve Clearance (cold)
- Intake ..... 0.009 inch
- Exhaust ..... 0.009 inch

TIGHTENING TORQUE FOR ENGINE BOLTS

- Intake Manifold Nuts ..... 12-15 foot-pounds
- Spark Plugs ..... 18-22 foot-pounds
- Water Pump Bolts ..... 3-3.5 foot pounds
- Thermostat Housing Bolts ..... 2-3.5 foot-pounds
- Cylinder Head Bolts
  - Tighten all bolts to ..... 22 foot-pounds
  - Then tighten all bolts to ... 47 foot-pounds
  - Finally tighten bolts to ..... 22 foot-pounds
- Exhaust Manifold Nuts ..... 12-15 foot-pounds

* Tighten all bolts in staggered sequence.

RESISTANCE OF GENERATOR WINDINGS

Rotor Windings
- Model 4W117H ..... 8.5 ohms
- Model 4W118H ..... 5.6 ohms

Stator Excitation Windings
- Take Readings Across ..... Wires 5 and 6
- Nominal Resistance ..... 0.45 ohm

Stator a-c Power Windings
- Across Leads S1 & S4 ..... 0.07 ohm
- Across Leads S7 & S10 .... 0.07 ohm
- Across Leads S8 & S11 .... 0.135 ohm
- Across Leads S3 & S6 ..... 0.135 ohm
- Across Leads S9 & S12 .... 0.135 ohm
- Across Leads S2 & S5 ..... 0.135 ohm

THERMAL PROTECTOR

The generator is equipped with a thermal protector, (Figure 27) which is physically imbedded in the generator stator windings and electrically connected in series with the stator excitation winding output to the voltage regulator (Wire #2). This device is a temperature sensitive switch having normally-closed (N.C.) contacts. Should stator temperatures increase above a safe value, the switch contacts open. Opening the contacts result in the following:

1. Excitation current flow to the voltage regulator is lost.
2. Without excitation current, generator output voltage drops to nearly zero (about 5-12 volts a-c).
3. The thermal protector fail while in open position, it is possible for a service technician to bypass the switch. To bypass a failed thermal protector, simply disconnect Wire #2 from field circuit breaker (CB1) and connect Wire #5 to field circuit breaker terminal from which Wire #2 was disconnected.

NOTE: When both the thermal protector and field circuit breaker (CB1) are open, the a-c output voltage is lost. If the contacts of either component opens, excitation current is lost and output voltage is that produced by the residual magnetism in the rotor (5-12 volts). Before bypassing the thermal protector, be sure to test the field circuit breaker for open condition as well as excitation winding leads 2 and 6. Do not bypass the thermal protector until you are certain it has failed open.

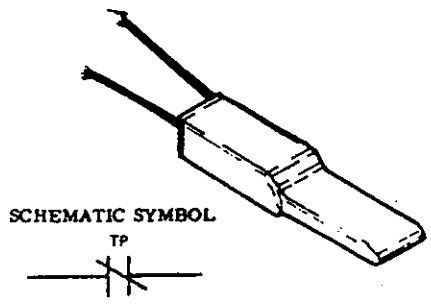


Figure 27 — Thermal Protector Circuit

Models 4W117H and 4W118H

Maintenance (Continued)

A FEW WORDS ABOUT SAFETY

PLEASE THINK SAFETY AT ALL TIMES. If you are not sure of instructions or procedures, seek qualified help before continuing.

This manual emphasizes the safety precautions required during assembly, installation, operation and maintenance of your generator set. Each section of the manual has warning and caution messages. These messages are for your safety and for the safety of the equipment. If you do not understand a caution or warning message, seek clarification from qualified personnel before proceeding.

Before any service work is done, disconnect or turn off all power sources and, where appropriate, turn off automatic start/stop and transfer controls. You can receive extremely dangerous electrical shock from the generator and utility power source if the system is misused. If automatic start/stop controls are not turned off or otherwise disabled, the generator can crank and start at any time without warning.

Local electrical codes require that the generator be grounded. See "Grounding the Generator" on Page 12.

Complying with the above safety precautions is necessary to prevent serious injury or even death.

Whenever the generator is running, always assume that dangerous power voltage is present and then proceed as if such dangerous voltage is present. Residual voltage may be present at generator leads and at control console connections. Be careful to prevent serious injury or even death from electrical shock.

When solvents, cleaners or flammable liquids are near the generator, provide adequate ventilation to avoid fire, explosion or health hazards. Avoid breathing vapors and use suitable protective equipment to prevent personal injury.

This manual is not intended to be a substitute for properly trained personnel. Only competent, qualified people should attempt repairs and some periodic maintenance. Each installation will create its own unique set of circumstances. No manual can cover every possible situation.

Warnings and cautions in the manual and on tags and decals affixed to equipment cannot eliminate the hazards they depict.

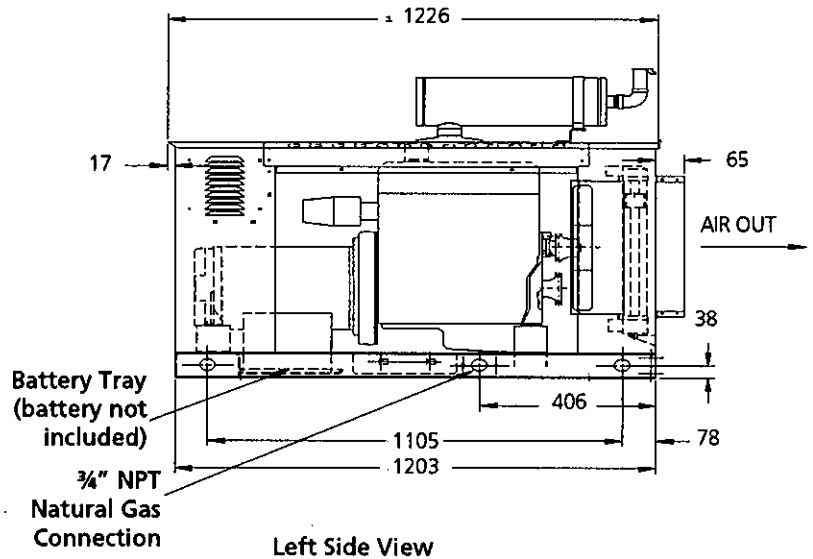
Stay alert at all times. The best safety rule may be to use "common sense" judgement in all circumstances. Strict compliance with warnings and cautions plus practicing common sense are major accident prevention measures.

Dayton®

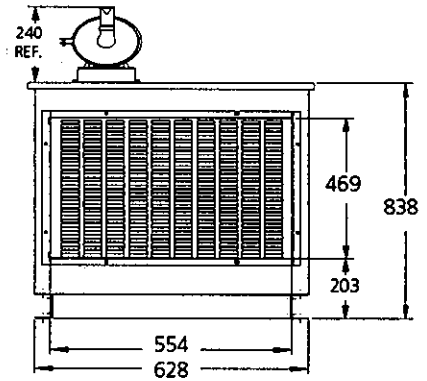
Installation Diagram

1.6 Liter Engine Service Connections
Natural Gas/LPG Vapor — ¾" NPT
Oil Drain Holes — ½" NPT
Exhaust Outlet — 1-½" NPT
Fuel system comes set up for outside fuel stub up connections. Small fuel system modifications required for inside stub up connections

All dimensions in mm



Left Side View
with Compartment



Radiator End View

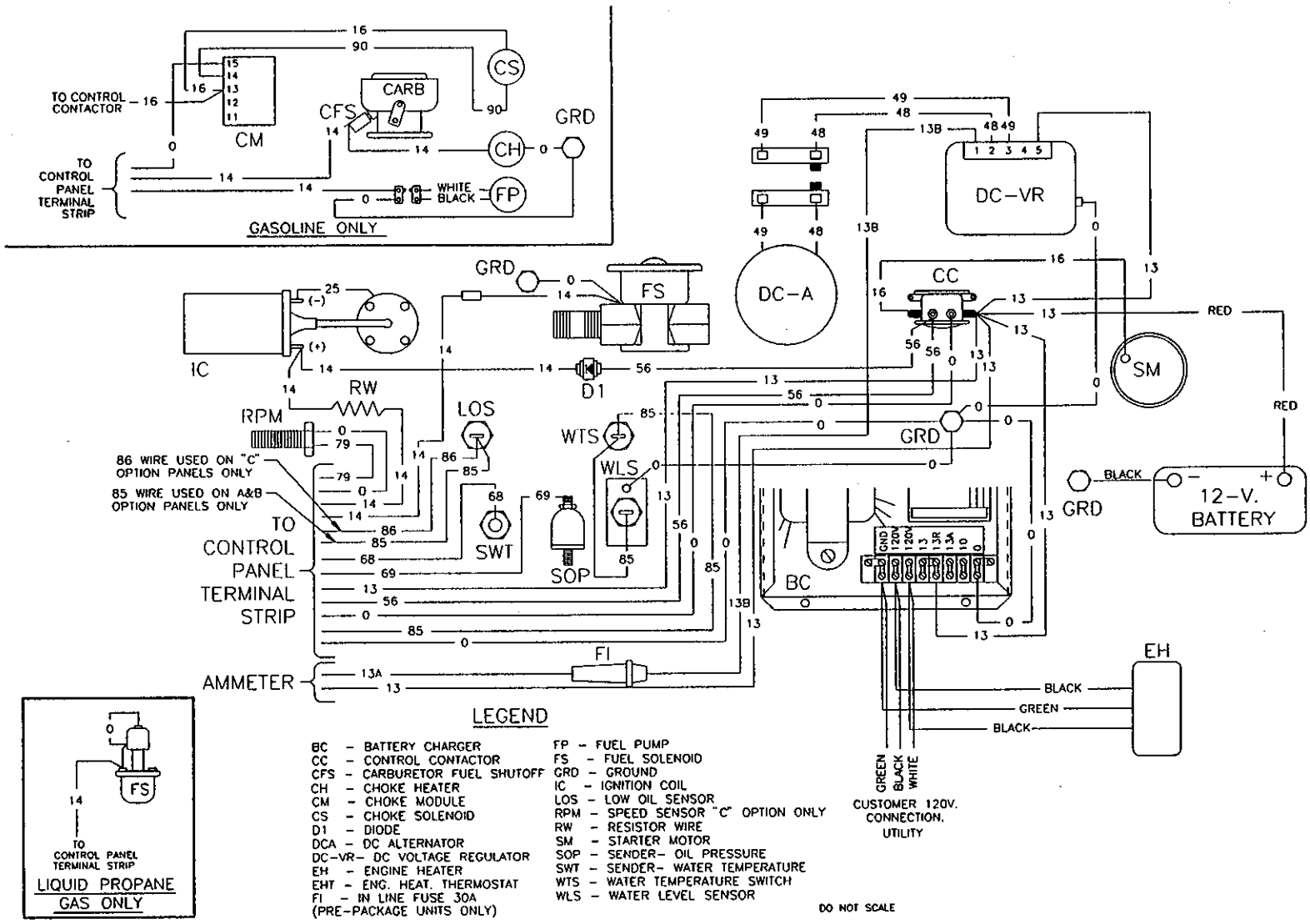
Figure 28 — Installation Diagram

Models 4W117H and 4W118H

Troubleshooting

Symptom	Possible Causes	Corrective Action
Engine won't start when Start/Stop switch is held at "Start"	1. Manual-Off Start switch is set to "OFF" 2. 30 amp fuse is blown 3. Weak or dead battery 4. Loose or corroded battery cables 5. Open or shorted control wires 6. Bad control/latch-crank circuit board 7. Bad starter motor	1. Set switch to "MANUAL" 2. Replace 30 amp fuse 3. Recharge or replace battery 4. Clean tighten or replace 5. Repair or replace bad wires 6. Replace bad circuit board 7. Replace bad starter
On loss of utility power supply to transfer switch,engine does not crank	1. Manual-Off-Auto switch set to OFF 2. Problem in automatic transfer switch 3. Bad control/latch-crank circuit board 4. Shorted generator circuit	1. Test/replace actuating coil 2. Repair/replace bad wire(s) 3. Replace defective circuit board 4. Have unit checked by authorized service facility
Engine cranks, will not start	1. Out of fuel 2. Manual shutoff valves in fuel supply are closed 3. Failure of one or more components in fuel supply system 4. Wire 14 to fuel solenoid is open 5. Defective fuel solenoid (FS) 6. Failure in engine fuel system	1. Replenish fuel supply 2. Open all shutoff valves 3. Replace bad fuel solenoid or faulty component 4. Repair/replace bad ignition parts 5. Replace bad solenoid 6. Have fuel system checked by qualified engine mechanic
Low or no AC output voltage	1. Main line circuit breaker is open 2. Failure in generator electrical systems	1. Reset (close) main breaker 2. Have unit tested and repaired by authorized service facility
Engine shuts down, fault indicator lamp comes ON	Engine shutdown fault occurred	Correct the fault
AC voltage and frequency are both high or low	Incorrect governed speed	Have engine governor adjusted by authorized service facility
Frequency is good but AC voltage is high or low	Voltage regulator problem	Have voltage regulator checked and adjusted by authorized service facility

Wiring Diagram



LEGEND

BC – BATTERY CHARGER	FP – FUEL PUMP
CC – CONTROL CONTACTOR	FS – FUEL SOLENOID
CFS – CARBURETOR FUEL SHUTOFF	GRD – GROUND
CH – CHOKE HEATER	IC – IGNITION COIL
CM – CHOKE MODULE	LOS – LOW OIL SENSOR
CS – CHOKE SOLENOID	RPM – SPEED SENSOR "C" OPTION ONLY
D1 – DIODE	RW – RESISTOR WIRE
DCA – DC ALTERNATOR	SM – STARTER MOTOR
DC-VR – DC VOLTAGE REGULATOR	SOP – SENDER– OIL PRESSURE
EH – ENGINE HEATER	SWT – SENDER– WATER TEMPERATURE
EHT – ENG. HEAT. THERMOSTAT	WTS – WATER TEMPERATURE SWITCH
FI – IN LINE FUSE 30A (PRE-PACKAGE UNITS ONLY)	WLS – WATER LEVEL SENSOR

Figure 29 — Engine Wiring Diagram

Electrical Schematic

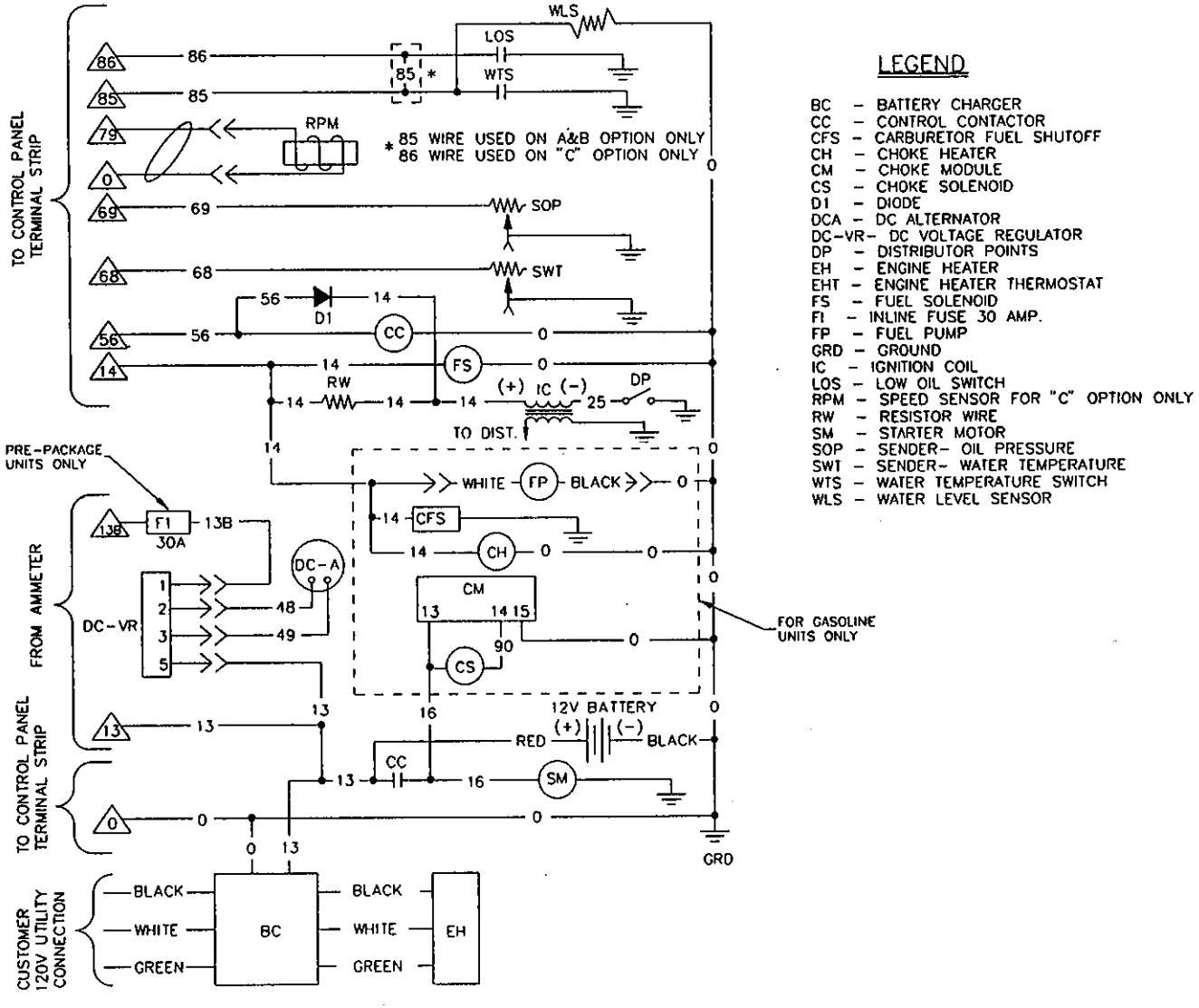


Figure 30 — Engine Electrical Schematic

Wiring Diagram

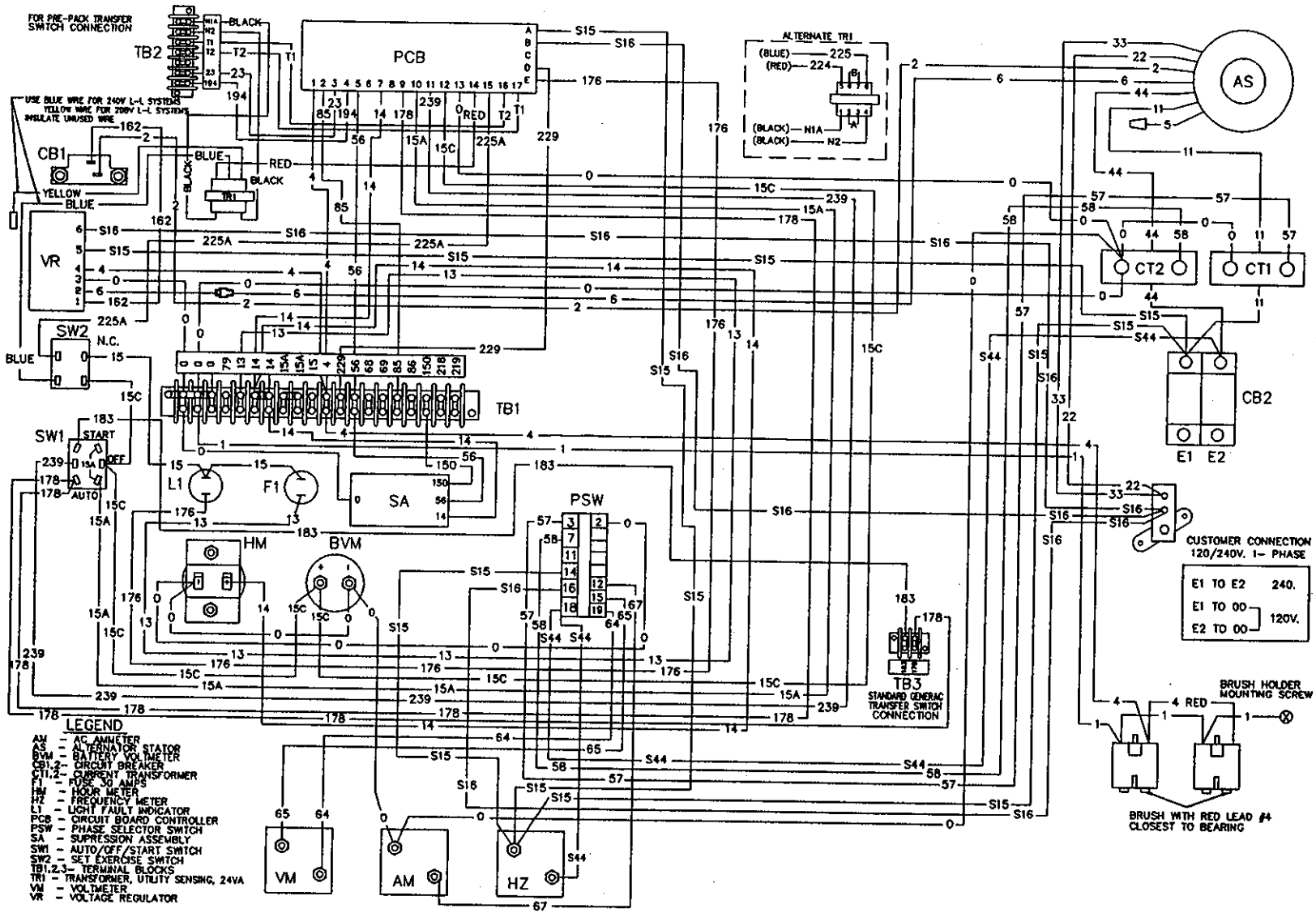


Figure 31 — Generator Wiring Diagram for Model 4W117H

Electrical Schematic

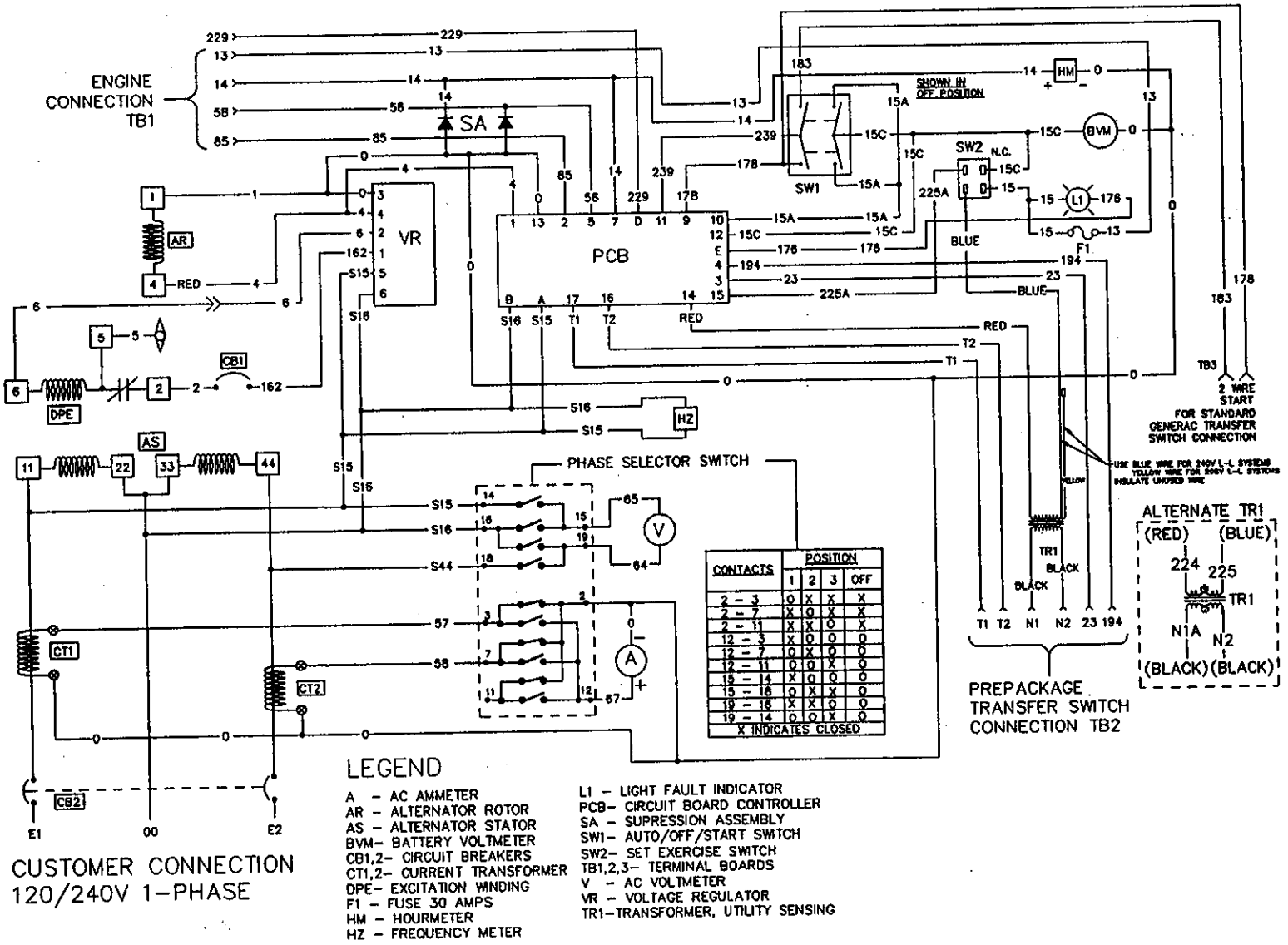


Figure 32 — Generator Schematic for Model 4W117H

Wiring Diagram

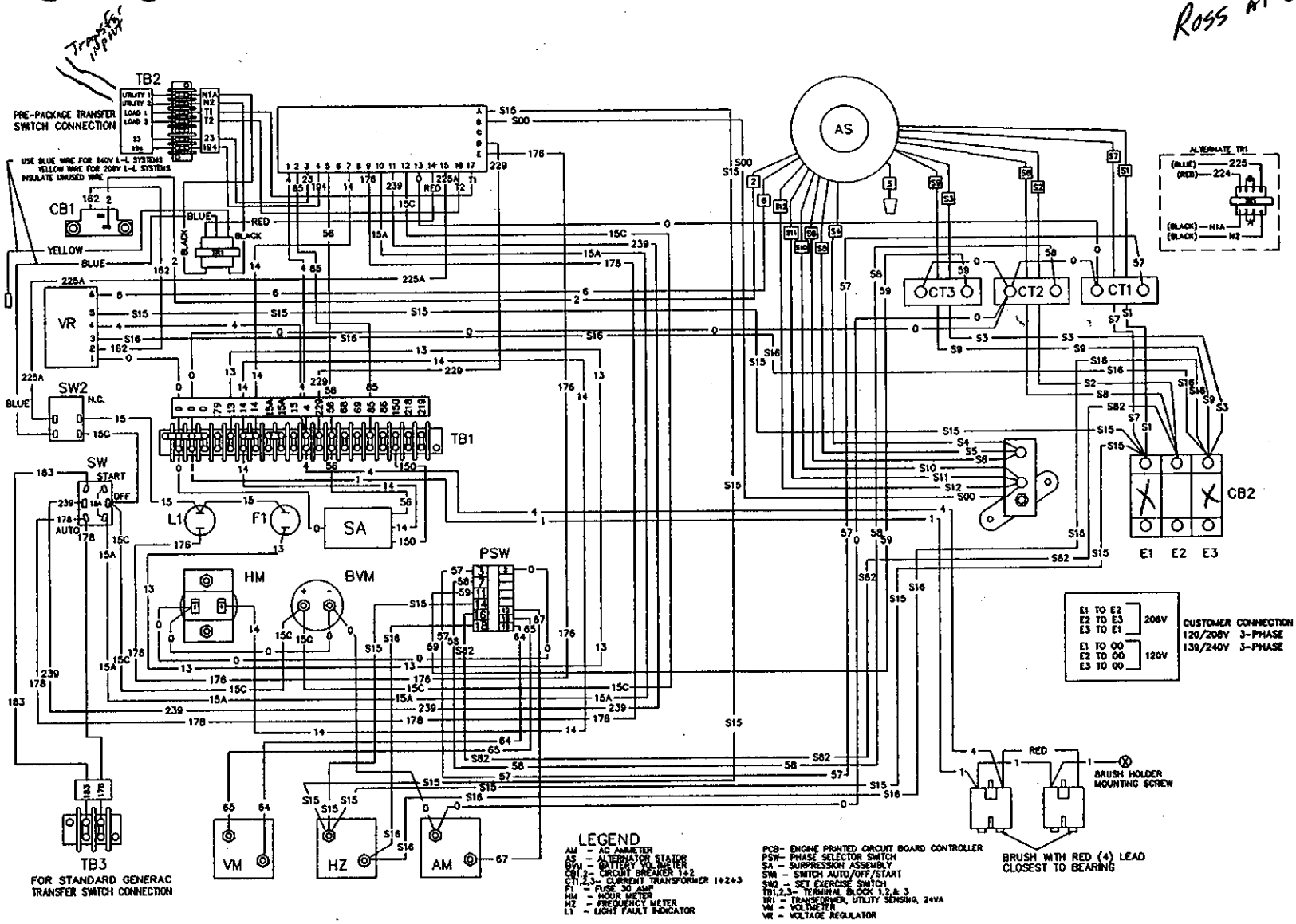


Figure 33 — Generator Wiring Diagram for Model 4W118H

Electrical Schematic

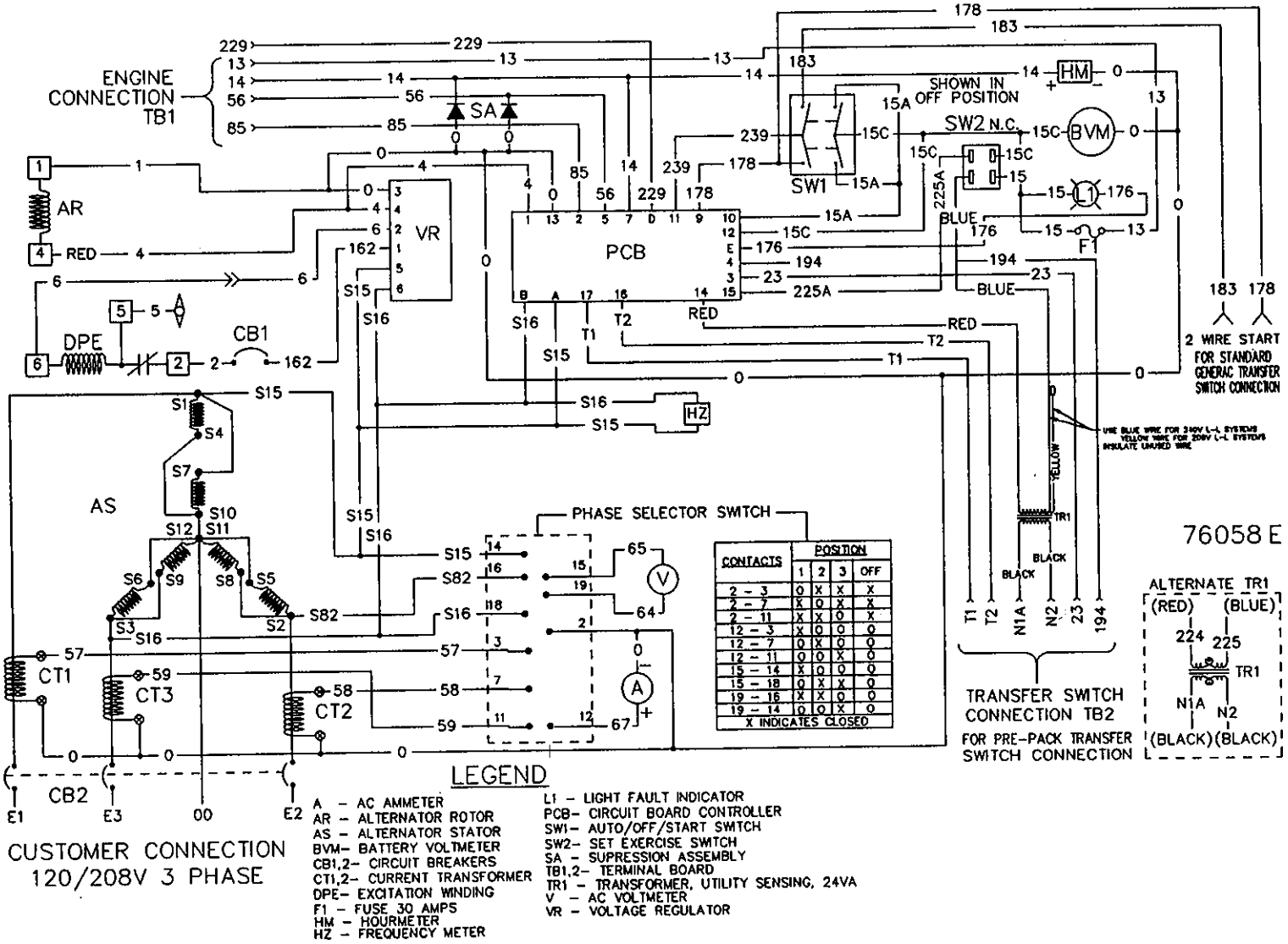


Figure 34 — Generator Schematic for Model 4W118H

For Replacement Parts, call 1-800-323-0620 24 hours a day — 365 days a year

Please provide following information:
-Model number
-Serial number (if any)
-Part descriptions and number as shown in parts list

Address parts correspondence to:
Grainger Parts Operations
P.O. Box 3074
1657 Shermer Road
Northbrook, IL 60065-3074

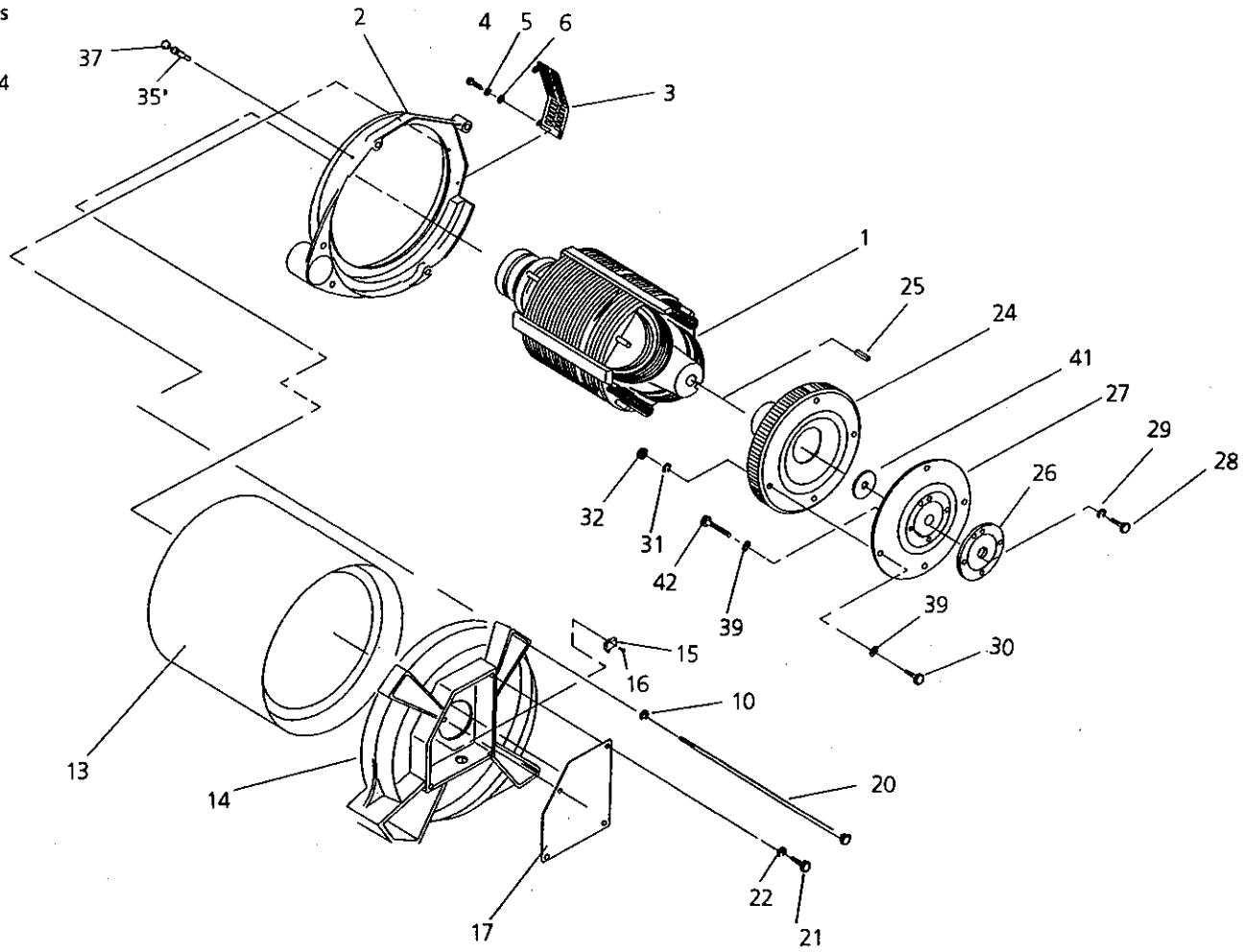


Figure 35 — Replacement Parts Illustration for Generator

Replacement Parts List

Reference Number	Description	Part Numbers for Models 4W117H & 4W118H	Quantity
1	Rotor assembly for Model 4W117H	98671	1
	Rotor assembly for Model 4W118H	98675	1
2	Blower housing	97079	1
3	Air outlet screen	98306	1
4	M5-0.8 x 10mm Hex head capscrew	*71912	4
5	M5 Lockwasher	*22152	4
6	M5 Flatwasher	*51713	4
10	M8 (5/16") Lockwasher	*22129	2
13	Stator assembly for Model 4W117H	98672	1
	Stator assembly for Model 4W118H	98676	1
14	Rear bearing carrier	69804-B	1
15	Brush assembly holder	98986	1
16	M4-0.7 x 20mm Hex head screw	*52813	2
17	Rear bearing carrier cover	98323	1
20	Stator bolt	75554-A	4
21	M6-1.0 x 16mm Hex head capscrew	*47411	4
22	M6 Lockwasher	*22097	4
24	Fan and ring gear assembly	97146	1
25	3/8" square x 1" long Key	42558	1
26	Flex plate spacer	97602	1
27	Flex plate	97295	1
28	M12-1.75 x 40mm Hex head capscrew	52213	1
29	M12 Lockwasher	*51769	1
30	M10-1.5 x 35mm Hex head capscrew	49541	4
31	M10 Lockwasher	*46526	4
32	M10-1.5 Hex nut	*45772	4
35	RPM speed sensor MPU	82130-B	1
37	Plastic plug	87599	1
39	M10 Flatwasher	*49809	10
41	Rotor shaft washer	72578	1
42	M10-1.25 x 16mm Capscrew	*98544	6
Δ	1" dia. x 10: long Flex guard		

(*) Standard hardware item, available locally.

(Δ) Not shown.

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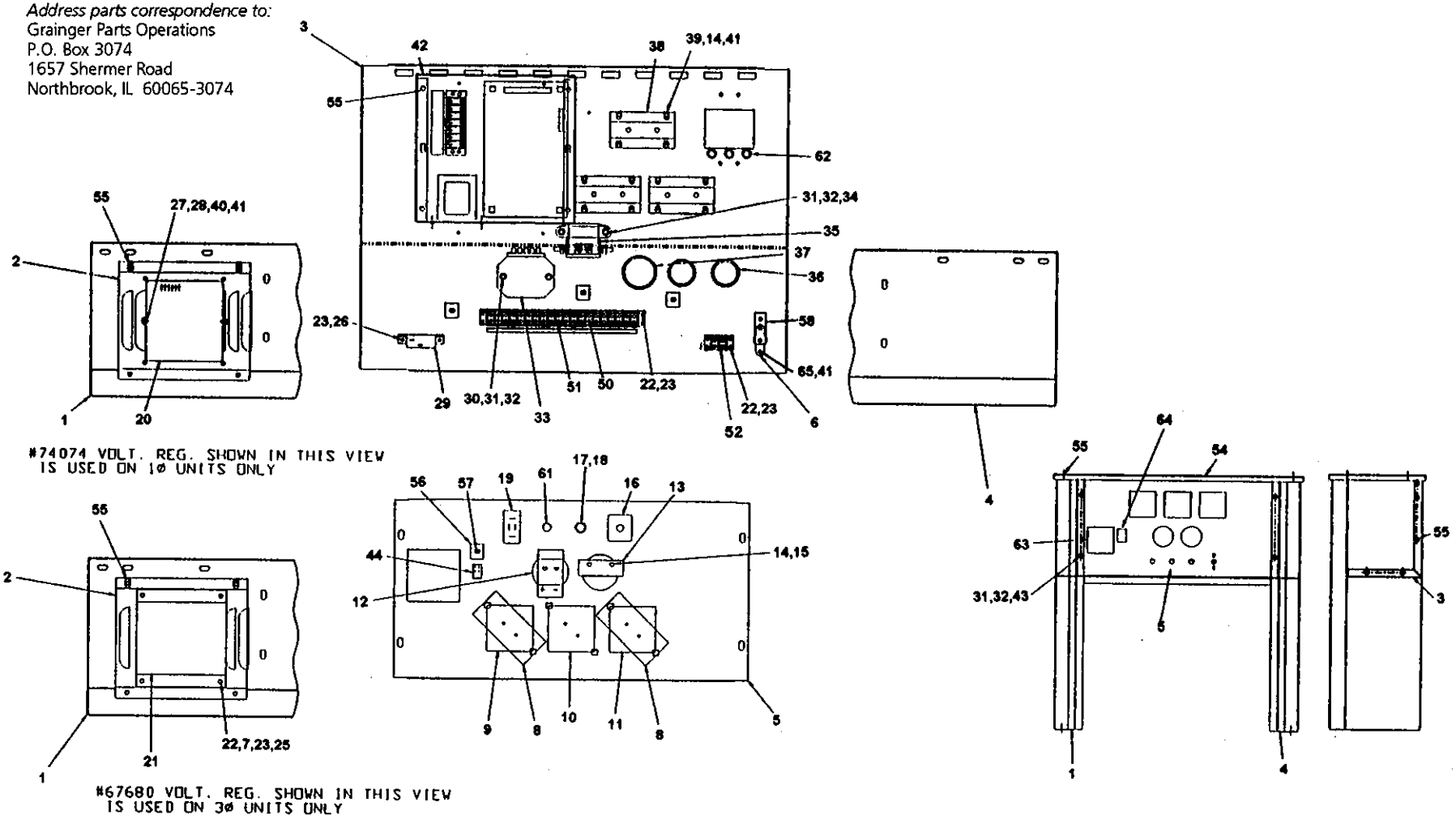

Figure 36 — Replacement Parts Illustration for Control Panel

Replacement Parts List for Control Panel

Reference Number	Description	Part Number for Models 4W117H and 4W118H	Quantity
1	Control Panel Support	98062	1
2	Voltage Regulator Bracket	75589	1
3	Control Panel back & bottom	98132	1
4	Control Panel Support	98063	1
5	Pre-packaged Control Panel	98663	1
6	Junction Block	57073	1
7	Flat Washer	22985	4
9	AC Voltmeter	70043	1
10	AC Ammeter	70055	1
11	Frequency Meter (Hertz)	70042	1
12	Hourmeter	70081	1
13	DC Voltmeter	76037	1
14	#10 Lock Washer	*22152	12
15	#10-32 Hex Nut	*22158	4
16	Voltage Selector Switch	61945	1
17	Fuse Holder	32300	1
18	30 amp Fuse	22668	1
19	ON/OFF/ON Switch	76020	1
20	Voltage Regulator Assembly	74074	1
21	Voltage Regulator (Direct)	67680	1
22	M4-0.7 x 16mm Screw	*75476	–
23	M4 Lock Washer	*22264	2
24	M8 Flat Washer	*22145	5
25	M4-0.7 Hex Nut	*51715	4
26	M4-0.7 x 10mm Screw	*75475	2
27	M5-0.8 x 40mm Screw	*76039	2
28	M5-0.8 Hex Nut	*51756	2
29	Breaker/Circuit-2.5 amp.	53623	1
	Breaker/Circuit-3 amp.	54502	1
	Breaker/Circuit-3.5 amp.	56247	1
	Breaker/Circuit-4 amp.	49350	1
	Breaker/Circuit-4.5 amp.	48476	1
	Breaker/Circuit-5 amp.	48512	1
	Breaker/Circuit 5.5 amp.	54450	1

(*) Standard hardware item, available locally.

(Δ) Not shown.

Reference Number	Description	Part Numbers for Models 4W117H and 4W118H	Quantity
29	6-amp Circuit breaker.	48505	1
	7-amp Cirucit breaker.	48487	1
30	M6-1.0 x 25mm Hex capscrew	45757	2
31	M6 Lockwasher	*22097	8
32	M6 Flatwasher	*22473	8
33	DC regulator	71938-A	1
34	M6-1.0 x 12mm Hex capscrew	43116	2
35	Silver solenoid	56739	1
36	Grommet	72252	2
37	Grommet	63212	1
38	Current transformer, 50/5	58568	
	Current transformer-150/5	58318	3
	Current transformer-100/5	61395	3
	Current transformer-200/5	58710	3
	Current transformer-300/5	58377	3
39	#10-32 x ½" Screw	*33121	2
40	M8 Flatwasher	*49226	2
41	M5 Flatwasher	*23897	2
42	Control module assembly	75595	1
43	M6 x 1.0 x 12mm Screw	*77438	4
44	Rocker switch (DPST)	82573	1
50	Terminal strip block	57335	1
51	Terminal strip decal	76061	1
52	2 pos. Terminal strip block	48766	1
54	Control panel cover	97219	1
55	Crimptite screw	75443	22
56	Cable tie mount	57593	4
57	4" long Tie wrap	28739	4
58	Bus bar	61979	1
Δ	Control panel harness (1-phase)	98266	1
Δ	Control panel harness (3-phase)	98266-A	1
61	Fault indicator lamp	64009	1
62	3/8" Button plug	56967	3
63	Exercise Instructions Decal Kit	81988	1
64	Rocker Switch (DPST)	82573	1

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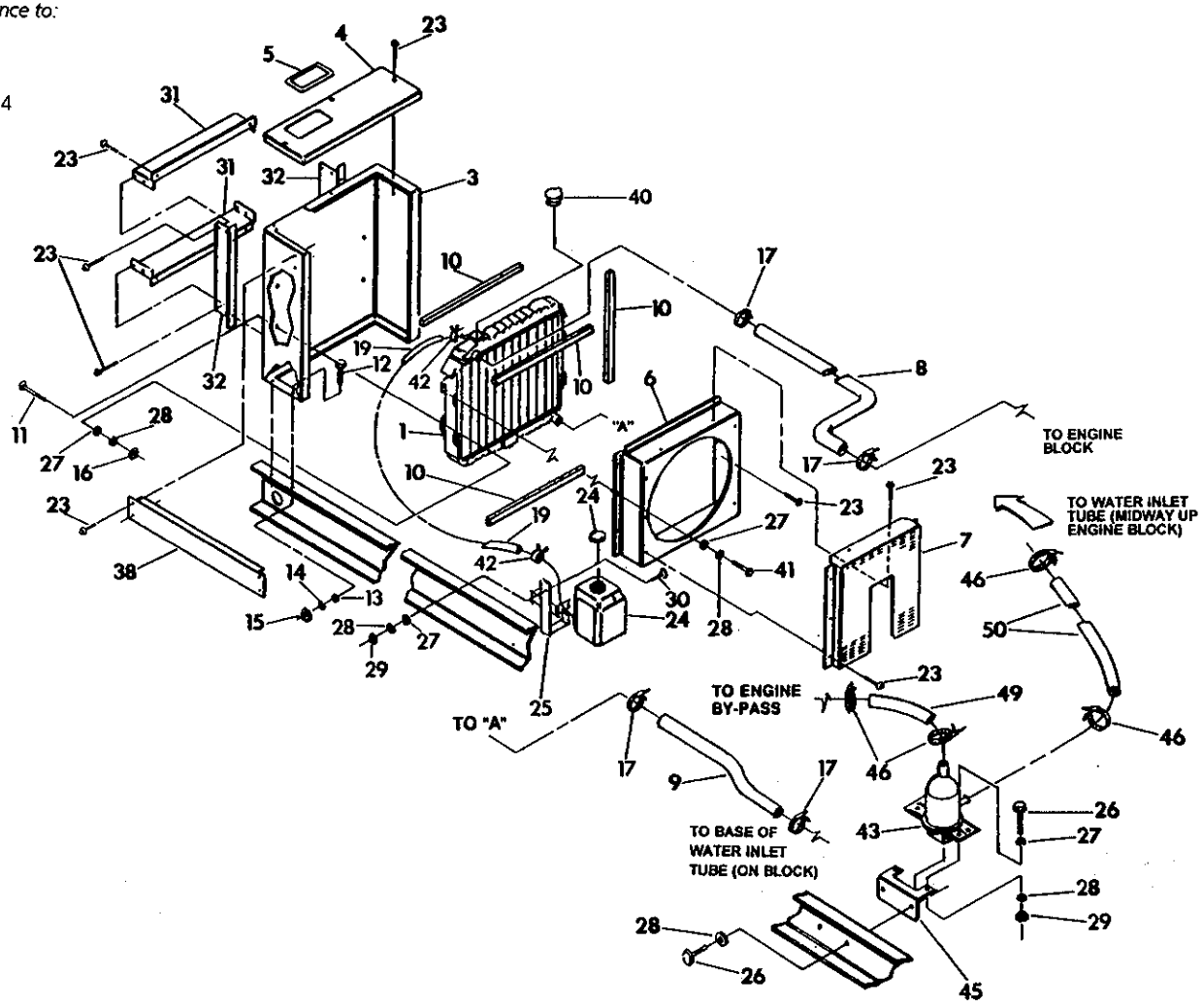

Figure 37 — Replacement Parts Illustration for Radiator

Replacement Parts List for Radiator

Reference Number	Description	Partr Numbers for Models 4W117H and 4W118H	Quantity
1	Radiator	97372	1
2	Mounting base	97341	1
3	Radiator support	97373	1
4	†Radiator top	97470	1
5	†Vinyl trim (18")	56326	1
6	Venturi	97469	1
7	Fan guard	97522	1
8	Upper hose	97377	1
9	Lower hose	97378	1
10	1" Foam tape (14")	52250	1
11	¼-20 x 1" Carriage bolt	*24334	4
12	M8-1.25 x 16mm Capscrew	*42907	4
13	M8 Flatwasher	*22145	4
14	M8 Lockwasher	*22129	4
15	M8-1.25 Hex nut	*45771	4
16	¼-20 Hex nut	*22127	4
17	#24 Hose clamp	*99502	4
19	5/16" x 72" long Hose	29032	1

(†) Used on non-compartment units only.
(‡) Used on air duct option only.
(*) Standard hardware item, available locally.

Reference Number	Description	Part Numbers for Models 4W117H and 4W118H	Quantity
23	¼-20 x 5/8" Screw	*75443	35
24	Coolant recovery bottle	76749	1
25	Bottle bracket	80712	1
26	M6-1.0 x 20mm Capscrew	*42568	4
27	M6 Flatwasher	*22473	8
28	M6 Lockwasher	*22097	10
29	M6-1.0 Hex nut	*49813	4
30	M6-1.0 x 16mm Capscrew	*47411	1
31	‡ Air duct	98900	2
32	‡ Air duct	98901	2
38	† Side brace	97575	2
40	Radiator cap	46627	1
41	#10-24 x 3/8" Screw	*56892	4
42	#9 Hose spring clamp	83709	1
43	500 watt Engine heater	84918	1
45	Engine heater bracket	84427	1
46	#10 Hose clamp	*57823	4
49	5/8" dia. x 18" long Hose	50967-18	1
50	5/8" dia. x 28" long Hose	50967-28	1

For Replacement Parts, call 1-800-323-0620 24 hours a day — 365 days a year

Please provide following information:
-Model number
-Serial number (if any)
-Part description and number as shown in parts list

Address parts correspondence to:
Grainger Parts Operations
P.O. Box 3074
1657 Shermer Road
Northbrook, IL 60065-3074

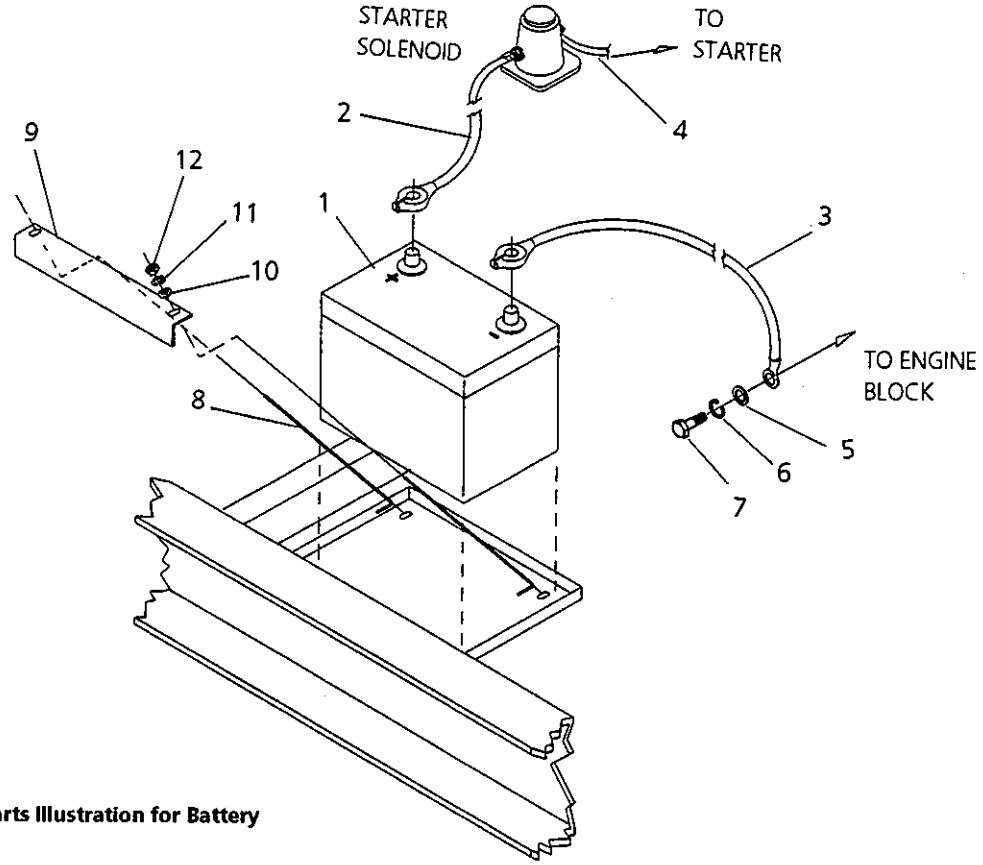

Figure 38 — Replacement Parts Illustration for Battery

Replacement Parts List

Reference Number	Description	Part Number For Models 4W117H and 4W118H	Quantity
1	Group 26 Battery	———	—
2	21" Red battery cable	38804-M	1
3	23" Black battery cable	38805-H	1
4	29" Red cable	10-74260	1
5	M10 Flatwasher	*22131	1
6	M10 Lockwasher	*46526	1
7	M10-1.25 x 20mm Hex head capscrew	*52213	1
8	Battyer hold-down J-bolts	59567	2
9	Hold-down bar	78121	1
10	5/16" Flatwasher	*22145	2
11	5/16" Lockwasher	*22129	2
12	5/16" Hex nut	*22259	2

(*) Standard hardware item, available locally.

For Replacement Parts, call 1-800-323-0620 24 hours a day — 365 days a year

Please provide following information:
-Model number
-Serial number (if any)
-Part description and number as shown in parts list

Address parts correspondence to:
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1657 Shermer Road
Northbrook, IL 60065-3074

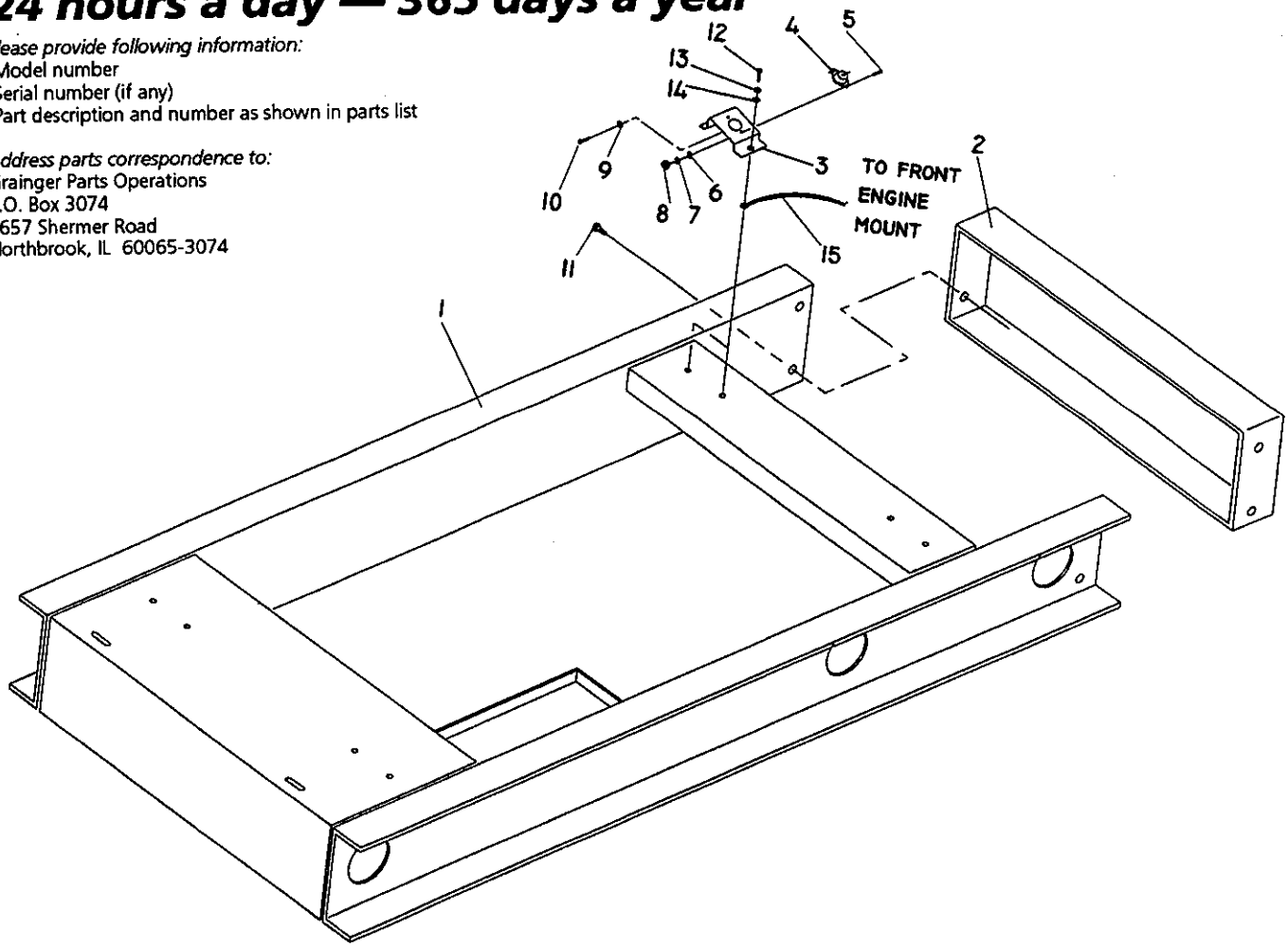

Figure 39 — Replacement Parts Illustration for Mounting Base

Replacement Parts List

Reference Number	Description	Part Number For Models: Models 4W117H and 4W118H	Quantity
1	Mounting base	97341	1
2	Mounting base end	98829	1
3	Engine mounting bracket	97374	4
4	Vibration isolator	70936	4
5	M8-1.25 x 20mm Hex head capscrew	*39253	8
6	M8 Flatwasher	*22145	8
7	M8 Lockwasher	*22129	8
8	M8-1.25 Hex nut	*45771	8
9	Vibration isolator washer	71956	3
10	M8-1.25 x 60mm Hex head capscrew	*51730	4
11	Crimptite screw	58442	4
12	M10-1.5 x 20mm Hex head capscrew	*51756	8
13	M10 Flatwasher	*46526	8
14	M10 Lockwasher	*22131	8
15	Grounding strap	67-44114	1

(*) Standard hardware item, available locally.

For Replacement Parts, call 1-800-323-0620 24 hours a day — 365 days a year

Please provide following information:
-Model number
-Serial number (if any)
-Part description and number as shown in parts list

Address parts correspondence to:
Grainger Parts Operations
P.O. Box 3074
1657 Shermer Road
Northbrook, IL 60065-3074

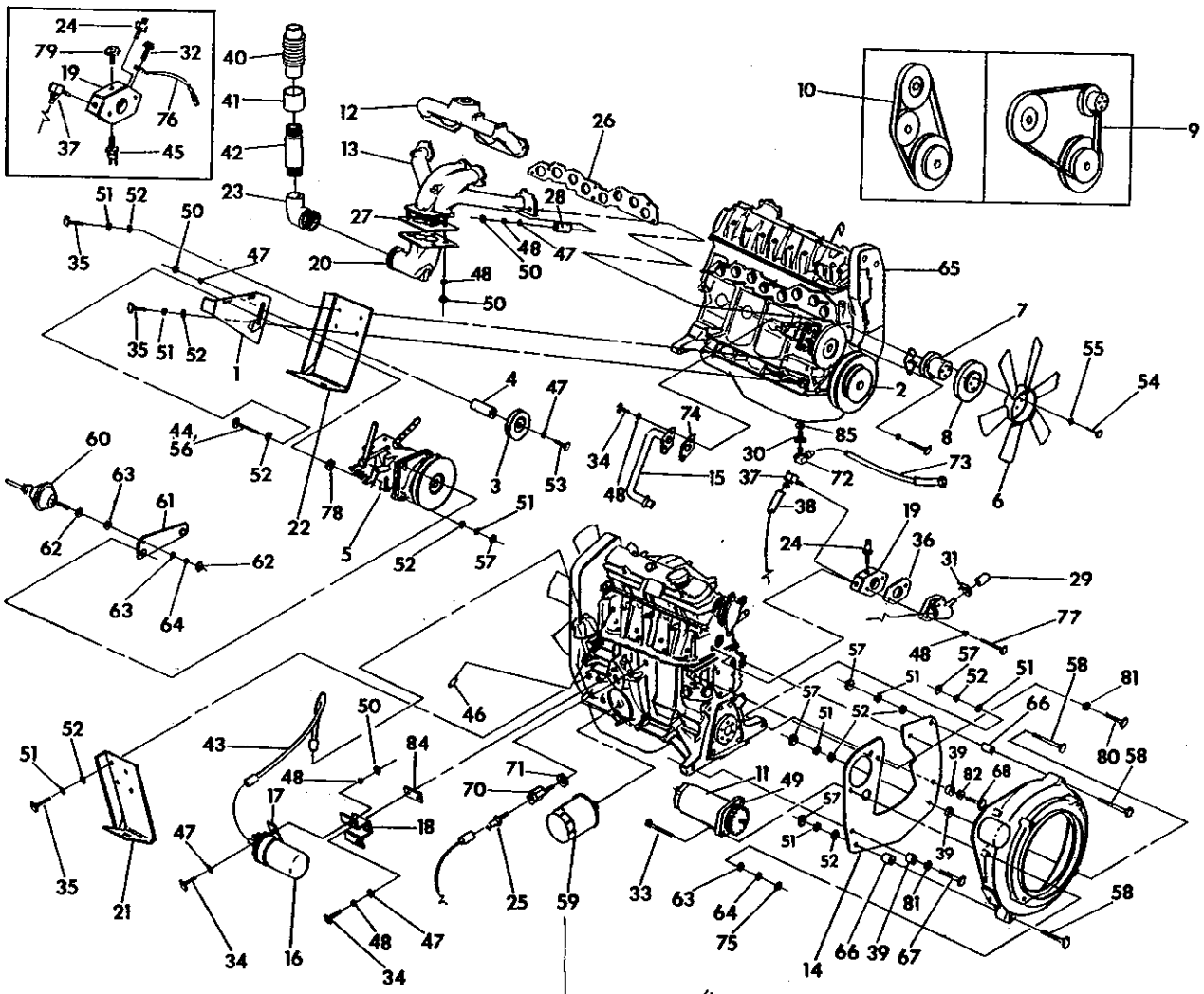

Figure 40 — Replacement Parts Illustration for Engine

Replacement Parts List for Engine

Reference Number	Description	Part Number for Models 4W117H and 4W118H	Quantity
1	Governor bracket	98064	1
2	Crank pulley	97280	1
3	Idler pulley	43604	1
4	Idler pulley spacer	97666	1
5	††Governor assembly	98966	1
	†Governor assembly	98996	1
6	Fan	75613	1
7	††Fan assembly	97406	1
	†Fan assembly	97408	1
8	†Fan pulley	52230	1
9	Fan belt	39379	1
10	Water pump belt	79199	1
11	Starter	70954	1
12	Intake manifold	97636	1
13	Exhaust manifold	98133	1
14	Engine plate	97221	1
15	Water inlet tube	98070	1
16	Ignition coil	72557	1
17	Ignition coil bracket	74816	1
18	Coil cover bracket	97632	1
19	Thermostat spacer	98509	1
20	Exhaust adaptor	98057	1
21	Motor mount left	98068	1
22	Motor mount right	98067	1
23	1½" Street elbow	62091	1
24	Low oil level sensor	57522	1
25	Oil pressure switch	60108	1
26	Intake/exhaust gasket	97402	2
27	Exhaust adaptor Gasket	98690	1
28	Exhaust spacer	22625B	2
29	By pass cap	77996	1
30	Oil drain adaptor	5809	1
31	#12 Hose Clamp	35473	4
32	#10-32 x ¼" Screw	46852	2
33	5/16"-18 x 3" Capscrew	*99379	2
34	M8 1.25 x 20mm Bolt	*39253	5
35	M10 1.25 Bolt	*52213	7
36	Thermostat gasket	98907	1
37	3/8" NPT 90 deg. elbow	*34339	1
38	5/8" Heater hose (3'.)	50967	1
39	Engine plate spacer	97981	2
40	Flex exhaust	75546	1
41	Coupling 1½" NPT	67729	1
42	1½" x 7½' Pipe Nipple	67730	1
43	Ignition coil wire	98852	1
44	††M10-1.5 x 55mm Capscrew	*49812	2
46	M10-1.25 x 10mm Capscrew	*99020	1
47	M8 Flatwasher	*22145	10
48	M8 Lockwasher	*22129	15
49	Adaptor, Starter	97220	1
50	1.25 x 8mm Hex Nut	*45771	9
51	M10 Lockwasher	*46526	10
52	M10 Flatwasher	*49809	10
53	M8-1.25 x 55mm Capscrew	52203	1
54	M6-1.00 x 20mm Capscrew	*42568	6
55	M6 Lockwasher	*70005	6
56	†M10 1.50 x 40mm Capscrew	*64416	2
57	M10-1.5 Hex nut	*45772	6
58	M10- 1.50 x 70mm Bolt	51735	2
59	Oil filter WIX # 5128 7	99021	1
60	††Dash pot NAPA # 128 1	57406	1
61	††Dash pot bracket	75866A	1
62	††5/16"-24 Nut	*31596	2
63	5/16" Flatwasher	*22145	4
64	5/16" Lockwasher	*22129	1
65	Engine, 1.6L	97390	1
66	Dowel Sleeve	70901	2
67	M12-1.25 x 40mm Capscrew	75672	1
68	M12-1.75 x 55mm Capscrew	81816	1
69	M10-1.5 x 90mm Capscrew	56768	1
70	Adaptor	75797	1
71	Nylon washer	57772	1
72	3/8" Barbed elbow	43790	1
73	Oil drain hose assembly	69860C	1
74	Water tube gasket	99478	1
75	5/16"-18 Hex nut	*22259	2
76	Thermostat ground wire	97308	1
77	M8-1.25 x 65mm Capscrew	52265	2
78	††Governor spacer	59526	2
79	3/8" NPT Pipe Plug	26925	1
80	M12-1.25 x 20mm Capscrew	*68485	2
81	M12 Lockwasher	51769	4
82	M12 Flatwasher	49808	2
83	M12-1.25 Hex nut	*69918	1
84	Coil cover gasket	99512	1
85	Nylon washer	97352	1

(*) Standard hardware item, available locally.
(†) 3600 RPM units only.
(††) 1800 RPM units only.

For Replacement Parts, call 1-800-323-0620 24 hours a day — 365 days a year

Please provide following information:
-Model number
-Serial number (if any)
-Part description and number as shown in parts list

Address parts correspondence to:
Grainger Parts Operations
P.O. Box 3074
1657 Shermer Road
Northbrook, IL 60065-3074

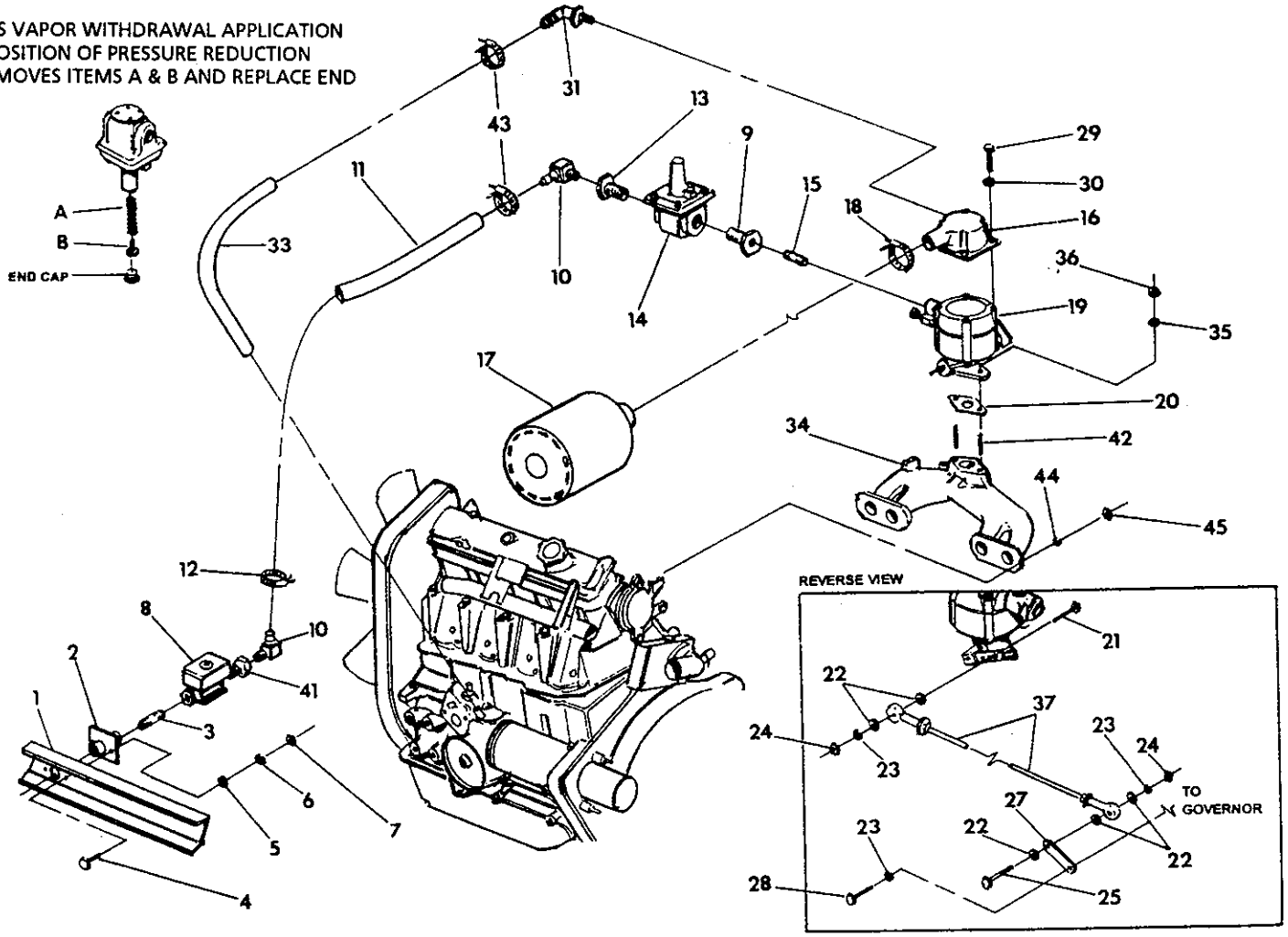

Figure 41 — Replacement Parts Illustration for Carburetion System

Replacement Parts List for Carburetion System

Reference Number	Description	Part Number For Models 4W117H and 4W118H	Quantity
1	Mounting base	97341	1
2	Fuel inlet flange	75580	1
3	3/4" NPT Nipple	*26915	1
4	M8-1.25 x 20mm Capscrew	*39253	2
5	M8 Flatwasher	*22145	
6	M8 Lockwasher	*22129	2
7	M8-1.25 Hex nut	*45771	2
8	Valve solenoid	43768-A	1
9	1-3/8" Red bushing	61909	1
10	3/4" NPT x 5/8" 90° Barbed fitting	*59412	2
11	5/8" dia. x 26" Hose	59194	1
12	No. 10 Hose clamp	57823	2
13	1"-3/4" Red bushing	26577	1
14	Pressure valve	55944	1
15	3/8" NPT x 1" Pipe nipple	35467	1
16	Air cleaner adaptor	98658	1
17	Air cleaner	73912	1
18	Hose clamp	35685	1
19	Carburetor	59403	1
20	Carburetor gasket	59401	1
21	M6 25mm Capscrew	*45757	1
22	M6 Flatwasher	*49811	1
23	M6 Lockwasher	*22097	3
24	M6 Hex nut	*49813	2
25	M6 x 60mm Capscrew	74095	1
27	Governor Arm	98800	1
28	1/4"-28 x 1" capscrew	*98859	1
29	No. 10-24 x 1/2" Screw	*76011	4
30	No. 10 Lockwasher	*22152	4
31	¾" x ½" NPT 90° Barbed fitting	*98704	1
33	Hose	50968	1
34	M8-1.25 x 65mm Capscrew	97636	1
35	5/16" Lockwasher	*22129	1
36	5/16" Hex nut	*22259	1
37	Carburetor linkage assembly	98321	1
41	¾" x ½" Bushing	40841	1
42	5/16"-18 x 1¼" Stud	28717	2
43	#12 Hose clamp	*35473	2
44	M8 Lockwasher	*22129	4
45	M8 Hex nut	*45771	4

(*) Standard hardware item, available locally

For Replacement Parts, call 1-800-323-0620 24 h ours a day — 365 days a year

Please provide following information:
-Model number
-Serial number (if any)
-Part description and number as shown in parts list

Address parts correspondence to:
Grainger Parts Operations
P.O. Box 3074
1657 Shermer Road
Northbrook, IL 60065-3074

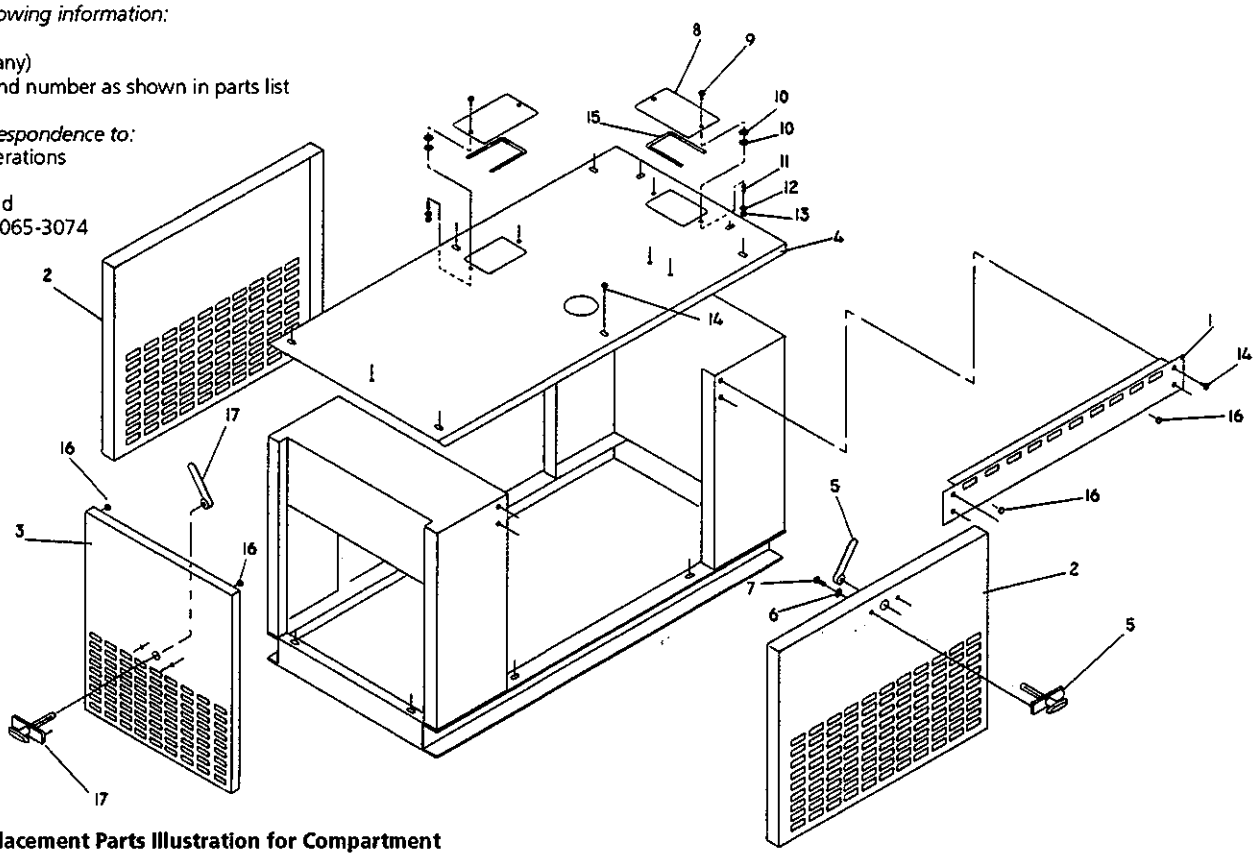

Figure 42 — Replacement Parts Illustration for Compartment

Replacement Parts List

Reference Number	Description	Part Number For Models 4W117H and 4W118H	Quantity
1	Side brace	975751	
2	Enclosure door	97431	1
3	Enclosure door	97432	1
4	Enclosure door	97433	1
5	Latch	67042	2
6	#8 Lockwasher	*22264	6
7	#8-32 x 5/16" Pan head machine screw	*67035	6
8	Access cover	56313	2
9	5/16"-18 x 1½ Hex head capscrew	*70013	2
10	Nylon washer	49850	4
11	Spring	56315	2
12	5/16" Flatwasher	*22145	2
13	5/16" -18 Stainless steel lock nut	70015	2
14	Crimptite screw	75443	10
15	Vinyl trim (18")	56326	2
16	Bumper	32990	6
17	Latch	77442	1

(*) Standard hardware item, available locally.

For Replacement Parts, call 1-800-323-0620 24 h ours a day — 365 days a year

Please provide following information:
-Model number
-Serial number (if any)
-Part descriptions and number as shown in parts list

Address parts correspondence to:
Grainger Parts Operations
P.O. Box 3074
1657 Shermer Road
Northbrook, IL 60065-3074

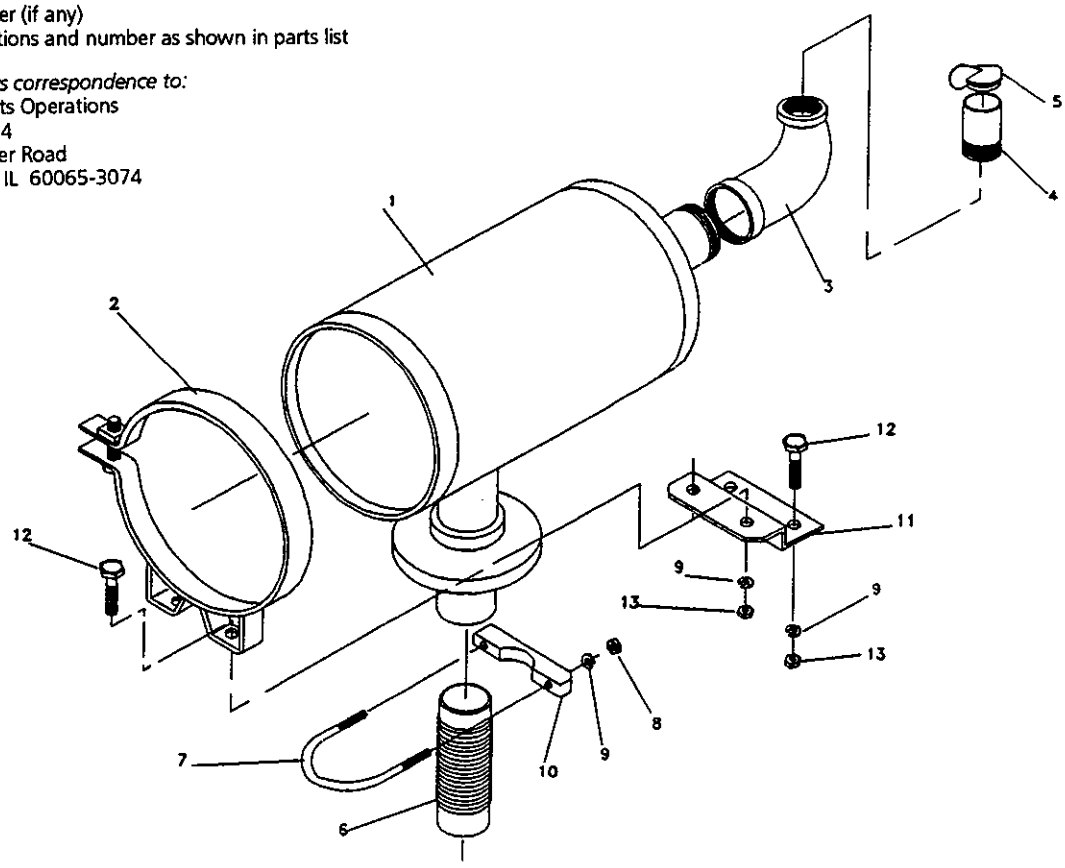

Figure 43 — Replacement Parts Illustration for Muffler

Replacement Parts List

Reference Number	Description	Part Number For Models: Models 4W117H and 4W118H	Quantity
1	Muffler	76017	1
2	Muffler strap	60366	1
3	1-½" NPT 90-degree Elbow	*62091	1
4	1-½" NPT x 3" long Pipe	78751	1
5	Rain cap	61192	1
6	Flexible exhaust pipe	75546	1
7	2" dia. x 5/16"-18 U-bolt	*36434	1
8	5/16"-18 Hex nut	*22259	2
9	5/16" (M8) Lockwasher	*22129	6
10	2" Saddle	36449	1
11	Muffler support	76032	1
12	M8-1.25 x 20mm Hex head capscrew	*39253	4
13	M8-1.25 Hex nut	*45771	1

(*) Standard hardware item, available locally.

For Replacement Parts, call 1-800-323-0620 24 hours a day — 365 days a year

Please provide following information:
-Model number
-Serial number (if any)
-Part descriptions and number as shown in parts list

Address parts correspondence to:
Grainger Parts Operation
P.O. Box 3074
1657 Shermer Road
Northbrook, IL 60065-3074

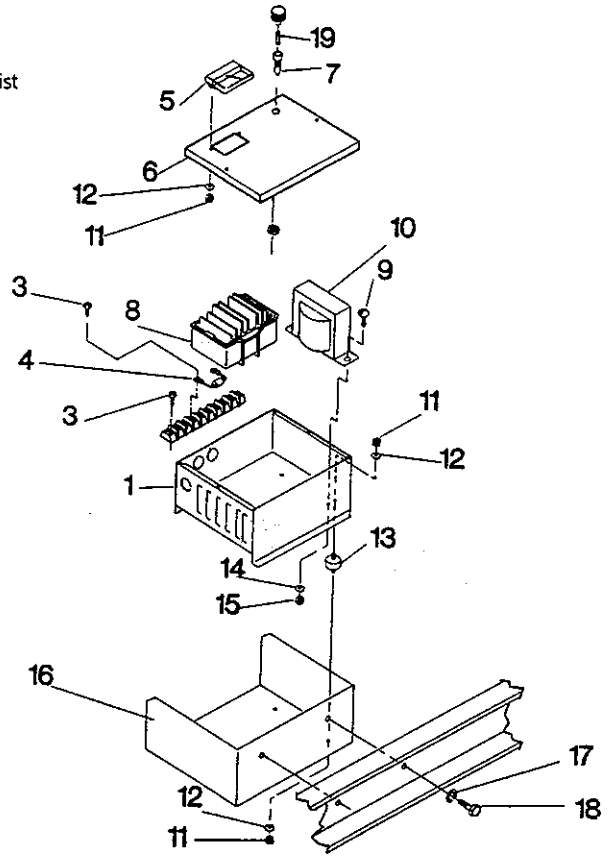

Figure 44 — Replacement Parts Illustration for Battery Charger

Replacement Parts List

Reference Number	Description	Part Number For Models 4W117H and 4W118H	Quantity
1	Battery charger enclosure	62063	1
2	Terminal block	22713	1
3	#10-32 x 5/8" Pan head machine screw	36934	2
4	Diode	49903	1
5	Ammeter	62060	1
6	Cover	62068	1
7	Fuse holder (with SFE 6A Fuse)	32300	1
8	2 Amp Battery charger regulator	67983	1
9	#10-32 x 3/8" Pan head machine screw	36933	2
10	Transformer	62061	1
11	M6-1.0 Hex nut	49813	10
12	M6 Lockwasher	22097	10
13	Vibration dampener	71908	4
14	Lockwasher	22152	2
15	#10-32 Hex nut	22158	2
16	Battery charger bracket	76057	1
17	M8 Lockwasher	22129	2
18	M8-1.25 x 16mm Hex head capscrew	42907	2
19	10 amp Fuse	28578	1
20	#10-32 x 1/4" Pan heac machine screw	36932	2

For Replacement Parts, call 1-800-323-0620 24 hours a day — 365 days a year

Please provide following information:
-Model number
-Serial number (if any)
-Part description and number as shown in parts list

Address parts correspondence to:
Grainger Parts Operations
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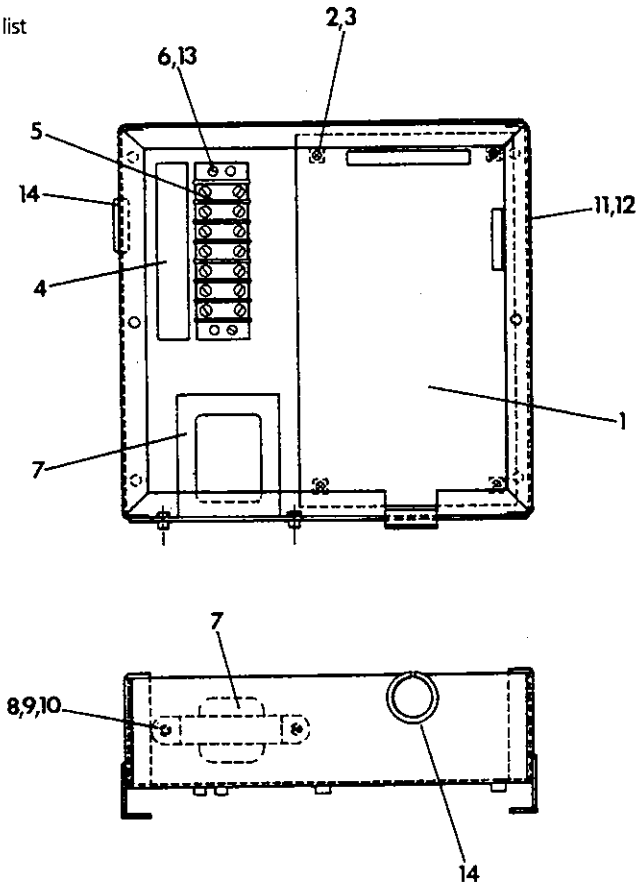


Figure 45 — Replacement Parts Illustration for CMA Assembly

Replacement Parts List

Reference Number	Description	Part Number For Models 4W117H and 4W118H	Quantity
1	DC Control/Latch Circuit Board	76009	1
2	Circuit Board Support Stand-Off	72566	4
3	6 x 5/8" Phillips Tapping Screw	80882	4
4	Terminal Strip Decal	74979	1
5	Terminal Strip Block	47822	Ref.
6	M4-0.7 x 16mm Phillips Machine Screw	75476	2
7	24VA 12SEC 240/12V Transformer	83264	1
8	M4 Flat Washer	22985	2
9	M4 Lock Washer	22264	2
10	M4-0.7 x 12mm Phillips Machine Screw	51787	2
11	CMA Box	79847	1
12	CMA Silk Screen Cover	*77401	1
13	M4 Lock Washer	22264	2
14	Grommet	38057	2
15	Crimptite	*58443	2
Δ	MFG. Nameplate Decal	*81224	1
Δ	Wire Harness	*79682	1

(*) Standard hardware item, available locally.
(Δ) Not shown

Dayton® Standby Generators

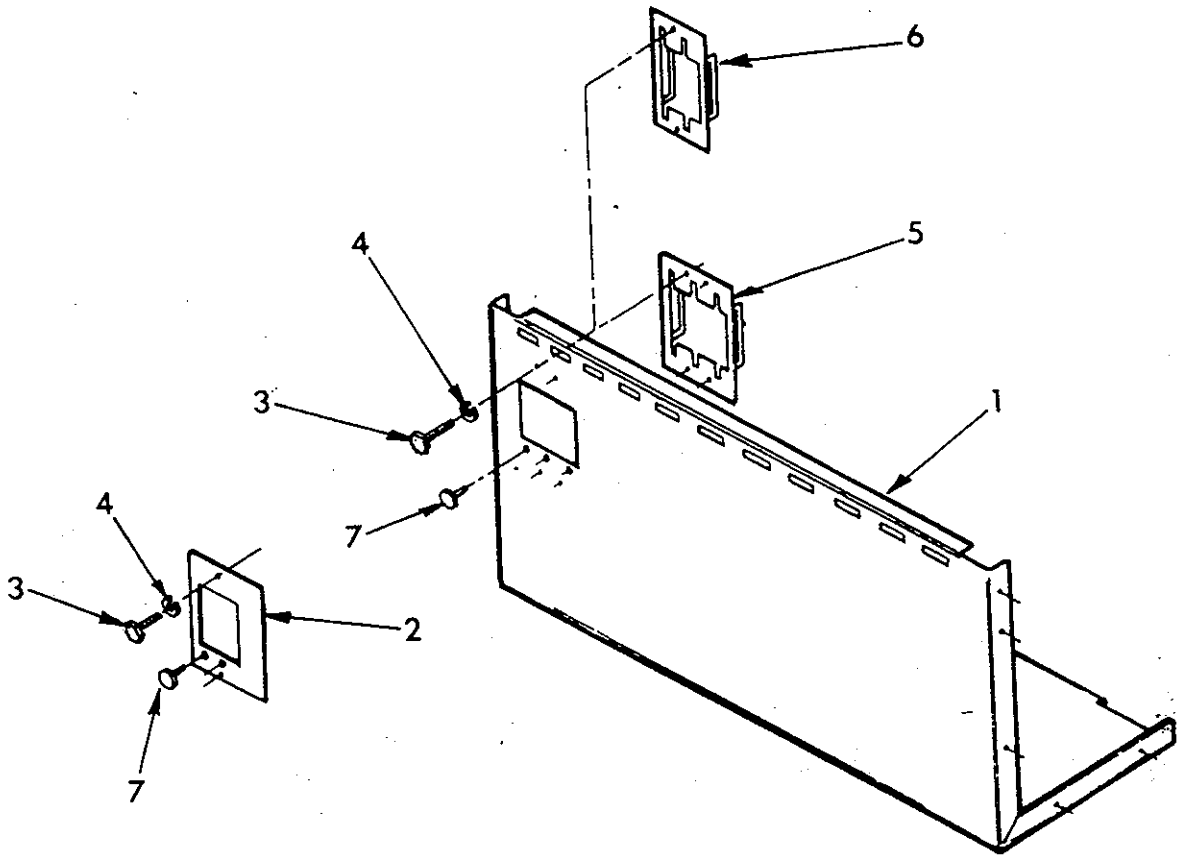
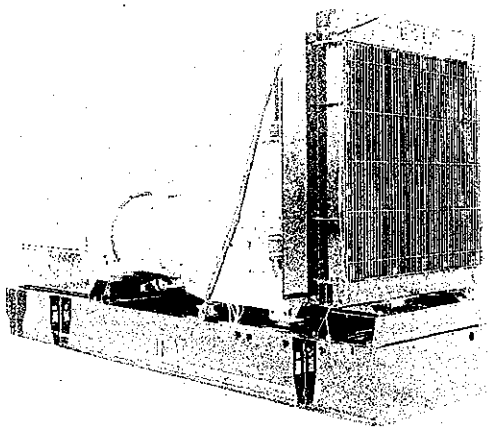


Figure 46 — Replacement Parts Illustration for Circuit Breaker

Replacement Parts List

Reference Number	Description	Part Number For Models 4W117H and 4W118H	Quantity
1	Control panel – bottom and back	75527	1
2	†Circuit breaker cover	75545	1
3	#8-32 x 1/4" Hex head machine screw	*33130	2
4	#8 Lockwasher	*22264	4
5	Circuit breaker mounting bracket (BQ3)	39783	1
6	Circuit breaker mounting bracket (BQ2)	29782	1
7	3/8" diameter Plastic plug	56967	3
Δ	Single phase circuit breaker (optional)	48374	1
Δ	Three-phase circuit breaker (optional)	62812	1

(†) Used with Ref. No. 6 only.
(Δ) Not shown
(*) Standard hardware item, available locally.



STANDBY 150 ekW
CONTINUOUS 150 ekW

60 Hz

Caterpillar is leading the power generation marketplace with Power Solutions engineered to deliver unmatched flexibility, expandability, reliability, and cost-effectiveness.

FEATURES

FULL RANGE OF ATTACHMENTS

- Wide range of bolt-on system expansion attachments, factory designed and tested

SINGLE-SOURCE SUPPLIER

- **Fully Prototype Tested** with certified torsional vibration analysis available

WORLDWIDE PRODUCT SUPPORT

- Worldwide parts availability through the Caterpillar dealer network
- With over 1,200 dealer outlets operating in 166 countries, you're never far from the Caterpillar part you need.
- 99.5% of parts orders filled within 48 hours. The best product support record in the industry.
- Caterpillar dealer service technicians are trained to service every aspect of your electric power generation system.
- Preventive maintenance agreements
- The Cat Scheduled Oil Sampling (S•O•S℠) program cost effectively detects internal engine component condition, even the presence of unwanted fluids and combustion by-products

CAT® G3406 NA GAS ENGINE

- Reliable, rugged, durable design
- Field-proven in thousands of applications worldwide
- Low pressure gas

CAT SR4B GENERATOR

- Designed to match performance and output characteristics of Caterpillar engines
- Optimum winding pitch for minimum total harmonic distortion and maximum efficiency
- Segregated AC/DC, low voltage accessory box provides single point access to accessory connections

CAT CONTROL PANELS

- Two levels of controls, designed to meet individual customer needs:

  EMCP II provides digital monitoring, metering, and protection

  EMCP II+ provides EMCP II features along with full-featured power metering and protective relaying

FACTORY INSTALLED STANDARD & OPTIONAL EQUIPMENT

System	Standard	Optional
Air Inlet	Single element canister type air cleaner Service indicator	
Cooling	Radiator with guard Coolant drain lines with valves Fan and belt guards Caterpillar Coolant Low coolant level sensors	Jacket water coolant heater with shutoff valves Radiator removal
Exhaust	Stainless steel exhaust flex with weld outlet flange	15 dBA muffler
Fuel	Gas pressure regulator Low pressure fuel system Energize To Run (ETR) gas shutoff valve	
Generator	Self excited Class H insulation Class F temperature rise (105° C continuous/130° C standby) VR6 Voltage Regulator, 3-phase sensing, with reactive droop 2:1 Volts/Hz or 1:1 Volts/Hz Bus bar termination Extension box	Permanent magnet excited Digital Voltage Regulator Digital Voltage Regulator with KVAR/PF control Anti-condensation space heater Oversize & premium generators Circuit breakers, UL, 3 pole with shunt trip Multiple breaker capability
Governor	Flo-Tech actuator and speed control	Electronic load sharing
Ignition	Digital ignition system	
Control Panels	EMCP II	EMCP II+ Customer Communication Module Local alarm & remote annunciator modules
Lube	Lubricating oil and filter Oil drain line with valve Fumes disposal	Manual sump pump
Mounting	Narrow base Linear vibration isolators between base and engine-generator	
Starting/Charging	35 amp charging alternator 24 volt starting motor Batteries with rack and cables Battery disconnect switch	Battery chargers, 5 & 10 amp Oversize batteries
General		Automatic Transfer Switches (ATS) Floor standing circuit breakers

SPECIFICATIONS

CAT SR4B GENERATOR

Frame 447
Type ..... Self excited, static regulated, brushless
Construction ..... Single bearing, close coupled
Three phase ..... 12 lead reconnectable
Insulation ..... Class H with tropicalization and antiabrasion
IP rating ..... Drip proof 22
Alignment ..... Pilot shaft
Overspeed capability
Prototype tested 150%
Production tested 125%
Wave form ..... Less than 5% deviation
Paralleling capability ..... Standard
Voltage regulator ..... 3-phasing sensing with Volts-per-Hertz
Voltage regulation ..... Less than ± 1/2% (steady state)
Less than ± 1% (no load to full load)
Voltage gain ..... Automatic
Telephone Influence Factor (TIF) ..... Less than 50
Harmonic Distortion (THD) ..... Less than 5%

CAT ENGINE

G3406 NA, 4-stroke-cycle
Bore – mm (in) 137 (5.4)
Stroke – mm (in) 164 (6.5)
Displacement – L (cu in) 14.6 (891)
Compression ratio 10.3:1
Aspiration ..... Naturally aspirated
Ignition system ..... Digital ignition
Governor type ..... Woodward Flo-Tech

CAT CONTROL PANEL

24 Volt DC Control
NEMA 1, IP22 enclosure
Electrically dead front
Lockable hinged door
Generator instruments meet ANSI C-39-1
Terminal box mounted
Single location customer connector point

Consult your Caterpillar dealer for available voltages.

LEHE1429-01

TECHNICAL DATA

Open Generator Set — 1800 rpm/60 Hz/480 Volts			Standby DM5437		Continuous DM5438	
Package Performance						
Power rating	ekW		150		150	
Power rating @ 0.8 PF	kVA		188		188	
Fuel Consumption						
100% load with fan	N•m³/hr	scf/hr	52	1954	51	1912
75% load with fan	N•m³/hr	scf/hr	42	1584	42	1575
50% load with fan	N•m³/hr	scf/hr	32	1213	32	1204
Cooling System						
Ambient air temperature*	Deg C	Deg F	40	105	40	105
Air flow restriction (system)	kPa	in water	0.12	0.5	0.12	0.5
Air flow (maximum @ rated speed for standard radiator arrangement)	m³/min	cfm	393	13,887	393	13,887
Engine coolant capacity with radiator	L	Gal	53	14	53	14
Jacket water outlet temperature	Deg C	Deg F	99	210	99	210
Exhaust System						
Combustion air inlet flow rate	N•m³/min	scfm	8	310	8	321
Exhaust gas stack temperature	Deg C	Deg F	639	1182	627	1161
Exhaust gas flow rate	N•m³/min	cfm	9	1080	9	1102
Exhaust flange size (internal diameter)	mm	in	127	5	127	5
Exhaust system backpressure (maximum allowable)	kPa	in water	6.7	27	6.7	27
Heat Rejection						
Low Heat Value (LHV) fuel input	kW	Btu/min	527	29,953	515	29,306
Heat rejection to jacket water (includes oil cooler)	kW	Btu/min	193	10,994	178	10,146
Total heat rejection to exhaust (LHV to 25° C)	kW	Btu/min	140	7965	144	8192
Heat rejection to exhaust (LHV to 120° C)	kW	Btu/min	117	5932	117	5926
Heat rejection to atmosphere from engine	kW	Btu/min	21	1198	21	1172
Heat rejection to atmosphere from generator	kW	Btu/min	16	897	16	897
Generator						
Motor starting capability @ 30% voltage dip**	kVA		649		649	
Frame			447		447	
Temperature rise	Deg C		130		105	
Emissions* **						
NOx	g/bhp-hr		11.3		21.6	
CO	g/bhp-hr		12.5		1.6	
HC (total)	g/bhp-hr		1.4		2.8	
HC (non-methane)	g/bhp-hr		0.21		0.42	
Exhaust O_2 (dry)	%		0.5		2.0	

*Ambient capability at 200 m (660 ft) above sea level. For ambient capability at other altitudes, consult your Caterpillar dealer.

**Assumes synchronous driver

***Emissions data measurement is consistent with those described in EPA CFR 40 PART 89 SUBPART D and ISO 8178-1 for measuring HC, CO, CO_2 and NOx. Data shown is based on steady state engine operating conditions of 77° F, 28.43 inches HG and fuel having a LHV of 920 BTU per cubic foot at 30.00 inches HG absolute and 32° F. Not to exceed emission data shown is subject to instrumentation, measurement, facility and engine fuel system adjustments.

RATING DEFINITIONS AND CONDITIONS

Standby — Output available with varying load for the duration of the interruption of the normal source power.

Continuous — Output available without varying load for an unlimited time.

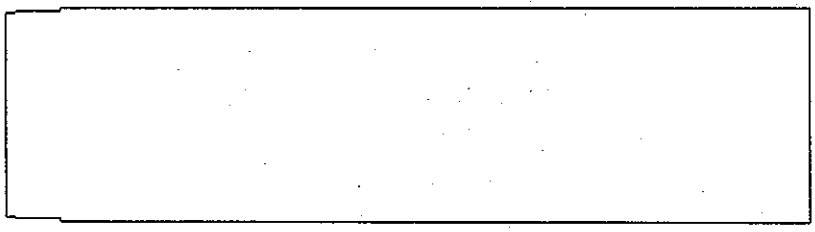
Ratings are based on ISO3046/1 standard reference conditions of 25° C (77° F) and 100 kPa (29.61 in Hg).

Ratings are based on pipeline natural gas having a LHV (low heat value) of 36.2 mJ/N•m³ (920 Btu/cu ft). Variations in altitude, temperature, and gas composition from standard conditions or the use of a three way catalyst may require a reduction in engine horsepower.

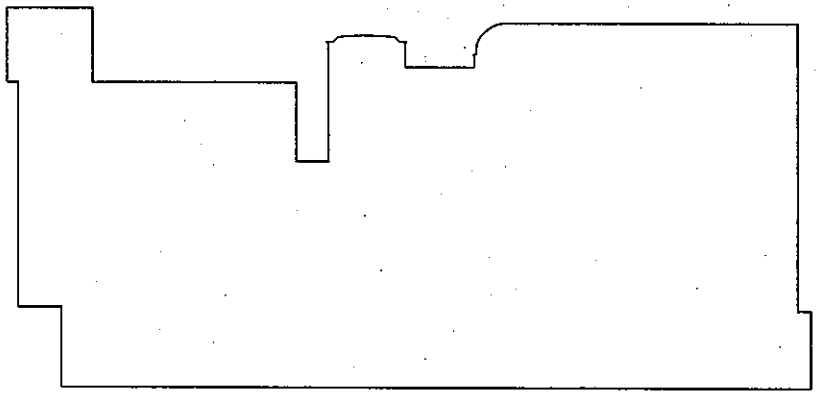
STANDBY 150 ekW
CONTINUOUS 150 ekW
60 Hz

CATERPILLAR

STANDBY/CONTINUOUS POWER GENERATOR SET PACKAGE — TOP VIEW



STANDBY/CONTINUOUS POWER GENERATOR SET PACKAGE — SIDE VIEW



Package Dimensions		
Length	4074 mm	160.39 in
Width	1306.7 mm	51.45 in
Height	2131.9 mm	83.93 in
Shipping Weight	4091 kg	9000 lb

Note: Do not use for installation design. See general dimension drawings for detail (Drawing #207-4500).

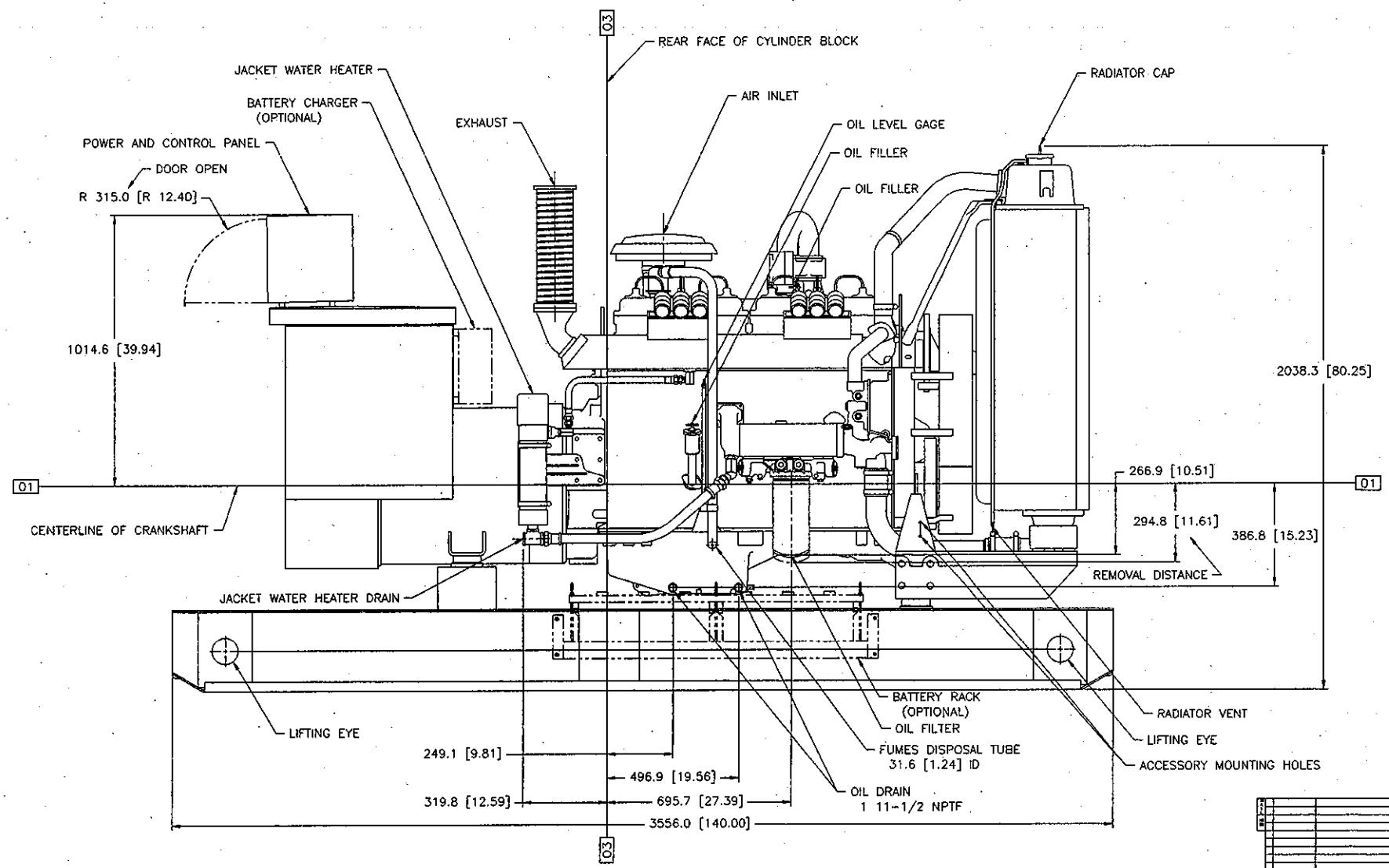
TMI Reference No.: DM5437, DM5438

U.S. sourced

LEHE1429-01 (03-02)

www.CAT-ElectricPower.com

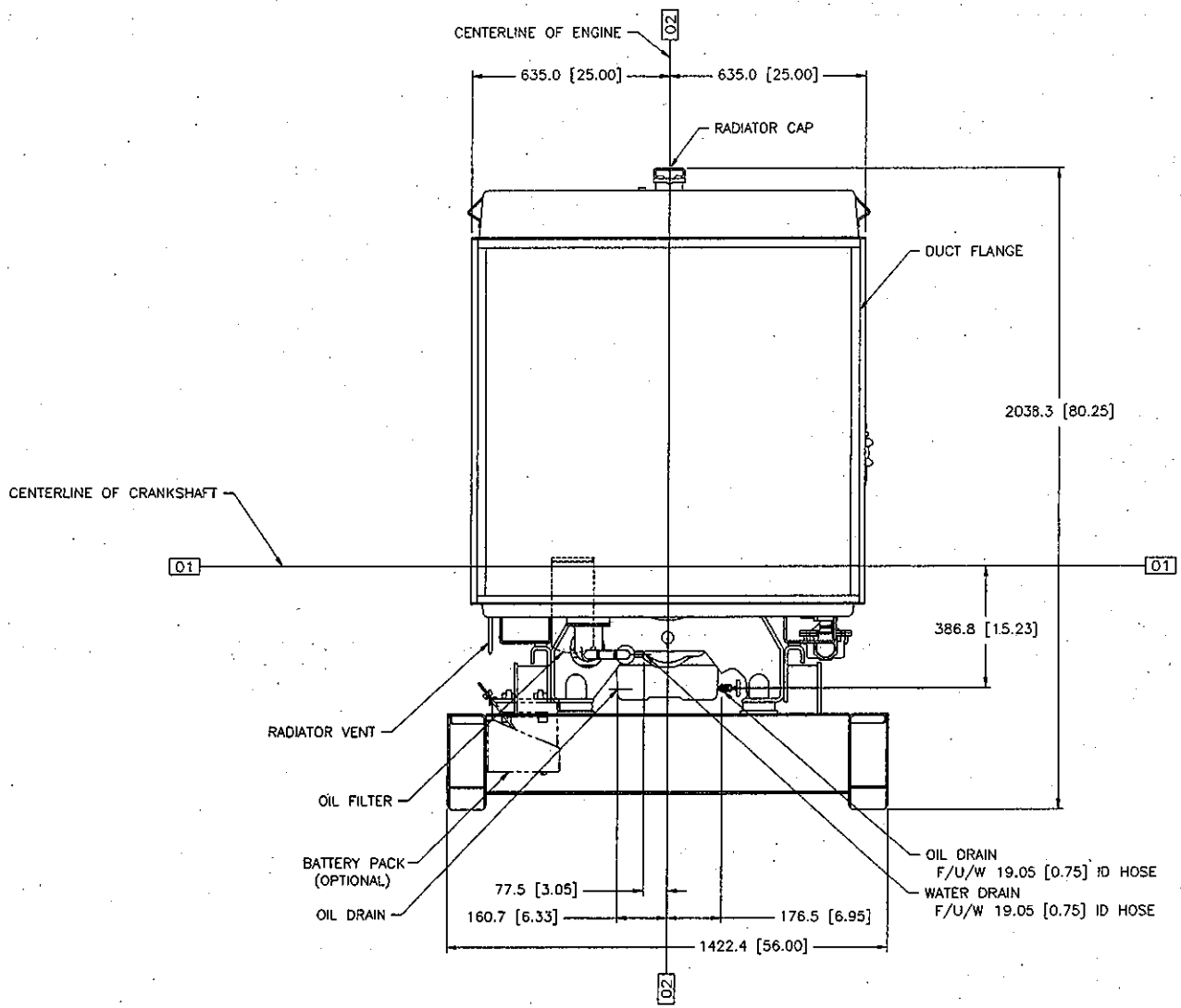
METRIC 123-8787



CAT G3406 NA STANDBY PACKAGE GEN SET
DWG# 123-8787 CHG 03
METRIC [INCH]
RIGHT SIDE VIEW
LA-2111 CHG 01 SHOWN

MODEL	TYPE	PRICING AR
G3406 NA	P	LA-2111 CHG 01

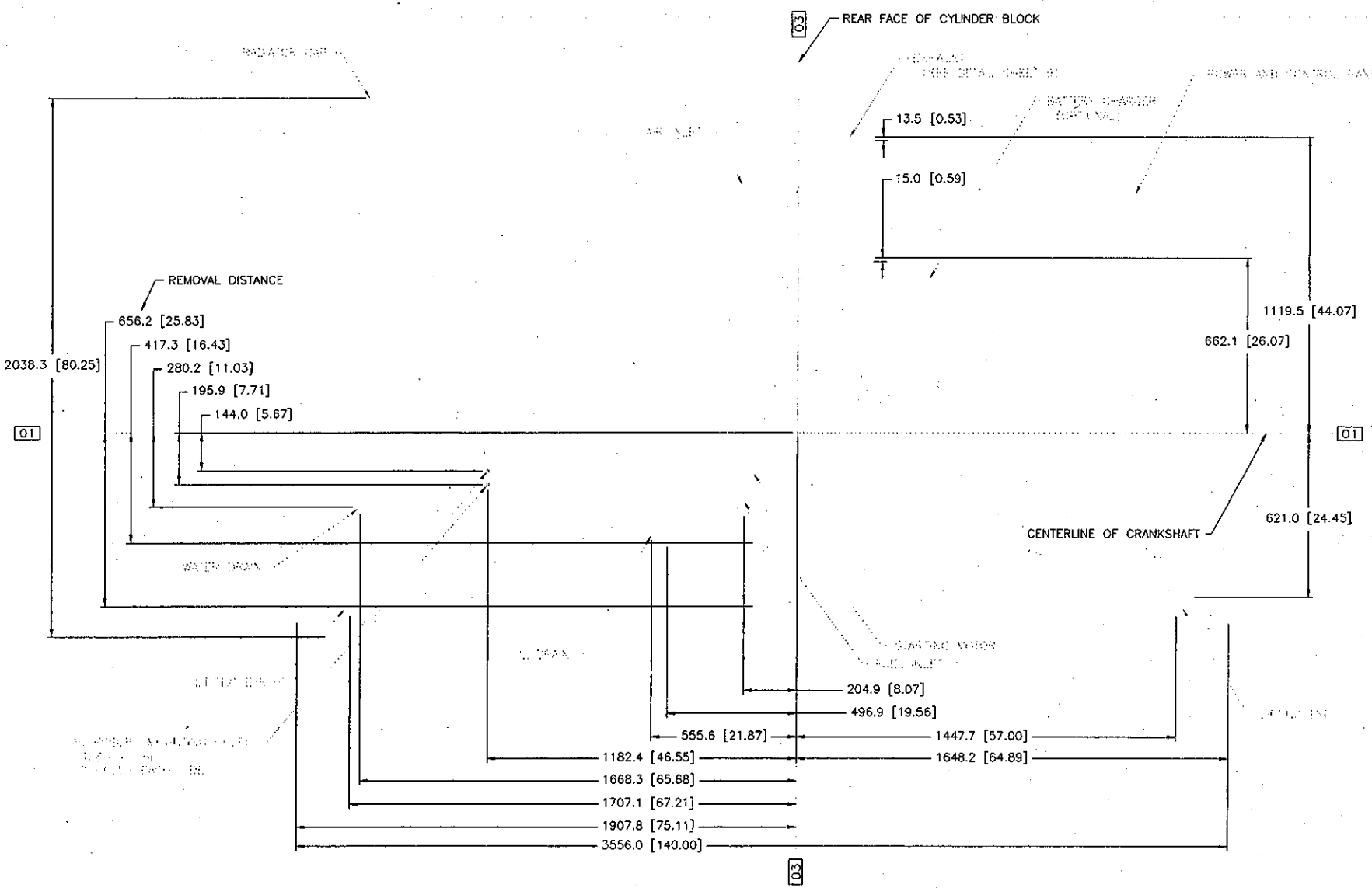
1E2233 DRAWING-AUTOCAD
1E0011 LINTER & TOL
E.R. VEST
W.A. SAMPSON
B.J. BROCK
03 18AUG99
CATERPILLAR INC.
INSTALLATION-ENGINE
GAS PACKAGE GEN SET
123-8787



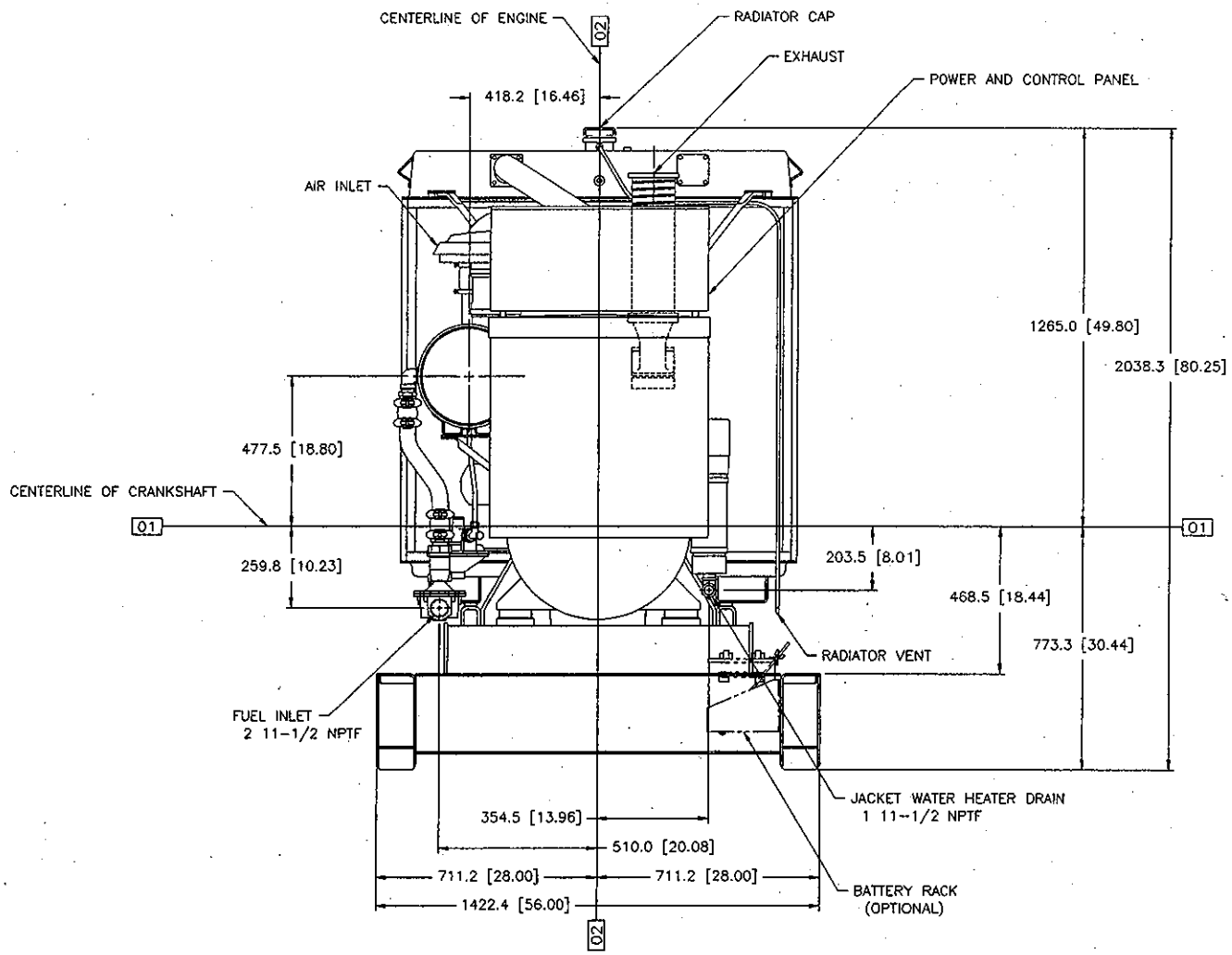
CAT G3406 NA STANDBY PACKAGE GEN SET
DWG# 123-8787 CHG 03
METRIC [INCH]
FRONT VIEW
LA-2111 CHG 01 SHOWN

TF2733 DRAWING-AUTOCAD
E.R. VEST
W.A. SANDSON
B.J. BROCK
CATERPILLAR INC.
INSTALLATION-ENGINE
GAS PACKAGE GEN SET
123-8787

METRIC

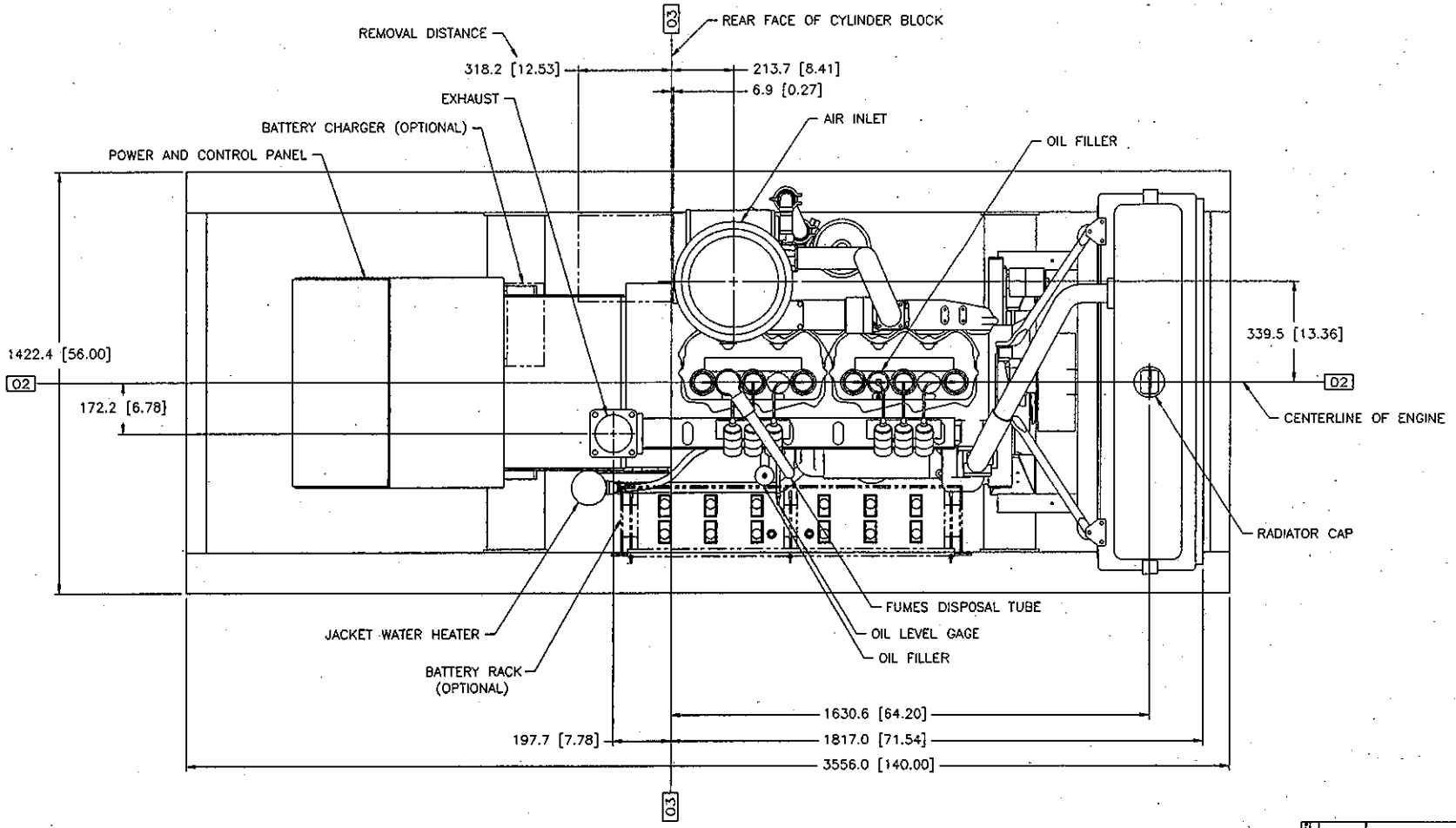


CAT G3406 NA STANDBY PACKAGE GEN SET
DWG# 123-8787 CHG 03
METRIC [INCH]
LEFT SIDE VIEW
LA-2111 CHG 01 SHOWN



CAT G3406 NA STANDBY PACKAGE GEN SET
DWG# 123-8787 CHG 03
METRIC [INCH]
REAR VIEW
LA-2111 CHG 01 SHOWN

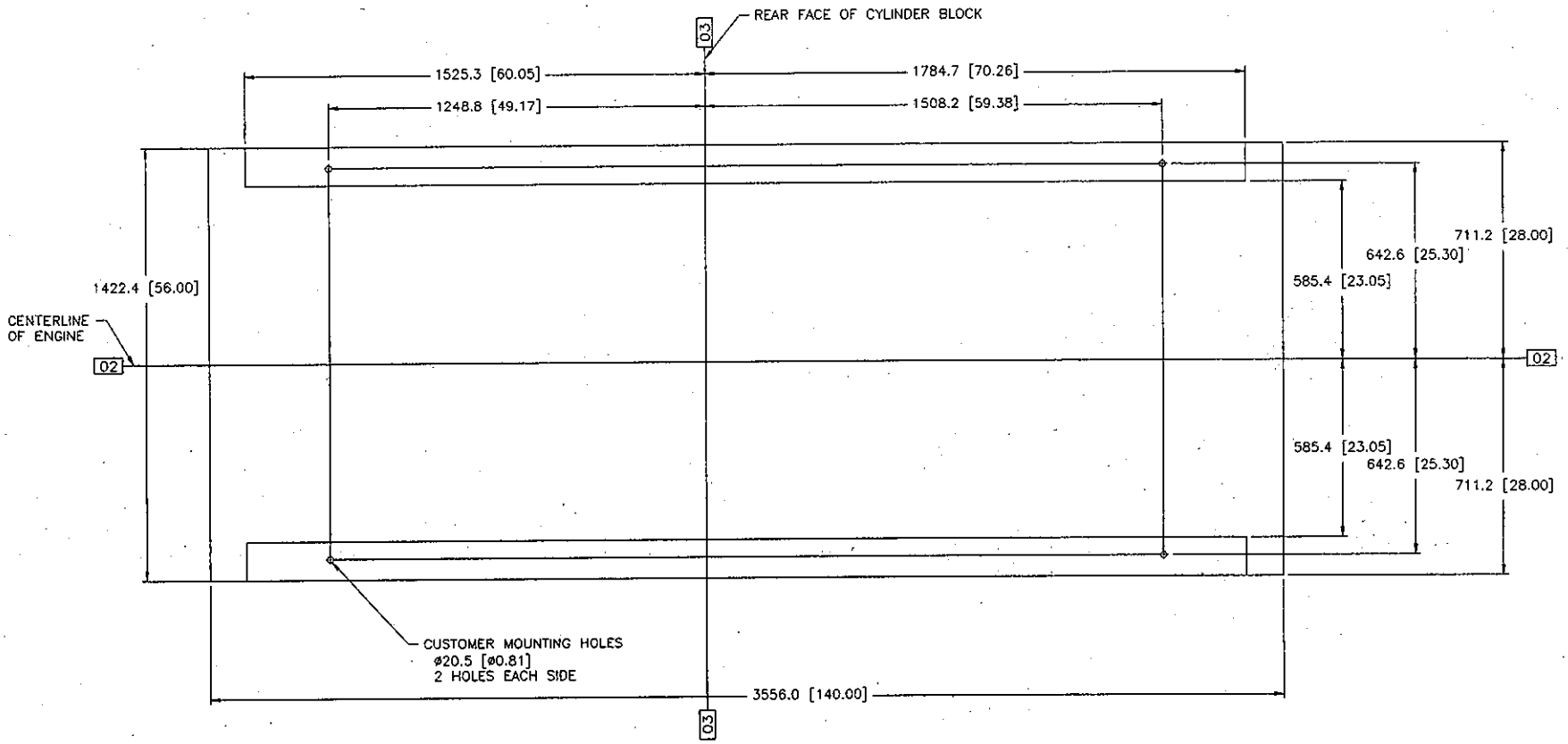
CATERPILLAR INC.
INSTALLATION-ENGINE
GAS PACKAGE GEN SET
123-8787



CAT G3406 NA STANDBY PACKAGE GEN SET
DWG# 123-8787 CHG 03
METRIC [INCH]
TOP VIEW
LA-2111 CHG 01 SHOWN

CATERPILLAR INC.
INSTALLATION-ENGINE
GAS PACKAGE GEN SET
123-8787

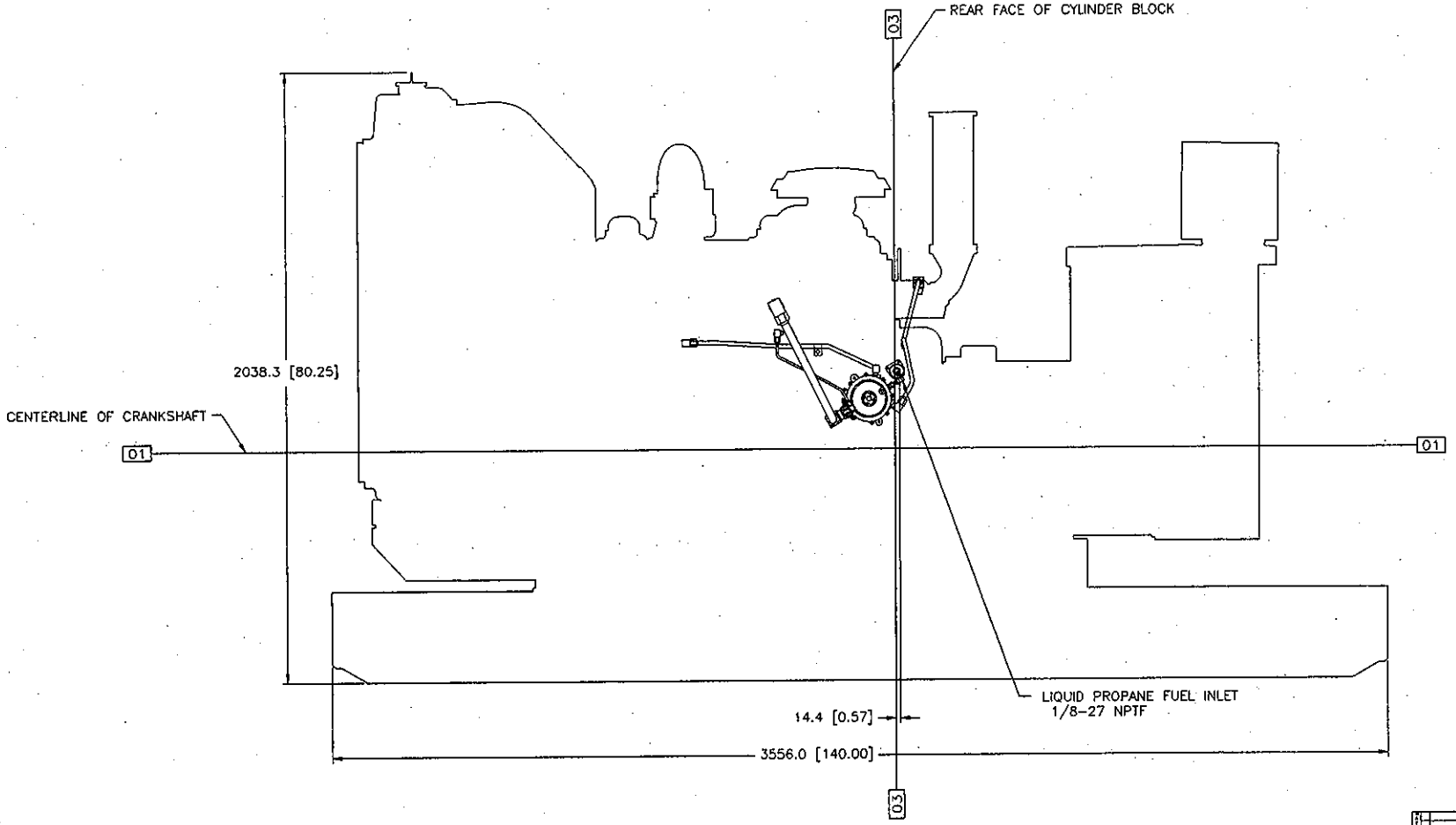
METRIC 123-8787



CAT G3406 NA STANDBY PACKAGE GEN SET
DWG# 123-8787 CHG 03
METRIC [INCH]
FOOTPRINT
LA-2111 CHG 01 SHOWN

F2743 DRAWING-AUTOCAD
FOOT, INTER & TOL
E.R. VEST
W.A. SAMPSON
D.J. BROCK
DX18AUG99
CATERPILLAR INC.
INSTALLATION-ENGINE
GAS PACKAGE GEN SET
123-8787-
W502
E

METRIC 123-8787



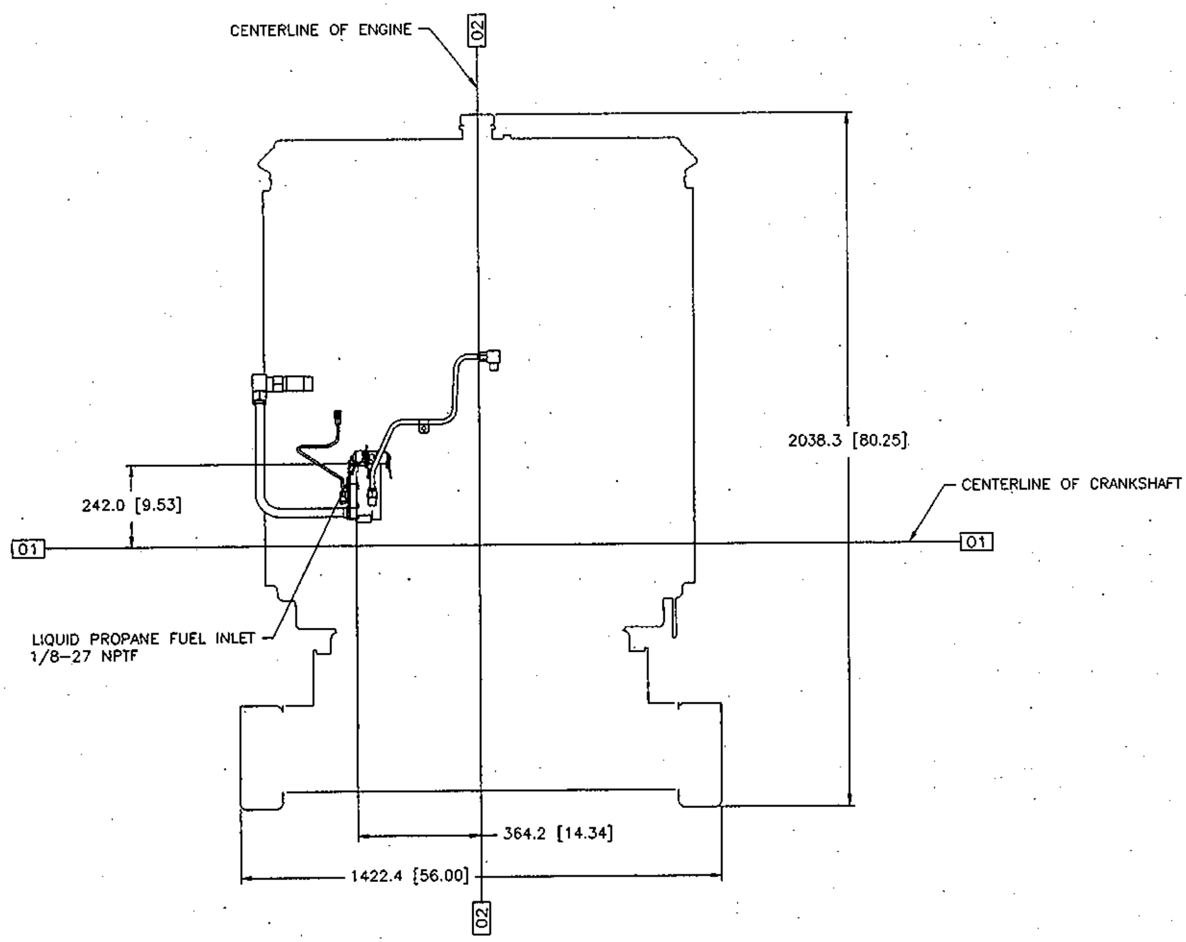
LEFT SIDE VIEW

LA-2110 SHOWN THE SAME AS LA-2111 EXCEPT FOR DIFFERENCES SHOWN.

MODEL	TYPE	PRICING AR
G3406 NA	P	LA-2110 CHG 01

TE2733 DRAWING-AUTOCAD
TECO11 INTER X 01
E.R. VEST
W.A. SAMPSON
B.J. BROCK
18AUG99
CATERPILLAR INC.
INSTALLATION-ENGINE
GAS PACKAGE, GEN SET
123-8787

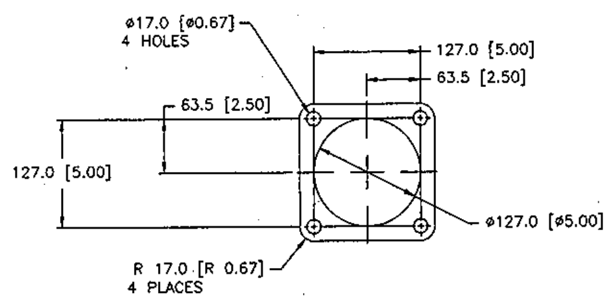
METRIC 123-8787



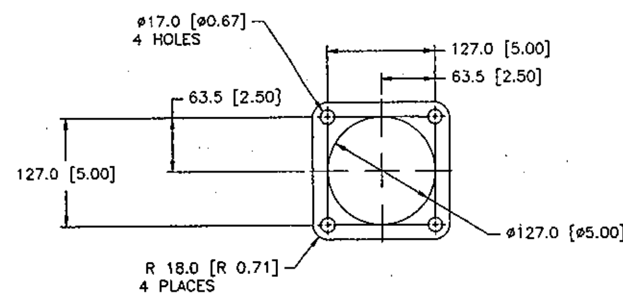
REAR VIEW

1E2733 DRAWING-AUTOCAD
1E0011 INTPR & TOL
E.R. VEST
W.A. SAMPSON
B.J. BROCK
SCALE 1 = 5
SHEET 8 OF 9
DX 18AUG99
CATERPILLAR INC.
INSTALLATION-ENGINE
GAS PACKAGE GEN SET
123-8787 E

METRIC 123-8787



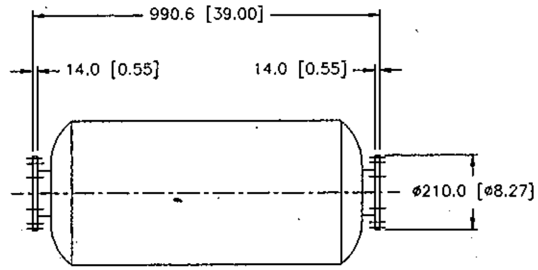
DETAIL OF EXHAUST ELBOW FLANGE
SCALE 1=2



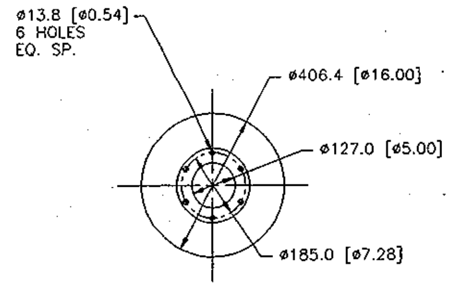
DETAIL OF FLEXIBLE EXHAUST FLANGE
SCALE 1=2

1E2733 DRAWING-AUTOCAD
1E0011 INTPR. & TOL
E.R. VEST
W.A. SAMPSON
B.J. BROCK
07AUG99
CATERPILLAR INC.
INSTALLATION-ENGINE
GAS PACKAGE GEN SET
123-8787 W552 E

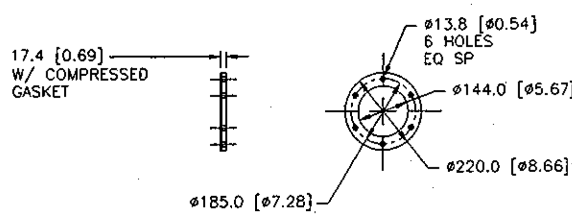
METRIC 5N-8697



LEFT SIDE VIEW



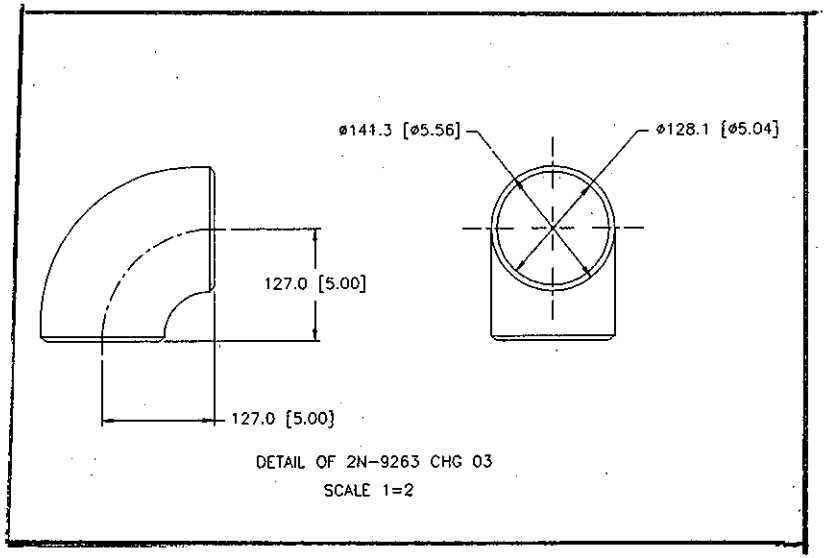
FRONT VIEW



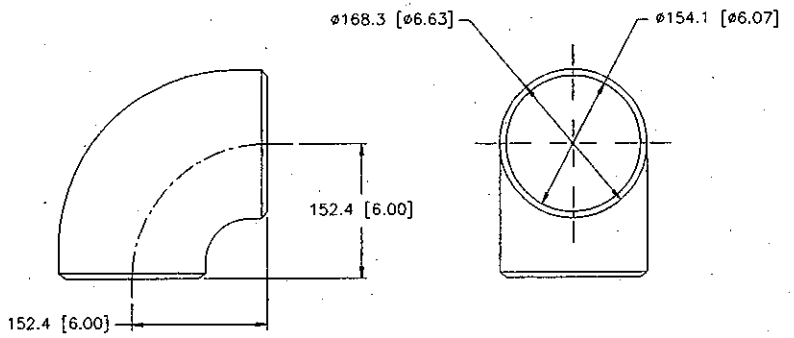
DETAIL OF EXHAUST MOUNTING FLANGE
SCALE 1=1
(SHIPPED LOOSE)

MODEL	TYPE	PRICING AR
3304	IOMARGPE	PL-5317 CHG 12
3306	IARGP	
G3306	IAEF	

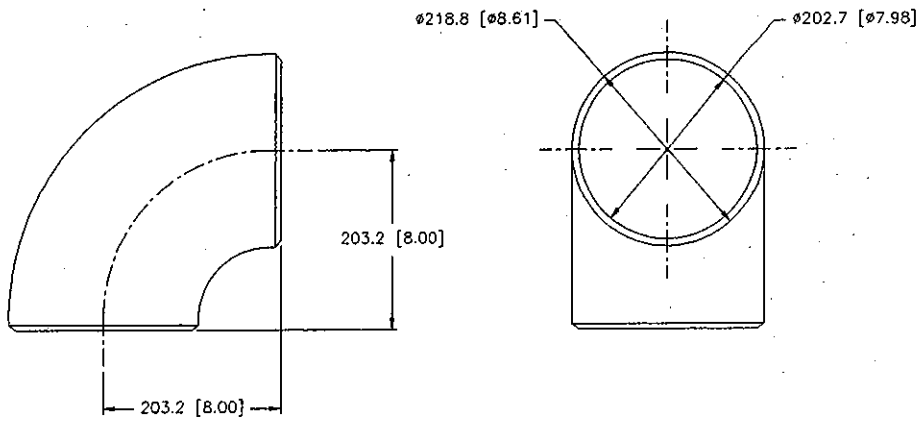
1E2733 DRAWING-AUTOCAD
1E0011 INTPR & TOL
M.F. WRAY
B.J. PYLE
B.J. BROCK
05-11SEP03
CATERPILLAR INC.
INSTALLATION-ATTACHMENT
MUFFLER SYSTEM
5N-8697 E



DETAIL OF 2N-9263 CHG 03
SCALE 1=2



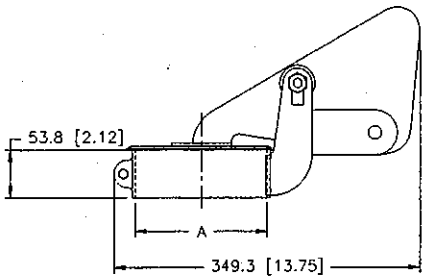
DETAIL OF 8L-9859 CHG 00
SCALE 1=2



DETAIL OF 5L-7520 CHG 03
SCALE 1=2

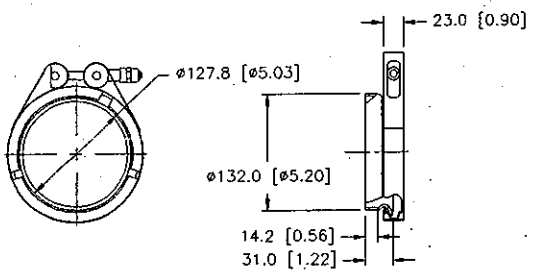
TE2733 DRAWING-AUTOCAD
TE0011 INTER & TOL
S.LUCKENBIHL
B.C.SHERVEN
B.J.BROCK
SCALE 1 = 5
2001JUN02
CATERPILLAR INC.
INSTALLATION-ATTACHMENT
EXHAUST ELBOW
212-6272

METRIC 163-4462

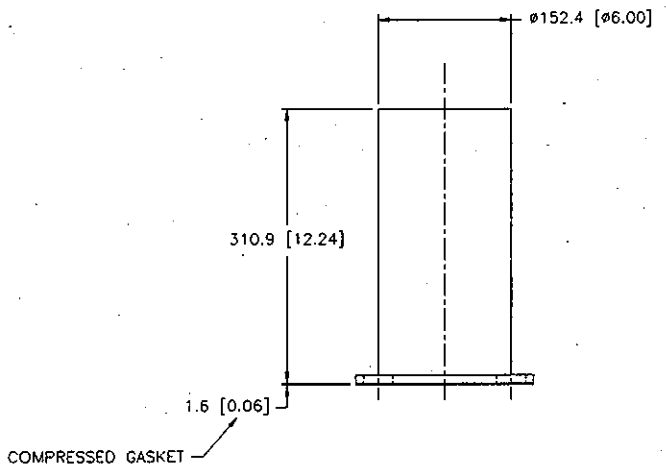


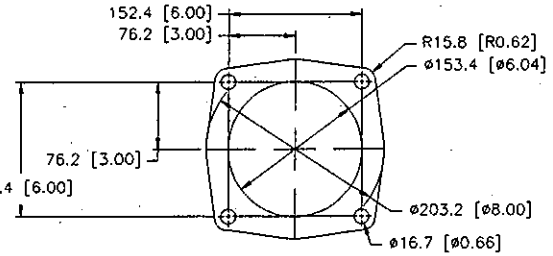
MODEL	TYPE	PRICING AR	A
C-9	I	9S-7148 CHG 09	MIN ø127.0 [ø5.00] MAX ø131.8 [ø5.19]
C-10			
C-12			
3196	H	7S-4411 CHG 06	MIN ø150.9 [ø5.94] MAX ø157.2 [ø6.19]
C-12			

7S-4411 SHOWN

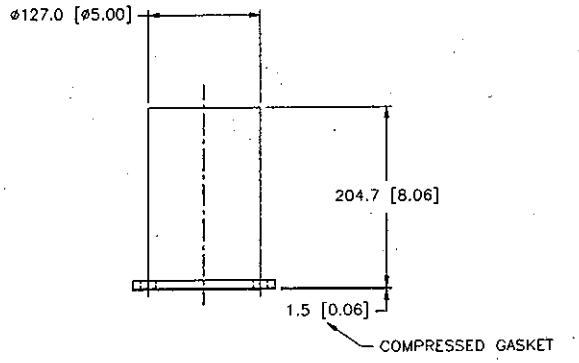


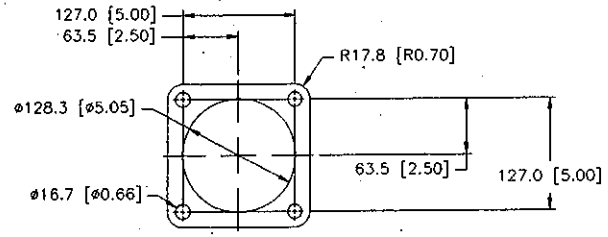
MODEL	TYPE	PRICING AR
C-10	I	4W-9183 CHG 01
C-12		
3176	IU	
3196	I	
C-9		PA-7822 CHG 01





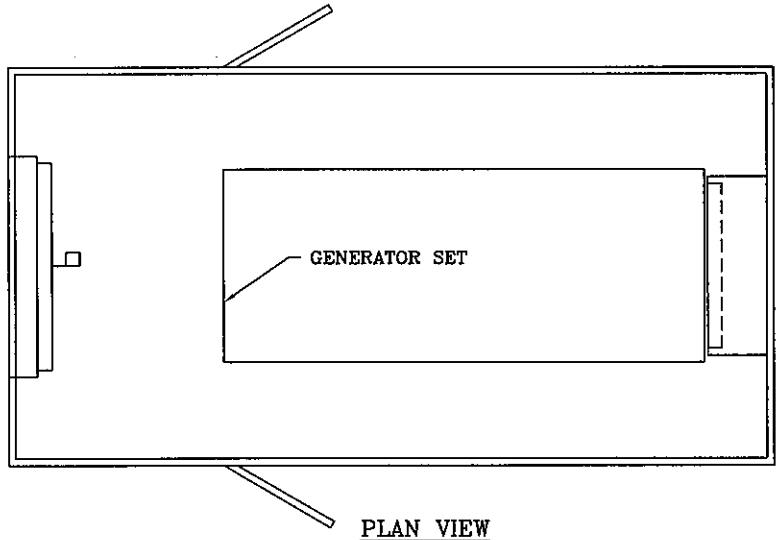
MODEL	TYPE	PRICING AR
3196	H	4L-5801 CHG 03
C-12		





MODEL	TYPE	PRICING AR
3176	IU	5L-8632 CHG 04
3196	I	
C-9		
C-10		
C-12		

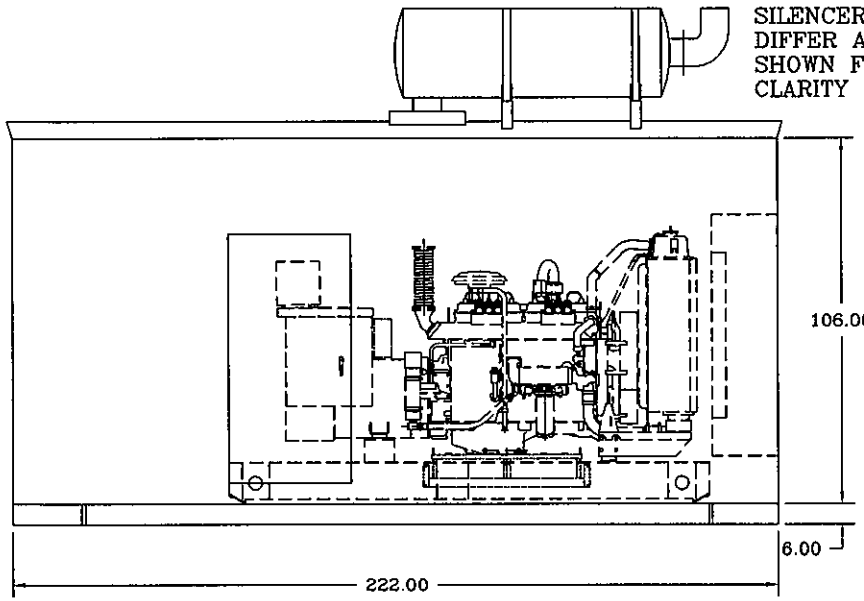
TE2733 DRAWING-AUTOCAD
TE0011 INTER & TOL
S.LUCKENBILL
S.L.CLARK
B.J.BROCK
03-23JAN03
CATERPILLAR INC.
INSTALLATION-ATTACHMENT
EXHAUST SYSTEM
163-4462 [-] W751 E



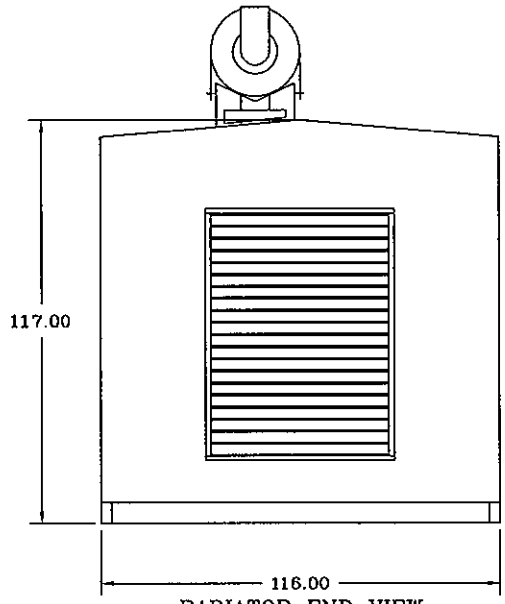
PLAN VIEW

ENCLOSURE:
- WALK IN
- 14 GA GALVANNEALED STEEL
- GALVANIZED ANGLE MOUNTING RAILS
- STRUCTURAL TUBING FRAME
- FIXED & GRAVITY EXHAUST LOUVER
- FIXED & MOTORIZED INTAKE LOUVERS
- ENCLOSURE LINED WITH THERMAL INSULATION
- VENTILATION DAMPER WITH SCREEN AND FILTER
- 3 - BATTERY POWERED 2 HEAD LIGHTS
- 100A 120/208V-3P LOAD CENTER
- 5 - 48" 2 LAMP FLUORESCENT LIGHTS
- 2 - 120V AC LIGHT SWITCHES
- 5 KW ELECTRIC HEATER WITH THERMOSTAT
- 2 - 15A-120V GFCI RECEPTACLES
- TAILPIPE, & RAIN CAP
- MUFFLER BRACKETS & RAIN SHIELD

FINISH:
- TWO COATS RUST INHIBITING PRIMER
- WEATHER PROOF CAULK BETWEEN PANELS
- TWO COATS STANDARD ENAMEL
- COLOR CHOICE BY CUSTOMER



RIGHT SIDE VIEW



RADIATOR END VIEW

AUTHORIZATION:	GENERATOR MODEL NUMBER: G3406	SUBBASE CAPACITY: N/A	COM-FAB, INC. PLAIN CITY, OH
	UNIT DWG #: 123-8787	WEIGHT:	DATE: 8-20-04 DRAWN BY: TWM
COLOR:	COMPANY: WALKER ENGINE POWER	1 2 3 4	SCALE: NTS APPROVED BY: JFP
	JOB NAME: ALCON PHASE II	NO. REVISION DATE	TITLE GENERATOR ENCLOSURE
ISOLATOR PART NUMBER:	QUOTE NO.: 081204-F		DWG NO. 81204F SHEET: 1 OF: 1

Walker Engine Power CAT

Bill of Materials

Caterpillar/Olympian Generator Set

G60F3

Standard Specifications:

122 deg F cooling radiator system
33% Coolant antifreeze/corrosion inhibitor
UL/CSA listed mainline breaker (rated to 600 volts)
EMCP 3.1 Control Panel
Starting battery, 12V
Battery rack and cables installed on skid
Engine lubrication oil
Steel skidbase with lifting points
Flexible fuel lines terminated at skidbase with NPT threaded connections.
Vibration isolators installed between engine / generator mounts and skid.
Lube oil drain and coolant drain piped to the edge of the base frame.
24-month warranty from startup
Operation & Maintenance manual pack

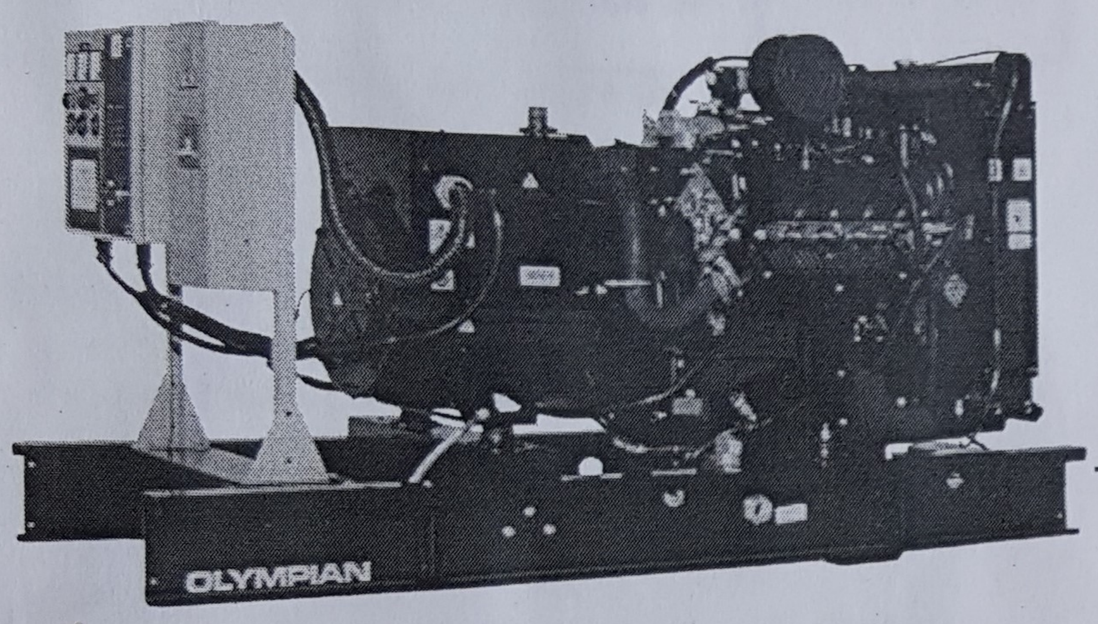
Options Included:

Weatherproof Enclosure
Canopied Silencer System (Critical Grade)
Battery Charger 5A, 120V pre-wired
Jacket Water Heater - 120V pre-wired
50% Antifreeze - 36 Degrees C Protection
EMCP 3.2 Control Panel
NFPA 110 Upgrade
Low gas pressure alarm
Voltage adjust Potentiometer
Low coolant temp alarm
Low coolant shutdown circuit
ASCO 3003260C1XC11BG Automatic Transfer Switch
Start-up by a Certified CAT Technician

LP & NATURAL GAS
GENERATOR SETS

OLYMPIAN™

Exclusively from your Caterpillar® dealer



STANDBY 55-80 kW
PRIME 50-68 kW

60 Hz

Model	Standby — kW (kVA)		Prime — kW (kVA)	
	LP	Natural	LP	Natural
G60F3	60 (75)	60 (75)	55 (68.8)	55 (68.8)
G80F3	80 (100)	75 (93.8)	68 (85)	63.5 (79.4)
G55F3S	55 (55)	55 (55)	50 (50)	50 (50)
G75F3S	75 (75)	70 (70)	64 (64)	60 (60)

FEATURES

GENERATOR SET
- Complete system designed and built at ISO 9001 certified facilities
- Factory tested to design specifications at full load conditions

ENGINE
- Governor, Isochronous Woodward electronic
- Electrical system, 12 VDC
- Cartridge type filters
- Battery, rack, and cables
- Coolant and lube oil drains piped to edge of base

GENERATOR
- Insulation system, class H
- Drip proof generator air intake (NEMA 2, IP23)
- Electrical design in accordance with BS5000 Part 99, IEC60034-1, EN61000-6, NEMA MG-1.33

AUTOMATIC VOLTAGE REGULATOR
- Voltage within ± 0.5% 3 Phase and ± 1.0% Single Phase at steady state from no load to full load
- Provides fast recovery from transient load changes

COOLING SYSTEM
- Radiator and cooling fan complete with protective guards
- Standard ambient temperatures up to 125° F (52° C)

MOUNTING ARRANGEMENT
- Heavy-duty fabricated steel base with lifting points
- Anti-vibration pads to ensure vibration isolation
- Complete OSHA guarding
- Stub-up pipe ready for connection to silencer pipework
- Flexible fuel lines to base with NPT connections

CIRCUIT BREAKER
- UL/CSA listed
- 3-pole with solid neutral
- NEMA 1 steel enclosure, vibration isolated
- Electrical stub-up area directly below circuit breaker

CONTROL SYSTEM
- 2001 Autostart control panel
- Vibration isolated NEMA 1 enclosure with lockable hinged door
- AC and DC wiring looms

EQUIPMENT FINISH
- All electroplated hardware
- Anticorrosive protection prior to painting
- High gloss polyurethane paint for durability and scuff resistance

QUALITY STANDARDS
- BS4999, BS5000, BS5514, IEC60034, EN61000-6, NEMA MG1-33, NFPA 110 (with optional equipment)

DOCUMENTATION
- Operation and maintenance manuals provided
- Wiring diagrams included

WARRANTY
- All equipment carries full manufacturer's warranty

LEHF1098-08 (02-05)

WHERE THE WORLD TURNS FOR POWER

STANDBY 60-80 kW
PRIME 55-68 kW
60 Hz

OLYMPIAN™

Exclusively from your Caterpillar® dealer

OPTIONAL EQUIPMENT*

ENCLOSURE
- Weatherproof enclosure (includes internal silencer system)
- Sound attenuated enclosure (includes internal silencer system)
- Panel viewing window
- External emergency stop pushbutton

SILENCER SYSTEM — OPEN UNIT
- Level 1 silencer
- Level 2 silencer
- Level 3 silencer
- Mounting kit
- Through-wall installation kits

ENGINE
- Battery heater
- Lube oil drain pump
- Lube oil sump heater

CIRCUIT BREAKER
- Auxiliary voltfree contacts
- Shunt trip (100+ amp breakers)

GENERATOR
- Anti-condensation heater
- AREP excitation system (3-Phase only)
- Permanent magnet generator
- Generator upgrade 1 size (3-Phase only)

COOLING SYSTEM
- Coolant heater
- Low coolant temperature alarm
- Low coolant level shutdown
- Radiator transition flange

MOUNTING ACCESSORIES
- Seismic (Zone 4) vibration isolators

CONTROL SYSTEM
- Control Panel Removal, AC and DC wiring looms terminated in sockets
- 4001 Autostart control panel
- 4001E Autostart control panel

FUEL SYSTEM
- LP gas (vapor)
- LP gas (liquid)
- Natural gas/LP gas (vapor) automatic changeover
- Natural gas/LP gas (liquid) automatic changeover
- Low gas pressure alarm

REMOTE ANNUNCIATORS
- 8- and 16-channel remote annunciator panel (supplied loose)
- Remote annunciator upgrade normal/run control switch
- Remote annunciator upgrade lockdown emergency stop button

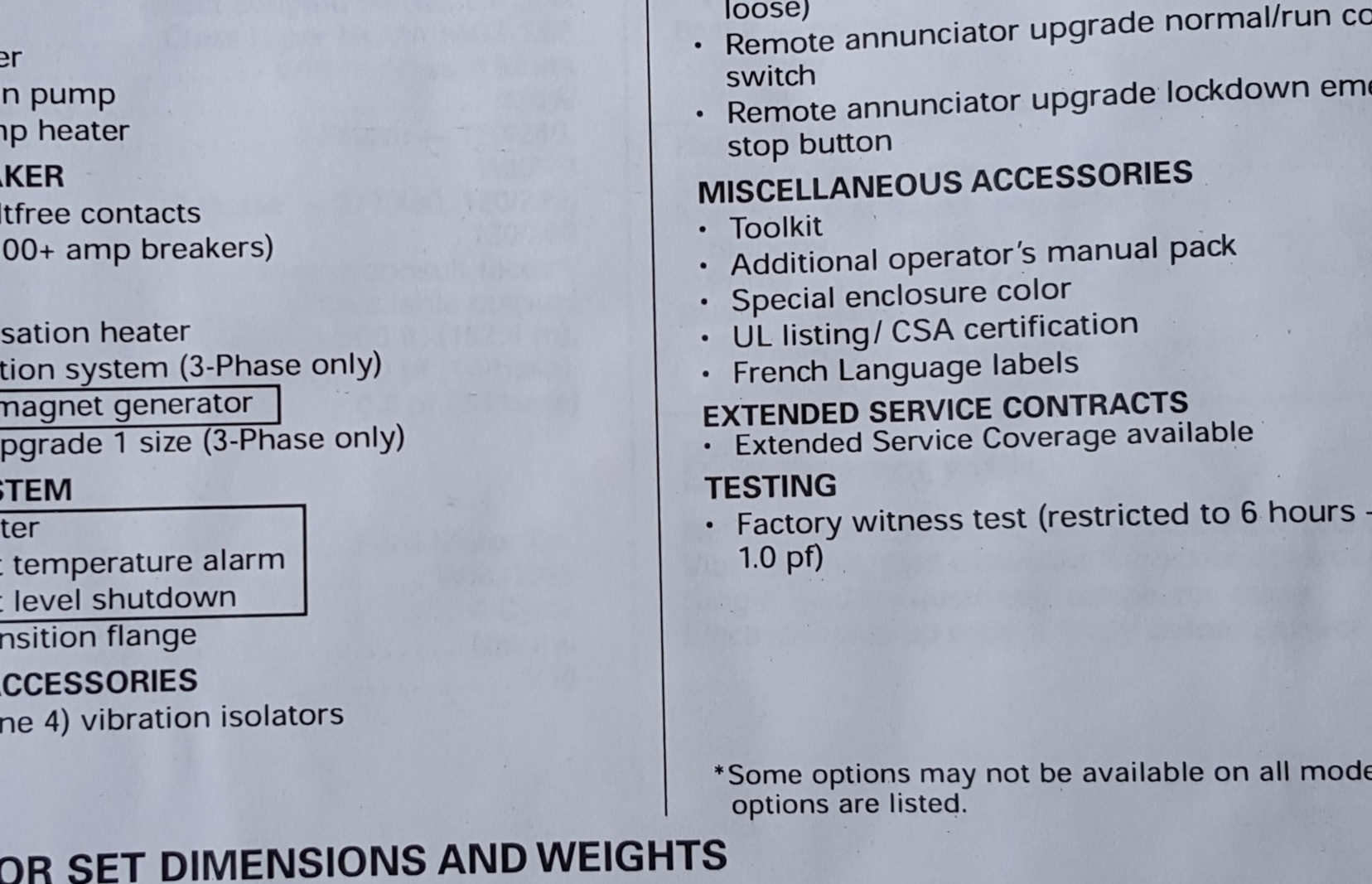
MISCELLANEOUS ACCESSORIES
- Toolkit
- Additional operator's manual pack
- Special enclosure color
- UL listing/ CSA certification
- French Language labels

EXTENDED SERVICE CONTRACTS
- Extended Service Coverage available

TESTING
- Factory witness test (restricted to 6 hours — full load, 1.0 pf)

*Some options may not be available on all models. Not all options are listed.

GENERATOR SET DIMENSIONS AND WEIGHTS



Model	Length in (mm)	Width in (mm)	Height in (mm)	Weight lbs (kg)**
G60F3	102 (2600)	43.3 (1100)	57.1 (1449)	2187 (992)
G80F3	102 (2600)	43.3 (1100)	57.1 (1449)	2410 (1093)
G55F3S	102 (2600)	43.3 (1100)	57.1 (1449)	2410 (1093)
G75F3S	102 (2600)	43.3 (1100)	57.1 (1449)	2410 (1093)

NOTE: General configuration not to be used for installation. See specific dimensional drawings for detail.

**Includes oil and coolant

STANDBY 60-80 kW
PRIME 55-68 kW
60 Hz

OLYMPIAN™

Exclusively from your Caterpillar® dealer

SPECIFICATIONS

GENERATOR

Voltage Regulation .... ±0.5% 3 Phase and 1.0% Single
..... Phase at steady state from no load to full load
Frequency ..... ±0.25% for constant load,
no load to full load
Waveform Distortion ..... THD less than 4%,
Radio Interference ..... Compliance with EN61000-6
Telephone Influence Factor ..... TIF <50
per NEMA MG 1-32.11
Telephone Harmonic Factor ..... THF <2%
Stator ..... 2/3 pitch
Type ..... Brushless, self excited, self-regulated,
drip proof, 4-pole, sealed bearings,
direct coupled by flexible disk
Insulation ..... Class H per NEMA MG1-1.66
Temperature Rise ..... Within Class H limits
Overspeed Capability 125%
Available Voltages ..... 1-Phase — 120/240,
110/220
3-Phase — 277/480, 120/240,
120/208
Deration ..... Please consult factory
for available outputs
Ratings ..... At 77° F (25° C), 500 ft. (152.4 m),
60% humidity, 1.0 pf (1-Phase),
0.8 pf (3-Phase)

ENGINE

Manufacturer ..... Ford Motor Co.
Model WSG1068
Type 4-Cycle
Aspiration ..... Natural
Cylinder Configuration V10
Displacement — cu in (L) 415 (6.8)
Bore — in (mm) 3.55 (90.2)
Stroke — in (mm) 4.16 (105.8)
Compression Ratio 9.0:1
Governor
Type ..... Electronic
Class A1
Piston Speed — ft/sec (m/sec) 20.8 (6.3)
Air Cleaner Type ..... Dry, light duty

LP Gas
Engine Speed — rpm 1800
Max Power at Rated rpm — hp (kW)
Standby 121.7 (90.1)
Prime 106.6 (79.6)
BMEP — psi (kPa)
Standby 130 (897)
Prime 114 (786)

Natural Gas
Engine Speed — rpm 1800
Max Power at Rated rpm — hp (kW)
Standby 112.4 (83.9)
Prime 96.3 (71.9)
BMEP — psi (kPa)
Standby 120.2 (829)
Prime 103 (710)

CONTROL PANEL

NEMA 1 steel enclosure with lockable hinged door
Vibration isolated mounted Autostart control panel
Single location customer connector point
Electrical stub-up area directly below control panel

RATING DEFINITIONS

Standby — Applicable for supplying continuous electrical power (at variable load) in the event of a utility power failure. No overload is permitted on these ratings. The generator is peak rated (as defined in ISO8528-3).

Prime — Applicable for supplying continuous electrical power (at variable load) in lieu of commercially purchased power. There is no limitation to the annual hours of operation and the generator set can supply 10 percent overload power for 1 hour in 12 hours.

Consult your Olympian representative for more information.

www.CAT-ElectricPower.com

Market: N. America
LEPW1098-08 (02-05)

STANDBY 60/60 kW
PRIME 55/55 kW
60 Hz

OLYMPIAN™

Exclusively from your Caterpillar® dealer

Materials and specifications are subject to change without notice.

G60F3 (3-Phase)

Generator Set Technical Data — 1800 rpm/60 Hz		LP Gas		Natural Gas	
		Standby	Prime	Standby	Prime
Power Rating	kW (kVA)	60.0 (75.0)	55.0 (68.8)	60.0 (75.0)	55.0 (68.8)
Lubricating System					
Type: Full Pressure					
Oil Filter: Spin-On, Full Flow					
Oil Type Required: API CD 15W-40					
Total Oil Capacity	U.S. gal (L)	1.5 (5.7)	1.5 (5.7)	1.5 (5.7)	1.5 (5.7)
Oil Pan	U.S. gal (L)	1.2 (4.7)	1.2 (4.7)	1.2 (4.7)	1.2 (4.7)
Fuel System					
Generator Set Fuel Consumption					
100% Load	Cfh (m^3/hr)	260 (7.4)	239 (6.7)	719 (20.4)	661 (18.7)
75% Load	Cfh (m^3/hr)	197 (5.6)	179 (5.1)	545 (15.4)	496 (14.0)
50% Load	Cfh (m^3/hr)	134 (3.8)	120 (3.4)	371 (10.5)	330 (9.3)
Engine Electrical System					
Ignition System: Electronic, Distributorless					
Voltage/Ground: 12/Negative					
Battery Charging Generator Ampere Rating	Amps	110	110	110	110
Cooling System					
Water Pump Type: Centrifugal					
Radiator System Capacity Incl. Engine	U.S. gal (L)	5.3 (20)	5.3 (20)	5.3 (20)	5.3 (20)
Maximum Coolant Static Head	Ft H_2O (m H_2O)	32.4 (9.8)	32.4 (9.8)	32.4 (9.8)	32.4 (9.8)
Coolant Flow Rate	U.S. gal/hr (L/min)	2268 (143)	2268 (143)	2268 (143)	2268 (143)
Minimum Water Temperature to Engine	°F (°C)	169 (76)	169 (76)	169 (76)	169 (76)
Temperature Rise Across Engine (Air)	°F (°C)	8.1 (4.5)	8.1 (4.5)	8.1 (4.5)	8.1 (4.5)
Heat Rejected to Coolant at Rated Power	Btu/min (kW)	2587 (45.5)	2377 (41.8)	2581 (45.4)	2377 (41.8)
Total Heat Radiated to Room at Rated Power	Btu/min (kW)	1478 (26.0)	1359 (23.9)	1479 (26.0)	1359 (23.9)
Radiator Fan Load	Hp (kW)	2.8 (2.1)	2.8 (2.1)	2.8 (2.1)	2.8 (2.1)
Air Requirements					
Combustion Air Flow	Cfm (m^3/min)	122 (3.4)	111 (3.1)	122 (3.4)	111 (3.1)
Maximum Air Cleaner Restriction	In H_2O (kPa)	10.1 (2.5)	10.1 (2.5)	10.1 (2.5)	10.1 (2.5)
Radiator Cooling Air (zero restriction)	Cfm (m^3/min)	8433 (239)	8433 (239)	8433 (239)	8433 (239)
Generator Cooling Air	Cfm (m^3/min)	678 (19.2)	678 (19.2)	678 (19.2)	678 (19.2)
Allowable Air Flow Restriction (After radiator)	In H_2O (kPa)	0.5 (0.125)	0.5 (0.125)	0.5 (0.125)	0.5 (0.125)
Cooling Airflow (@ rated speed)					
Rate with restriction	Cfm (m3/min)	5721 (162)	5721 (162)	5721 (162)	5721 (162)
Exhaust System					
Maximum Allowable Backpressure	In Hg (kPa)	4.5 (15.3)	4.5 (15.3)	4.5 (15.3)	4.5 (15.3)
Exhaust Flow at Rated kW	Cfm (m^3/min)	495 (14)	452 (12.8)	495 (14)	452 (12.8)
Exhaust Temperature at Rated kW —					
Dry Exhaust	°F (°C)	1162 (628)	1140 (616)	1162 (628)	1140 (616)
Generator Set Noise Rating*					
(Without Attenuation) at 3 ft (1 m)	dB(A)	95	95	95	95

Generator Technical Data		277/480V	120/240V	120/208V
Motor Starting Capability:	(kVA)			
(30% Voltage Dip)	Self Excited	166	125	125
	PM Excited	215	162	162
	AREP Excited	215	162	162
Full Load Efficiencies (LPG):	Standby	91.1	90.2	90.2
	Prime	91.3	90.6	90.6
Reactances (per unit):	X_d	2.75	3.66	3.66
	X'_d	0.10	0.13	0.13
Reactances	X''_d	0.050	0.067	0.067
shown are	X_q	1.65	2.19	2.19
applicable to the	X''_q	0.063	0.084	0.084
standby rating.	X_2	0.057	0.076	0.076
	X_0	0.005	0.007	0.007
Time Constants:		t'_d 50 ms	t''_d 5 ms	t'_{do} 1354 ms	t_a 8 ms

* dB(A) levels are for guidance only

AS 3 PHASE LP AND NATURAL GAS

Model		VOPT601 480/277V	VOPT602 460/266	VOPT606 240/120V	VOPT608 220/127V	VOPT610 208/120V	VOPT612 600/346
G12U3	Prime	—	—	—	—	—	—
	Standby	20	—	40	—	40	—
G15U3	Prime	—	—	—	—	—	—
	Standby	25	—	50	—	50	—
G20UH3	Prime	—	—	—	—	—	—
	Standby	30	—	60	—	80	—
G25UH3	Prime	—	—	—	—	—	—
	Standby	40	—	80	—	100	—
G20F3	Prime	—	—	—	—	—	—
	Standby	30	—	60	—	80	—
G25F3	Prime	—	—	—	—	—	—
	Standby	40	—	80	—	90	—
G30F3	Prime	50	—	100	—	100	—
	Standby	50	—	100	—	100	—
G40F3	Prime	60	—	125	—	150	—
	Standby	60	—	125	—	150	—
G50F3	Prime	80	—	150	—	250	—
	Standby	80	—	150	—	250	—
G60F3	Prime	100	—	250	—	250	—
	Standby	100	—	250	—	250	—
G80F3	Prime	125	—	250	—	400	—
	Standby	125	—	250	—	400	—
G100F3	Prime	150	—	400	—	400	—
	Standby	150	—	400	—	400	—
G125G1	Prime	250	250	400	600	600	150
	Standby	250	250	400	600	600	150
G150G1	Prime	250	250	600	600	600	250
	Standby	250	250	600	600	600	250

ues of breakers shown in amps

ATTACHMENT O

MONITORING, REPORTING, RECORDKEEPING PLAN

Attachment O
Monitoring, Recordkeeping, Reporting, and Testing

Alcon will demonstrate compliance with the monitoring, recordkeeping, reporting, and testing requirements set forth by all applicable regulations.

ATTACHMENT P

PUBLIC NOTICE

Attachment P

AIR QUALITY PERMIT NOTICE
Notice of Application

Notice is given that Alcon Research, Ltd has applied to the West Virginia Department of Environmental Protection, Division of Air Quality, for a Rule 13 Modification Permit Application for an ophthalmic device facility located on Kyle Lane, Huntington, in Cabell County, West Virginia. The latitude and longitude coordinates are: 38.460487, -82.308159.

The applicant estimates the potential to discharge the following regulated air pollutants on a facility-wide basis will be:

Volatile Organic Compounds (VOCs) = 0.29 tpy
Hazardous Air Pollutants (HAPs) = 0.11 tpy
Carbon Monoxide (CO) = 4.05 tpy
Nitrogen Oxides (NO_x) = 7.27 tpy
Particulate Matter (PM) = 0.24 tpy
Sulfur Dioxide (SO_2) = 0.33 tpy
Carbon Dioxide Equivalents (CO_2e) = 3,716 tpy

Written comments will be received by the West Virginia Department of Environmental Protection, Division of Air Quality, 601 57th Street, SE, Charleston, WV 25304, for at least 30 calendar days from the date of publication of this notice.

Any questions regarding this permit application should be directed to the DAQ at (304) 926-0499, extension 1227, during normal business hours.

Dated this the XX day of June, 2015.

By: Alcon Research, Ltd
Jackie Murphy
Plant Manager
6065 Kyle Lane
Huntington, WV 25702