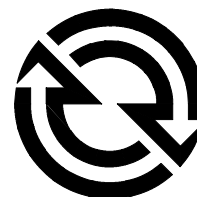


Service Parts

SPECTRUM®

DETROIT DIESEL



Generator Sets

Models:

2000DS

See Group 701, Literature for
Engine and Accessory Parts Catalogs



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Introduction

This manual contains a list of generator and some engine service replacement parts for Spectrum industrial generator sets. Refer to the Specification Number Index for models and specifications covered.

This manual includes the following main sections:

- *Table of Contents:* Lists the sections of this catalog.
- *Introduction (and other information sections):* Contains introductory material followed by sections on specification numbers, part numbers, and hardware.
- *Index:* Indexes generator set specifications and their groups.

- *Group Parts Lists:* Lists part numbers of parts in the groups.

- *Kit List and kit sections:* Lists controller and cooling system kits (by model) and their parts. See Parts Catalog MP-5707 for parts lists of optional accessory kits installed on the generator set.

- *Appendices:* Includes Glossary of Abbreviations, Common Hardware Application Guidelines, Common Hardware Identification, General Torque Specifications, and Common Hardware List.

Number Significance

This catalog uses a variety of numbering systems. A description of these follows:

- *Specification Number:* The generator specification number (spec number) is six digits with a PA-, PB- or PE-prefix (Specification Number Index does not show prefixes). The first three digits designate generator size and engine model (specification series). The remaining digits are in sequence and identify a particular spec in a series. Spec numbers break down into groups.
- *Group Number:* A group consists of parts needed to perform one or more related functions. For example, the 101 group is the generator set Air Intake group.

- *Variation Number:* A group might have several variations. Parts comprising each variation perform the same function, but parts list vary. For example, a 50 Hz generator alternator and 60 Hz generator alternator both perform the same function. However, they are constructed of different parts. Each of these differences necessitates the assignment of a group variation number.

- *Part Number:* The part number identifies an individual assembly, subassembly, component, or accessory kit.

How to Find Part Numbers

FOLLOW THESE STEPS to identify a part:

STEP 1: Turn to the Composite Exploded View in front of the catalog. Notice the boxed groupings identifying a corresponding group number and function. The group function and number applies to all generator set models. For example:

Function & <u>Group Title/Description</u>	Group <u>Number</u>
Air Intake	101
Fuel System	103
Cooling System	104
Engine	105
etc.	

Note the Group Number in which you located your part. If the part you need is not illustrated, locate a function related to your part and use that Group Number.

STEP 2: Turn to the Specification Number Index. The index lists generator set specification numbers vertically down the first column (grouped by model) and variation numbers in the group title/number columns. Locate your specification number in the first column and read across the page to the group description/number column for your part. Note the variation number found in that column.

STEP 3: Using the page number in the Table of Contents, turn to the group of parts in which your part belongs (noted in step 1). Variation numbers in the heading correspond to variations used in that group. Read down the column noted in step 2 to locate parts used in the variation. The number in the column represents the quantity of that part number used in the variation. A part is not used in the variation if a part number does not have a quantity listed.

Hardware Grades

When replacing hardware do not substitute inferior grade hardware. All hex. head screws are hardness grade 5, except where noted. Socket head screws are similar to grade 8. All replacement hardware should be at

least equal to original manufacturer's hardware quality. Refer to Common Hardware Application Guidelines and Common Hardware Identification in the back of the manual.

Hardware References

Many common hardware items will appear in parts catalogs as **common hardware entries** or **hardware references**. A common hardware entry refers to the size of common hardware to apply in accordance with hardware guidelines. For example, item 2 (nut) in Figure 1 below would appear as "3/8-16 hardware" in the text. It indicates that the nut is 3/8-16 size. See Common Hardware Application Guidelines.

Many common hardware items will appear in parts catalogs as common hardware entries or hardware references. A common hardware entry refers to the size of common hardware to apply in accordance with hardware guidelines. For example, an item may appear as "3/8-16 hardware" in the text. It indicates that the piece is 3/8-16 size. See Common Hardware Application Guidelines.

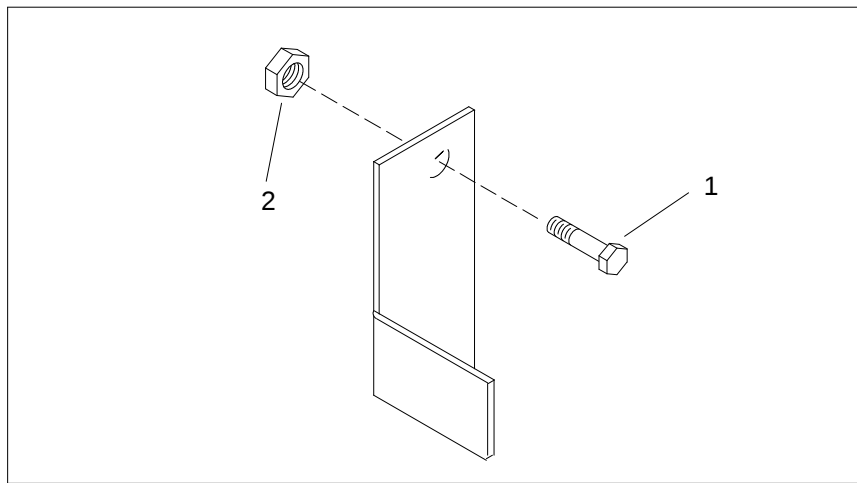
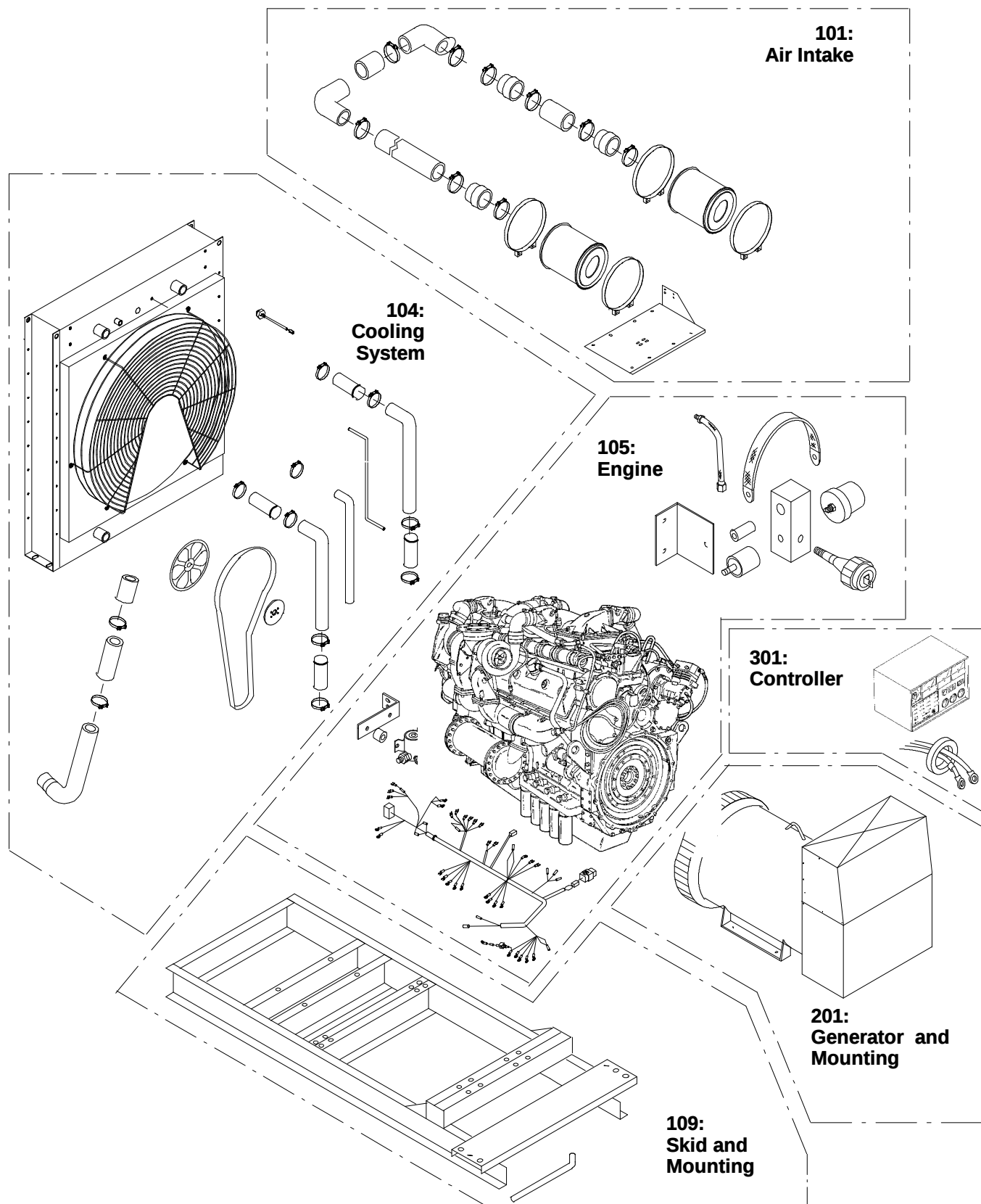


Figure 1. Hardware References

Generator Composite View



581601

Specification Number Index

GROUP TITLE & NUMBER													
	<i>Air Intake</i>	<i>Cooling System</i>	<i>Engine</i>	<i>Nameplates and Decals</i>	<i>Skid and Plant Mounting</i>	<i>Recommended Spare Parts</i>	<i>Generator and Mounting</i>	<i>Controller and Mounting</i>	<i>Literature</i>				
GROUP NO.	101	104	105	107	109	119	201	301	701				
SPEC NO.	VARIATION NUMBER												

2000DS													
191323	37	34	67	69	51	-	335	116	80				
191324	37	34	67	69	51	-	336	116	80				
191325	37	34	67	69	51	-	337	118	80				
191326	37	34	67	69	51	-	338	113	80				
191327	37	34	67	69	51	-	339	115	80				
191328	@	@	67	69	@	-	&	@	80				
191332	37	34	67	69	51	-	339	119	80				

@ Desired air intake, cooling, skid, and generator kit chosen from price list. See Group parts section for parts list.
 & See Controller Kits in kits section for parts list.

Group 101: Air Intake

Item	Part Number	Description	Quantity		
			Variation/Kit No.		
			37	347667	347810
1	X-101-13	Nut, Lock	24	24	24
2	X-268-7	Cap, Pipe	6	6	6
3	X-522-66	Tube, Steel	1	1	
3	X-522-45	Tube, Steel			1
4	254344	Clamp, Hose	4	4	
5	272983	Clamp	12	12	
5	291666	Clamping Bracket			8
5	279715	Clamping Bracket			4
6	274430	Hose, Hump	4	4	
6	274430	Hose, Hump			2
6	347807	Hose, Elbow			2
7	274614	Bracket, Air Cleaner (Right Side)	1	1	
7	279782	Bracket, Air Cleaner (Right Side)			1
8	274616	Bracket, Air Cleaner (Left Side)	1	1	
8	279783	Bracket, Air Cleaner (Left Side)			1
9	274617	Bracket, Air Cleaner	2	2	
9	279781	Bracket, Air Cleaner			2
10	274663	Tube Assembly	2	2	2
11	274664	Tube Assembly	4	4	
11	274819	Tube Assembly			2
11	274623	Tube Assembly			2
12	274821	Cleaner, Air	6	6	
12	A-279713	Cleaner, Air			3
12	A-279714	Cleaner, Air			2
12	A-354106	Cleaner, Air			2
13	272674	Cap, Rain			4
13	279722	Cap, Rain			2
14	280998	Clamp	22	22	12
14	254013	Clamp			4
14	279743	Camp			2
14	272960	Clamp			6
15	291504	Clamp, Hose	2	2	2
16	291559	Clamp, Hose	2	2	2
17	291567	Hose, 90 Degree Elbow	2	2	2
18	291678	Hose, 90 Degree Elbow	2	2	2
19	291679	Hose, Hump	4	4	
19	279744	Hose, Hump			2
19	279720	Hose, Hump			2
20	347476	Bracket, Air Cleaner	2	2	2
21	347477	Hose, Offset	2	2	
21	347806	Hose, Elbow			2
22	347591	Tube Assembly	1	1	
22	347808	Tube Assembly			1
23	279715	Bracket, Air Cleaner			4
24	279288	Bracket			1
25	347722	Bracket, Air Cleaner (Right)	1	1	
25	347773	Bracket, Air Cleaner (Right)			1
26	347723	Bracket, Air Cleaner (Left)	1	1	
26	347774	Bracket, Air Cleaner (Left)			1

Group 104: Cooling System

Item	Part Number	Description	Quantity	
			Variation/Kit No.	
			34	347646
1	A-347485	Radiator Assembly	1	1
2	X-202-28	Bushing, Reducer 3/8 X 1/2	1	1
3	X-286-22	Key, Square	1	1
4	X-391-13	Connector, Elbow	1	1
5	X-422-32	Hose (Vent Line), 16.7 Ft.	2	2
6	X-422-34	Hose (Vent Line), 11.25 Ft.	1	1
7	X-426-10	Clamp, Hose	6	6
8	X-468-7	Tie, Cable	9	9
9	X-507-6	Hose, Radiator .58 Ft.	4	4
10	X-582-4	Connector, Hose	2	2
11	X-582-5	Connector, Hose	3	3
12	X-6003-8	Conduit, Convuluted	1	
13	X-6006-4	Hose, Radiator .75 Ft.	4	4
14	X-6014-86	Hose, Radiator 1.08 Ft.	2	2
15	X-672-19	Clamp, Insulated	2	2
16	254832	Sensor, Low Fluid	1	1
17	279748	Decal, Caution	2	2
18	291537	Clamp, Hose	8	8
19	291542	Clamp, Hose	8	8
20	291590	Clamp, Hose	2	2
21	328021	Bracket, Tube Mounting	2	2
22	343049	Clamp, Hose	4	4
23	347422	Bushing, Pulley	1	1
24	347423	Pulley	1	1
25	347429	Belt, Poly V	1	1
26	347432	Pulley, Idler	1	1
27	347437	Tube, Upper Radiator	2	2
28	347440	Tube, Lower Radiator	1	1
29	347441	Tube, Inner Cooler	1	1
30	347442	Tube, Inner Cooler	1	1
31	347443	Bushing, Idler	1	1
32	347474	Tube, Inlet	1	1
33	347504	Gasket, Inlet	1	1
34	347505	Brace, Radiator Tube	1	1
35	347506	Brace, Radiator Tube	1	1
36	347507	Shim, Radiator	1	1
37	347585	Guard, Belt	1	1
38	347586	Guard, Belt Top	1	1
39	347587	Guard, Belt R.S.	1	1
40	347588	Guard, Belt L.S.	1	1
41	347590	Guard, Belt R.S.	1	1
42	347721	Brace, Bearing Support	1	1
43	347728	Brace, Bearing Support	1	1
44	354113	Sensor, Liquid Level	1	1

Group 105: Engine

Item	Part Number	Description	Quantity
			Variation
			67
1	A-347395-1	Engine Assembly, 2000 kW	1
2	A-347395-2	Engine Assembly, 2000 kW (See TP-5819 for engine parts lists)	1
3	A-347569	Box Assembly, Interface	1
4	X-202-1	Bushing, Reducer 3/4	4
5	X-202-27	Bushing, Reducer 1/8 X 1/4	1
6	X-22-12	Washer, Shakeproof	13
7	X-22-30	Washer, Shakeproof 5/8	4
8	X-22-43	Washer, Lock 5/8	8
9	X-256-5	Valve, Drain	2
10	X-274-3	Elbow, 45 Degree 1/4	1
11	X-296-15	Connector, Half Union	2
12	X-447-10	Elbow, 7/16-20x1/8	1
13	X-447-18	Elbow	3
14	X-447-19	Elbow	1
15	X-651-3	Hose, Rubber 3/8 X 18"	1
16	X-672-3	Clamp, Insulating	4
17	X-748-29	Tube, Shrink	26
18	X-75-1	Plug, Pipe 1/8	2
19	X-75-18	Plug, Pipe 3/4	1
20	X-75-42	Plug, Pipe	2
21	X-794-1	Screw, Drill Hex.	1
22	223033	Strap, Ground 3/8 x 5	3
23	241481	Switch, High Engine Temperature	1
24	259632	Bumper	5
25	267548	Block, Oil Gauge	1
26	268298	Sender, Water Temperature	1
27	272713	Solenoid, Cranking	1
28	274327	Bracket, Relay Mount	2
29	279602	Bracket, Sender Mounting	1
30	280905	Line, Fuel 3/16x6 1/2	1
31	287363	Strap, Ground	2
32	328071	Sender, Oil Pressure	1
33	328309	Switch, Low Oil Pressure	1
34	344358	Line, Flexible Fuel	1
35	347494	Line, Flexible Fuel	1
36	347495	Line, Flexible Fuel	1
37	347496	Bracket, Mounting	1
38	347567	Harness, Wiring (Interface Box To Battery)	1
39	347571	Harness, Wiring	1
40	347580	Bracket, Box	1
41	347584	Bracket, Pressure Mount	1
42	279260	Oil Filter	2

Group 107: Nameplate and Decals

Item	Part Number	Description	Quantity
			Variation
			69
1	X-6301-5	Decal	1
2	X-6302-2	Decal	1
3	238402	Decal	2
4	249808	Decal, Warning	1
5	249809	Decal, Warning	2
6	254454	Foam, Packing	2
7	255798	Tag, Instruction	1
8	255882	Decal	1
9	257438	Decal, Warning	2
10	279598	Tag, Instruction	1
11	324069	Nameplate	1
12	343165	Decal, Caution-Not A Step	2
13	347166	Nameplate, CSA	1
14	347746	Decal, Caution	1

Group 109: Skid and Plant Mounting

Item	Part Number	Description	Quantity	
			Variation/Kit No.	
			51	347645
1	SA-472	Elbow	2	2
2	X-202-41	Bushing, Reducer	2	2
3	X-426-8	Clamp, Hose 1 15/16 X 1 3/16	4	4
4	X-577-18	Hose, Oil Drain .625" X 25"	2	2
5	241062	Plug, Drain	2	2
6	272701	Valve, Oil Drain	2	2
7	276552	Washer, Nylon	2	2
8	280562	Decal, Oil Drain	2	2
9	347438	Skid	1	1
10	347469	Support, Rear Engine	2	2

Group 119: Recommended Spare Parts List

Item	Part Number	Description	Quantity
			Variation/Kit No.
1	291207	Fuse, 1.5 Amp	5
2	243273	Fuse, 3 Amp	5
3	283645	Fuse, 15 Amp	5
4	A-336415	Main Circuit Board	1
5	328725	Voltage Regulator	1
6	A-336432	Indicator Circuit Board	1
7	283420	Bulb	5
8	X-6006-4	Upper Radiator Hose	1
9	X-507-6	Lower Radiator Hose	1
10	347429	V-Belt	1
11	274821	Air Cleaner	26
12	279260	Oil Filter	26
13	291740	Lamp	5

Group 201: Generator and Mounting

Item	Part Number	Description	Quantity				
			Variation/Kit No.				
			335	336	337	338	339
1	A-328115	Alternator Assembly	1				
1	A-347466	Alternator Assembly		1			
1	A-328126	Alternator Assembly			1		
1	A-328138	Alternator Assembly				1	
1	A-347467	Alternator Assembly					1
2	X-284-26	Grommet	2	2	2	2	2
3	X-6021-13	Screw, H.C.	6	6	6	6	6
4	X-6217-10	Screw, Hex Flange	20	20	20	20	20
5	X-6301-2	Decal, Spectrum	1	1	1	1	1
6	X-73-5	Screw, R.H.M. 1/4-20 X 3/8	4	4	4	4	4
7	X-794-2	Screw, Drill	6	6	6	6	6
8	X-801-5	Washer, Hardened	6	6	6	6	6
9	X-801-8	Washer, Hardened	4	4	4	4	4
10	290743	Shim	8	8	8	8	8
11	290744	Shim	12	12	12	12	12
12	290945	Washer, Hardened	16	1	16	16	16
13	291191	Shim	4	4	4	4	4
14	328898	Cover, Top Back	1	1	1	1	1
15	328901	Cover, Louvered	1	1	1	1	1
16	328904	Screen	1	1	1	1	1
17	347717	Box, Control	1	1	1	1	1
18	347718	Cover, Control Box	1	1	1	1	1

Modular Spec Cross Reference Table

Alternator Kit	Equivalent Variation Number
350022	335
350023	336
350024	337
350025	338
350026	339

Group 301: Controller and Mounting (Spectrum)

Item	Part Number	Description	Quantity				
			Variation				
			113	115	116	118	119
1	X-22-14	Washer, Shakeproof 3/8	1	1	1	1	1
2	X-22-16	Washer, Lock 5/16	4	4	4	4	4
3	X-22-20	Washer, Shakeproof E.T.	8	8	8	8	8
4	X-284-25	Grommet	1	1	1	1	1
5	X-51-11	Screw, R.H.M. 8-32 X 3/4	2	2	2	2	2
6	X-51-3	Screw, R.H.M. 8-32 X 1	1	1	1	1	1
7	X-6129-8	Block, Fuse	1	1	1	1	1
8	X-6129-9	Block, Fuse	1	1	1	1	1
9	X-6134-9	Fuse	1	1	1	1	1
10	X-794-2	Screw, Drill	6	6	6	6	6
11	255080	Marker, Strip	1	1	1	1	1
12	258453	Harness, Wiring (CT)	1		1	1	
12	347563	Harness, Wiring (CT)		1			1
13	272684	Relay	1	1	1	1	1
14	274796	Panel, Relay	1	1	1	1	1
15	282829	Mount, Vibro	4	4	4	4	4
16	287684	Transformer, Potential			3		
16	287578	Transformer, Potential				3	
16	258990	Transformer, Potential	3				
16	X-6121-50	Transformer, Potential		3			
16	X-6121-55	Transformer, Potential					3
17	291288	Pick-Up, Speed	1	1	1	1	1
18	295314	Block, Terminal	1	1	1	1	1
19	297676	Transformer, Current			3	3	
19	297675	Transformer, Current	3				
19	248874	Transformer, Current		3			3
20	347872	Harness, Wiring (AC)	1		1	1	
20	347562	Harness, Wiring (AC)		1			1
20	347564	Harness, Wiring (AC)		1			1
21	A-325880	Controller Assembly	1				
21	A-325881	Controller Assembly		1			1
21	A-325879	Controller Assembly Controller Includes *			1	1	
22	A-336415	*Circuit Board, Dec-3+ Main	1	1	1	1	1
23	A-336432	*Circuit Board, Dec-3+ Indicator	1	1	1	1	1
24	X-22-20	*Washer, Shakeproof	1	1	1	1	1
25	X-22-50	*Washer, Lock	2	2	2	2	2
26	X-22-6	*Washer, Lock #6	4	4	4	4	4
27	X-22-7	*Washer, Lock #8	3	3	3	3	3
28	X-284-31	*Grommet	1	1	1	1	1
29	X-301-29	*Plug, Button			1	1	
30	X-301-34	*Plug, Button	1	1	1	1	1
31	X-468-3	*Tie, Cable Nylon	5	5	5	5	5
32	X-49-2	*Screw, R.H.M. 6-32 X 3	2	2	2	2	2
33	X-49-25	*Screw, R.H.M. 6-32 X 1	18	18	18	18	18
34	X-49-39	*Screw, Pan Head	2	2	2	2	2
35	X-50-3	*Screw, R.H.M. 10-24 X	5	5	5	5	5
36	X-50-70	*Screw, R.H.M.	1	1	1	1	1
37	X-51-53	*Screw, R.H.M.	2	2	2	2	2
38	X-519-1	*Plug, Cap 1/8 Inch	2	2	2	2	2
39	X-6046-2	*Strap, Ground	1	1	1	1	1
40	X-6048-2	*Jumper, Terminal Block	1	1	1	1	1
41	X-6216-1	*Screw, Hex Crimptite	10	10	10	10	10
42	X-6234-6	*Nut, Hex.	2	2	2	2	2
43	X-67-127	*Screw, Thread Forming	2	2	2	2	2
44	X-696-5	*Sleeve	1	1	1	1	1
45	X-712-9	*Spacer	4	4	4	4	4
46	X-71-2	*Nut, Hex.	2	2	2	2	2
47	X-72-4	*Nut, Hex.	4	4	4	4	4
48	201620-86	*Tab, Identification	1	1	1	1	1
49	238736	*Meter, Hour	1	1	1	1	1
50	238898	*Terminal	1	1	1	1	1
51	241617	*Connector, 6 Position	1	1	1	1	1
52	246115	*Block, Terminal	1	1	1	1	1
53	253241	*Lens, Red	12	12	12	12	12
54	253242	*Lens, Green	1	1	1	1	1
		Parts list continues					

Group 301: Controller and Mounting, continued

Item	Part Number	Description	Quantity				
			Variation				
			113	115	116	118	119
55	255224	*Voltmeter	1	1	1	1	1
56	255931	*Lens, Yellow	3	3	3	3	3
57	268297	*Resistor, 24 Volt	2	2	2	2	2
58	282815	*Voltmeter, AC	1				
58	282814	*Voltmeter, AC			1	1	
58	299898	*Voltmeter, AC		1			1
59	295069	*Meter, Frequency	1	1	1	1	1
60	282898	*Gauge, Water Temperature	1	1	1	1	1
61	283420	*Bulb	2	2	2	2	2
62	284990	*Socket, Lamp	2	2	2	2	2
63	287948	*Spacer, Circuit Board	9	9	9	9	9
64	291207	*Fuse, 1.5 Amp	3	3	3	3	3
65	291740	*Lamp	2	2	2	2	2
66	292347	*Decal	1	1	1	1	1
67	292352	*Resistor	1	1	1	1	1
68	292374	*Switch, Selector	1	1	1	1	1
69	325073	*Box, Controller	1	1	1	1	1
70	292383	*Decal, Selector Switch	1	1	1	1	1
71	325003	*Cover, Controller	1	1	1	1	1
72	292821	*Holder, Fuse	1	1	1	1	1
73	292823	*Marker, Strip	1	1	1	1	1
74	292834	*Bumper	4	4	4	4	4
75	292908	*Plate, Hinged Back	1	1	1	1	1
76	328072	*Gauge, Oil Pressure	1	1	1	1	1
77	299967	*Ammeter, AC	1				
77	295340	*Ammeter, AC		1			1
77	325467	*Ammeter, AC			1	1	
78	336428	*Cable Assembly	1	1	1	1	1
79	292364	*Switch, Pushbutton	1	1			1
80	292467	*Decal, Emergency Stop	1	1			1

Group 701: Literature

Item	Part Number	Description	Quantity
			Variation
			80
1	MP-5583	S/M 350-1600DS	1
2	MP-5700	Standby Installation Manual	1
3	MP-5707	P/C 20-100DS Accessories	1
4	MP-5722	Wiring Diagram Manual, 350-1600 kW	1
5	MP-5750	Operation Manual, 20-2000 kW	1
6	MP-5816	Parts Catalog, 2000DS	1
7	TP-5384	Service Manual, Ddc 149 Series Engine	1
8	TP-5578	Operation Manual, Marathon Alternator	1
9	TP-5579	Operation Manual, Marathon DVR	1
10	TP-5611	Operation Manual, DDC 71/92/149 Series Engine	1
11	TP-5819	Engine Parts Catalog, DDC 2000 kW	1

Kit List

2000 kW

Controllers, optional (Group 301)

7-Light Microprocessor Controllers (Level 2)

Standard meterbox	350033
Standard meterbox, 600V	350011
Standard meterbox, 380V	350007
Standard meterbox, 4160V	350015
Standard meterbox, 3300V	350029
Oversized meterbox	350035
Oversized meterbox, 600V	350013
Oversized meterbox, 380V	350009
Oversized meterbox, 4160V	350017
Oversized meterbox, 3300V	350031

16-Light Microprocessor Controllers

Standard meterbox	350032
Standard meterbox, 600V	350010
Standard meterbox, 380V	350006
Standard meterbox, 4160V	350014
Standard meterbox, 3300V	350028
Oversized meterbox	350034
Oversized meterbox, 600V	350012
Oversized meterbox, 380V	350008
Oversized meterbox, 4160V	350016
Oversized meterbox, 3300V	350030

Engine Gauge Box for Paralleling

Standard meterbox	350005
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Cooling Systems, optional (Group 104)

Cooling, radiator	
Cooling, remote radiator set-up	(See Group 104: Cooling System for parts list.)
Duct Flange, radiator	347831
Heater, block with circulating pump	347609
Valve, block heater isolation valve	347687
	347881

Miscellaneous

Generator Paint (Spray Can)	221331
Generator Paint (Gallon Can)	221332

Optional Accessories

See Parts Catalog MP-5707 for parts lists of optional accessories.

7-Light Controller Kits

7-LIGHT MICROPROCESSOR CONTROLLER KIT PARTS							
Qty.	Description	Common	Kit Numbers/Unique Parts				
			350007	350009	350011	350013	350015
1	Controller Assembly*		A-325895	A-325903	A-325896	A-325904	A-325897
1	Washer, shakeproof 3/8	X-22-14					
4	Washer, lock 5/16	X-22-16					
8	Washer, shakeproof	X-22-20					
1	Grommet	X-284-25					
2	Screw, R.H.M 8-32 x 3/4	X-51-11					
1	Screw, R.H.M 8-32 x 1	X-51-3					
1	Block, fuse	X-6129-8					
1	Block, fuse	X-6129-9					
1	Fuse	X-6134-9					
6	Screw, drill	X-794-2					
1	Marker, strip	255080					
1	Harness, wiring (CT)		258453	258453	258453	258453	347563
1	Relay	272684					
1	Panel, relay	274796					
3	Transformer, potential		276578	276578	258990	258990	X-6121-50
4	Mount, vibro	282829					
1	Speed Pickup	291288					
1	Block, terminal	295314					
3	Transformer, current		297676	297676	297675	297675	248874
1	Harness, wiring (AC)		347872	347872	347872	347872	347562
1	Harness, wiring (AC)						347564

7-LIGHT MICROPROCESSOR CONTROLLER KIT PARTS							
Qty.	Description	Common	Kit Numbers/Unique Parts				
			350017	350029	350031	350033	350035
1	Controller Assembly*		A-325905	A-325897	A-325905	A-325895	A-325903
1	Washer, shakeproof 3/8	X-22-14					
4	Washer, lock 5/16	X-22-16					
8	Washer, shakeproof	X-22-20					
1	Grommet	X-284-25					
2	Screw, R.H.M 8-32 x 3/4	X-51-11					
1	Screw, R.H.M 8-32 x 1	X-51-3					
1	Block, fuse	X-6129-8					
1	Block, fuse	X-6129-9					
1	Fuse	X-6134-9					
6	Screw, drill	X-794-2					
1	Marker, strip	255080					
1	Harness, wiring (CT)		347563	347563	347563	258453	258453
1	Relay	272684					
1	Panel, relay	274796					
3	Transformer, potential		X-6121-50	X-6121-55	X-6121-55	287684	287684
4	Mount, vibro	282829					
1	Speed Pickup	291288					
1	Block, terminal	295314					
3	Transformer, current		248874	248874	248874	297676	297676
1	Harness, wiring (AC)		347562	347562	347562	347872	347872
1	Harness, wiring (AC)		347564	347564	347564		

* See Controller Assembly section for parts list.

7-Light Controller Assemblies

Qty.	Description	Common Parts	7-Light Controller Assembly Number/Unique Parts				
			A-325895	A-325896	A-325897		
1	Indicator Circuit Board	A-336430					
1	Main Circuit Board	A-336415					
1	Washer, Shakeproof	X-22-20					
2	Washer, Lock	X-22-50					
4	Washer, Lock #6	X-22-6					
3	Washer, Lock #8	X-22-7					
1	Grommet	X-284-31					
1	Plug, Button		X-301-29				
1	Plug, Button	X-301-34					
2	Screw, r.h.m. 6-32 x 3/8	X-49-2					
18	Screw, r.h.m. 6-32 x 1/4	X-49-25					
2	Screw, Pan Head	X-49-39					
4	Screw, r.h.m. 10-24 x 3/4	X-50-3					
1	Screw, Pan Head Machine	X-50-70					
2	Screw, r.h.m.	X-51-53					
1	Strap, Ground	X-6046-2					
1	Jumper	X-6048-2					
10	Screw, Hex	X-6216-1					
2	Nut, Hex.	X-6234-6					
2	Screw, Thread Forming	X-67-127					
1	Sleeve	X-696-5					
2	Nut, Hex.	X-71-2					
4	Spacer	X-712-9					
4	Nut, Hex.	X-72-4					
1	Tab, Ident.	201620-86					
1	Meter, Hour	238736					
1	Terminal	238898					
1	Connector, Plug 6 Position	241617					
1	Block, Terminal	246115					
7	Lens, Red	253241					
1	Voltmeter	255224					
2	Lamp	291740					
2	Bulb	283430					
1	Plate, Hinge	292908					
1	Voltmeter, AC		282814	282815	350143		
1	Gauge, Oil Pressure	328072					
1	Gauge, Water Temperature	282898					
1	Ammeter		325467	299967	295340		
2	Socket, Lamp	284990					
8	Spacer, Circuit Board	287948					
3	Fuse, 1.5 Amp	291207					
1	Decal	292347					
1	Resistor	292352					
1	Decal	292361					
1	Switch, Selector	292374					
1	Holder, Fuse	292821					
1	Marker, Strip	292823					
1	Bumper	292834					
1	Harness, Cable	336428					
1	Meter, Frequency	295069					
1	Cover, Controller	325003					
1	Decal, Selector Switch	325072					
1	Box, Silkscreened Controller	325945					
1	Resistor, 24 volt	268297					
1	Switch, Pushbutton		292364	292364			
1	Decal, Emergency Stop		292467	292467			

N/A Not Applicable

7-Light Controller Assemblies

Qty.	Description	Common Parts	7-Light Controller Assembly Number/Unique Parts				
			A-325903	A-325904	A-325905		
1	Indicator Circuit Board	A-336430					
1	Main Circuit Board	A-336415					
1	Washer, Shakeproof	X-22-20					
2	Washer, Lock	X-22-50					
4	Washer, Lock #6	X-22-6					
3	Washer, Lock #8	X-22-7					
1	Grommet	X-284-31					
1	Plug, Button			X-301-29	X-301-29		
1	Plug, Button	X-301-34					
2	Screw, r.h.m. 6-32 x 3/8	X-49-2					
18	Screw, r.h.m. 6-32 x 1/4	X-49-25					
2	Screw, Pan Head	X-49-39					
4	Screw, r.h.m. 10-24 x 3/4	X-50-3					
1	Screw, Pan Head Machine	X-50-70					
2	Screw, r.h.m.	X-51-53					
1	Strap, Ground	X-6046-2					
1	Jumper	X-6048-2					
12	Screw, Hex	X-6216-1					
2	Nut, Hex.	X-6234-6					
2	Screw, Thread Forming	X-67-127					
1	Sleeve	X-696-5					
2	Nut, Hex.	X-71-2					
4	Spacer	X-712-9					
4	Nut, Hex.	X-72-4					
1	Tab, Ident.	201620-86					
1	Meter, Hour	238736					
1	Terminal	238898					
1	Connector, Plug 6 Position	241617					
1	Block, Terminal	246115					
7	Lens, Red	253241					
1	Voltmeter	255224					
2	Lamp	291740					
2	Bulb	283420					
4	Bumper	255443					
1	Plate, Hinge	273785					
1	Voltmeter, AC		282814	282815	350143		
1	Gauge, Oil Pressure	328072					
1	Gauge, Water Temperature	282897					
1	Ammeter		325437	299967	295340		
3	Socket, Lamp	284990					
9	Spacer, Circuit Board	287948					
3	Fuse, 1.5 Amp	291207					
1	Decal	292347					
1	Resistor	292352					
1	Decal	292361					
1	Switch, Selector	292374					
1	Holder, Fuse	292821					
1	Marker, Strip	292823					
1	Bumper	292834					
1	Harness, Cable	292836					
1	Meter, Frequency	295069					
1	Cover, Controller	325007					
1	Decal, Selector Switch	325072					
1	Box, Silkscreened Controller	325943					
1	Resistor, 24 volt	268297					
1	Switch, Pushbutton			292364	292364		
1	Decal, Emergency Stop			292467	292467		

N/A Not Applicable

16-Light Controller Kits

16-LIGHT MICROPROCESSOR CONTROLLER KIT PARTS							
Qty.	Description	Common	Kit Numbers/Unique Parts				
			350006	350008	350010	350012	350014
1	Controller Assembly*		A-325879	A-325887	A-325880	A-325888	A-325881
1	Washer, shakeproof 3/8	X-22-14					
4	Washer, lock 5/16	X-22-16					
8	Washer, shakeproof	X-22-20					
1	Grommet	X-284-25					
2	Screw, R.H.M 8-32 x 3/4	X-51-11					
1	Screw, R.H.M 8-32 x 1	X-51-3					
1	Block, fuse	X-6129-8					
1	Block, fuse	X-6129-9					
1	Fuse	X-6134-9					
6	Screw, drill	X-794-2					
1	Marker, strip	255080					
1	Harness, wiring (CT)		258453	258453	258453	258453	347563
1	Relay	272684					
1	Panel, relay	274796					
3	Transformer, potential		276578	276578	258990	258990	X-6121-50
4	Mount, vibro	282829					
1	Speed Pickup	291288					
1	Block, terminal	295314					
3	Transformer, current		297676	297676	297675	297675	248874
1	Harness, wiring (AC)		347872	347872	347872	347872	347562
1	Harness, wiring (AC)						347564

16-LIGHT MICROPROCESSOR CONTROLLER KIT PARTS							
Qty.	Description	Common	Kit Numbers/Unique Parts				
			350016	350028	350030	350032	350034
1	Controller Assembly*		A-325889	A-325881	A-325889	A-325879	A-325887
1	Washer, shakeproof 3/8	X-22-14					
4	Washer, lock 5/16	X-22-16					
8	Washer, shakeproof	X-22-20					
1	Grommet	X-284-25					
2	Screw, R.H.M 8-32 x 3/4	X-51-11					
1	Screw, R.H.M 8-32 x 1	X-51-3					
1	Block, fuse	X-6129-8					
1	Block, fuse	X-6129-9					
1	Fuse	X-6134-9					
6	Screw, drill	X-794-2					
1	Marker, strip	255080					
1	Harness, wiring (CT)		347563	347563	347563	258453	258453
1	Relay	272684					
1	Panel, relay	274796					
3	Transformer, potential		X-6121-50	X-6121-55	X-6121-55	287684	287684
4	Mount, vibro	282829					
1	Speed Pickup	291288					
1	Block, terminal	295314					
3	Transformer, current		248874	248874	248874	297676	297676
1	Harness, wiring (AC)		347562	347562	347562	347872	347872
1	Harness, wiring (AC)		347564	347564	347564		

* See Controller Assembly section for parts list.

16-Light Controller Assemblies

Qty.	Description	Common Parts	16-Light Controller Assembly Number/Unique Parts				
			A-325879	A-325880	A-325881		
1	16-light Circuit Board	A-336432					
1	Main Circuit Board	A-336415					
1	Washer, Shakeproof	X-22-20					
2	Washer, Lock	X-22-50					
4	Washer, Lock #6	X-22-6					
3	Washer, Lock #8	X-22-7					
1	Grommet	X-284-31					
1	Plug, Button		X-301-29				
1	Plug, Button	X-301-34					
2	Screw, r.h.m. 6-32 x 3/8	X-49-2					
18	Screw, r.h.m. 6-32 x 1/4	X-49-25					
2	Screw, Pan Head	X-49-39					
4	Screw, r.h.m. 10-24 x 3/4	X-50-3					
1	Screw, Pan Head Machine	X-50-70					
2	Screw, r.h.m.	X-51-53					
1	Strap, Ground	X-6046-2					
1	Jumper	X-6048-2					
12	Screw, Hex	X-6216-1					
2	Nut, Hex.	X-6234-6					
2	Screw, Thread Forming	X-67-127					
1	Sleeve	X-696-5					
2	Nut, Hex	X-71-2					
4	Spacer	X-712-9					
4	Nut, Hex	X-72-4					
1	Tab, Ident.	201620-86					
1	Meter, Hour	238736					
1	Terminal	238898					
1	Connector, Plug 6 Position	241617					
1	Block, Terminal	246115					
12	Lens, Red	253241					
1	Voltmeter	255224					
2	Lamp	291740					
2	Bulb	283420					
1	Plate, Hinge	292908					
1	Voltmeter, AC		282814	282815	350143		
1	Gauge, Oil Pressure	328072					
1	Gauge, Water Temperature	282898					
1	Ammeter		325467	299967	295340		
2	Socket, Lamp	284990					
9	Spacer, Circuit Board	287948					
3	Fuse, 1.5 Amp	291207					
1	Decal	292347					
1	Resistor	292352					
1	Switch, Selector	292374					
1	Holder, Fuse	292821					
1	Marker, Strip	292823					
1	Bumper	292834					
1	Harness, Cable	336428					
1	Meter, Frequency	295069					
1	Cover, Controller	325003					
1	Decal, Selector Switch	325072					
1	Box, Silkscreened Controller	325073					
1	Lens, Green	253242					
3	Lens, Yellow	255931					
1	Switch, Pushbutton			292364	292364		
1	Decal, Emergency Stop			292467	292467		
1	Resistor, 24 Volt	268297					

N/A Not Applicable

16-Light Controller Assemblies, Continued

Qty.	Description	Common Parts	16-Light Controller Assembly Number/Unique Parts				
			A-325887	A-325888	A-325889		
1	16-light Circuit Board	A-336432					
1	Main Circuit Board	A-336415					
1	Washer, Shakeproof	X-22-20					
2	Washer, Lock	X-22-50					
4	Washer, Lock #6	X-22-6					
3	Washer, Lock #8	X-22-7					
1	Grommet	X-284-31					
1	Plug, Button		X-301-29				
1	Plug, Button	X-301-34					
2	Screw, r.h.m. 6-32 x 3/8	X-49-2					
18	Screw, r.h.m. 6-32 x 1/4	X-49-25					
2	Screw, Pan Head	X-49-39					
4	Screw, r.h.m. 10-24 x 3/4	X-50-3					
1	Screw, Pan Head Machine	X-50-70					
2	Screw, r.h.m.	X-51-53					
1	Strap, Ground	X-6046-2					
1	Jumper	X-6048-2					
12	Screw, Hex	X-6216-1					
2	Nut, Hex.	X-6234-6					
2	Screw, Thread Forming	X-67-127					
1	Sleeve	X-696-5					
2	Nut, Hex	X-71-2					
4	Spacer	X-712-9					
4	Nut, Hex	X-72-4					
1	Tab, Ident.	201620-86					
1	Meter, Hour	238736					
1	Terminal	238898					
1	Connector, Plug 6 Position	241617					
1	Block, Terminal	246115					
12	Lens, Red	253241					
1	Voltmeter	255224					
2	Lamp	291740					
2	Bulb	283420					
1	Plate, Hinge	273785					
1	Voltmeter, AC		282814	282815	350143		
1	Gauge, Oil Pressure	328072					
1	Gauge, Water Temperature	282898					
1	Ammeter		325467	299967	295340		
2	Socket, Lamp	284990					
9	Spacer, Circuit Board	287948					
3	Fuse, 1.5 Amp	291207					
1	Decal	292347					
1	Resistor	292352					
1	Switch, Selector	292374					
1	Holder, Fuse	292821					
1	Marker, Strip	292823					
1	Bumper	292834					
1	Harness, Cable	336428					
1	Meter, Frequency	295069					
1	Cover, Controller	325007					
1	Decal, Selector Switch	325072					
1	Box, Silkscreened Controller	325075					
1	Lens, Green	253242					
3	Lens, Yellow	255931					
1	Switch, Pushbutton			292364	292364		
1	Decal, Emergency Stop			292467	292467		
1	Resistor, 24 Volt	268297					

Engine Gauge Box for Paralleling

ENGINE GAUGE BOX KIT PARTS							
Qty.	Description	Common	Kit Numbers/Unique Parts				
			350005				
1	Controller Assembly*		A-325125				
1	Washer, shakeproof 3/8	X-22-14					
4	Washer, lock 5/16	X-22-16					
8	Washer, shakeproof	X-22-20					
1	Grommet	X-284-25					
2	Screw, R.H.M 8-32 x 3/4	X-51-11					
1	Screw, R.H.M 8-32 x 1	X-51-3					
1	Block, fuse	X-6129-8					
1	Block, fuse	X-6129-9					
1	Fuse	X-6134-9					
6	Screw, drill	X-794-2					
1	Marker, strip	255080					
1	Harness, wiring	354087					
1	Relay	272684					
1	Panel, relay	274796					
4	Mount, vibro	282829					
1	Sensor, magnetic	226529					
1	Block, terminal	295314					
1	Water Level Switch	336657					

* See Controller Assembly below.

N/A Not Applicable

Qty.	Description	Common Parts	Controller Assembly Number/ Unique Parts		
			A-350125		
1	Strap, Ground	X-6046-2			
1	Switch, Speed	X-6122-1			
1	Meter, Hour	238736			
1	Voltmeter	255224			
1	Box, Controller	325004			
1	Panel	263154			
1	Resistor, 24 volt	268297			
1	Harness, Wiring (24-pin)	273764			
1	Strip, marker	273781			
1	Harness, Wiring (shielded)	273984			
1	Gauge, Oil Pressure	328072			
1	Gauge, Water Temperature	282898			
6	Strip, Terminal (9-terminal)	283060			
3	Bulb	283420			
3	Socket, Lamp	284990			
1	Switch, pushbutton	292364			
1	Decal, Emergency Stop	292467			
1	Cover, Controller	325003			
4	Bumper	292834			

Cooling System Kits

Qty.	Description	Part No.
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Block Heater with Circulating Pump 347687

1	Bushing, reducer, 3/4 x 1 1/4 NPT	X-202-18
1	Tee, black iron 3/8	X-203-15
1	Nipple, pipe 3/8	X-204-9
1	Cross Pipe	X-207-5
1	Elbow, pipe 3/4	X-215-2
1	Elbow, 45°, 1	X-274-10
1	Elbow, 90 deg.	X-391-23
6	Clamp, hose, .69-1.25 ID	X-426-12
2	Connector, hose	X-582-11
2	Connector, hose, 3/4 ID 1 NPT	X-582-15
1	Connector, hose, 3/4 ID 3/4 NPT	X-582-8
3	Washer, beveled, .44	X-6011-4
1	Socket	X-6124-4
1	Hose	X-691-19
1	Hose	X-691-25
1	Hose	X-691-33
2	Screw, drill, 8-18	X-794-2
1	Bushing, reducing, 1/2 x 3/4	153659
1	Adapter, plate	274881
1	Gasket	274882
1	Harness, block heater	279956
1	Socket assembly	291273
1	Relay	291309
1	Track, mounting	347278
1	Heater, block	347686
1	Thermostat Assembly	34742

Duct Flange, radiator 347609

12	Rivet, alumin./steel pop	X-781-10
2	Frame, air duct	347611
1	Frame, air duct	347612
1	Frame, air duct	347613
2	Bracket, air duct	347610

Qty.	Description	Part No.
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Cooling, Remote Radiator 347831

2	Hose, radiator	X-507-6
1	Clamp, U	X-722-11
4	Clamp, exhaust pipe	286283
4	Clamp, hose	291542
1	Gasket, inlet	347504
1	Guard, pulley (front)	347852
1	Guard, pulley (left)	347853
1	Guard, pulley (right)	347854
1	Tube, intercooler	347985
1	Tube, intercooler	347986
1	Tube, inlet	347987
1	Tube, outlet	347988
1	Bracket, inlet tube	354017
1	Bracket, intercooler tube	354015
1	Bracket, intercooler tube	354016
2	Gasket, outlet	354043
1	Bracket, guard	354086
1	Guard, pulley (right)	354088

Valve, Block Heater Isolation 347881

2	Bushing, reducer, 3/4	X-202-1
4	Nipple, pipe	X-206-9
2	Union, pipe	X-206-9
2	Valve	255632

Appendix A.

Glossary of Abbreviations

Abbreviations are used throughout this manual. Normally in the text they will appear in complete form with the abbreviation following in parenthesis the first time they are used. After that they will appear in the abbreviated form. The commonly used abbreviations are shown below.

AC	alternating current	etc.	etc etera (and so forth)
AISI	American Iron and Steel Institute	ext.	external
Amp	ampere	°F	Fahrenheit degree
Amps	amperes	fl. oz.	fluid ounce, fluid ounces
ANSI	American National Standard Institute	FM	frequency modulation
API	American Petroleum Institute	ft.	foot, feet
approx.	approximate, approximately	ft. lbs.	foot pound, foot pounds
A/R	as required, as requested	ga.	gauge
A/S	as supplied, as stated, as suggested	gal./ gals.	gallon, gallons
ASA	American Standards Association	gph	gallons per hour
ASME	American Society of Mechanical Engineers	gpm	gallons per minute
assy.	assembly	gr.	grade
ASTM	American Society for Testing Materials	grd.	ground
ATDC	after top dead center	HCHT	high cylinder head temperature
aux.	auxiliary	HET	high exhaust (or engine) temperature
AWG	American Wire Gauge	Hg	mercury (element)
AWM	appliance wiring material	H ₂ O	water
BBDC	before bottom dead center	HP	horsepower
BDC	before dead center	hr, hrs	hour
BHP	brake horsepower	Hz	hertz (cycles per second)
bmep	brake mean effective pressure	ID	inside diameter
Btu	British thermal unit	IEEE	Institute of Electrical and Electronic Engineers
°C	Celsius degree	in.	inch(es)
cc	cubic centimeter	inc.	incorporated
CCA	cold cranking Amps.	in. lbs.	inch pounds
CEC	Canadian Electrical Code	int.	internal
cfh	cubic feet per hour	int.-ext.	internal-external
cfm	cubic feet per minute	ISO	International Standards Organization
CID	cubic inch displacement	J	joule, joules
cm	centimeter, centimeters	JIS	Japanese Industry Standard
cmm	cubic meters per minute	kg	kilogram, kilograms
co.	company	kg/cm ²	kilograms per square centimeter
cont'd.	continued	kgm	kilogram meter(s)
CSA	Canadian Standards Association	kJ	kilojoules (btu cal)
CT	current transformer	km	kilometer, kilometers
cu. in.	cubic inch, cubic inches	kPa	kiloPascal, kiloPascals
cyl.	cylinder	kph	kilometers per hour
dB	decibel	kV	kilovolt
dBA	decibels (A weighted)	kVA	kilovolt amperes
DC	direct current	kW	kilowatt, kilowatts
DCR	direct current resistance	kWH	kilowatt hour
deg.	degree	L	liter, liters
dept.	department	LxWxH	length x width x height
dia.	diameter	LED(s)	light emitting diode
e.g.	example given	lb., lbs.	pound, pounds
EIA	Electronic Industries Association	L/hr.	liter per hour, liters per hour
EMI	electromagnetic interference	L/min.	liter(s) per minutes,
EPA	Environmental Protection Agency	LOP	low oil pressure

LP	liquefied petroleum	pot.	potentiometer
m	meter, meters	ppm	parts per million
m ³	cubic meter, cubic meters	psi	pounds per square inch
max.	maximum	pt., pts.	pint, pints
MCM	one thousand circular mils.	PVC	polyvinyl chloride
megger	megohmmeter	qt., qts.	quart, quarts
MHz	megahertz	qty.	quantity
mi.	mile, miles	ref.	reference
mil	one one-thousandth of an inch	RFI	radio frequency interference
min.	minimum	r.h.m.	round-head machine (screw)
mJ	millijoule, millijoules	rms	root mean square
MJ	mega joule, mega joules	RPM	revolutions per inch
mm	millimeter, millimeters	RTV	room temperature vulcanization
m ³ /min	cubic meters per minute	SAE	Society of Automotive Engineers
MPa	megaPascal	SCR	silicon controlled rectifier
mW	milliwatt, milliwatts	sec.	second, seconds
MW	megawatt, megawatts	spec.	specs, specification
N/A	not available or not applicable	sq.	square
NBS	National Bureau of Standards	sq. cm	square centimeters
N.C.	normally closed	sq. in.	square inch, square inches
NEC	National Electrical Code	tach	tachometer
NEMA	National Electrical Manufacturers Association	TDC	top dead center
NFPA	National Fire Protection Association	tech. pub.	technical publications
Nm	Newton meter, Newton meters	temp.	temperature
no., nos	number, numbers	TIF	telephone influence factor
NPT	National Standard taper pipe thread per general use	TP, TPs	technical publications
N/R	not required	turbo	turbocharger
OC	overcrank	UHF	ultrahigh frequency
OD	outside diameter	UNC	Unified coarse thread (was NC)
OEM	original equipment manufacturer	UNF	Unified fine thread (was NF)
OS	overspeed, oversize	UL	Underwriter's Laboratories, Inc.
O/S	oversize	U/S	undersize
OSHA	Occupational Safety and Health Act	U.S.A.	United States of America
OV	overvoltage	V	volt, volts
oz.	ounce, ounces	vac	Volts alternating current
PF	power factor	vdc	volts direct current
PMG	permanent magnet generator	VHF	very high frequency
		W	watt, watts

Appendix B.

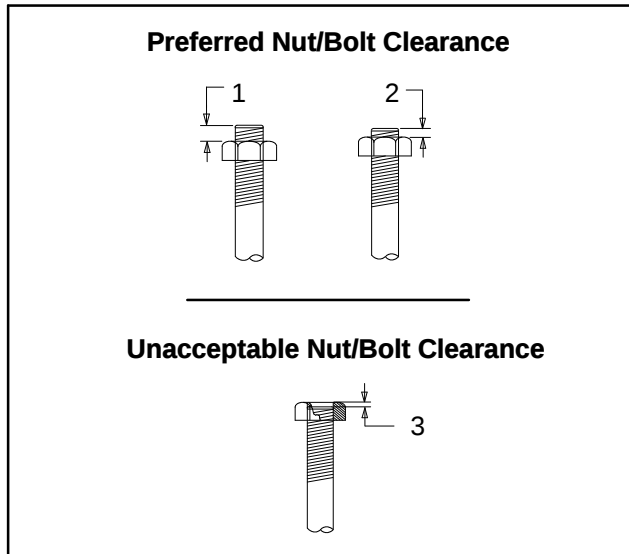
Common Hardware Application Guidelines

Use the information below and on the following pages to identify proper fastening techniques when no specific reference for reassembly is made.

Bolt/Screw Length: When bolt/screw length is not given, use Figure 2 as a guide. As a general rule, a minimum length of one thread beyond the nut and a maximum length of 1/2 the bolt/screw diameter beyond the nut is the preferred method.

Washers and Nuts: Use split lock washers as a bolt locking device where specified. Use SAE flat washers with whiz nuts, spirallock nuts, or standard nuts and preloading (torque) of the bolt in all other applications.

See General Torque Specifications and other torque specifications in the service literature.



1. 1/2 of Bolt Diameter
2. Min. 1 Full Thread Beyond Top of Nut
3. Below Top of Nut

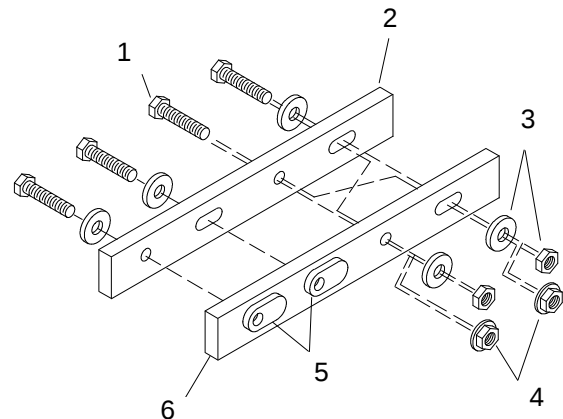
Figure 2. Acceptable Bolt Lengths

Steps for common hardware application:

1. Determine entry hole type: round or slotted.
2. Determine exit hole type: fixed female thread (weld nut), round, or slotted.

For round and slotted exit holes, determine if hardware is greater than 1/2 inch in diameter, or 1/2 inch in diameter or less. Hardware that is *greater than 1/2 inch* in diameter takes a standard nut and SAE washer. Hardware 1/2 inch or less in diameter can take a properly torqued whiz nut or spirallock nut. See the diagram below.

3. Follow these SAE washer rules after determining exit hole type:
 - a. Always use a washer between hardware and a slot.
 - b. Always use a washer under a nut (see 2 above for exception).
 - c. Use a washer under a bolt when the female thread is fixed (weld nut).
4. Refer to the diagram below, which depicts the preceding hardware configuration possibilities.



1. Cap screw
2. Entry hole types
3. Standard nut and SAE washer
4. Whiz nut or spirallock: up to 1/2" dia. hardware
5. Weld nuts: above 1/2" dia. hardware
6. Exit hole types

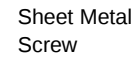
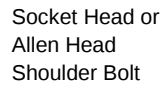
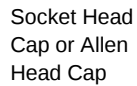
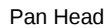
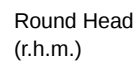
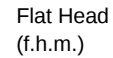
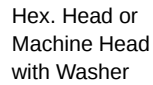
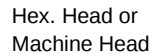
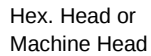
Figure 3. Acceptable Hardware Combinations

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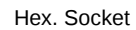
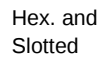
Common Hardware Identification

Screws/Bolts/Studs

Head Styles



Drive Styles



Grade (Hardness)

American Standard



Metric

Sample Dimensions

American Standard

Major Thread Diameter In Fractional Inches Or _____ $\frac{1}{4}-20 \times \frac{1}{8}$ Length In Inches
Screw Number Size Threads Per Inch

Metric

Major Thread Diameter In Millimeters _____ M8-1.25 x 20 _____ Length In Millimeters
Distance Between Threads In Millimeters _____

Figure 4. Screws/Bolts/Studs

Nuts

Styles



Hex. Head



Lock Nut or
Nylock Nut



Square Nut



Cap Nut or
Acorn Nut



Wing Nut

Grade (Hardness)

American Standard



Grade 2



Grade 5

Metric



5.8



8.8



10.9



12.9

Sample Dimensions

American Standard

Major Thread Diameter In Fractional Inches Or $\frac{1}{4}$ -20 Threads Per Inch
Screw Number Size

Metric

Major Thread Diameter In Millimeters $M8-1.25$ Distance Between Threads In Millimeters

Washers

Styles



Plain
Washer



Split Lock Washer
or Spring Washer



Spring Washer
or Wave Washer



External
Tooth Lock
Washer



Internal Tooth
Lock Washer



Internal-External Tooth
Lock Washer

Grade (Hardness)

There is no marking to identify hardness. Usually hardened washers have a black oxide or black phosphate finish rather than a zinc (silver-colored) finish.

Sample (Hardness)

Plain Washers

Internal Dimension $\frac{9}{32} \times \frac{5}{8} \times \frac{1}{16}$ Thickness
External Dimension

Lock Washers

$\frac{5}{8}$
Internal Dimension

Figure 5. Nuts/Washers

Appendix D.

General Torque Specifications

Use the following specifications for SAE fasteners when no torque values are given elsewhere in this or the service manual for a specified bolt. The values given are based on

new plated threads. Increase values by 20% if nonplated threads are used.

Size	Measurement	Assembled in Cast Iron or Steel			Assembled into
		Grade 2	Grade 5	Grade 8	Aluminum Grade 2 or 5
8-32	in. lbs. (Nm)	16 (1.8)	20 (2.3)	–	16 (1.8)
10-24	in. lbs. (Nm)	26 (2.9)	32 (3.6)	–	26 (2.9)
10-32	in. lbs. (Nm)	26 (2.9)	32 (3.6)	–	26 (2.9)
1/4-20	in. lbs. (Nm)	60 (6.8)	96 (10.8)	132 (14.9)	60 (6.8)
1/4-28	in. lbs. (Nm)	72 (8.1)	108 (12.2)	144 (16.3)	72 (8.1)
5/16-18	in. lbs. (Nm)	120 (13.6)	192 (21.7)	264 (29.8)	120 (13.6)
5/16-24	in. lbs. (Nm)	132 (14.9)	204 (23.1)	288 (32.5)	132 (14.9)
3/8-16	in. lbs. (Nm)	18 (24)	28 (38)	39 (53)	18 (24)
3/8-24	ft. lbs. (Nm)	20 (27)	31 (42)	44 (60)	20 (27)
7/16-14	ft. lbs. (Nm)	29 (39)	44 (60)	63 (85)	
7/16-20	ft. lbs. (Nm)	32 (43)	50 (68)	70 (95)	
1/2-13	ft. lbs. (Nm)	44 (60)	68 (92)	96 (130)	
1/2-20	ft. lbs. (Nm)	49 (66)	76 (103)	108 (146)	
9/16-12	ft. lbs. (Nm)	60 (81)	98 (133)	138 (187)	
9/16-18	ft. lbs. (Nm)	67 (91)	109 (148)	154 (209)	
5/8-11	ft. lbs. (Nm)	83 (113)	135 (183)	191 (259)	
5/8-18	ft. lbs. (Nm)	94 (128)	153 (208)	216 (293)	
3/4-10	ft. lbs. (Nm)	147 (199)	240 (325)	338 (458)	
3/4-16	ft. lbs. (Nm)	164 (222)	268 (363)	378 (513)	
1-8	ft. lbs. (Nm)	191 (259)	532 (721)	818 (1109)	
1-12	ft. lbs. (Nm)	209 (283)	582 (789)	895 (1214)	

Use the following specifications for metric fasteners when no torque values are given elsewhere in this manual for a specified bolt. These values are based on new plated threads. Increase values by 20% if nonplated threads are used.

Screws threaded into aluminum must have two diameters of threads engaged and may require 30% or more reduction in the torque.

Torque ft-lb (Nm)				Fasteners Assembled Into
Size (mm)	5.8	6.8	10.9	Aluminum
6 x 1.00	5 (7)	6 (9)	9 (12)	5 (7)
8 x 1.25	14 (19)	14 (20)	20 (37)	14 (19)
8 x 1.00	16 (21)	17 (24)	23 (31)	16 (21)
10 x 1.50	25 (35)	27 (37)	38 (51)	25 (35)
10 x 1.25	29 (39)	34 (46)	45 (61)	29 (39)
12 x 1.75	42 (57)	45 (61)	65 (89)	
12 x 1.50	48 (65)	55 (75)	78 (106)	
14 x 2.00	64 (86)	69 (94)	101 (137)	
14 x 1.50	74 (100)	81 (110)	116 (157)	
16 x 2.00	98 (133)	104 (141)	150 (204)	
16 x 1.50	104 (141)	116 (157)	168 (228)	
18 x 2.50	133 (181)	145 (196)	208 (283)	
18 x 1.50	145 (196)	156 (212)	226 (306)	

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Appendix E.

Common Hardware List

The Common Hardware List gives part numbers and dimensions for common hardware items.

HEX BOLTS (GRADE 5)

<u>Part Number</u>	<u>Dimensions</u>	<u>Part Number</u>	<u>Dimensions</u>
X-465-17	1/4-20 x .38	X-6238-13	3/8-16 x 4.50
X-465-6	1/4-20 x .50	X-6238-18	3/8-16 x 5.50
X-465-2	1/4-20 x .62	X-6238-25	3/8-16 x 6.50
X-465-16	1/4-20 x .75		
X-465-18	1/4-20 x .88	X-6238-14	3/8-24 x .75
X-465-7	1/4-20 x 1.00	X-6238-16	3/8-24 x 1.25
X-465-8	1/4-20 x 1.25	X-6238-21	3/8-24 x 4.00
X-465-9	1/4-20 x 1.50	X-6238-22	3/8-24 x 4.50
X-465-10	1/4-20 x 1.75		
X-465-11	1/4-20 x 2.00	X-6024-5	7/16-14 x .75
X-465-12	1/4-20 x 2.25	X-6024-2	7/16-14 x 1.00
X-465-14	1/4-20 x 2.75	X-6024-8	7/16-14 x 1.25
X-465-21	1/4-20 x 5.00	X-6024-3	7/16-14 x 1.50
		X-6024-4	7/16-14 x 2.00
X-465-25	1/4-28 x .38	X-6024-11	7/16-14 x 2.75
X-465-20	1/4-28 x 1.00	X-6024-12	7/16-14 x 6.50
X-125-33	5/16-18 x .50	X-129-15	1/2-13 x .75
X-125-23	5/16-18 x .62	X-129-17	1/2-13 x 1.00
X-125-3	5/16-18 x .75	X-129-18	1/2-13 x 1.25
X-125-31	5/16-18 x .88	X-129-19	1/2-13 x 1.50
X-125-5	5/16-18 x 1.00	X-129-20	1/2-13 x 1.75
X-125-24	5/16-18 x 1.25	X-129-21	1/2-13 x 2.00
X-125-34	5/16-18 x 1.50	X-129-22	1/2-13 x 2.25
X-125-25	5/16-18 x 1.75	X-129-23	1/2-13 x 2.50
X-125-26	5/16-18 x 2.00	X-129-24	1/2-13 x 2.75
		X-129-25	1/2-13 x 3.00
230578	5/16-18 x 2.25	X-129-27	1/2-13 x 3.50
		X-129-29	1/2-13 x 4.00
X-125-29	5/16-18 x 2.50	X-129-30	1/2-13 x 4.50
X-125-27	5/16-18 x 2.75	X-463-9	1/2-13 x 5.50
X-125-28	5/16-18 x 3.00	X-129-44	1/2-13 x 6.00
X-125-22	5/16-18 x 4.50	X-129-51	1/2-20 x .75
X-125-32	5/16-18 x 5.00	X-129-45	1/2-20 x 1.25
X-125-35	5/16-18 x 5.50	X-129-52	1/2-20 x 1.50
X-125-36	5/16-18 x 6.00		
X-125-40	5/16-18 x 6.50	X-6021-3	5/8-11 x 1.00
		X-6021-4	5/8-11 x 1.25
X-125-43	5/16-24 x 1.75	X-6021-2	5/8-11 x 1.50
X-125-44	5/16-24 x 2.50	X-6021-1	5/8-11 x 1.75
X-125-30	5/16-24 x .75		
X-125-39	5/16-24 x 2.00	273049	5/8-11 x 2.00
X-125-38	5/16-24 x 2.75		
		X-6021-5	5/8-11 x 2.25
X-6238-2	3/8-16 x .62	X-6021-6	5/8-11 x 2.50
X-6238-10	3/8-16 x .75	X-6021-7	5/8-11 x 2.75
X-6238-3	3/8-16 x .88	X-6021-12	5/8-11 x 3.75
X-6238-11	3/8-16 x 1.00	X-6021-11	5/8-11 x 4.50
X-6238-4	3/8-16 x 1.25	X-6021-10	5/8-11 x 6.00
X-6238-5	3/8-16 x 1.50	X-6021-9	5/8-18 x 2.50
X-6238-1	3/8-16 x 1.75		
X-6238-6	3/8-16 x 2.00	X-6239-1	3/4-10 x 1.00
X-6238-17	3/8-16 x 2.25	X-6239-8	3/4-10 x 1.25
X-6238-7	3/8-16 x 2.50	X-6239-2	3/4-10 x 1.50
X-6238-8	3/8-16 x 2.75	X-6239-3	3/4-10 x 2.00
X-6238-9	3/8-16 x 3.00	X-6239-4	3/4-10 x 2.50
X-6238-19	3/8-16 x 3.25	X-6239-5	3/4-10 x 3.00
X-6238-12	3/8-16 x 3.50	X-6239-6	3/4-10 x 3.50
X-6238-20	3/8-16 x 3.75		
		X-792-1	1-8 x 2.25
		X-792-5	1-8 x 3.00
		X-792-8	1-8 x 5.00

NUTS

<u>Part No.</u>	<u>Dimensions</u>	<u>Type</u>
X-6009-1	1-8	Std. Nut
X-6210-3	6-32	Whiz Nut
X-6210-4	8-32	Whiz Nut
X-6210-5	10-24	Whiz Nut
X-6210-1	10-32	Whiz Nut
X-6210-2	1/4-20	Spiralock Nut
X-6210-6	1/4-28	Spiralock Nut
X-6210-7	5/16-18	Spiralock Nut
X-6210-8	5/16-24	Spiralock Nut
X-6210-9	3/8-16	Spiralock Nut
X-6210-10	3/8-24	Spiralock Nut
X-6210-11	7/16-14	Spiralock Nut
X-6210-12	1/2-13	Spiralock Nut
X-6210-15	7/16-20	Spiralock Nut
X-6210-14		Spiralock Nut
X-85-3	5/8-11	Std. Nut
X-88-12	3/4-10	Std. Nut
X-89-2	1/2-20	Std. Nut

NOTE

6-32 and 8-32 standard nuts must be used for circuit board mountings and some controller assembly applications and are not classified as common hardware. For this reason they are not on this list.

PLAIN WASHERS

<u>Part No.</u>	<u>Inner Diameter</u>	<u>Outer Diameter</u>	<u>Thickness</u>	<u>Bolt/Screw</u>
X-25-46	.125	.250	.022	#4
X-25-9	.156	.375	.049	#6
X-25-48	.188	.438	.049	#8
X-25-36	.219	.500	.049	#10
X-25-40	.281	.625	.065	1/4
X-25-85	.344	.687	.065	5/16
X-25-37	.406	.812	.065	3/8
X-25-34	.469	.922	.065	7/16
X-25-26	.531	1.062	.095	1/2
X-25-15	.656	1.312	.095	5/8
X-25-29	.812	1.469	.134	3/4
X-25-127	1.062	2.000	.134	1

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MP-5816 10/96a

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