

Winkle Industries 2080 West Main Street, Alliance, Ohio 44601 Tel: 330.823.9730 Fax: 330.823.9788

Winkle Industries Model

72 ACC, WI-GS33BDKUD15-1121-, WI-SDS200, WI-SLP-RG-12, WI-F-EDC11577 & HC-4291-91805-202

Electro-Lifting Magnet, DC Power Generator, Magnet Meter Package, DC Magnet Safety Disconnect Switch, Magnet Monitor & Nema Size 4 Magnet Controller

Spare Parts & Operating Instructions



Winkle Industries 2080 West Main Street, Alliance, Ohio 44601 Tel: 330.823.9730 Fax: 330.823.9788

Winkle Magnetics Model 72 ACC, WI-GS33BDKUD15-1121, WI-SDS200, WI-SLP-RG-12, WI-F-EDC11577 & HC-4291-91831-202

Electro-Lifting Magnet, DC Power Generator, Magnet Meter Package, DC Magnet Safety
Disconnect Switch, Magnet Monitor & Nema Size 4 Magnet Controller
- Operating Instructions

Magnet Monitor Manual1
Operating Specifications2
Power Hook-up3
Component Description4
Recommended Electrical Spare Parts5
Baldor DC Generator Spare Parts6
Single-Pole DC Contactor NEMA Size 2 (CC1- CC6)
Lambda LW Series Power Supply8
Hubbell Lift/Drop Switch9
Yokogawa Volt Meter10
Crompton Analogue meter relay11
Potter-Brumfield Time Delay Relay

IDEC Control Relay
Magnet Controller Instruction and Renewal Parts Manual
Baldor DC Generator Installation and Operating Manual15
Kubota Engine Manual
Magnet Preventive Maintenance Manual
Instructions for Engine Driven DC Magnet Generator Sets
Main Electrical Control Drawings
Engine and Generator Electrical Drawings
Magnet Drawing21
Generator General Arrangement Drawing
Notes

SECTION 1

MAGNET MONITOR MANUAL



Winkle Industries 2080 West Main Street, Alliance, Ohio 44601 Tel: 330.823.9730 Fax: 330.823.9788

Operations Manual for:

WINKLE MAGNETICS Model # WI-F-EDC11577 DC CURRENT MAGNET MONITOR

FULLY READ AND UNDERSTAND THIS MANUAL BEFORE PUTTING THIS UNIT IN SERVICE

Table of Contents

<u>Description</u>		Page #
I.) Power Requirements		1
II.) Safe Operating Instructions_		2
III.) Calibration Procedures		3
IV.) Warranty		4
V.) Notes		5
VI.) Electrical Drawing	See Drawing # WI-1791D-005 in Ta	ab 19

WI-F-EDC11577 I.) POWER REQUIREMENTS

Input Voltage Nominal 230 VDC

Input Current Max .2 Amps

II.) SAFE OPERATIONING INSTRUCTIONS

- When power is applied with no magnet voltage or magnet current, the green "IN RANGE" light will be on and the power output relay (CR2) will not be energized.
- 2.) When the magnet voltage is applied, the "AMPERES" meter and "VOLTS" meter will display the voltage and current applied to the magnet.
- 3.) If the current to the magnet falls below the value of the push wheels in the "AMPERES" meter, the green "IN RANGE" light will go out. The red "LOW" light will come on and the output relay (CR2) will be energized.
- The WI-F-EDC11577 will stay in the "LOW" condition with CR2 energized until power to the entire unit (on terminals T10 and T11) is turned "OFF".
- If the system reset is required with out a complete power down, an auxiliary power switch may be installed on the power input leads T10 and T11. This control should be keyed so as to eliminate override by operator,

III.) CALIBRATION PROCEDURES

DELAY RELAY

- 1. Set the dip switches for normal operation (1,4,5= ON, 2,3,6,7=OFF). *
- 2. Adjust the knob for enough delay to allow the current to settle and the current meter to stabilize (two seconds should be sufficient) under normal conditions.

CURRENT METER

- With no current flowing through the current transformer CT1, adjust the Display Zero pot (third pot from the edge in the back of the meter) to read zero.
- 2. Allow approximately 200 Amps DC to flow through CT1 and measure the actual current with a reliable DC Ammeter.
- Adjust the Display Span pot (fourth pot from the edge in the back of the meter) until the display on the meter matches the actual measured current.

VOLTAGE METER

- 1. Snap off the front cover of the "VOLTS" meter.
- 2. Allow approximately 250-300 volts DC to be applied to terminals T8 (-M) and T9 (+M) and measure the actual voltage with a reliable meter.
- 3. Adjust the "SPAN" pot (in the lower right corner) until the meter shows the correct reading.

*- NOTE: Configuration of dip switch setting has changed for the delay relay, the old configuration was (1,4,5,6= ON, 2,3,7=OFF). The new settings allow for a one to one-hundred second delay.

IV.) WARRANTY

Our Warranty is for a period of (1) one year from the date of shipment to the customer. The warranty covers defects in material and workmanship of the WI-F-EDC11577 DC Current Magnet Monitor.

V.) NOTES

SECTION 2

OPERATING SPECIFICATIONS

Before Attempting to Wire, Trouble-Shoot or Service this Equipment Make Sure ALL Power is Locked Out.

OPERATING SPECIFICATIONS:

The Model HC-4291-91831-202 Magnet Controller is rated to safely energize and de-energize one or more DC Electromagnets. Please observe the operating limits stated below to avoid damage to the control package or electromagnet(s):

Minimum Recommended Magnet Current Draw: 40 Amps DC
 Maximum Recommended Magnet Current Draw: 175 Amps DC

- Normal operating voltage: 230 VDC ± 5%

The controller is pre-wired and in a nema 4 ventilated enclosure. The unit is designed to operate from a push-button station or drum type master switch. Other types of operation (Pendant, PLCs, etc.) are possible however, modification to the standard controller hardware may be required. Please consult Winkle Industries BEFORE attempting to alternately wire any other Lift/Drop circuit.

** PLEASE NOTE **

Before servicing the controller or magnets, make sure that the main power "OFF". The power should be padlocked in the OFF position, to avoid inadvertent power-up of the system.

SECTION 3

POWER HOOK-UP

Before Attempting to Wire, Trouble-Shoot or Service this Equipment Make Sure ALL Power is Locked Out.

POWER HOOK-UP:

1.) Mount the DC Power Generator, Magnet Meter Package, DC Magnet Safety Disconnect Switch, Magnet Monitor, and Magnet Controller.

Magnet Monitor to Magnet Controller Connections

- 1.) Locate the Magnet Controller Terminals (R, B, W, G).
- 2.) Place the output hole through the Magnet Controller enclosure in a position for easy hook-up.
- 3.) Using appropriately sized wire cable, attach each wire of the cable to these poles.
- 4.) Run this (R, B, W, G) cable to the Magnet Monitor.
- 5.) Locate the Terminals (R, B, W, G) in the Magnet Monitor.
- 6.) Place the input hole through the Magnet Monitor enclosure in a position for easy hook-up.
- 7.) Attach the (R, B, W, G) cable to these poles.
- 8.) Locate the Magnet Controller Terminals (M1, M2, M+, M-, 7M, 8M).
- 9.) Place the output hole through the Magnet Controller enclosure in a position for easy hook-up.
- 10.) Using appropriately sized wire cable, attach each wire of the cable to these poles.
- 11.) Run this (M1, M2, M+, M-, 7M, 8M) cable to the Magnet Monitor.
- 12.) Locate the Terminals (M1, M2, M+, M-, 7M, 8M) in the Magnet Monitor.
- 13.) Place the input hole through the Magnet Monitor enclosure in a position for easy hook-up.
- 14.) Attach the (M1, M2, M+, M-, 7M, 8M) cable to these poles.

Magnet Controller to Magnet Connections

- 1.) Locate the Magnet Controller Terminals (M1, M2).
- 2.) Place the output hole through the Magnet Controller enclosure in a position for easy hook-up.
- 3.) Using appropriately sized wire cable, attach each wire of the cable to these poles.
- 4.) Run this (M1, M2) cable to the Magnet.

- 5.) Locate the Cable Plugs on the Magnet.
- 7.) Attach the (M1, M2) cable to these Cable Plugs.

Lift/Drop Master Switch to Magnet Controller Connections

- 1.) Locate the Magnet Controller Terminals (6, 7, 15).
- 2.) Place the output hole through Magnet Controller enclosure in a position for easy hook-up.
- 3.) Using appropriately sized wire cable, attach each wire of the cable to these poles.
- 4.) Run this (6, 7, 15) cable to the Lift/Drop Master Switch.
- 5.) Locate the Terminals (6, 7, 15) in the Lift/Drop Master Switch.
- 7.) Attach the (6, 7, 15) cable to these poles.

Magnet Generator to Magnet Safety Disconnect Switch Connections

- 1.) Locate the Magnet Generator Terminals (A1, S1).
- 2.) Using appropriately sized wire cable, attach each wire of the cable to these poles.
- 3.) Run this (A1, S1) cable to the Magnet Safety Disconnect Switch.
- 4.) Locate the Terminals (A1, S1) in the Magnet Safety Disconnect Switch.
- 5.) Place the input hole through the Magnet Safety Disconnect Switch enclosure in a position for easy hook-up.
- 6.) Attach the (A1, S1) cable to these poles.

Magnet Generator to Magnet Controller Connection

- 1.) Locate the Magnet Generator Terminal (F1).
- 2.) Using appropriately sized wire cable, attach the cable to this pole.
- 3.) Run this (F1) cable to the Magnet Controller.
- 4.) Locate the Terminal (F1) in the Magnet Controller.
- 5.) Place the input hole through the Magnet Controller enclosure in a position for easy hook-up.
- 6.) Attach the (F1) cable to this pole.

Magnet Meter Package to Magnet Controller Connections

1.) Locate the Magnet Controller Terminals (+/5, -, AM+, AM-).

- 2.) Place the output hole through Magnet Controller enclosure in a position for easy hook-up.
- 3.) Using appropriately sized wire cable, attach each wire of the cable to these poles.
- 4.) Run this (+/5, -, AM+, AM-) cable to the Magnet Meter Package.
- 5.) Locate the Terminals (+/5, -, AM+, AM-) in the Magnet Meter Package.
- 6.) Place the input hole through the Magnet Meter Package enclosure in a position for easy hookup.
- 7.) Attach the (+/5, -, AM+, AM-) cable to these poles.

Magnet Safety Disconnect Switch to Magnet Controller Connections

- 1.) Locate the Magnet Controller Terminals (M+, M-).
- 2.) Place the output hole through Magnet Controller enclosure in a position for easy hook-up.
- 3.) Using appropriately sized wire cable, attach each wire of the cable to these poles.
- 4.) Run this (M+, M-) cable to the Magnet Safety Disconnect Switch.
- 5.) Locate the Terminals (M+, M-) in the Safety Disconnect Switch.
- 6.) Place the input hole through the Safety Disconnect Switch enclosure in a position for easy hook-up.
- 7.) Attach the (M+, M-) cable to these poles.

SECTION 4

COMPONENT DESCRIPTION

I.) Magnet Controller

A.) The Magnet Controller supplies 230 vdc power to the lifting magnet (s) by way of the "LIFT/DROP" Master Switch inputs provided by the operator.

V.) "Lift/Drop" Control

A.) Push-button control (when supplied)

1.) The push-button control contains two (2) push-buttons. One button is marked "LIFT" and the second is marked "DROP". The buttons control the Lift Contactors and Drop Contactors in the Magnet Controller. the "LIFT" button is a maintained type that is mechanically interlocked with the "DROP" button which is a momentary type to avoid inadvertent dropping of the magnet load.

B.) Lifting

A.) When the "LIFT" button is pressed, DC current is supplied to the coil of the Lift Contactors (Marked 1L, 2L). When these coils are energized, the Normally Open Lift Contactors are closed and DC power is supplied to the magnet(s).

C.) Dropping

A.) When the "DROP" button is pressed, the "LIFT" button is opened because of a electrical interlock. Current ceases to flow through the Lift Contactor Coils. The Normally Open Lift Contactors open and the Normally Closed Lift Contactor closes. When this contactor closes, and the "DROP" button is pressed, current flows through the Drop Contactor coil. This closes the Normally Open Drop Contactors (Marked 1D, 2D). This establishes a reverse DC current through the magnets that aids in the decay of "Lift" current and de-magnetizes the load ("Drop" current flows in the opposite direction of "Lift" current). This reverse flow of current is reduced to avoid damaging the controller components by the use of the discharge resistor (Marked "R1"). The length of time this "Drop" circuit is energized is controlled through the use of a potentiometer (Marked "R4"). Adjust the "R4" rheostat for a clean drop of the magnet load, to avoid "re-picking" adjust "R4" from "0" to "100" until a clean drop is achieved. This adjustment should be made only once. If adjustment of this rheostat occurs on a daily or weekly basis, please consult the factory for specific instructions as to magnet duty, and controller function. Failure to consult the Winkle Magnetics may causing damage to the magnet(s) or controller.

SECTION 5

RECOMMENDED ELECTRICAL SPARE PARTS

RECOMMENDED ELECTRICAL SPARE PARTS LIST

Minimum				Price U	Jpon
Stocked Level	Part No.	Description	Key	DWG No. Re	equest
1	WI-5210-59345-011	Size 3 Lift Contactor (Complete)	1L	WI-1791D-E-002	-
1	WI-5210-59345-802	Size 3 Lift Contactor (Complete)	2L	WI-1791D-E-002	-
1	WI-5210-59322-504	Size 2 Drop Contactor (Complete)	D	WI-1791D-E-002	-
2	WI-16924-000	Size 3 contactor tip kit	1L, 2L	WI-1791D-E-002	-
2	WI-2317-000 & WI-5722-000	Size 2 contactor tip kit	D	WI-1791D-E-002	-
2	WI-68014-007	Size 2 12VDC Coil	D	WI-1791D-E-002	
1	WI-17489-000	Size 3 12VDC Coil	1L, 2L	WI-1791D-E-002	-
1	WI-LWD-30-1212	Power Supply	-	WI-1791B-E-005	-
2	WI-225/200AC50	Shunt Field Resistors	F-RES.	WI-1791D-E-002	-
1	WI-JKS-3	CFU Fuse	CFU	WI-1791D-E-002	_
2	WI-JKS-20	RFU Fuses	RFU	WI-1791D-E-002	-
2	WI-FRS-R-200	Safety Disconnect Fuses	FUSE	WI-1791B-E-004	-
1	WI-K2180HIEBI-S	Safety Disconnect Diode Assembly	DIODE	WI-1791B-E-004	-
1	WI-18-136-16AR	Safety Disconnect Resistor	RESISTOR	R WI-1791B-E-004	-

Respectfully,

Winkle Magnetics

Rich Edling

Engineering

SECTION 6

BALDOR DC GENERATOR SPARE PARTS



Product Information Packet **DMG2340**

40KW/1750RPM/DC/DPFG/NEMA AD329AT

Copyright © All product information within this document is subject to Baldor Electric Company copyright © protection, unless otherwise noted.

		A	V.C.C.C.			Proprietary:	No
Revision:	and the second s	Status:	ראט!א		Management of the control of the con		UUUUUUUUUUUUUUUUUUUUUUUUU
Tyne.	DC	Prod Type:		Elec. Spec:	3291977	CD Diagram:	
13 PC.		Mfg Plant:	The state of the s	Mech Spec:	94A101	Layout:	1486
Dinciosare) - 10 1 - 10	Mounting	F.7	Poles:	7	Created Date:	
Frame:	329A1	Mounting.				Eff Date:	04-11-2006
Base:	RG	Rotation:	X	Insulation:		Don't Day	direct
eads:	2#14,2#2,2#2	. "!				Replaced by.	
	(NE						
Statement Addition when the statement of		PA	MODEL	94A101-1977			The state of the s
CAT.NO.	DIMG2340) L.J. L., L.	Out in Y	FRAME	329AT	<u> </u>
K.W.	40 KW	X	RPM	1750			1 TO THE RESERVE THE PARTY OF T
ARWV	230	AF	ARM A	174	MOOND		
	230	11	FLDA	3.7	A STATE OF THE PARTY OF THE PAR	HATTER MAY TO THE STATE OF THE	
FLUV		7,777	A STATE OF THE PARTY OF THE PAR		7	<u>L</u>	***************************************
CONN	ഗ	0	OHMS	44.2		And	
ENCL	DPFG	D	DUTY	CONT	MX AMB		
SER.F.	1.00		And the second s	MATERIAL PROPERTY AND ADMINISTRATION OF THE PROPERTY OF THE PR	And other terms of the state of		Allowed the state of the state
SER.NO		Ш	E/S	3291977			
ALONG THE			A CONTRACTOR OF THE PROPERTY O	ALLOW THE PROPERTY OF THE PROP		And the second s	THE PARTY AND TH
ODE BRG	6210	Q	DE BRG	6211			A LANGUAGE AND A LANG
BRUSH	28610-1	3	QTY	9		A AND THE RESERVE AND THE PARTY OF THE PARTY	The same of the sa
	The second secon						

Product Information Packet: DMG2340 - W/1750RPM/DC/DPFG/NEMA AD329AT

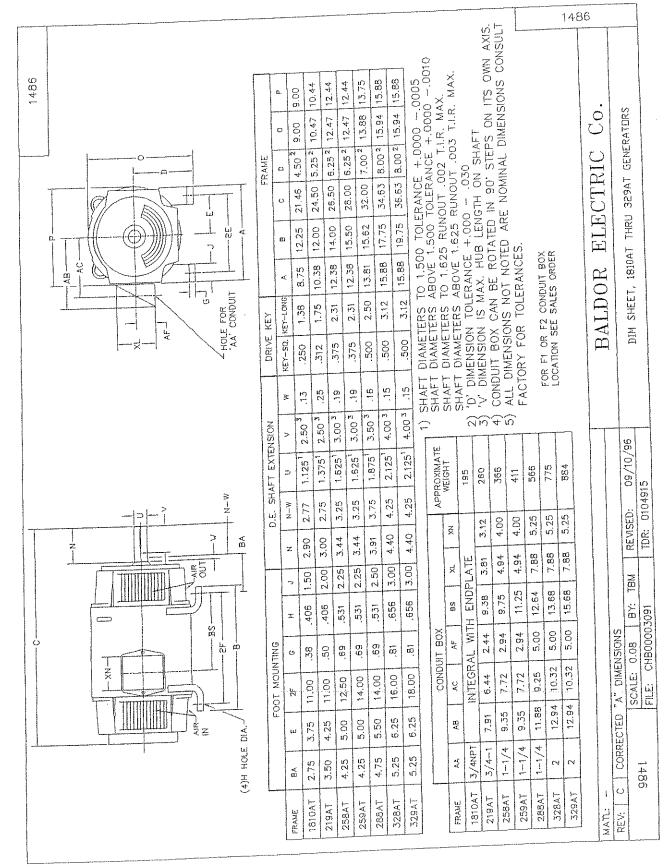
BALDC. . RELIANCE

DALDA

THE PROPERTY OF THE PROPERTY O		
40KW/1750RPM/DC/DPFG/NEMA AD329AT	Product Information Packet: DMG2	JR · RELIANCE

MAT

Product ID	Description	Quantity	List Price
150449-31	GRD STUD ARG .312DIA STUD	1.000	3.00
15555-312	KEY .500 / .448 SQ	1.000	22.00
MN605	INTEGRAL HP DC MOTORS 5/05	1.000	ALL PARTY AND AL
BP5228R03	BR ROCKER ASSY, FR 28/32 3 BR/STUD	1.000	732.00
37146-7	VENT COVER FRAME 32 SERIES #18 GA STE	3.000	50.00
00000	GASKET COVER COM END FRAME 320 SERIES 3/	3.000	14.00
75020-2	ATA IC CINC 11 TO ALL TO A CO. CO. CO.	12.000	2.00
10XN3118K08	5/16-18 X .50 GKADE #5, SIL, ZINO FLAIE	Management of the Committee of the Commi	00 001
MG1025G05	PAINT DRK MET. GRAY, W/ACTIVATOR	0.120	00.701
トロンスによっています。	NPI RAI DOR GENERATOR DC ALUMINUM	1.000	22.00
10400	S HOW NOT TO THE TAKE THE STATE OF THE STATE	1.000	2.00
LB1009	LABEL, RUTATION DIRECTION (ON TOLES)		
151128	LABEL DC GENERATOR CONN. & TERMINAL MARK	DOO.1	00 603
PA2200	PACK FOR #2 SKID; STOCK	1.000	00.000
The state of the s			



SECTION 7

SINGLE-POLE DC CONTACTOR NEMA SIZE 2 (CC1-CC6) SINGLE-POLE DC CONTACTOR NEMA SIZE 3 (1L,2L)

SERVICE AND REPAIR PARTS Publication Named January 1988

NEMA SIZE 1, SINGLE POLE, NORMALLY ONEN, P/N 59311/59312/59313 SERIES NEMA SIZE 2, SINGLE POLE, NORMALLY OPEN, P/N 59321/59322/59323 SERIES

INSTALLATION AND ADJUSTMENT

Mount the contactor vertically on a rigid support. Refer to Figure 1 for proper clearances above the top of the contactor, dimension A, and in front of the Arc Shield, dimension B, for arcing clearance, or Arc Shield removal. nameplate data for correct equipment. Check that the contactor operating coil (26) is the correct voltage. With a all power removed, pivol the Arc Shield upwards and operate the contacfor by hand. The contact tips (21)(33) should meel SQUARELY. If they do not, align them by the procedure in the Contact Tip Adjustment. Pivot the Arc Shield back to its proper position. CAUTION: DO NOT OPERATE THE CON-TACTOR UNDER LOAD UNLESS THE ARC SHIELD IS PIVOTED TO THE FULLY DOWN POSITION.

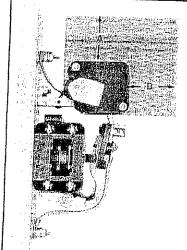
CONTACTOR TIP ADJUSTMENT

- With all power removed, remove the Arc Shield.
- Check that the square projection on the lower end of the movable contact (33) is seated in the recess in the finger board (32).
- Make sure that the stationary contact tip is against the stationary contact bracket located on the blowout coil assembly. (Fig. 2).
- 4. Replace the Arc Shield and pivol back to its proper position.

NTACT TIP REPLACEMENT

wie contact tips should be replaced when the contacts are word down to dimensions shown if Figure 2.

- With all power removed, remove the Arc shield,
- Remove the movable contact finger (33) by removing the sems screw (35) and brass washer (8). To remove spring (31), push down toward contact and twist to right or left and release.
- Remove the stationary contact tip by removing the Stainless Steel screw (1) and lockwasher located on stationary contact bracket (20).
- Install the new stationary contact tip using the Stainless Steel screw and lockwasher.
- Install new movable finger over spring hook on fingerboard. Replace spring by pushing down and releasing so that hook inside spring engages fingerboard hook. Replace shunt (36), brass washer and sems screw. On size 2 contactors, arc horn (34) is held under shunt by shunt screw (35).
- Manually operate the contactor and check the contact tips for alignment. Align the contact tips to meel squarely.
- Replace the Arc Shield and pivot back to its proper position.



ELECTRICAL CLEARANCES

Note: Shaded area for arcing clearances to ground, uninsulated enclosure or other control devies.

NEM	NEMA SIZES							
DIM.	1	2						
Α	2.5"	2.5"						
В	.75"	.85"						

Fig. 1

WARNING: ALL METAL PARTS OF THE CONTACTOR MAY BE AT LINE VOLTAGE. ALL POWER MUST BE DISCONNECTED FROM THE CONTACTOR BEFORE PERFORMING ANY ADJUSTMENT, MAINTENANCE OR TROUBLE-SHOOTING PROCEDURES.

CAUTION: FAILURE TO CONNECT THE OPERATING COIL TO THE PROPER VOLTAGE MAY RESULT IN IMPROPER CONTACTOR OPERATION OR DAMAGE TO THE COIL.

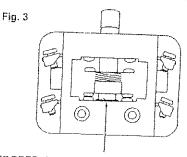
Fig. 2	A		ACTOR IZE	1	A IMENSION REPLACE
SIZE 1, 2 N.O.	(21) (20)	1	N.O.	3/8"	7/32"
,,,,,,		2	N.O.	13/32"	1/4"

AUXILIARY ELECTRICAL CONTACTS

 With all power removed, check that auxiliary contact (39) has the proper follow-up. With new auxiliary contacts, the correct operating height is as shown in Fig. 3 when the armature (30) is FULLY CLOSED.

The Auxiliary Electrical Contacts should be replaced when inspection of the contacts shows that they are Burned or badly Pitted. It is necessary that the entire auxiliary block be replaced as a unit.

 With all power "OFF", loosen terminal screws and remove terminal leads. NOTE POSI-TION OF LEADS so they can be replaced properly.



PROPER OPERATED HEIGHT
The snap ring on plunger is even with bottom edge of cover opening

- Remove fingerboard (32) by removing screws (12) and washers (13).
- Remove Contact Assembly by removing slotted screws (38).
 - Install NEW CONTACT ASSEMBLY as shown in the exploded view.
- Replace lingerboard, lockwashers and screws.
- Manually operate the contactor and check the moving contacts for proper follow-up in Fig. 3.
- 7. Replace leads on terminals.

COIL REPLACEMENT

- With all power removed, disconnect the coil leads.
- Remove the hinge pin locknut (30) and hinge pin (30). The hinge pin is THREAD-ED into the armature side piece.

- 3. Remove the armature assembly (30).
- Remove the brass screw (29) on the front of the magnet core and remove non-magnetic spacer (28), core cap (27) and coil (26).
- 5. Install the new coll using the core cap, non-magnetic spacer and tighten the brass screw. Note that the steel core cap, which is thicker than the non-magnetic phosphor bronze spacer, bust be installed against the coll. (See Exploded View).
- Replace armature, hinge pin, lock washer and locknut.
- 7. Reconnect the coll leads.

SHUNT REPLACEMENT

The shunt (36) should be replaced when the flexible braided wires are broken or burned or if the wires are loose in the terminal connectors on either end of the shunt:

- With all power removed, disconnect the bottom end of the shunt (26) by removing hex nut (4), washer (3), and shunt.
- 2. Disconnect the top end of the shunt by removing screw (35), washer (8) and the shunt
- Install the new shunt. Connect the top end of the shunt by replacing washer and screw
- Connect the bottom end of the shunt by replacing the shunt, nut and washer.

CAUTION: SHUNT MUST BE DIRECTLY AGAINST MOVABLE CONTACT (33) OR ARC HORN (34) AT THE TOP END AND DIRECTLY AGAINST THE WIRE TERMINAL AT THE BOTTOM.

Size 1 and 2 Normally Open Contactor

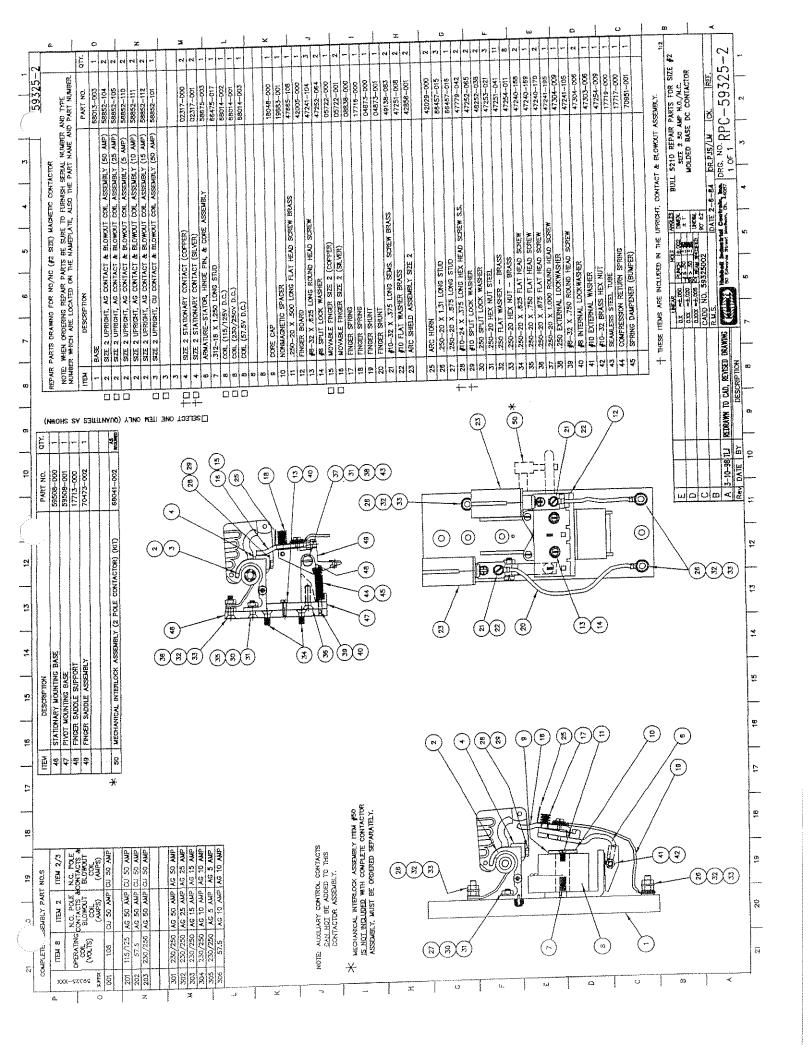
				Qty.			The state of the s			Qty.	
Item		Part No.	1 Pole	2 Pole	3 Pole	ltem No.	Description	Part No.	1 Pole	2 Pole	3 Pole
No.	Description					* 21	Stationary Contact Tip	2315-000	1	2	3
1	Base (Size 1 & 2)	68013-001	1	1		Z., 1	(Standard, Size 1)				
	Base (Size 1 & 2)	68013-002		1	1		Stationary Contact Tip	2317-000	1	2	3
	Base (Size 1)	68013-003			1		(Standard, Size 2)				
	Base (Size 2)	68035-001	2	4	6		Stationary Contact Tip	2315-001	1	2	3
2	Stud (1/4-20 x 1-1/8")	66475-015	2 2	4	6		(Silver, Size 2)				
3	Flat Washer (Brass, 1/4")	48251-010		10	15		Stationary Contact Tip	2317-001	1	2	3
4	Hex Nut (1/4-20)	47253-021	5		3		(Silver, Size 2)				
*5	Arc Shield Assembly (Size 1)	42855-000	1	2	3	22	Groove Pin	57404-001	1	2	3
	Arc Shield Assembly (Size 2)	42856-000	1	2	ა 3	23	Lockwasher (1/4°)	47252-038	1	2	3
6	Blowout Coll Support (L.H., Size 1)	42872-000	1	2	3	24	Stud (5/16-18 x 1-1/4")	66475-017	1	1	1
7. 7	Blowout Coll (5 Amp) Size 1	58726-004	1	2	3	25	Core	58660-001	1	1	1
. '	Blowout Coil (10 Amp) Size 1	58726-003	1	2	ა 3	*26	Coil (57.5 Volts)	68014-003	1	1	1
	Blowout Coil (15 Amp) Size 1	58726-006	1	2		. 26	Coil (115/125 Volts)	68014-002	1	1	1
	Blowout Coil (25 Amp) Sizes 1 & 2	58726-002	1	2	3		Coll (230/250 Volts)	68014-001	1	1	1
	Blowout Coil (50 Amp) Size 2	58726-001	1	2	3	07	Core Cap	18048-000	1	1	1
8	Flat Washer (Brass, No. 10)	47251-008	2	4	6	27	Non-Magnetic Spacer	19683-001	1	1	1
9	Lockwasher (No. 10)	47252-065	2	4	6	28	Flat Head Screw (Brass,	47665-108	1	1	1
-	Hex Head Screw - Stainless	47779-042	2	4	6	29		.,			
10	(10-24 x 3/8")						1/4-20 x 1/2") Armature-Stator-Hinge Pin	58675-001	1	1	1
11	Blowout Coil Core (Size 1)	42023-000	1	2	3			30012 001	•	-	
11	Round Head Screw (8-32 x 5/8")	47241-104	3	4	5		Assembly (Circ 1)	4657-000	1	2	3
. 12	Size 1					* 31	Finger Spring (Size 1)	8838-000	1	2	3
	Round Head Screw (8-32 x 5/8")		0	2	2		Finger Spring (Size 2)	42005-000		1	1
	Size 2	47241-104	2	_		32	Finger Board	5721-000	1	2	3
40	Lockwasher (No. 8) Size 1	47252-064	3	4	5	* 33	Movable Finger (Standard,	3721-000	'	-	
13	Lockwasher (No. 8) Size 2	47252-064	2	2	2		Size 1)	5722-000	1	2	3
	Lockwasher (No. 6) 5126 2	68040-001	1				Movable Finger (Standard,	57 22-000	•	-	
14	Mechanical Interlock Assembly Kit	000100					Size 2)	E204 000	1	2	3
	(includes item 18)	68040-002		1	1		Movable Finger (Silver,	5721-000	1	2	J
	Mechanical Interlock Assembly Kil	00040 001					Size 1)	wmon 004		0	
	(Includes Item 18)	42871-000	1	2	3		Movable Finger (Silver,	5722-001	1	2	3
15	Blowoul Coil Support (R.H., Size 1)	42014-000	2	4	6		Size 2)			•	
16	Blowout Coil Insulator (Size 2)		1	2	3	34	Arc Horn (Size 2 Only)	42029-000		2	3
17	Blowoul Coll Core (Size 2)	42024-000	1	1	1	35	Sems Screw (10-32 x 3/8")	47800-128		2	3
18	Round Head Sems (10-24 x 3/8")	00 (75 040	1	2	3	36	Finger Shunt (Size 1)	4870-001	1	2	3
19	Slud (1/4-20 x 7/8")	66475-016	ı	2	Ų	D.C	Finger Shunt (Size 2)	4873-000	1	2	3
				^	3	37	Auxiliary Contact Assembly	68040-003	}	as req	d
20	Stationary Contact Support (Size 1)	58661-001	1	2	3	31	Kit (Consists of items 38,				
	Stationary Contact Support (Size 2)	58661-002	1	2	s		39, and 40)				
						20	Screw (8-32 x 2-1/16")		2	oer auxi	diary
						38		67976-001		as reg'	
						*39	Auxiliary Contact Block	01010-001		,	
						40	Lockwasher (No. 8)			oer auxi	нену

^{*} Recommended Parts for Maintenance



TROUBLE SHOOTING

	POSSIBLE CAUSE	SOLUTION
TROUBLE Contacts will no Uperate or operation is sluggish.	1. Improper or defective operating coil. 2. Low control circuit 3. Loose connection in control circuit. 4. Mechanical interference or binding.	 Check coil part number resistance to determine if coil is defective. Check that control circuit voltage is a minimum of 80% of rated coil voltage. If it is zero, the problem is elsewhere in the circuit. Check connections and tighten if loose. Check for mechanical interference or bindings: Check mechanical interlock interference. Manually close the contact arm, check that the armature hinge pins are not binding.
Contacts will not open.	Core cap spacer damaged or missing.	Inspect core cap spacer. Check contact tips and shunt connections and tighten if loose.
Contact tips overheating, short contact tip life.	Loose connections. Movable or stationary contact tip not properly aligned	Check contact tips and shark educations of the ADJUSTMENT-Contact Tip Alignment instructions in this Service Bulletin. Check for positive contact pressure from spring (31).
	Foreign matter on contact surfaces. Contact tips worn beyond recommended limits. Contact surfaces severely scored or burned.	 Remove foreign matter. Check for contact war by the procedure listing in the MAINTENANCE-Contact Tip Replacement instructions in this Service Bulletin. Inspect contact surfaces and dress with a file as required. Check that arc shield is pivoted to the fully down position.
	Arc shield not properly installed Normal load currents below 5% of rated current of contactor. Excessive current.	Use a smaller size contactor to improve blowout action. . Check that load currents are within contactor rating.
Operating Coil Overheats.	Improper or defective High voltage condition on coll.	Check coil part number and resistance to determine if coil is defective. Check that control circuit voltage does not exceed 110% of rated coil voltage for extended periods.
	3. Loose connection at coil terminals.	3. Check connection and tighten if loose.



May 1982 Repl.: Mav. 1980

SERVICE AND REPAIR PARTS

NEMA SIZE 3, SINGLE POLE, NORMALLY OPEN, P/N 59331 & 59335 SERIES NEMA SIZE 4, SINGLE POLE, NORMALLY OPEN, P/N 59341 & 59345 SERIES

INSTALLATION AND ADJUSTMENT

Mount the contactor vertically on a rigid support. Refer to Figure 1 for proper clearances above the top of the contactor, dimension A, and in front of the Arc Shield, dimension B, for arcing clearance, or Arc Shield removal. Check nameplate data for correct equipment. Check that the contactor operating coils (31) is the correct voltage. With all power removed, pivol the Arc Shield upwards and operate the contactor by The contact tips (8) should meet SQUARELY. If they do not, align them by the procedure in the Contact Tip Adjustment. Pivot the Arc Shield back to its proper position. CAU-TION: DO NOT OPERATE THE CONTACTOR UNDER LOAD UNLESS THE ARC SHIELD IS PIVOTED TO THE FULLY DOWN POSITION.

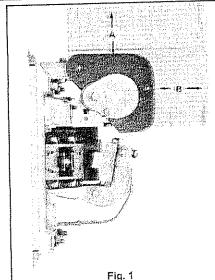
CONTACTOR TIP ADJUSTMENT

- With all power removed, pivot the arc shield upward.
- Check that the movable contact tip is against the ledge located on the movable contact holder (36) (Fig. 2).
- Make sure that the stationary contact bracket located on the blowout coil assembly. (Fig. 2).
- The contact tip surfaces must be aligned both vertically and horizontally (Fig. 2).
- Pivot the Arc Shield back to its proper position.

CONTACT TIP REPLACEMENT

The contact tips should be replaced when the contacts are worn down to dimensions shown if Figure 2.

- With all power removed, remove the Arc shield.
- Remove the movable contact tip by removing the Stainless Steel cap screw and lockwasher located on movable contact holder
- 3. Remove-the-stationary-contact_tip_by_removing the Stainless Steel cap screw and lockwasher located on stationary contact bracket (30).
- install the new stationary contact tip using the Stainless Steel screw and lockwasher
- Install the new movable contact tip using the Stainless Steel Screw and lockwasher.
- Manually operate the contactor and check the contact tips for alignment. Align the contact tips to meet squarely.
- Pivot the Arc Shield back to its proper posi-



ELECTRICAL CLEARANCES

Note: Shaded area for arcing clearances to ground, uninsulated enclosure or other control devices.

NEMA SIZES						
DIM.	1	2				
Α	4 1/4"	4 1/4"				
В	2 3/4"	2 3/4"				

WARNING: ALL METAL PARTS OF THE CONTACTOR MAY BE AT LINE VOLTAGE. ALL POWER MUST BE DISCONNECTED FROM THE CONTACTOR BEFORE PERFORMING ANY ADJUSTMENT, MAINTENANCE OR TROUBLE-SHOOTING PROCEDURES.

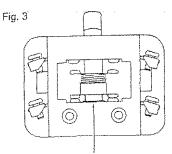
CAUTION: FAILURE TO CONNECT THE OPERATING COIL TO THE PROPER VOLTAGE MAY RESULT IN IMPROPER CONTACTOR OPERATION OR DAMAGE TO THE COIL.

Fig. 2 SIZE 3, 4	74/	CONTACTOR SIZE		A MATED DIMENSION NEW REPLACE		
N.O.		3	N.O.	9/16"	5/16"	
		4	N.O.	9/16"	5/16"	

AUXILIARY ELECTRICAL CONTACTS

- With all power removed, check that auxiliary contact (62) has the proper follow-up. With new auxiliary contacts, the correct operating height is as shown in Fig. 3 when the armature (46) is FULLY Closed.
- If adjustment is needed bend the lower portion of the Knockers (44) (65).

The Auxiliary Electrical Contacts should be replaced when inspection of the contacts shows that they are Burned or badly Pitted. It is necessary that the entire auxiliary block be replaced as a unit.



PROPER OPERATED HEIGHT The snap ring on plunger is even with bottom edge of cover opening.

- With all power "OFF", loosen terminal screws and remove terminal leads. NOTE POSITION OF LEADS so they can be replaced properly.
- Remove Contact Assembly by removing slotted screws (60).
- Install NEW CONTACT ASSEMBLY as shown in the exploded view.
- Manually operate the contactor and check the moving contacts for proper follow-up in Fig. 3.
- 5. Replace terminal leads,

COIL REPLACEMENT

- With all power removed, disconnect the coil leads.
- Remove the armature bearing pin (45) by loosening the set screw (50).
- 3. Remove the armature assembly (46).
- 4. Remove the brass screw (35) on the front of the magnet core and remove non-mag-

- netic spacer (34), core cap (33) and coil (31).
- Install the new coil using the core cap, non-magnetic spacer and tighten the brass screw. Note that the steel core cap, which is thicker than the non-magnetic phosphor bronze spacer, must be installed against the coil. (See Exploded View).
- Replace the armature and armature bearing pin and tighten set screw.
- Check that contact bearing pin (48) is centered and set screw (37) is tight.
- 8. Reconnect the coll leads.

SHUNT REPLACEMENT

The shunt (36) should be replaced when the flexible braided wires are broken or burned or if the wires are loose in the terminal connectors on either end of the shunt:

- With all power removed, disconnect the bottom end of the shunt (39) by removing hex head screw, lockwasher, washer and shunt.
- Disconnect the top end of the shunt by removing hex nut (38), lockwasher and the shunt
- 3. Check that contact bearing pin (48) is centered and set screw (37) is tight.
- Install the new shunt. Connect the top end of the shunt by replacing lockwasher and hex nut.
- Connect the bottom end of the shunt by replacing the shunt, washer, lockwasher and hex head screw.

CAUTION: SHUNT MUST BE DIRECTLY AGAINST MOVABLE CONTACT (33) OR ARC HORN (34) AT THE TOP END AND DIRECTLY AGAINST THE WIRE TERMINAL AT THE BOTTOM.

Item	Description	Part No.		ty. Size	Item No.	Description	Parl No.		ùty. e Size 4
No.	Description		3	4			58664-001	1	1
1	Mounting Pan	68005-001	1	1	32	Stator Core	16940-000	1	1
2	Base	67995-001	1	1	33	Core Cap	19683-001	1	1
2A	Base	67995-002	1	1	34	Non-Magnetic Spacer – Brass	47665-108	1	1
* 3	Arc Shield Assembly	16973-000	1		35	Flat Head Screw - Brass	47000*100	•	•
	Arc Shield Assembly	16993-000		1		(1/4-2 × 1/2")	ፈውስሳማ ሰብስ	1	1
4	Spacer (Blowout Guard Mounting)	66870-015	1	1	36	Movable Contact Holder	16927-000	1	1
4A	Arc Shield Retainer	59653-100		1	37	Set Screw (1/4-20)	47103-022		1
+/ 5	Blowout Coil Guard Assembly	16922-000			38	Hex Nut (1/4-20)	47253-021		ŧ
,	Blowout Coil Guard Assembly	17370-000		1	39	Shunt Assembly	68000-001	-	1
5A	Blowout Coil Guard Assembly	68054-001	1			Shunt Assembly	68000-002		4
3M	Blowout Coil Guard Assembly	68054-002		1	40	Hex Head Screw (1/4-20 x 3/4")	47246-064		4
6	Lockwasher (1/4")	47252-038		9	41	Flat Washer (1/4")	47250-502		1
5 7	Hex Head Screw (1/4-20 x 1-3/4")	47246-070		1	42	Auxiliary Contact Assembly Kit	68040-001	1	1
7 7 A	Hex Head Screw (1/4-20 x 1-1/4")	47246-068		1		(Consists of items 43, 44,			
' 8	Contact Tip (Standard)	16924-000				60, 61 and 62)	00040.000		
0	Contact Tip (Standard) Contact Tip (Standard)	17279-000		2	42A	Double Auxiliary Contact Assembly	68040-002	. 1	7
	Contact Tip (Standard) Contact Tip (Silver)	16924-001				Kit (Consists of Items 43, 60, 61,			
	Contact Tip (Silver)	17279-001		2		62, 63, 64 [two required], and 65)		_	
٠,	Hex Head Cap Screw – Stainless	47779-063		2	43	Sems Screw (8-32 x 5/16")		2	2
9	Hex Head Cap Sciew - Granicos		_		44	Auxiliary Knocker	*****	1	1
400	(1/4-20 x 5/8") Blowout Coil Assembly (Standard)	67998-001	1		45	Armature Bearing Pin	58843-000		1
100	Blowout Coil Assembly (Standard) Blowout Coil Assembly (Standard)	67998-002		1	46	Armature Assembly	17354-000		1
	Blowout Coil Assembly (550 Volts)	67998-003		-	47	Contact Spring	16960-000		
		67998-004		1		Contact Spring	17556-000		1
464	Blowout Coil Assembly (550 Volts)	67998-005		•	48	Contact Bearing Pin	16968-000		1
10A	Blowout Coil Assembly (Standard)	67998-006		1	*49	Arc Horn	16925-000		1
	Blowout Coil Assembly (Standard)	67998-007		,	*49A	Arc Horn	68056-000		
	Blowout Coil Assembly (550 Volts)	67998-008		1	50	Hinge Pin Screw (10-24 x 3/8")	47103-00		
	Blowout Coil Assembly (550 Volts)	16962-000		•	51	Stator Assembly	17356-000		
11	Blowout Coil Core Insulator	17351-000		1	52	Stud (3/8-16 x 1-5/8")	66475-014		
	Blowout Coil Core Insulator	17348-000		•	53	Hex Nut (5/16-18)	47253-60		
12	Blowout Coil Core	17349-000		1	54	Flat Washer (5/16")	47250-50		
	Blowout Coil Core	16961-000		2	55	Bottom Terminal	67997-00		
13	Blowout Coil Insulator Washer	16964-000		1	56	Hex Head Screw (5/16-18 x 3/4")	47246-079		
14	Flux Plate Assembly (R.H.)			2	57	Hex Head Screw - Stainless	47779-06	51	1
15	Lockwasher (1/4" External Tooth)	47303-008 47253-20		1	U I	(1/4-20 x 1")			
16	Hex Nut (1/4-20)	68041-00		1	58	Flux Plate Assembly (L.H.)	16965-00		
17	Mechanical Interlock Assembly Kit	00041-00	<i>)</i> [1	59	Hex Head Screw (1/4-20 x 2-1/2")	47246-07		
	(Consists of items 18 thru 24)		1	1	60	Screw (8-32 x 2-1/16")		2	
18	Hex Nut (1/4-20)		1	1	61	Lockwasher (No. 8)		2	
19	Lockwasher (1/4")		2	2	*62	Auxiliary Contact Block	67976-00		
20	Flat Washer (1/4")		1	1	63	Sems Screw (6-32 x 1-1/2")		2	
21	Interlock Bar		1	1	64	Nut (6-32)		2	
22	Collar		1	1	65	Knocker, Double		1	
23	Mounting Plate Assembly		2	2	66	Tie Bar Kit	59400-00	4 1	1
24	Flat Head Screw (8-32 x 3/8")	1990 10 00		1	00	(Consists of items 67 thru 71)			
25	Hex Head Screw (5/16-18 x 1/2")	47246-00		5	67	Round Head Screw (8-32 x 1/2")		4	
26	Lockwasher (5/16")	47252-03		5 1	68	Lockwasher (No. 8)		4	
27	Contact Support Bracket	67999-00			69	Washer (No. 8)		4	4
28	Socket Head Screw (5/16-18 x 3/4")	47100-08		1		Spacer		4	
29	Blowout Coil Spacer	16971-00		1	70 71	Tie Bar		1	1
30	Stationary Contact Bracket	58665-00			7.1	HE Dat			
* 31	Operating Coil (230/250 Volts)	17359-00							
	Operating Coil (115/125 Volts)	17487-00							
	Operating Coil (57.5 Volts)	17488-00	0 1	1					

^{*} Recommended Parts for Maintenance

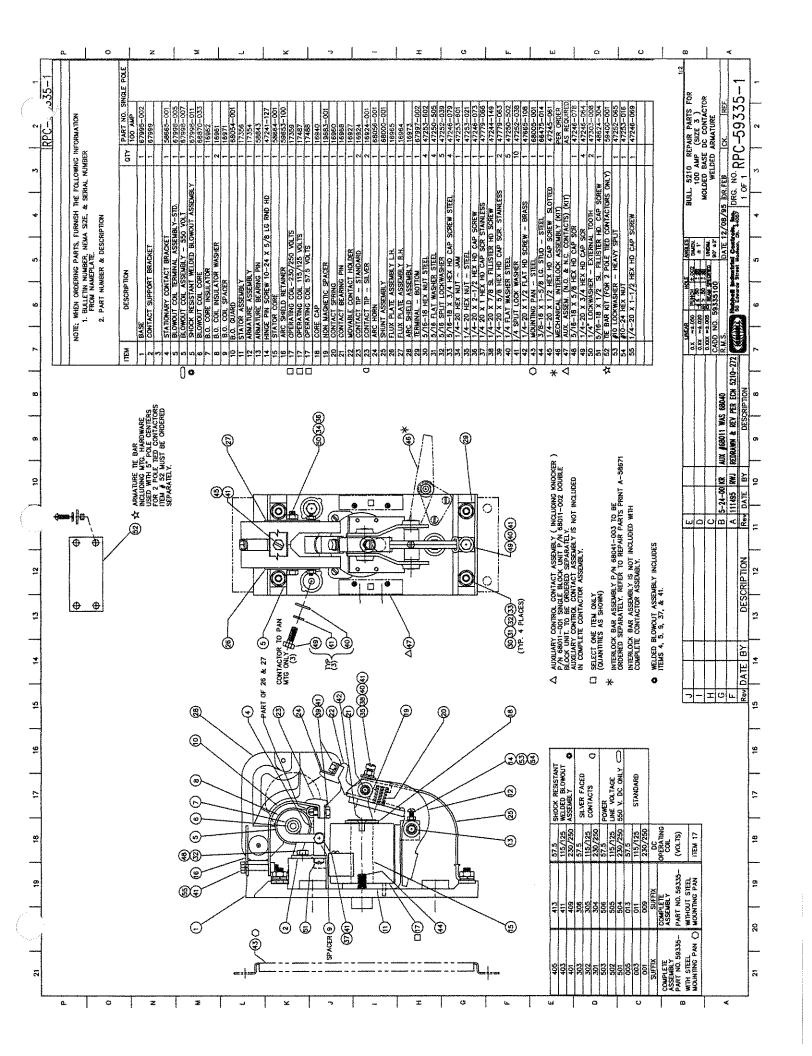


	NI A PIT	
)	CHART OHMS at 20° C±10%	(a) (a)
Coil P/N - Voltage	95	7A-1
		6-6
17487 115/125	1	
17359 230/250	1500	3 () B A (4A-1)
62	56 59 57 41 56 55 54 26 53 61 60 61 60	13

TROUBLE SHOOTING

TROUBLE SHOOTING SOLUTION						
TROUBLE	POSSIBLE CAUSE	Check coil part number resistance to determine if coil is defective.				
Contacts will no operate or operation is sluggish.	Improper or defective operating coil. Low control circuit voltage.	 Check that control circuit voltage is a minimum of 80% of rated coil voltage. If it is zero, the problem is elsewhere in the circuit. 				
	3. Loose connection in control circuit.	3. Check connections and tighten if loose.				
	4, Mechanical interference or binding.	4. Check for mechanical interference or bindings:				
		4a. Check mechanical interlock interference.				
		4b. Manually close the contact arm, check that the armature hinge pins are not binding.				
		 Manually close the contactor, check that the armature bearings are not binding. 				
Contacts will not open.	Core cap spacer damaged or missing.	1. Inspect core cap spacer.				
Contact tips overheating, short	Loose connections,	Check contact tips and shunt connections and tighten if loose.				
contact tip life.	Movable or stationary contact tip not properly aligned	Align contact tips by the procedure listed in the ADJUSTMENT-Contact Tip Alignment instructions in this Service Bulletin. Check for positive contact pressure from spring (31).				
	Foreign matter on contact surfaces.	3. Remove foreign matter.				
	Contact tips worn beyond recommended limits.	Check for contact war by the procedure listing in the MAINTENANCE-Contact Tip Replacement instructions in this Service Bulletin.				
	Contact surfaces severely scored or burned	5. Inspect contact surfaces and dress with a file as required.				
	6. Arc shield not properly installed	6. Check that arc shield is pivoted to the fully down position.				
	Normal load currents below 5% of rated current of contactor.	7. Use a smaller size contactor to improve blowout action.				
	8. Excessive current.	8. Check that load currents are within contactor rating.				
Operating Coll Overheats.	Improper or defective	Check coll part number and resistance to determine if coll is defective.				
	2. High voltage condition on coil.	Check that control circuit voltage does not exceed 110% of rated coil voltage for extended periods.				
	3. Loose connection at coll terminals.	3. Check connection and tighten if loose.				

Hubbell Industrail Controls, Inc. a subsidiary of Hubbell Incorporated 4301 Cheyenne Dr., Archdale, NC 27263 Telephone (336) 434-2800 • FAX (336) 434-2803 http://www.hubbell-icd.com Sales@hubbell-icd.com



SECTION 8

LAMBDA L W SERIES POWER SUPPLY



Lambda Electronics Inc.

515 Broad Hollow Road Melville, New York 11747-3700 United States of America

Tolephone +1 516 694 4200 Faceirnile + 1 516 293 0519 http://www.lamtxla.com

Instruction Manual for Lambda Electronics Model LWD-30

.012.000.



A Slebe Group Company

INSTRUCTION MANUAL LWD30 SERIES

SPECIFICATIONS

aper age.

INOP'I	LUDOS ALTO	LW030-0524	LUNAN_1919	LWD30-1224	LWD30-	1516
MODEL	LW030-0512			CH1 CH2	CH1	CH2
ITEMS		_ CU1 CU2		12 24	15	15
1 Nominal Output Voltage 1	5 12	524	12 12 1.2 1.2	1 2 0 6	1.0	
	3.0 1.2	3.0 1.0.6	20 0	28, 8		
3 Haximum Output Power V		29.4	28.8		30	
4 Efficiency (IVp) (*1)	śZQ	68	70	72		1
5 Input Voltage Range (*2)	85	-265VAC (47 - 44	OHZ) or 110∼330	NAC	NA / 200	patra)
8 Input Current (Ivp) (*6)/	. AC Input Voltar	ie and Freq. Rang	e shown on Panci	_tapet_:_85~~25t	JYAC, 147	<u>- 631(Z)</u>
	4		0.72 / 0.36			,
7 In-rush Current (Typ) (*8)/		14A. at:	100VAC : 284 at	200VAC		
8 Output Voltage Range (lyp)	1	<u>, CH1 : (+5%,-0%</u>) : _CH2, : FIXED	(±5X)	7	
9 Haximum Ripple & Noisc h	100 150	100 200	150150	150 200	150	150
10 Haximum Line Regulation (*3)	/ 50 120	50 240	120 120	120 240	150	150
lift Having min Load Regulation (*4) bi	J 100 240	100 480	240 240	240 480	300	300
12 Over Current Protection (*51)	4	More tha	n 105% for each	<u>channel</u>		
13 Over Voltage Protection (*7)	r	CH1_On	y 115% ~	135%		
14 Hold-Up Time (*6)h			Hore than 20 / 1	00		
G Remote ON/OFF Control 7 Parallel Operation						
18 Series Operation						
19 Operating Temperature 19	1 0 ~ 6027	0 °C ~ 40°C	100% 50%	C 60% 60	Υ	40%
PO Operating Humidity	1		304 ~ 904 BH			4.00
21 Storage Temperature						
		*				
22 Storage Humidity	·		Convection cool			
P3 Cooling	CHI	. Less than 1%			BOY	,
	i Innit	Chassis Input	. Outnut 2.8	KVAC for 1 min	6 20mA	
25 Withstand Voltage K	/ India	than $100M\Omega$ at				
26 Isolation Resistance (*9)C	nore		1 41 B	BIN THA INT TOTAL	_B!.[11	
R7 Vibration S						
28 Strock C			Less than 20	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,		
29 Weight p		-76	8, 84	o Sutling Snowle	.a.\	
NOTES .						
MOIES						
*1 : At 100VAC and Haximum Gutput Power.						
*2 : For cases where conformance to various safety specs (UL, CSA, etc.)						
are required, input voltage and frequency range will be 85 ~ 250VAC,						
are regarded, input varieties and recovery range arm to be $47 \sim 63 \text{ Hz}$.						
*3 : From 85 ~ 265YAC or 110 ~ 330VDC,						
*3 : From 85 ~ 265VAC Or.110 ~ 330VDC, *4 : From No Load to Maximum Load, constant input voltage,						
*5 : Foldback current limiting		stuvei y.				
*G : At 100VAC/200VAC, 30W Outp						
*7 : Inverter shul-down method,	manual resot.		: lunn			
*8 : When resuming operation in						
at No load, softstart circuit will not limit the in-rush current						

- at No load, softstart circuit will not limit the in-rush current
- at turn on. *9 : Output Chassis.



LWD30 SERIES

OUTPUT VOLTAGE RANGE

By means of V. ADJ. in the power supply, output voltage, can be adjusted within the range of nominal voltage $-0\% \sim +5\%$.

Turning clockwise increases the voltage.

CAUTION: Increasing the voltage excessively, i.e. more than the nominal 5%, may cause the over-voltage protection (OVP) device to operate.

OVER CURRENT PROTECTION

There is an over-current protection (OCP) function built-in. When any excessive current or an output short-circuit occurs, OCP operates to shut down the power supply intermittently. On removing the over-current condition, the supply automatically recovers. The OCP setting is fixed and cannot be adjusted.

OVER VOLTAGE PROTECTION

There is an over-voltage protection (DVP) function built in CH1. After DVP activates, a minimum time lapse of 30 sec. is required from the moment of switching off the input before switching on the input again. BVP setting is fixed at $115\sim125\%$ of CH1 nominal output voltage.

OUTPUT RIPPLE/NOISE

311

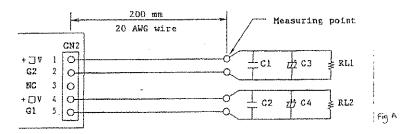
11 /42

3,000

To measure the output ripple/noise, please refer to Fig A for the connections. Accurate measurements cannot be made if the ground wire of the oscilloscope probe is too long. (Bondwidth of stope: 20 MHz DIM). For better noise characteristics,

(a) input and output wiring should be separated;

(b) input wires as well as output wires should be twisted.



Cl, C2 : Film Capacitor

0.luF

C3 : Electrolytic Capacitor

100uF

C4 : Electrolytic Capacitor

.470uF

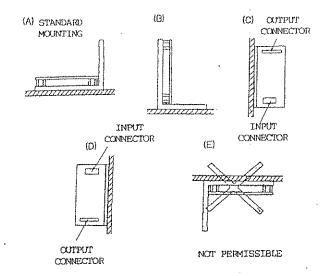
INPUT SURGE CURRENT SUPPRESSION

Suppression of input surge current is built-in. However, if a few units are used together, care must be taken in the selection of the input switch and external fuse.

WITHSTAND VOLTAGE/ ISOLATION RESISTANCE

CAUTION: Before testing ensure that both input terminals as well as output terminals are shorted. The high voltage applied should be gradually increased from or reduced to zero, to avoid any excessive transient pulses.

MOUNTING POSITION



OUTPUT DERATING

(PERCENTAGE OF FULL LOAD)

MOUNTING POSITION TEMPERATURE	А	В	С	а
20°C -	100	100	100	100
30°C	100	100	100	100
40°C	100	100	80	- 100
50°C	60	60	50	60.
60°C	4,0	40	30	40

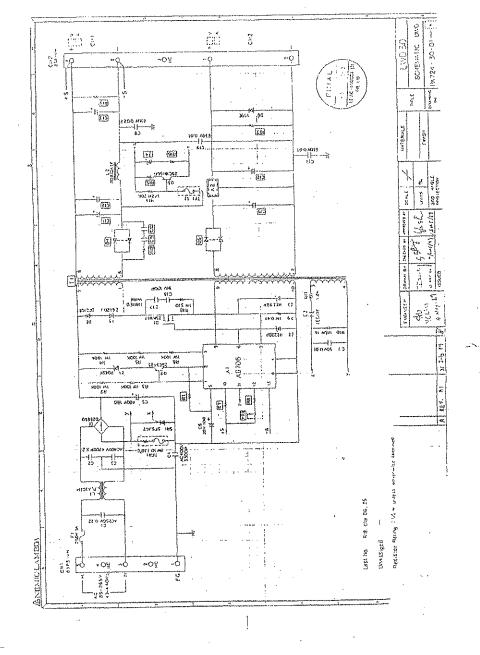
FUSE

TATING: 250V 3A UL/CSA or IEC-Approved type should be used to meet safety requirements. When changing fuse, ensure that the same type and rating is used. Avoid using fast-blow fuse.



region of 46

CUT_NE DWS PARTICIO - 0 - 01-£.№. 30 100 CHAND CRUPING BOOL 4 TC-16. MARUPACTURER * J.S.E.) [3.7] NAUFACTURER 5.8.3 EX.2 TITLE FINAL - X OUT IND REMCHASIM IN 13 EL . SVH-237-PLS YHH - 5N PART NAME B3P5-VH HATERALS FreSt SOCKET HOUSING COUTPUT SIDE CN23 PART OESCHPTION
PIN HEADER
(HMOT SIDE CN1)
PIN HEADER
(OUTPUT SIDE CH2) CONNECTORS USED SOCKET HOUSING CHANT SIDE CHIT HODEL KAME, DUPUT VOLINGE MED CHROEKT ARE INDICATED BELLOW: ACCESSORIES: TERMINAL PINS JAND ANGLE PROJECTION (1) = 9 gr 6 (4,4 with 2) APPROVED BY SCALE 2-13 Had a Like 05. N AC 3 2 314V (45) West to the state of the state NATE 2: COUNTRY OF HANGFOLDS WILL BE SHOWN AS EITHER ASSENDLED IN SIKAAPORE OR MADE IN JAPAN OR MASENELED IN HALARSIN. HOTE 1: HOWELMS SCREW MUST NOT PROTRUCE INTO THE POWER SUPPLY BY MORE THAN 4H/M. 50,001 138 tas 15071 22 35 \$ -0 7 E E. P **ANEMICLAMBLA** 9.4E 7157 1:09

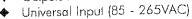




Low Profile Dual & Triple Output



Outputs 2 and 3 isolated from output 1



	Key Market S	egments & Applications
1600	Factory Automation	Process Control, NC-Machining, Automotive, Packaging Equipment, Materials Handling, Chemical Processing, Robots
	Test & Measurement	Burn-in & Test, Automated Test, Instrumenlation,
	Automated Service	Measurement, Detection Vending Machines, Elevators, Video Gamina, Point of Sale Equipment

Features and Benefilts

Feature

- ◆ Low Profile
- ♦ Isolated 2nd and 3rd outputs
- ♦ Wattbox design on LWT

Benefit

♦ Assists System Integration

- Enable series operation for higher voltages
- Power trading between outputs

◆ Wattbox design on Lyvi				uran karrina valva (dalam dalam d	MANAGORAL SANGORAL SANGORA SANGORAL SANGORA SANGOR	(2) (1) (1) (1) (1) (1) (1) (1) (1) (1) (1
Specifications		Captille graph (Sec	Explored Section 1995	Commence of the second		
MOD	EL	LWD15	LWD30	LWT15H	LWT30H	LWT50H
ITEMS Max Output Power (lyp) Efficiency (Typ)	W. %	15: 64	70 %/30 % % % % % % % % % % % % % % % % % % %	72	30 73	50 0 4 9 72
AC Input Voltage range	15-21		110 - 350VDC	- 265VAC (47 - 44		110 - 330VDC
DC Input Voltage range Input Current Typ (100/200VAC) Inrush Current (110/200VAC)	A A	0.4/0.2 17/34	0:72/0:36	14/28	0.7/0.42 16/32 5V: 15V to 15.75V	1.2/0/7 16/32
Output: 1 Voltage Adjustment Output Voltage Accuracy	-	Outpu	# 2 +5%	2v: #2.16; #2.0v;	Output 2 & 3 ±5%	
Temperature Coefficient Line Regulation Load Regulation			e de	1% 2%	ysymany maka	
Ripple & Noise Overcurrent Protection	-	5V:100mV, 12V & 15V	: 150mV, 24V: 200mV	>105%	100mV, Outputs 2 8	k 3: 150mV
Overvoltage Protection Hold Up Time (Typ at 100VAC)	V ms		Main output	only: 5.75 - 6.75V,	, manual reset	
Series Operation Operating Temperature	- .v <u>-</u>	LWD: 0°C	to +60°C, derate to +60°C, derate	as follows: 40°C: 1	100%, 50°C: 60%, 6	60°C: 40% 60°C: 60%
Storage Temperature Operating Humidity	°C.		30 - 9	-30 to ±85°C 20% RH (Non cond	ensing)	·
Storage Humidity			. 10'-9	95% RH (Nön:cond Convection		
Cooling Withstand Vollage Isolation Resistance		Input to Gnd, Input to	Output 2kVAC (20mA). > 100M at 25C 8	70%RH, Output to	2kVAC Input to Output 3 o Ground 500VDC	
Vibration (non operating) Shock	-	19	.6m/s²	10-55H 196.1m/s²	tz(1" min) <19.6m/:	
Safety Agency Approvals (1) Conducted EMI	-	UL60950-1, CSA60950 FCC ()-1,:B160950-1;CELMD Class A	VD	SA60950-1, EN609 E Class B, FCC Cla	ss B
Weight (Typ) Size (WxHxD)	g mm	180	250 Please	220 refer to outline dr	300 rawings	400
Warranty	-			One Year		

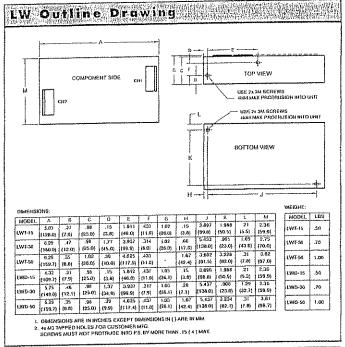
(1) LWD Series approved as ELV

Note: See Installation Manual for full details, test methods of parameters and application notes



LW Series

_011 E 19 11	t Rating	5		and the second
THE RESERVE	il in an all a second		70	Max
- (#)	Ada S		Min	4
Model	ூ ப	The state of the s		
LWD15-0:	512 V			1.5
	٧	_		0.6
LWD15-0		•		1.5 0.3
	V			0.3
LWD15-13		•		0.6
1,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	V			0.6
LWD15-12	224 V V	,		0.3
1.WD15-15	-			0.5
TAAD 12-13	V C10			0,5
LWD30-05				3.0
L441230-0.	V V	•		1.2
LWD30-05		_		3.0
1 277200.00	V V	•	0.0	0.6
LWD30-12	-	_	0.0	1.2
	V	2 12\	0.0	1.2
LWD30-12	224 V	1 12	/ 0.0	1.2
	٧	2 24\		0.6
LWD30-15	515 V	1 15		1.0
	٧			1,0
LWT15H-5				3.0
	V			0.6
	. V	_		0,4 3.0
LWT15H-5		•		0.6
	V			0.4
·	V 525 V			3.0
:LWT15H-5	525 V	•		0.6
	V			0.4
i LWT30H-5		~		5.0
27710071-5	, , , , , , , , , , , , , , , , , , ,	•		1.2
	V		/ 0.0	0.6
LWT30H-5	SFF V	1 5'	√ 0.7	5.0
	٧	2 +15	/ 0.0	1.2
	V	3 -15\		0.6
LWT30H-5	525 V] 5 [\]		5.0
1	V			1.2
1	٧			0.6
LWT50H-5				8.0 1.5
1	V			1.0
lugrect :	·== V	-		8.0
LWT50H-5	SFF V	*	•	
1	V V			
LWT50H-5		•		8.0
LYY LOWIT-C	,25 V	•	•	1.5
	v	~		1.0



Other Lam	bda Industrial Products
HWS	15W-1500W Single output
ZWQ	80W-170W Quad output
ZP	40W-60W Single, dual & triple output
SC40 & SC60	40W-80W Single & triple output, low cost

For Additional Information, please visit www.lambdapower.com/products/lw-series.htm

SPECIFICATIONS

PA724-01-014

Nominal Output Voltage						1		1	
1 Nominal Output Voltage	i			LHD30~0512	LWD30-0024	LWD30-1212	FMD20-1224		
12 Maximum Dutput Power	1 11				5 , 24	12 , 12	12 , 24		
13 Maximum Dutput Power W 27.4 27.5	1 21	Maximum Output Current	A	3,1.2	3,0.6	1.2 , 1.2	1.2, 0.6	1 1 , 1	
1 Efficiency (Tyo)	1 31	Maximum Dutput Power	 14 1	29.4	29.4	28.8	28.8	; 30 ;	
AC Input Voltage And Freq. Range shown on Panel Late! 100-240-Wh. (4) San O,727/0.36			 %	70) 50 5	70	72	74	
4 Input Current (Typ) (46) A				AC Input Voltag	83 — 263VAG (47 je and Freq. Rang	7 — 440Hz) DR III je shown on Fanel) — 350VBC Label: 100-240	VAC (47 — 63Hz)	
17 Introduce 17 10 16 16 17 17 17 18 18 18 18 18		Input Current (Typ) (\$6)	A						
BB Output Voltage Range (Typ)	 7	Intrush Current (Typ) (48)	 A	have some rappy year and come instruction from their figure daily when their daily be	14A at 10	DOVAC, 28A at ZUC)VAC		
	;		11 1 %1	are majorine them day and began are may may have them and "Pri-to-	CHANNEL I =	±§ % , CHANNEL	2 FIXED ±5	7	
100 Maximum Line Regulation (x3) mV 50 120 50 240 120 120 240 150	;:			100 , 150	100	150 , 150	150 , 200	150 , 150	
	 10	Maximum Line Repulation (#3)	;: ¦m∀:	50 , 120		120 , 120	120 , 240	1 150 , 150	
More than 103% for each channel	 1	Maximum Load Regulation (%4)		100 , 240	100 , 480	240 , 240	240 , 480	300 , 300	
13 Over Voltage Protection (17) V	 12	Over Current Protection (#5)		More than 1057 for each change				**	
14 Hold-up Time (16)	131	Over Voltage Protection (*7)	į vi	Channel only115% ∼ 135%					
15 Remote Sensing	 14	Hold-up Time (*6)	11	More than 20 / 100					
16 Remots GN/OFF Control	1151	Remote Sensing	 -						
17 Parallel Operation	161	Remote ON/OFF Control	;; { {						
POSSIBLE POSSIBLE	171	Parallel Operation			ning way, mad had man your gird now way, and had dark now byte has been see		معاد عمد جانباً الله هذه عليه حيث ليك كما الله الله عليه الله الله الله الله الله الله الله ا	والم الله عرب جربية بدي المال والم رابع عدد مدل والم المال المال المال المال المال المال المال المال	
19 Operating Temperature	181	Series Operation	1 1			POSSIBLE			
20 Operating Humidity	191	Operating Temperature		0-09-0-0	0°C~ 40°C1	00% 50°C60%	60°C40%		
21 Storage Temperature °C	201	Operating Humidity					KH 	are and their man with their one and other one had been mad over many days been	
	21	Storage Temperature) "C		and they have the total and subjected their standard the said days.				
231 Cooling	1221	Storage Humidity	;	may long arm week globs man good while first for your goods have man were a		10 10 75 %	KH 		
24 Temperature Coefficient (Typ) -	1231	Cooling						يسم ومن ميس شد عليه المن المن المن المن المن المن المن المن	
25 Withstand Voltage	241	Temperature Coefficient (Typ)		4					
126 Isolation Resistance 149 Max More than 100 Max at 00 5000 at 25°c and 70, no. 101 127 127 128 Shock -	251	Withstand Voltage	;; ;;	Input-Chassis , Input-Output2.0 kVAC for 1 min, @ 20mA					
27 Vibration	1261	Isolation Resistance (#9)		the second state of the second section of the second secon					
mail	271	Vibration		- \\ \(\qquad \qu					
250	1281	Shock		The state of the s					
1 to 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	1291	Weight	l a		The second secon				
1-1 60 X 26 X 150 (Refer to Outline Owg)		() #44 P 10 44 P 10 4 10 4 10 10 10 10 10 10 10 10 10 10 10 10 10	•		60 X 26 X 150	(Refer to	Outline Owg)		

- NOTES

 1 : At 100VAC and Maximum Output Power.

 1 : At 100VAC and Maximum Output Power.

 2 : For cases where conformance to various safety specs (UL, CSA, etc.) are required, input voltage and frequency range will be 100 240VAC, 47 63Hz.

 1 3 : From 85 265VAC or 110 350VDC, constant load.

 1 4 : From No load to Maximum load, constant input voltage.

 1 5 : Foldback current limiting with automatic recovery.

 1 6 : At 100VAC/200VAC, 300 Output Power.

 1 7 : Inverter shut-down method, manual reset.

 1 8 : When requiring operation in less than 15 sec. after power failure at no load, softstant circuit will

- * 8 : When resuming operation in less than 15 sec. after power failure at no load, softstart circuit will not limit the in-rush current at turn on. \$ 7 : Output - Chassis.

SPECIFICATIONS

PA724-01-02 A		
Model		LWD30-1524
Items		15, 24
1. Nominal Output Voltage	V	
2. Maximum Output Current	A	1, 0.6
3. Maximum Output Power	W	72
4. Efficiency (Typ) (*1)	%	85-265VAC (47-440Hz) OR 110-350VDC
5. Input Voltage Range (*2)	-	85-2659AC (4/-440NZ) On 110 000 FDO
		AC Input Voltage and Freq. Range shown on Panel Label
		: 100-240VAC (47-63llz) 0.72/0.38
3. Input Current (Typ) (*6)	A	14A at 100YAC, 28A at 200YAC
7. In-rush Current (Typ) (*8)	A	
3. Output Voltage Range (Typ)	%	Channel 1 = $+5\%$, -0 , Channel 2 Fixed $\pm 5\%$ 150 , 200
. Maximum Ripple & Noise	m∇	150 , 240
10. Maximum Line Regulation (*3)	mV	300 . 480
11. Maximum Load Regulation (*4)	mΥ	More than 105% for each channel
12. Over Current Protection (*5)	A	Channel 1 only 115%~135%
13. Over Voltage Protection (*7)	V	More than 20 / 100
4. Hold-up Time	mS	NOTE LIIBIT AV 7 TAV
15. Remote Sensing	-	
16. Remote ON/OFF Control	ļ-	
[7. Parallel Operation	١-	Possible
18. Series Operation		0°C~60°C 0°C~40°C 100% 50°C 60% 60°C 40%
19. Operating Temperature	C	$0^{\circ}C \sim 60^{\circ}C$ $0^{\circ}C \sim 40^{\circ}C$ 1000 30 $\sim 900^{\circ}R$ RII
20. Operating Humidity	1%	-30 ~ 85
21. Storage Temperature	Ç	10 ~ 95% RH
22. Storage Humidity	1%	Convection cooled
23. Cooling	 - -	10° Channel 2 6 28 at 0~60°C
24. Temperature Coefficient (Typ)	72.77	Input Chassis, Input Output 2.0 KVAC for I min. @ 20mA
	k A	More than 100M Ω at DC500V at 25 $^{\circ}$ and 70% RH for 1 min.
28. Isolation Resistance (*9)		More than 100m12 at popular at as 5 and 100 miles
27. Yibration	G	< 20
28. Shock		250
	g m	
29. Weight 30. Size (W.H.D)	10	60 X 26 X 150 (Refer to Outline Dwg)

NOTES

* 1: At 100VAC and Maximum Output Power.

* 2: For cases where conformance to various safety specs (UL, CSA, etc.) are required, input voltage and frequency range will be 100-240VAC, 47-63Hz.

* 3: From 85-265VAC or 110-350VDC, constant load.

* 4: From No load to Maximum load, constant input voltage.

* 5: Foldback current limiting with automatic recovery.

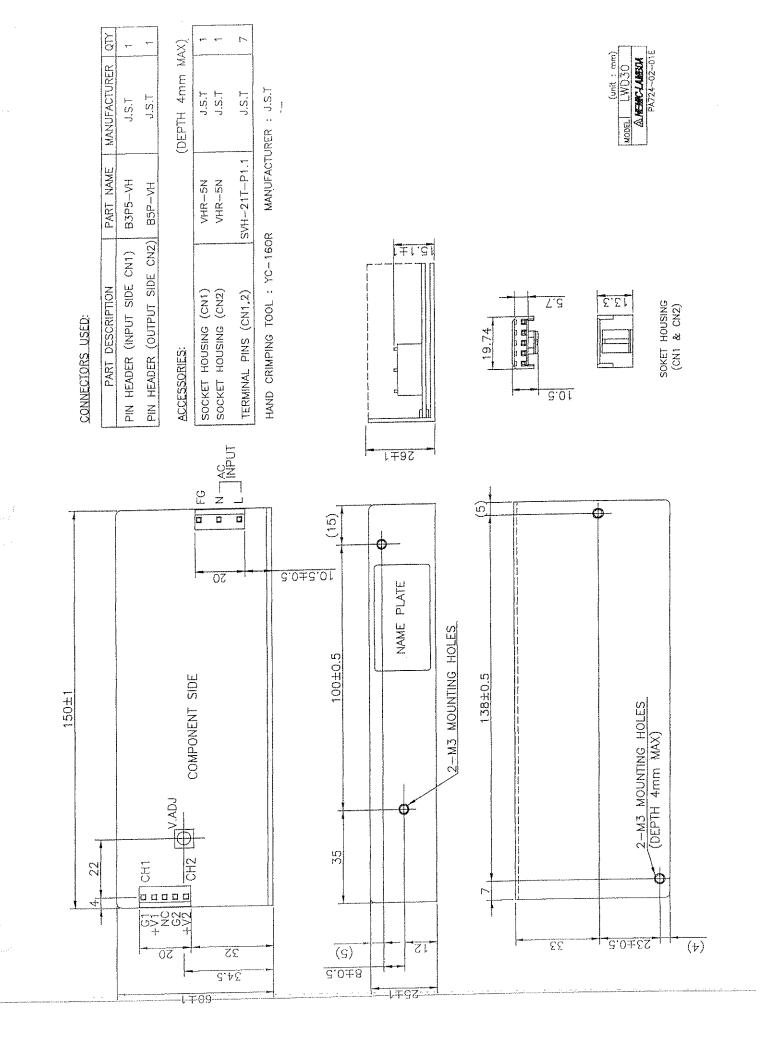
* 6: At 100VAC/200VAC, 30V Output Power.

* 7: Lavanter shut-down methods samual reset.

- * 7: Inverter shut-down method, manual reset.
 * 8: When resuming operation in less than 15 sec. after power failure at no load, softstart circuit will not limit the incrush current at turn-on.

* 9 : Output - Chassis.

NEMIC - LAMBDA



SECTION 9

HUBBELL LIFT/DROP SWITCH

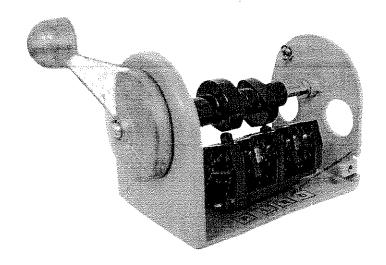
Hubbell Industrial Controls, Inc.

Magnet Controller Lift/Drop Switches Catalog Price List 4215 • July 2007 • Replaces March 2004

4215

Features

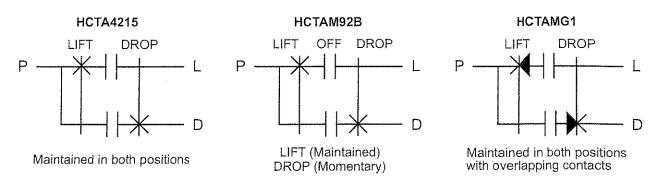
- · Easy Terminal Access
- · Heavy Duty Double Break Contacts
- · NEMA Type 1 Enclosure



How to Order

Part Number	Description	Discount Schedule (ET)
HCTA4215	Lift/Drop Switch Types 4291, 4292 or 4295 Controllers	\$450
НСТАМ92В	Lift/Drop Switch for Type 4296 Controller	\$450
HCTAMG1	Lift/Drop Switch with Overlapping Contacts	\$450

<u>Connection Diagrams</u> 4291/4292/4295 Automatic Discharge Magnet Controllers

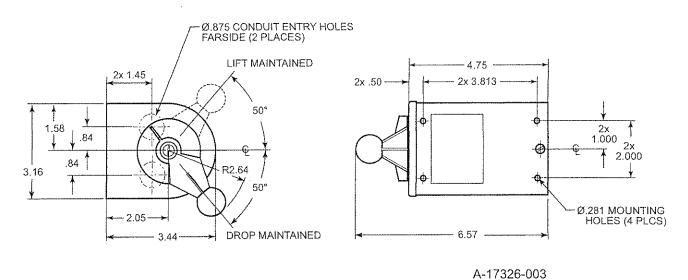


Contact Rating Table					
Part Number	Voltage	Amps			
HCTA4215	115/230 VDC	5			
НСТАМ92В	115/230 VDC	5			
НСТАМ92В	115/230 VDC	5			

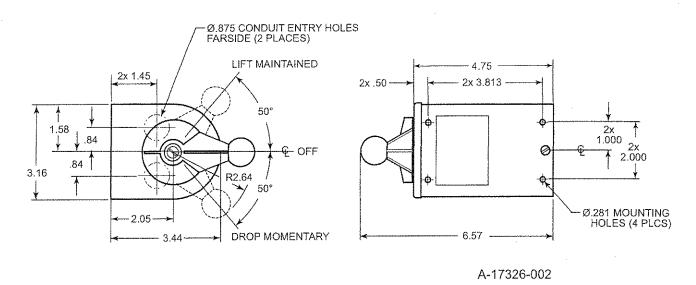




HCTA4215 AND HCTAMG1



HCTAM92B



HUBBELL -



Replacement Parts

May 2007

H-HCTA4215

6 9/16 TO HANDLE

Magnet Master Switch Master Switch Type H TA4215

15

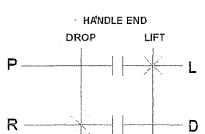
ITEM		PCS	PART
NO.	NAME OF PART	REQD	NO.
1	Rotor Assembly, complete with Spindle; Shaft Collar; (2)Cams; Detent Cam; Spacer; Cv Srg.	1	HC91113302
	Wsh.; .25 Snap. Ring.; & Trapping.Ring.		
2	Spindle	1	HC91113-297
3	Nylon Shaft Collar	1	HCD08581-001
4	Cam	1	HCD09300-001
5	Cam	1	HCD09301-001
6	Detent Cam	1	HC-91113-298
7	Spacer	1	HCD09580-002
8	Curved Spring Washer	2	HC-57535-004
9	.25 Snap Ring	1	HCS00183-001
10	Trapping Ring	1	HCD09324-001
11	Top End Plate	1	HCD08592-001
12	Detent Compression Spring	1	HC67981-033
13	Contact Block	1	HCD50542-002
14	Cover Assembly	1	HC-91113-303
15	Operating Handle	1	HCD50620-001-
16	#8-32 x.375 Lg Rd Hd Sem Scr	1	HC-47661-096
17	#8 Brass Flat Washer	1	HC-47251-007
18	#8-32 x.312 Bnd Hd Grnd Scr	1	HCS00280-001
19	Ground Cup Washer	1	HCD00862-001
20			

12 13 -18,19

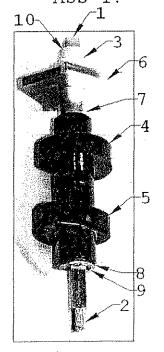
17,16-

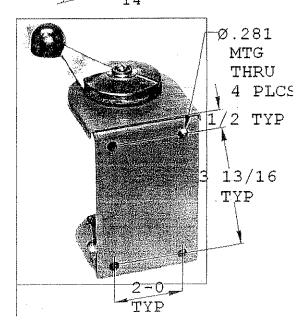
11-

CONNECTION DIAGRAMS Diagram For Magnet Master Switch



TA4215 ROTOR ASS'Y.





SECTION 10

YOKOGAWA VOLT METER

INSTRUCTIONS



CAUTION: Before insighting in a traitee.

TYPE 180 EDGEWISE INSTRUMENT

Cut the panel as indicated in Fig. 1. All drilling and wiring on the switch-board should be completed before mounting the instruments. It is advisable to keep wires carrying heavy current as far as possible from all indicating instruments.

A-C instruments should be connected as shown in Fig. 2 to obtain best results. No leads should be placed adjacent to the edges (the narrower side) of the instrument case. Leads may be brought back from the rear of the case at any angle. The leads for ammeters with full-scale ratings of 20 amperes or more, if the leads are to be attached to the panel, should be arranged as shown in Fig. 3.

CARE OF PLASTIC CASE

CLEANING

To clean the plastic case, wash it with soap and water. To remove grease or oil, use kerosene sparingly. DO NOT use acetone, benzene, carbon tetrachloride, fire-extinguisher fluids, lacquer thinners, or window sprays containing these solvents, since they will smear and soften the window. After cleaning, treat the window with an antistatic agent as described below.

REMOVAL OF ELECTROSTATIC CHARGE

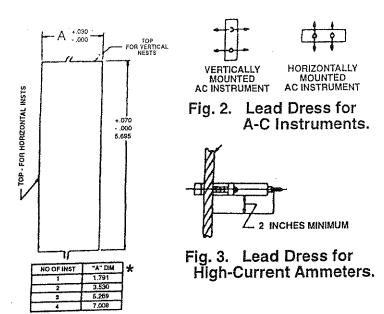
It is recommended that the case and window be wiped or blotted periodically with a clean chamois or soft cloth dampened with antistatic solution. This must be performed after each window cleaning. Do not rub the window with a dry cloth as this is likely to cause scratches and build up an undesirable electrostatic charge.

RENEWAL PARTS

The parts listed below may be obtained through the nearer Yokogawa Corp. of America Sales office

Sales office.	Aluminum Color	Black Color		
Part Name	Cat. No.	Cat. No.		
Gasket Trim Piece	3829K13P001 8688K10P002	3829K13P001 8688K10P003		
Mounting and Terminal Hardware Cover Assembly	4149K16G766 2827K24G701	4149K16G766 2827K24G711		
Light Bulb (6.3V)	4868K33P003			

These instructions do not purport to cover all details or variations in equipment nor to provide for every possible contingency to be met in connection with installation, operation or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to the Yokogawa Corporation of America.



*For 5 or more instruments, add 1.739" to Dim. A for each additional instrument.

Fig. 1. Panel Cutout Dimensions.

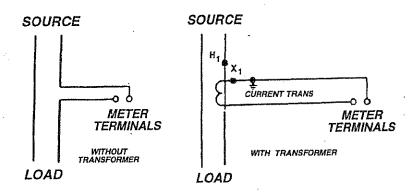


Fig. 5. External Connections, A-C Ammeters.

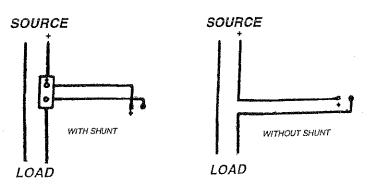
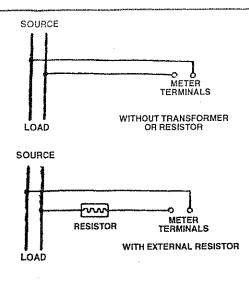


Fig. 6. External Connections, D-C Ammeters.



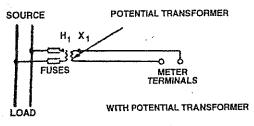
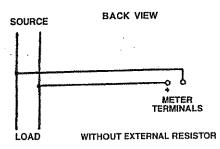


Fig. 4. External Connections, A-C Voltmeters.



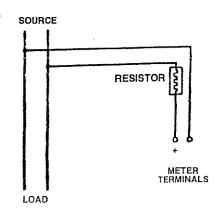


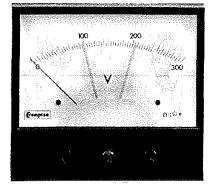
Fig. 7. External Connections, D-C Voltmeters.

SECTION 11

CROMPTON ANALOGUE METER RELAY

Meter Relays

239 Series Analogue Meter Relays



Series 239 meter relays combine a highly accurate indicator with High and Low set point relays. The relays can operate alarm and control devices when the monitored signal value moves outside the chosen set point limits shown by adjustable red index pointers.

A single compact case houses the unit which requires only the input signal and power supply thus saving space and installation time.

Meter Relays	Product Code
One relay, two setpoints Upscale de-energised, down scale energised. Typical applications: Liquid level control, load shedding & power factor correction.	239-300
One relay, one set point Upscale energised, downscale de-energised. Typical application: High alarm.	239 301
Two relays, two set points Mid band de-energised, outside band energised. Typical applications: High and Low alarm, High alarm plus shut down.	239-302
Two relays, two setpoints Both upscale energised, downscale de-energised Typical application: High alarm plus shutdown.	239-303
Two relays, two setpoints High and low midband energised, outside band de-energised. No time delay. Typical application: High alarm plus shutdown.	239-304
Two relays, two set points Both upscale de-energised, downscale energised. Typical application: Frequency monitoring.	239-305
One relay, one set point Upscale de-energised, downscale energised. Typical application: Low alarm.	239-307
Two relays, two set points Midband de-energised, outside band energised. Operates from from 2, 3 or 4 wire resistance temperature detector (RTD). Typical application: Temperature indication / control.	239-30R
Two relays, two set points Midband de-energised, outside band energised. Operates from thermocouple input. Cold junction compensation and thermocouple break protection are standard features. Typical application: Temperature indication / control.	239-30T

Features

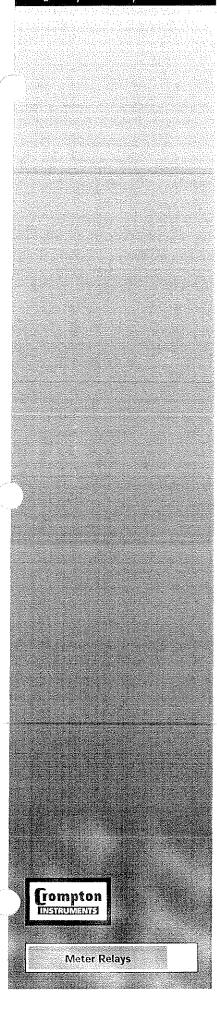
- Monitors and controls any variable which can be converted in to an A.C. or D.C. signal
- Rugged shock and vibration resistant design
- Indicator, relays and power unit in one housing
- Control function continues if the indicator becomes damaged
- Stable electronic switching circuit does not use lamps, photocells, inductors or capacitors
- Taut band, fluid damped indicator
- Isolated input signal
- LED relay state indicators

Applications

- Voltage monitoring/ control current monitoring
- Overload alarm
- Battery monitoring/ charging
- Temperature indication
- Temperature control
- **∑** Load shedding
- Power factor correction
- Frequency monitoring
- ∑ Level control



Meter Relays



Meter Relays

239 Series Analogue Meter Relays

Specification

Adjustments

Front panel comprises Set-point potentiometer(s),

one per set-point

Rear panel comprises Delay potentiometer(s), one

per set-point

Measuring Input:

Note: All inputs are average sensing, but RMS

calibrated

A.C. Voltage:

10V to 600V RMS (Sensitivity $1K\Omega/V$ to 100KΩ/V max. 2.5MΩ

A.C. Current: 1mA to 15A RMS (20mV

drop)

10mV to 600V RMS D.C. Voltage:

(Sensitivity 1KΩ/V to 100ΚΩ/V

max. 2.5MΩ Centre zero

option up to 600/0/600V 100µA to 15A (20mV drop)

Centre zero option up to 15/0/15 amps

Maximum continuous

input voltage

D.C. Current:

1.2 x rating continuously

(600V max.)

Maximum continuous

input current 1.2 x nominal (15A max.)

Maximum short duration

6 x nominal for 6 seconds input current

<0.5VA

(30A max.)

Frequency monitoring: 50Hz to 60Hz ±10%

Burden

1 second Damping time:

100° deflection 4" Scale:

Panel material: Dielectric test: Ferrous or non-ferrous 2600V r.m.s. for 1 minute

Auxiliary supply

Aux. voltage D.C.

Aux. voltage A.C. 110, 120, 220, 230, 240, 277, 480V A.C. (±20%)

> 12, 24, 48, 120, or 135V maximum 156V D.C

Aux. frequency 50 to 60Hz ±10% <1.5W

Burden: Adjustments and Accuracy

Indicator accuracy Class 1.5

Set-point range 98% of scale

Set-point accuracy 1% of range Set-point hysteresis 1% of range

Trip repeatability 0.5% of range Relay tripping time <1 second

0 to 20 seconds, adjustable Time delay

by potentiometer on rear panel Option: 0 to 10

seconds and 0 to 40 seconds Single red LED, per set-point,

to indicate trip condition

Outputs

Indication

DPCO contacts Relays

rated 5A @ 250V A.C. 5A @ 30V D.C. resistive electrical life >10* operations

@ 5A, 250V A.C. contact class IIB (IEC 60255-0-20)

Relay logic Configurable to energise or

de-energise on trip

Options

Relay latching When the measured signal

reaches the set-point, the relay changes state and stays in this condition until the auxiliary supply is

interrupted

Environmental and Mechanical

Ambient temperature

+15°C to +30°C reference range nominal range of use0°C to +60°C Storage temperature -20°C to +70°C

Relative humidity <90%, non condensing 15g/11ms (EN 60068-2-27) Shock

40g/6ms (EN 60068-2-29) Bumping Vibration 10 to 300Hz (EN 60068-2-6)

Protection class

(BS EN 60529)

Terminals to IP20

Enclosure to IP50

Enclosure

UL94V1 Flammability

Terminal capacities 1 to 4mm² solid or stranded

conductors

Weight <1kg

EU Directives

Low Voltage Directive 73/23/EEC amended by

93/68/EEC

89/336/EEC amended by **EMC Directive**

93/68/EEC

CE Mark Directive 93/68/EEC

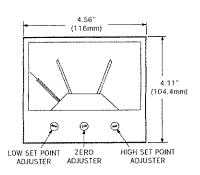
Options

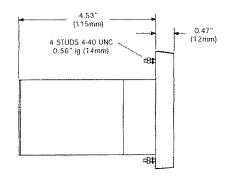
- Calibrated at °C
- Both relays latch, external switch to
- EΗ High relay latch, external switch to reset
- EL Low relay latch, external switch to
- Finger knob setpoint adjusters
- K۷ Sensitivity 100k/volt for A.C. input
- ΚW Sensitivity 1k/volt for D.C. input
- Sensitivity 100k/volt for D.C. input LB Both relays latch, remove auxiliary
- supply to reset High relays latch, remove auxiliary LH supply to reset

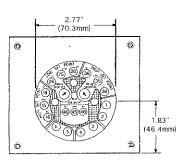
- Low relays latch, remove auxiliary supply to reset
- MC Clamp band fixing
- Hysteresis
- Electrical heavily damped movements
- Panel mounting gasket
- RP Retro-fit plate 237 meter relay
- Red line on instrument dial
- Customer logo on instrument dial (Note: one off setup charge may apply)
- Coloured band on instrument dial
- TPC-Time proportional control (proportional plus derivative control)

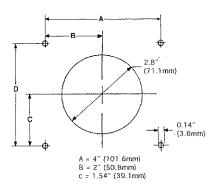
*Meter Relays*239 Series Analogue Meter Relays

Dimensions and Panel cut-out









Connections

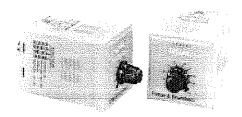
Measuring Input

Terminal

- 1 Meter N or -VE
- 2 Meter L or +VE
- 3, 4. RTD or Thermocouple input
- 5. Auxiliary supply neutral (-ve if D.C.)
- 6. Auxiliary supply live (+ve if D.C.)
- 4. Auxiliary supply tap for dual supply models

SECTION 12

POTTER-BRUMFIELD TIME DELAY RELAY



Timing Modes

See the following page for a complete description of timing modes.

Timing Specifications

Timing Ranges: 0.1 to 1.0 / 1.0 to 10 / 10 to 100 sec.; 0.1 to 1.0 / 1.0 to 10 / 10 to 100 min. Timing Adjustment: Knob adjustable within selected range.

Tolerance: -0, +20% of max, specified at high end of timing range; min.

specified, or less, at low end.

Delta Time (for AC units add ±1 cycle 60 Hz.): ±10%

Repeatability (Including first cycle of operation.): ±2% (for AC units add

±1 cycle 60 Hz.).

Reset Time (power interruption): 45 ms, typ.; 60 ms, max.

Minimum Pulse Width, Control: 50 ms. Recycle Time: 45 ms, typ.; 60 ms, max.

Contact Data @ 25°C

Arrangements: 2 Form C (DPDT). Material: Silver cadmium oxide alloy.

Rating: 10 A @ 30VDC or 277VAC, resistive; 1/2 HP @ 250VAC; 1/3 HP @

Expected Mechanical Life: 10 million operations.

Expected Electrical Life: 100,000 operations, min., at rated load.

Initial Dielectric Strength

Between Open Contacts: 1,000V rms, 60 Hz. Between All Other Conductors: 1,500V rms, 60 Hz.

CNS series

Multifunction Time Delay Relay

- 8 programmable timing modes (4 on 8-pin models)
- 0.1 sec. to 100 min, programmable timing range
- Universal (24-240VAC/VDC) and fixed input types
- 10A output relay with DPDT contacts
- DIP switch selection of timing mode and range
- Knob and dial scale for setting actual delay time

FII File E22575

© File LR15734

Users should thoroughly review the technical data before selecting a product part number. It is recommended that user also seek out the pertinent approvals files of the agencies/laboratories and review them to ensure the product meets the requirements for a given application.

Input Data @ 25°C

Voltage: Universal Input Type: 24 - 240V ±15%, 50/60 Hz. AC or DC.

Fixed Input Type: 120VAC ±15%, 50/60 Hz.

Power Requirement:

Universal Input Type: 10VA @ 240VAC; 5VA @ 120VAC; 1VA @ 24VAC. 10W @ 240VDC; 5W @ 120VDC; 1W @ 24VDC.

Fixed Input Type: 3VA @ 120VAC Transient Protection: Yes.

Reverse Voltage Protection: Yes. Input Voltages and Limits @ 25°C

Input Type	Nominal Voltage	Minimum Voltage	Maximum Voltage
Universal	24-240VAC/VDC	20.4VAC/VDC	276VAC/VDC
Fixed	120VAC	102VAC	138VAC

Note: DC voltage must be filtered (5% p-p rippie max. at nom. voltage).

AC models will operate on 50 or 60 Hz.

Environmental Data

Temperature Range: Storage: -20°C to +70°C.

Operating: -10°C to +55°C.

Humidity: 85% relative humidity, non-condensing.

Mechanical Data

Accessory Part Number

SSA-24C667

Termination: 8- or 11-pin octal style plug.

Enclosure: Beige plastic 1/16 DIN case. Dial scale provided for knob

adjustment reference.

Name

Mounting Clip

Sockets: Models with 8-pin base fit either 27E122 or 27E891 (snap-on)

screw terminal sockets. 11-pin types fit either 27E123 or

27E892 (snap-on) screw terminal sockets.

Weight: 4.3 oz. (122g) approximately.

Ordering Information - Authorized distributors are more likely to stock boldface items listed below.

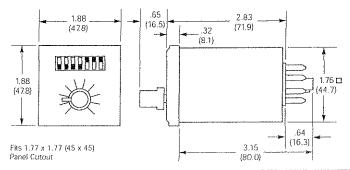
Universal Input Models

Input Voltage	Timing Functions	No. of Pins	Wiring Dia.	Part Number
24-240VAC/VDC	4	8	1	CNS-35-92
24-240VAC/VDC	8	11	2	CNS-35-96

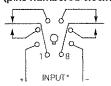
Fixed Input Models

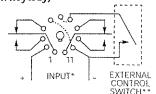
rixea inpucivic	uceiz			
Input Voltage	Timing Functions	No. of Pins	Wiring Dia.	Part Number
-120VAC	4	. 8	1 .	CNS-35-72
120VAC	8	11	2	CNS-35-76

Outline Dimensions



Wiring Diagrams (Bottom Views) (pins numbered clockwise from keyway)





Description

Ratchet-fit clip slides onto CNS from behind

to secure CNS in panel mount applications.

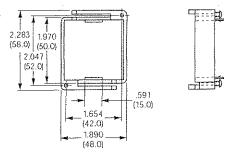
- Note: Input polarity for DC operation. For most reliable operation on AC, connect high side to "+" and low side to "-".
- Important: A dry circuit switch is recommended. A "dry circuit" switch is one rated to reliably switch currents of less than 50mA. Use of a switch rated for other than dry circuit may result in failure of the time delay relay to function properly.

The datted lines shown between pins on 11-pin diagram indicate internal connections

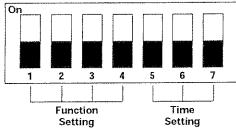
Mounting Clip Dimensions

SSA-24C667



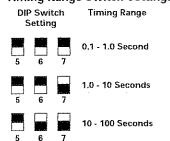


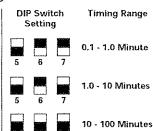
DIP Switch Layout



Note: The solid black blocks in the DIP switch diagrams indicate the switch positions. For example, all the switches are "off" in the diagram above.

Timing Range Switch Settings





Timing Function Descriptions and Switch Settings

8 Or 11 Pin

Delay on Operate



72 & 92 - Output relay is energized at the completion of the time interval which is initiated

by the application of input voltage.

76 & 96 - Same as the above except, closing the control switch after time out will deenergize the relay and reset the timer. Opening the switch will initiate another time interval. Closing the control switch during timing will reset the time to zero and inhibit timing until opened again

11 Pin Only

Delay on Release



76 & 96 · Output relay is energized by the closing of the control switch with the input applied or the application of input voltage with the control switch already closed. The time interval will be initiated by the opening of the control switch with the relay de-energizing at the completion of the time interval. Closing the control switch after time out will energize the relay in preparation for another time interval. Closing the control switch during timing will reset the time to zero and inhibit timing until opened again.

Interval On (Input Controlled)



72 & 92 - Output relay is energized by the application of input voltage. The time interval is initiated at the same time with the relay de-energizing at the completion of the time interval. 76 & 96 - Same as above. Closing the control switch will have no effect on timing or the

state of the relay.

Inverted Delay on Release



72 & 92 - No Time Delay - Instantly On

76 & 96 - Output relay will energize with the application of the input voltage when the control switch is open. Control switch closing will de-energize the relay. A timing interval will be initiated with the opening of the control switch, at the completion of which the relay willenergize. With the control switch closed upon application of input voltage, the relay will wait until the control switch is opened to initiate a time interval after which the relay will energize. Closing of the control switch during timing will reset the time to zero and inhibit timing until opened again

Recycler (Initially Off)



72 & 92 · Output relay will begin cycling at a 50% duty cycle with the application of input over. The initial state of the relay will be de-energized.

76 & 96 - Same as the above except, closing the control switch will de-energize the relay and inhibit timing until it is once again opened, at which time it will start from zero time.

Interval On (Switch Controlled)



76 & 96 - Output relay is energized by the application of input voltage with the control switch closed or the closing of the control switch with the input applied. Immediately upon either, timing is initiated with the relay de-energizing at the completion of the time interval. Closing the control switch after time out will reset the timer, energize the relay, and initiate another time interval. Closing the control switch during timing will have no effect on timing or the state of the

Recycler (Initially On)



72 & 92 - Output relay will begin cycling at a 50% duty cycle with the application of input power. The initial state of the relay will be energized.

76 & 96 - Same as the above except, closing the control switch will energize the relay and

inhibit timing until it is once again opened, at which time it will start from zero time

Dimensions are shown for

Dimensions are in inches over (millimeters) unless otherwise

Interval Off



76 & 96 - Output relay will initially be energized with the application of the input voltage when the control switch is open. Control switch closing will de-energize the relay and start a time interval. At the completion of the time interval, the relay will energize. With the control switch closed upon application of input voltage, a time interval will be initiated after which the relay will energize. Closing of the control switch during timing will have no effect on timing or the state

Specifications and availability subject to change.

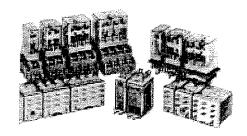
www.tycoelectronics.com Technical support: Refer to inside back cover

SECTION 13

IDEC CONTROL RELAY

- · Compact midget size saves space
- High switching capacity (10A)
- · Choice of blade or PCB style terminals
- Relay options include indicator light, check button, and top mounting bracket
- DIN rail, surface, panel, and PCB type sockets available for a wide range of mounting applications

vailable for a wide range of	mounting applications
Contact Material	Silver cadmium oxide
Contact Resistance	50mΩ maximum (initial value)
Minimum Applicable Load	24V DC/30mA, 5V DC/100mA (reference value)
Operating Time	SPDT (RH1), DPDT (RH2): 20ms maximum 3PDT (RH3), 4PDT (RH4): 25ms maximum
Release Time	SPDT (RH1), DPDT (RH2): 20ms maximum 3PDT (RH3), 4PDT (RH4): 25ms maximum
Maximum Continuous Applied Voltage (AC/DC) at 20°C	110% of the rated voltage
Minimum Operating Voltage (AC/DC) at 20°C	80% of the rated voltage
Drop-Out Voltage (AC)	30% or more of the rated voltage
Drop-Out Voltage (DC)	10% or more of the rated voltage
Power Consumption	SPDT (RH1): DC: 0.8W AC: 1.1VA (50Hz), 1VA (60Hz) BPDT (RH2): DC: 0.9W AC: 1.4VA (50Hz), 1.2VA (60Hz) 3PDT (RH3): DC: 1.5W AC: 2VA (50Hz), 1.7VA (60Hz) 4PDT (RH4): DC: 1.5W AC: 2.5VA (50Hz), 2VA (60Hz)
Insulation Resistance	100MΩ min (measured with a 500V DC megger)
	SPDT (RH1) Between live and dead parts: 2,000V AC, 1 minute; Between contact circuit and operating coil: 2,000V AC, 1 minute; Between contacts of the same pole: 1,000V AC, 1 minute
Dielectric Strength	DPDT (RH2), 3PDT (RH3), 4PDT (RH4) Between live and dead parts: 2,000V AC, 1 minute; Between contact circuit and oper- ating coil: 2,000V AC, 1 minute; Between contact circuits: 2,000V AC, 1 minute; Between contacts of the same pole: 1,000V AC, 1 minute
Frequency Response	1;800 operations/hour
Temperature Rise	Coil: 85°C maximum Contact: 65°C maximum
Vibration Resistance	0 to 6G (55Hz maximum)
Shock Resistance	SPDT/DPDT: 200N (approximately 20G) 3PDT/4PDT: 100N (approximately 10G)
Life Expectancy	Electrical: over 500,000 operations at 120V AC, 10A; (over 200,000 operations at 120V AC, 10A for SPDT [RH1], 3PDT [RH3], 4PDT [RH4]) Mechanical: 50,000,000 operations
Operating Temperature	−30 to +70°C
Weight	SPDT: 24g, DPDT: 37g (approximately) 3PDT: 50g, 4PDT: 74g (approximately)



Relays



UL Recognized

Files No. RH1 = E66043 RH2 = E66043

RH3 = E66043 RH4 = E55996 CSA Certified File No.LR35144



File No. B020813332452



Ordering Information

Order standard voltages for fastest delivery. Allow extra delivery time for non-standard voltages.

Basic Part No.

Coil Voltage:

RH2B-U

AC110-120V



Part Numbers

Part Numbers: RH Series with Options

Termination	Contact Configuration	Basic Part No.	Indicator Light	Check Button	Indicator Light and Check Button	Top Bracket
Commence	SPDT	RH1B-U	RH1B-UL	RH1B-UC	RH1B-ULC	RH1B-UT
В	DPDT	RH2B-U	RH2B-UL	RH2B-UC	RH2B-ULC	RH2B-UT
(blade)	3PDT	RH3B-U	RH3B-UL	RH3B-UC	RH3B-ULC	RH38-UT
	4PDT	RH4B-U	RH4B-UL	RH4B-UC	RH4B-ULC	RH4B-UT
	SPDT	RH1V2-U	RH1V2-UL	RH1V2-UC	RH1V2-ULC	
V2	DPDT	RH2V2-U	RH2V2-UL	RH2V2-UC	RH2V2-ULC	
(PCB 0.078" [2mm] wide)	3PDT	RH3V2-U	RH3V2-UL	RH3V2-UC	RH3V2-ULC	To provide the control of the contro
	4PDT	RH4V2-U	RH4V2-UL	RH4V2-UC	RH4V2-ULC	

Ratings

Coil Ratings

	ai iir ta		Rated Current ±15% at 20°C								Coil Resistance ±15% at 20°С			
Hate	ed Voltage	60Hz				50H2				Culi nesistance ±1376 at 20°C				
Estate Association (SPDT	DPDT	3PDT	4PDT	SPDT	DPDT	3PDT	4PDT	SPDT	DPDT	3PDT	4PDT	
	6V	150mA	200mA	280mA	330mA	170mA	238mA	330mA	387mA	18.8Ω	9.4Ω	6.0Ω	5.4Ω	
	12V	75mA	100mA	140mA	165mA	86mA	118mA	165mA	196mA	76.8Ω	39.3Ω	25.3Ω	21,2Ω	
AC	24V	37mA	50mA	70mA	83mA	42mA	59.7mA	81mA	98mA	300Ω	153Ω	103Ω	84.5Ω	
	120V*	7.5mA	11mA	14.2mA	16.5mA	8.6mA	12.9mA	16.4mA	19.5mA	7,680Ω	4,170Ω	2770Ω	2220Ω	
	240V†	3.2mA	5.5mA	7.1mA	8.3mA	3.7mA	6.5mA	8.2mA	9.8mA	3,1200Ω	15,210Ω	12,100Ω	9120Ω	
	Lanaman	SI	DT	DPDT		3PDT		4PDT		SPDT	DPDT	3PDT	4PDT	
	6V	128	8mA	150	0mA	240)mA	25	0mA	47Ω	40Ω	25Ω	24Ω	
	12V	64	mA	75	mA	120	120mA		125mA		160Ω	100Ω	96Ω	
DC	24V	32	mA	36.	9mA	60	mA	62	mA	750Ω	650Ω	400Ω	388Ω	
	48V	18	mA	18.	18,5mA		mA	31	lmA	2,660Ω	2,600Ω	1,600Ω	1550Ω	
	110V‡	81	πA	9.1	ImA	12.	8mA	15	imA	13,800Ω	12,100Ω	8,600Ω	7,340Ω	



- * For RH2 relays = 110/120V AC.
- † For RH2 relays = 220/240V AC. ‡ For RH2 relays = 100/110V DC.

******			011	December		Coil Inductance								
Rat	ed Voltage	Coil Inrush				Ener	gizing			De-End	ergizing			
		SPDT DPDT		3PDT	4PDT	SPDT	DPDT	3PDT	4PDT	SPDT	DPDT	3PDT	4PDT	
	6V	250mA	340mA	520mA	620mA	0.09H	0.08H	0.05H	0.05H	0.06H	0.04H	0.03H	0.02H	
	12V	120mA	170mA	260mA	310mA	0.037H	0.30H	0.22H	0.18H	0.22H	0.16H	0.12H	0.10H	
AC	24V	56mA	85mA	130mA	165mA	1.5H	1.2H	0.9H	0.73H	0.9H	0.63H	0.5H	0.36H	
	120V*	12mA	16mA	26mA	33mA	37H	33H	21H	18H	22H	15H	12H	9H	
	240V†	7mA	8mA	12mA	16mA	130H	130H	84H	73H	77H	62H	47H	36H	
******		S	PDT	DI	TO	31	TO	41	TO	SPDT	DPDT	3PDT	4PDT	
	6V													
	12V													
DC	24V	١	V/A	A	I/A	ļ N	I/A	l N	I/A	N/A	N/A	N/A	N/A	
	48V							***************************************			1]		
	110V							{						



- * For RH2 relays = 110/120V AC. † For RH2 relays = 220/240V AC.



Ratings con't

Contact Ratings

# of	Max Cont	act Power	General Ratings				
Poles	Resistive	Inductive	Voltage	Resistive	Inductive*		
<u> </u>			AC110	10A	7A		
RH1	AC1540VA DC300W	AC990VA DC210W	AC220	7A	4.5A		
	2031211		DC30	10A	7A		
RH2			AC110	10A	7.5A		
RH3	AC1650VA DC300W	AC1100VA DC225W	AC220	7.5A	5A		
RH4			DC30	10A	7.5A		

L/R - 7ms

CSA Ratings

Relays E

90											
	Resi	stive			Gener	HP Rating					
RH1	RH2	RH3	RH4	RH1	RH2	RH3	RH4	RH1, 2, 3			
10A	10A		7.5A	7A	7A	7A	5A	1/3HP			
10A	10A	10A	10A	7.5A	7.5A		7.5A	1/6HP			
10A	10A	10A	10A	7A	7.5A		*****				
	RH1 10A 10A	RH1 RH2 10A 10A 10A 10A	Resistive RH1 RH2 RH3 10A 10A — 10A 10A 10A	Resistive RH1 RH2 RH3 RH4 10A 10A 7.5A 10A 10A 10A 10A	Resistive RH1 RH2 RH3 RH4 RH1 10A 10A 7.5A 7A 10A 10A 10A 7.5A	Resistive Gener RH1 RH2 RH3 RH4 RH1 RH2 10A 10A	Resistive General Use RH1 RH2 RH3 RH4 RH1 RH2 RH3 10A 10A 7.5A 7A 7A 7A 10A 10A 10A 10A 7.5A 7.5A 7.5A	Resistive General Use RH1 RH2 RH3 RH4 RH1 RH2 RH3 RH4 10A 10A 7.5A 7A 7A 7A 5A 10A 10A 10A 10A 7.5A 7.5A 7.5A 7.5A			

UL Ratings

Voltage		sistive		Ge	neral (Jse	Horse Power Rating		
	RH1, RH2	RH3	RH4	RH1, RH2	RH3	RH4	RH1, RH2 RH3		
AC240V	10A	7.5A	7.5A	7A	6.5A	5A	1/:	3HP	
AC120V	10A	10A	10A	7A	7,5A	7.5A	1/	6НР	
DC30V	10A	10A		7A		_			
DC28V	10A	10A	10A	7A				<u> </u>	

TÜV Ratings

Voltage	RH1	RH2	RH3	RH4
AC240V	10A	10A	7.5A	7.5A
DC30V	10A	10A	10A	10A

Applicable Sockets

Part Numbers: Sockets

Relay	Standard DIN Rail Mount	Finger-Safe DIN Rail Mount	Surface Mount	Panel Mount	PCB Mount
RH1B	SH1B-05	SH1B-05C		SH1B-51	SH1B-62
RH2B	SH2B-05	SH2B-05C	SH2B-02	SH2B-51	SH2B-62
RH3B SH3B-05 SH3B-05C			SH3B-51	SH3B-62	
RH4B	SH4B-05	.SH4B-05C		SH4B-51	SH4B-62

	Ì.			
See	Section F for details on sockets. All D	IN rail mount sock	eis shown above	
can	be mounted using DIN rail BNDN100	10.		

The state of the s	ps (optional)
Part Number	Use With
SY2S-02F1③ SFA-101① SFA-202②	SH1B-05, 05C
SY4S-51F1③ SFA-301① SFA-302②	SH1B-51, 62
SY4S-02F1③ SFA-101① SFA-202②	SH2B-05, 05C
SY4S-51F1③ SFA-301① SFA-302②	SH2B-51,62
SH3B-05F1③ SFA-101①, -202②	SH3B-05, 05C
SY4S-51F1③ SFA-301① SFA-302②	SH3B-51, 62
SH4B-02F1③ SFA-101①, -202②	SH4B-05, 05C
SY4S-51F13 SFA-3010 SFA-3022	SH4B-51, 62



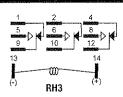
- 1) Top latch
- ② Side latch
- 3 Pullover spring



Internal Circuits







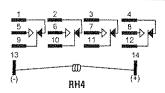
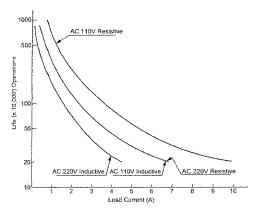


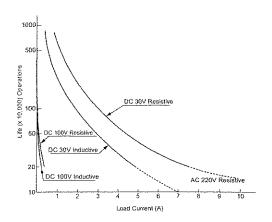


Image as viewed from bottom of relay. Refer to socket for exact wiring layout (Section F).

Electrical Life Curves

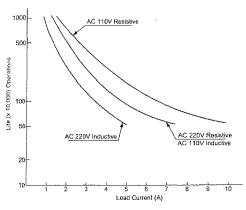


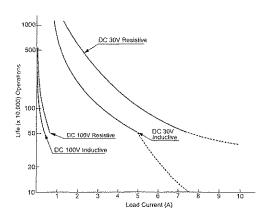




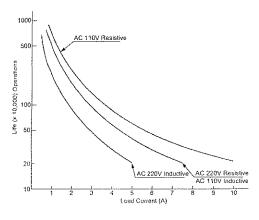


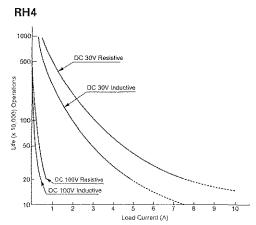






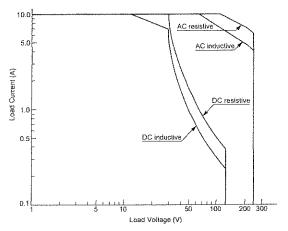
RH3



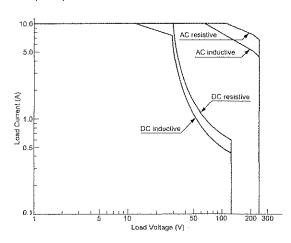


Maximum Switching Capacity

RH1



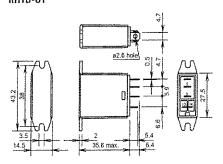
RH2/RH3/RH4



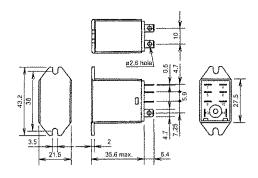
Relays

Dimensions

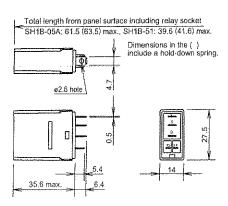
Top Bracket Mounting Blade Terminal RH1B-UT



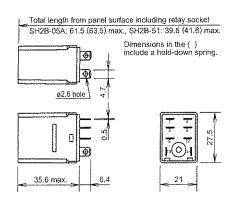
RH2B-UT



Plug-in Blade Terminal RH1B



RH2B

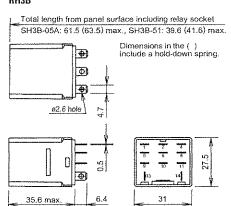


All dimensions in mm.

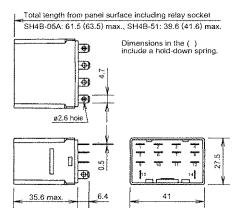
IDEC Relays

Dimensions con't

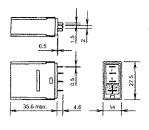
Plug-in Blade Terminal RH3B

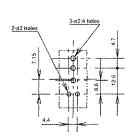


RH4B

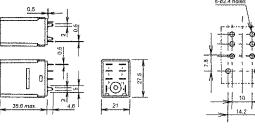


PCB Terminal RH1V2

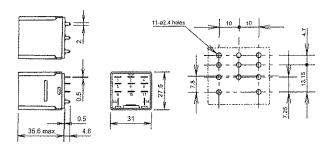


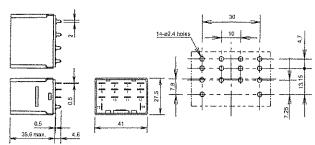


RH2V2



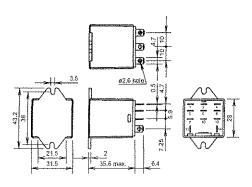
RH4V2



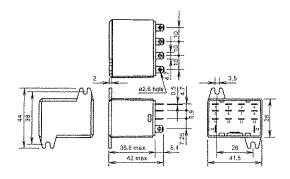


RH3B-UT

RH3V2



RH4B-UT



All dimensions in mm.

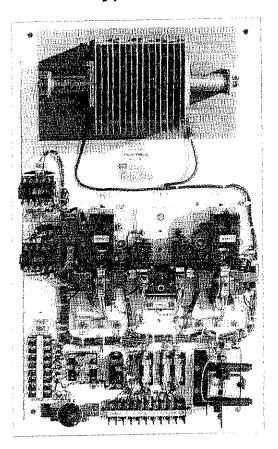
SECTION 14

MAGNET CONTROLLER INSTRUCTION AND RENEWAL PARTS MANUAL

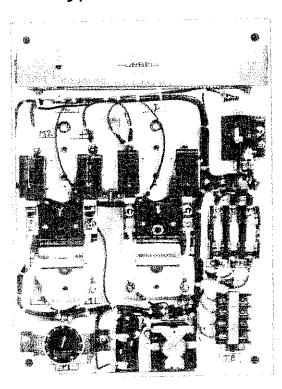
Instruction & Renewal Parts Manual

Instructions/Parts Manual • March 2004 • Publication No. 180 • Replaces Sept. 1991

Type 4291



Type 4295 & 4296



- Varistor Discharge
- ♦ 50 amp to 350 amp

- ♦ Resistor Discharge
- 15 amp to 175 amp

Contents:	4291 Description of Operation 4295/96 Description of Operation	3 4 6 8	Lift Contactor – Size 3, 4 & 5 Drop Contactors	13 13 14 15
	4295/96 Part Numbers	10	Addendum	1 -

4291 Description of Operation

Lifting magnets operate more efficiently with greater life and safety to equipment when controlled by Hubbell Type 4291 Magnet Controllers. Magnets are cleanly discharge, permitting prompt return for another lift because of exclusive patented features.

A mechanically rugged high thermal capacity varistor assembly permanently connected around the magnet always provides a positive, safe discharge path for the stored magnetic energy. The use of a non-linear silicon carbide material in this varistor permits the fastest possible discharge of the magnetic energy and at peak voltages not exceeding 700 volts.

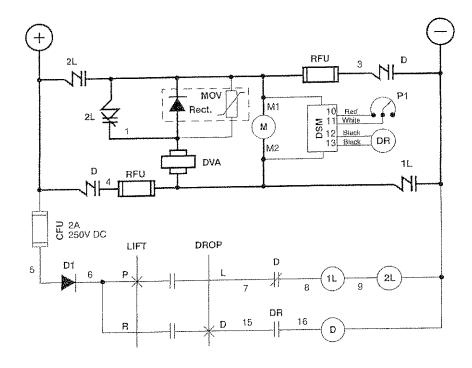
Inductive voltage from the magnet discharge cannot be returned to the line, permitting rectifier power supplies to be safely used without requiring special protective load resistors or other by-pass circuitry.

Figure 1 covers the complete schematic of the basic controller. The Lift and Drop contactors designated "1L", "2L" and "D" respectively, provide a reversing circuit to the magnet. The discharge circuit is composed of the permanently connected Discharge Varistor-"DVA" and the Blocking Rectifier-"RECT".

Throwing the master switch handle to the Lift Position closes the master switch contact in the lift contactor coil circuit, thereby energizing the Lift contactors. The control circuit power is supplied through "CFU" and Rectifier-"D1". This rectifier assures that correct polarity connections have been made to the controller. No operation is possible without proper polarity being supplied.

Figure 1 — Type 4291 Lifting Magnet Control Automatic Discharge Constant Voltage (230V DC) Schematic Diagram

Sym.	Function
DR	Drop Relay
P1	Potentiometer Assembly
CFU	Control Fuse
RFU	Drop Fuses
D1	Diode
RECT	Rectifier, Magnet Discharge Path
MOV	Surge Suppressor
DVA	Discharge Varistor
DSM	Discharge Sensor Module
D	Drop Contactor
2L	Lift Contactor
1L	Lift Contactor



Lifting magnets operate more efficiently with greater life and safety to equipment when controlled by the Hubbell Type 4295 Magnet Controllers. Magnets are cleanly discharged, permitting prompt return for another lift because of exclusive patented features.

A mechanically rugged high thermal capacity resistor assembly permanently connected around the magnet always provides a positive, safe discharge path for the stored magnetic energy.

Inductive voltages from the magnet discharge cannot be returned to the line, permitting rectifier power supplier to be safely used without requiring special protective load resistors or other by-pass circuitry.

Figure 2 covers the complete schematic of the basic controller. The Lift and Drop contactors designated "L" and "D" respectively, provide a reversing circuit to the magnet. The discharge circuit is composed of the permanently connected resistor—"RES1" and the blocking rectifier—"D1".

Throwing the master switch handle to the Lift Position closes the master switch contact in the lift contactor coil circuit, thereby energizing the Lift contactors. The control circuit power is supplied through "CFU" and Recifier-"D2". The rectifier assures that correct polarity connections have been made to the controller. No operation is possible without proper polarity being supplied.

A small resistor-"RES2" is connected in series with a normally closed auxiliary contact "1L" on the Lift contactor. This series combination is connected in parallel with the discharge path blocking rectifier-"D1". The purpose of this resistor is twofold:

- This resistance forces the primary magnet discharge current to flow through the blocking rectifier-"D1" and not through the auxiliary "1L" contact, and
- This resistance dissipates some of the remaining secondary discharge energy from the reverse current drop cycle.

11. M 1L = 11 White RES2 M 12 Black M2 RES1 RFU <mark>წ</mark> 250V DC LIFT DROP T.B. D2 D

4295/96 Description of Operation

Figure 2 – Type 4295 Lifting Magnet Control Automatic Discharge Constant Voltage (230V DC) Schematic Diagram

Sym.	Function
DR*	Drop Relay
P1*	Potentiometer Assembly
CFU	Control Fuse
RFU	Drop Fuses
D1	Diode
D2	Rectifier Magnet Discharge Path
MOV	Surge Suppressor
RES1	Discharge Resistor
RES2	Forcing Resister (if used)
DSM*	Discharge Sensor Module
D	Drop Contactor
2L	Lift Contactor
1L	Lift Contactor

^{*} Not Used on 4296

Sequence of Operation

The following circuits provide sequential operating steps of the basic functions of this control with reference to the appropriate schematic figure. The magnet discharge device for the Type 4291 controllers use varistor discharge devices. Type 4295 & 4296 controllers use resistor discharge devices.

Figure 3 —Schematic Diagram Lift Cycle, 230V DC

- The master switch handle-moves to the lift position and closes the master switch Lift contact.
- The lift contactors are energized through "CFU" and "D".
- The lift contactors close and the main Lift Contactors "1L" and "2L" energize the magnet.

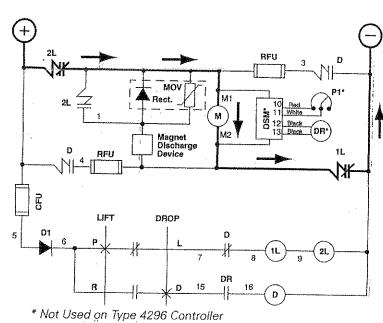


Figure 4 — Schematic Diagram Primary Discharge Cycle, 230V DC

- The master switch handle is moved to the central position (Dribble) or to the drop position. The master switch Lift contact opens.
- 2. The "1L" and "2L" Lift Contractors are deenergized.
- The Lift Contactors "1L" and "2L" open and disconnect the magnet from the 230V supply.
- 4. The magnet voltage reverses and the magnet discharges through the permanently connected Discharge Varistor ("DVA" for 4291) or Discharge Resistor ("RES1" for 4295/96).

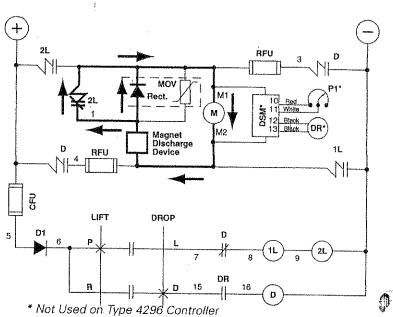
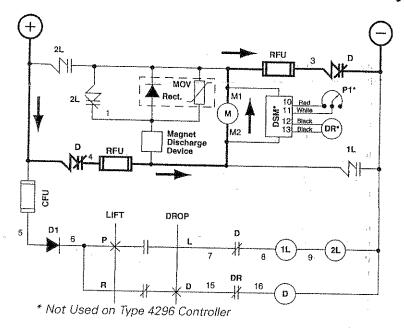


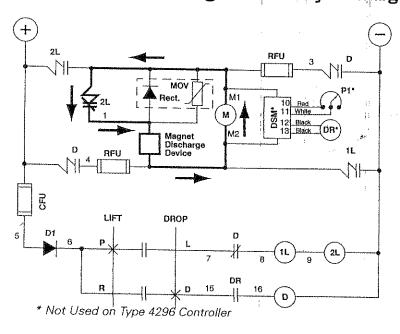
Figure 5 — Schematic Diagram Reverse Current Cycle, 230V DC



- The reverse magnet voltage resulting from the discharge cycle, Fig. 4, signals the "DSM" that the discharge cycle has begun.
- When the reverse magnet voltage falls to 250-300 volts, the "DSM" energizes the Drop Relay "DR".
- The Drop Relay
 energizes the Drop
 Contactor if the
 master switch drop
 contact is closed.
- When the main Drop Contact "D" closes, the reverse magnet current begins to

- flow. (this is done to force the residual magnetism to zero).
- 5. As the "DSM" energizes the Drop Relay, it also begins the fixed time reverse current period. The drop time adjustment potentiometer "P1" determines the length of this period.
- At the end of this fixed time period, the "DSM" deenergizes the Drop Relay which causes the Drop Contactor to open. This terminates the reverse current cleaning cycle.

Figure 6 — Schematic Diagram Seondary Discharge Cycle, 230V DC



- When the Drop Contactor "D" opens: and interrupts the reverse magnet current, the magnet voltage reverses once again.
- The remaining reverse magnet current flows through the secondary discharge path: the normally closed Lift Power Auxiliary Contact "2L" and the Discharge Varistor "DVA".

Installation and Maintenance

Hubbell, Type 4291, 4295 and 4296 Magnet Controllers should be installed in accordance with accepted practices for installation of industrial control equipment.

Polarity of the incoming line connections MUST BE observed; these controllers will not function.

An understanding of the principle of operation will help in analyzing and in keeping this controller operating at maximum efficiency.

Basically, this controller serves the three functions necessary for magnet operation:

- 1. Energize the magnet for movement of load
- Dissipate the stored energy of the magnet to release the load
- Apply reverse current through the magnet to remove the residual magnetism effect

Two electrically and mechanically interlocked sets of contactors "LIFT" and "DROP" serve to apply the DC power for energization and reverse current cleaning respectively in two separate actions without time overlap.

The permanently connected magnet discharge path around the magnet absorbs and dissipates the stored magnet energy when the Lift contactor interrupts the supply power.

During the time of the stored energy dissipation, the reverse voltage appearing across the magnet and the discharge varistor assembly signals the discharge sensor module "DSM" that a discharge voltage falls to 250 to 300 volts, the "DSM" module closes a pilot drop relay which energizes the "DROP" contactor.

The fixed time reverse current cycle begins with the closing of the "DROP RELAY" after practically all of the stored magnet energy is dissipated by the magnet discharge device assembly. The "DSM" module also controls the length of the reverse current cycle. After a preset period, controlled by the Drop Time adjustment potentiometer, the "DSM" deenergizes the drop relay. This action causes the drop contactor to open and end the reverse current cycle.

Another unique feature of Hubbell Magnet Controllers is that full supply voltage is utilized to force the buildup of reverse current cycle thus contributing to the overall controller speed.

Note:

Reverse current adjustment should always be made with the lightest material handled and starting with the least current. Turn the adjustment knob clockwise until the magnet drops the material cleanly. The adjusting potentiometer is mounted beside the "DSM".

Since the discharge of the magnet is a separate function from the reverse current magnet cleaning action, it is easy to obtain close control of partial load drops or to "DRIBBLE" a load if desired. A portion of the load can be dropped merely by moving the master switch handle midway between the lift and drop positions to open the "LIFT" contactor without "SETTING UP" the automatic drop cycle.

Contactor Maintenance

For proper maintenance of the "LIFT" and "DROP" contactors refer to the following Hubbell Contactor Service Publications:

Contactor Size	Contactor Series	RPC Number
2	59322	59323-1
3	59335	59335-1, -2
4	59345	59345-1, -2
5	59495	59495-003, 4
5A	59676	59656-003, 4

Symptom	Possible Cause	Diagnosis/Action
"Lift" contactor does not pick up.	Polarity not observed at time of controller installation.	Reverse the supply power connections to the controller.
,	Lift contactor coil circuit open.	Check continuity of lift contactor coils. Check master switch contacts.
	CFU or Diode D1 open.	Replace CFU or D1.
Magnet does not clean properly.	Reverse current cycle time is too short. Drop contactor does not remain closed long enough to clean magnet.	Increase the Drop Time adjustment potentiometer setting (clockwise rotation).
	Reverse current cycle time is too long. Drop contactor remains closed too long & allows excessive reverse current build-up.	Decrease the Drop Time adjustment potentiometer setting (counter clockwise rotation).
	Drop contactor operate but no reverse current flows	Replace RFU fuses.
	4291 DVA varistor path circuit open.	Check DVA. IF fins are warped or ohm value is under 50k ohms, varistor may be defective. Replace.
	4295 and 4296 RES1 resistor path circuit open.	Check continuity in RES1. If open circuit replace, Correct values shown in table to right.
"Drop" contactor does not operate.	Drop contactor coil circuit open.	Check continuity of Drop contactor coils. Check master switch contacts.
does not operate.	Reversed M2-M1 connections to the DSM.	Check DSM wiring and correct if necessary.
	Faulty drop relay.	Replace drop relay.
	Faulty DSM	Replace DSM (see page 14).
Drop contactor operates but does not drop out.	Faulty drop time adjustment potentiometer or open potentiometer circuit.	Repair or replace potentiometer assembly or wiring.
1.00 d.0p odi.	Faulty DSM	Replace DSM (see page 14).
No adjustment of the reverse current	Faulty drop time adjustment potentiometer.	Replace potentiometer assembly.
cycle.	Faulty DSM	Replace DSM (see page 14).
Magnet discharge device over heats.	Too many magnet discharges per minute.	Avoid frequent cycling or use controller with increased capacity.
	Blocking rectifier is shorted. Full line voltage applied to magnet discharge daying diff cycle.	Replace blocking rectifier assembly.

Troubleshooting

The following covers a general list of possible troubles that may be encountered with the causes and suggested cures given respectively. See pages 8-13 for renewal parts information.

RES1 Value

Magnet	RES1
Current	Values
(amps)	(ohms)
13-25	80
25-50	23
50-80	11.3
85-130	6.9
130-175	4.7

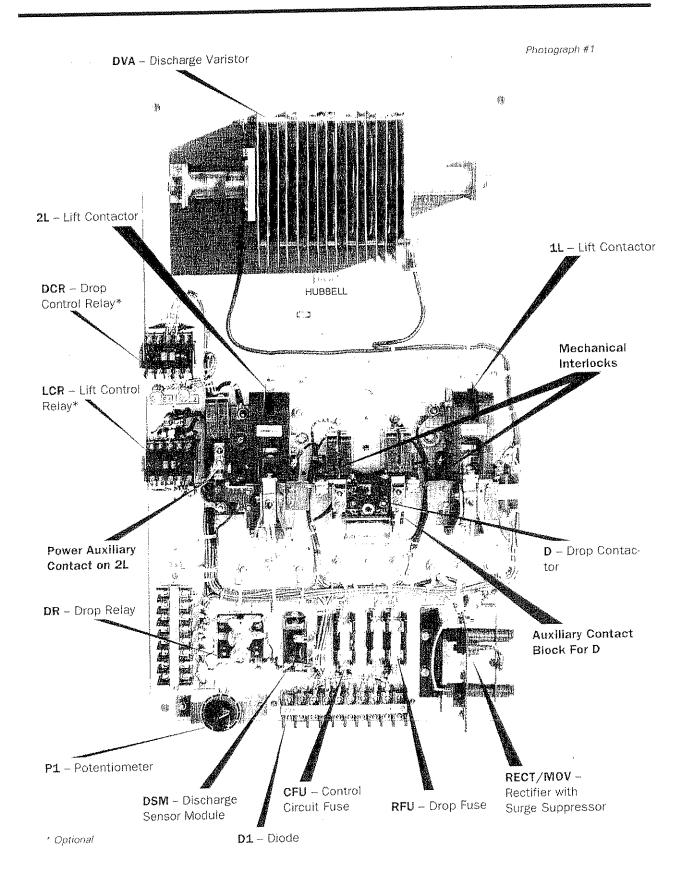
Consult factory if further recommendations or troubleshooting assistance are desired. Call 336/434-2800

device during lift cycle.

4291 Part Numbers For Renewal Parts

]
Product	Maximum Cold Magnet Current			
Component Description	50 Amp	150 Amp	175 Amp	350 Amp
Magnet Controller Size →	2	3	4	5
DVA Discharge Varistor	3009-020	3009-040	3009-050	3009-053
RECT/MOV Rectifier/Surge Suppressor	71386-005	71386-001	71386-001	71386-001
RFU Drop Fuses	57361-005 15A, 250V	57361-006 20A, 250V	57361-006 20A, 250V	57361-015 45A, 250V
D1 Diode	57355-001	57355-001	57355-001	57355-001
DSM Discharge Sensor Module	48684-001	48684-001	48684-001	48684-001
DR Drop Relay	31658-038	31658-038	31658-038	31658-038
P1 Potentiometer Assembly	48686-001	48686-001	48686-001	48686-001
Drop Contactor *	5210-59325-501	5210-59322-504	5210-59322-504	5210-59430-010
CFU Control Fuse	57361-001 3A, 250V	57361-001 3A, 250V	57361-001 3A, 250V	57361-001 3A, 250V
2L Lift Contactor *	5210-59325-101	5210-59335-802	5210-59345-802	5210-59495-811
includes Power Auxiliary Assembly 1L Lift Contactor *	5210-59321-102	5210-59335-001	5210-59345-011	5210-59495-011
DCR-LCR Drop-Lift Control Relay	57418-326	57418-326	57418-326	57418-326
Auxiliary contact Block	67976-001	67976-001	67976-001	67976-001
Power Auxiliary Block For "2L"	59509-001	70472-001	70472-011	70472-012
Mechanical Interlocks	68015-002	71696-001	71696-001	58671-005

^{*}See Contactor Part Selection Pg. 12-13



4295/96 Part Numbers For Renewal **Parts**

Product	Maximum Cold Magnet Current				
Component	DE A		85 Amp	130 Amp	175 Amp
Description	25 Amp	50 Amp	3 3	3	4
Magnet Controller Size →	1	2			
RES 1 Discharge Resistor Assembly	69451-855	69451-856	69451-857	69451-858	69451-859
RECT/MOV Rectifier/Surge Suppressor	71386-005	71386-005	71386-006	71386-007	71386-007
RFU Drop Fuses	57361-004 10A, 250V	57361-005 15A, 250V	57361-006 20A, 250V	57361-010 25A, 250V	57361-010 25A, 250V
D1 Diode	57355-001	57355-001	57355-001	57355-001	57355-001
DSM* * Discharge Sensor Module	48684-001	48684-001	48684-001	48684-001	48684-001
DR* * Drop Relay	31658-038	31658-038	31658-038	31658-038	31658-038
P1* * Potentiometer Assembly	48686-001	48686-001	48686-001	48686-001	48686-001
Drop Contactor *	5210-59312-507	5210-59322-503	. 5210-59322-104	5210-59322-104	5210-59322-104
CFU Control Fuse	57361-071 2A, 250V	57361-071 2A, 250V	57361-071 2A, 250V	57361-071 2A, 250V	57361-071 2A, 250V
2L Lift Contactor *	5210-59322-503	5210-59332-804	5210-59335-802	5210-59335-802	5210-59335-802
1L Lift Contactor *	***		5210-59335-011	5210-59335-011	5210-59345-011
Auxiliary contact Block N.O. & N.C. For "D"	67976-001	67976-001	67976-001	67976-001	67976-001
RES 2 Forcing Resistor		pa wa	57419-035	57419-035	57419-035
Mechanical Interlocks	68015-002	68015-002	71696-001	71696-001	71696-001

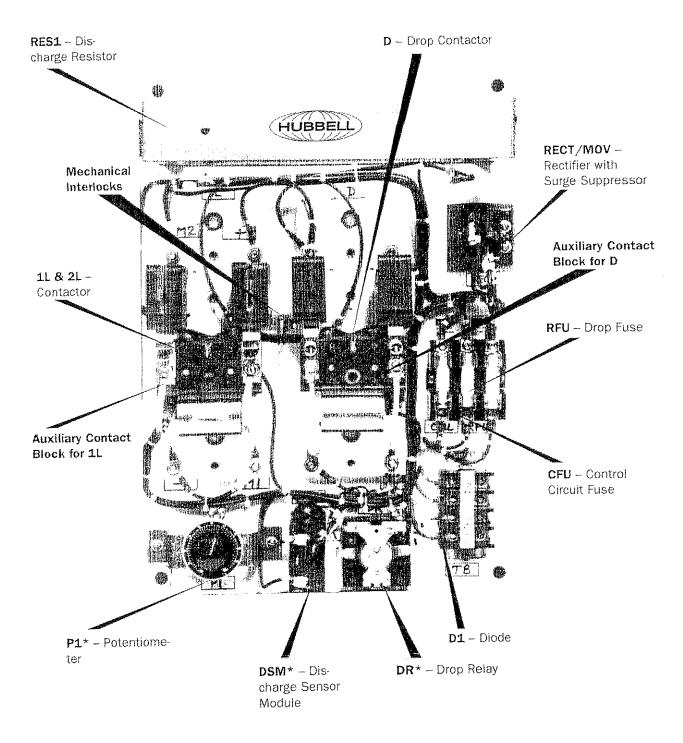
RES1 - Discharge Resistor Assembly (4295)

Assembly P/N	69451-885	69451-856	69451-857	69451-858	69451-859
Res. Coils Used	1 – Size 3	2 – Size 3	3 – Size 3	3 – Size 3	5 – Size 5
Res. Coll Ratings	2Α, 40Ω	5.5A, 11.5Ω	11Α, 3.75Ω	15Α, 2.14Ω	24Α, .945Ω
Res. Coil P/N	69423-004	69323-001	69323-005	69323-009	69323-014

RES1 - Discharge Resistor Assembly (4296)

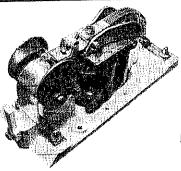
_					
Assembly P/N	69451-885	69451-856	69451-857	69451-858	69451-859
Res. Coils Use	d 1 – Size 3	2 – Size 3	3 – Size 3	3 – Size 3	5 – Size 5
Res. Coil Rating	ıs 2A, 40Ω	5.5A, 11.5Ω	11Α, 3.75Ω	15Α, 2.14Ω	24Α, .945Ω
Res. Coll P/N	69423-004	69323-001	69323-005	69323-009	69323-014

^{*} See Contact Part Selection Pg. 12 & 13
* * These items are not used on Type 4296 Controller

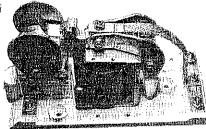


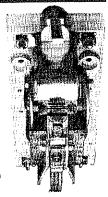
^{*} Not Used on 4296 Controllers

Lift Contactor Size 3/4



Lift Contactor Series 59335 (Size 3) & 59345 (Size 4)





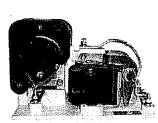
Photograph #3

Renewal Parts

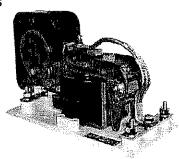
for exploded view of contactor see RPC 59335-1, -2 for Size 3 and see RPC 59345-1, -2 for Size 4

See	KFC 09040-1, -2 for 0/20 1	
1)	Single Pole Contact Kit (includes items 2, 3 & 4 plus hardware) Size 3 ("L" Tip)	P/N 59672-103
	Size 4 ("L" Tip)	P/N 59672-105
2)	Contact Tips (2 reg'd per contactor)	P/N 16924-000
	Cine 4 /8 " Tip)	F/18 1/2/0"000
3)	Arc Horn	E/14 00000-00 i
4) 5)	Movable Contact Holder	P/N 16927-000
6)	Ara Chield Accembly	
	Size 3	P/N 16993-000
7)	Operating Coil (1 req'd per contactor)	. P/N 17488-000
	115/125V Coil (for 230V systems)	. P/N 1/40/-000
8)	Auxiliary contact Block Kit	F"/N 00040=00 I
9)	ZL MUMBI Maximary Contract	• =

Lift Contactor Size 5



Lift Contactor Series 59495 (Size 5) 59656 (Size 5A)

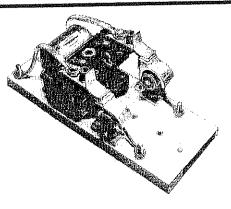


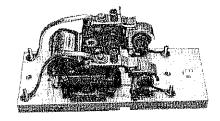
Renewal Parts

(see Publication #174 for exploded view of contactor)

(300	e i dollocatori i i i i i i i i i i i i i i i i i i	
1.	Single Pole Contact Kit (includes items 2, 3 & 4 plus hardware) Size 5/5A	/N 59672-024
2.	Contact Tins (2 reg'd per contactor)	
3.	Cha 5/50	/N 18402-000
	0 1 1 C-1 C-1 C-1 C-1 C-1 C-1 C-1 C-1 C-1	111 01 201-020
4.	Arc Horn	/N 59465-002
5.	Arc Shield Assembly	/N 18063-000
6.	Arc Shield Assembly	
7.	Operating Coil (1 reg'd per contactor)	/NI 67890_005
8.	57.5V Coil (for 115V systems)	M 67990.003
9.	115/125V Coil (for 230V systems)P	WI 600YO 000
10.	Auxiliany contact Block Kit	M 99040-000
11	2L Power Auxiliary Contact se	ee page 13

Drop Contactor Size 2





Photograph #7

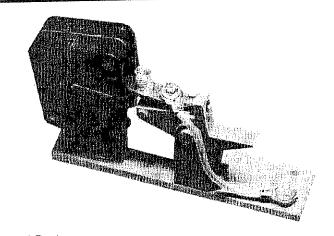
Renewal Parts

(see RPC 59323-1 for exploded view of contactor)

11	Single Pole Contact Kit (includes items 2, 3 & 4 plus hardware)	
' '		P/N 59672-003
σ.	Contact Tips (2 req'd per contactor)	P/N 2317-000
2)	Contact Finger (2 req'd per contactor)	P/N 5722-000
3)	Contact Finger (2 red ti per contactor)	P/N 8838-000
4)	Contact Springs	D/N 42029-000
5)	Arc Horn	D/N 42025-000
6)	Arc Shield Assembly	, F/14 42030*000
7)	Operating Coil /1 regid per contactor)	
. ,	11EV Coil (for 115V eystems)	P/N 68014-002
	250V Coil (for 230V systems)	. P/N 00014-001
O.	Auxiliary contact Block Kit	P/N 68040-003
8)	Auxiliary contact block file minimum	

Size 2 drop contactor used on Size 3 & 4 controllers.

2L Power **Auxiliary** Assembly (for Type 4291 Controllers only)



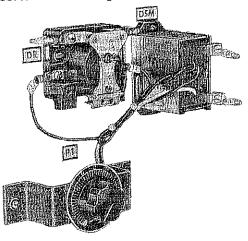
Renewal Parts

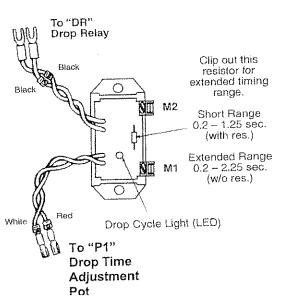
110	11011011 011	DIN 50079 044
11	Contact Kit (includes items 2, 3, & 4 plus hardware)	P/N 59672-014
1/	Dofficace (in the first term of the first term	P/N 17718-003
2)	Movable Finger	D#1 00045 000
a)	Cintionary Tip	P/N UZ315-UUU
U)	Finger Spring	P/N 17716-000
4)	Finger Spring	mail 10005 000
E.	Arc Shield Assembly	., P/M 4Z000~000
5)	Shint	P/N 09298-000
61	Shint	[331 032.00 000

The DSM, Discharge Sensor Module, is a potted electronic assembly which operates a pilot relay. This module monitors the primary discharge voltage of a lifting magnet and controls the drop contactor during the drop cycle. The DSM contains a voltage sensing section and an adjustable timing section. The voltage sensing section causes the drop contactor to engage when the discharge voltage falls to about 250V. The adjustable timing section controls the length of time that the drop contactor is engaged. This adjustment allows the magnet controller to be set to clean the magnet.

Small magnets, generally size 2 through the low end of size 3 controllers, will require the short range timing. This range is available by leaving the exposed resistor on top of the DSM assembly intact. Larger magnets, mid range size 3 through size 4, will require the extended range timing. This range is selected by "Clipping Out" the exposed resistor.

Discharge Sensor Module (DSM)





Troubleshooting

The operation of the DSM can be verified by watching the magnet controller operation:

- When the lift circuit opens, the magnet begins discharging through the primary discharge path. As the magnet energy is expanded, the discharge voltage falls.
- When the discharge voltage falls to 250-300V, the DSM causes the drop relay to operate. At the same time, the drop cycle LED on the DSM lights.
- When the drop relay closes, the drop contactor picks up and begins the controller's reverse current cycle.
- After the pre-set drop time has expired, the DSM de-energizes the drop relay. The drop cycle LED on the DSM goes out.
- 5. The drop time potentiometer, P1, is used to adjust the drop time to suit the particular magnet and load.

Magnet Controller Contact Kit

NEMA Size 1	59403-108	
NEMA Size 2	59403-101	
NEMA Size 3 with contactor series 59335	59403-102	Set of movable and stationary contacts for "Lift" contactors
NEMA Size 4	59403-103	1 – Set of movable and stationary contacts for "Drop" contactors
series 59345	1 — Set of movable cor	1 — Set of movable contact springs for "Lift" and "Drop" contactor
NEMA Size 5 with contactor series 59495	59403-207	1 – Set of Arc Horns for "Lift" and "Drop" contactors
		1 – Auxiliary Contact Block
		1 – Replacement hardware to mount new parts
		Finger, Tip & Springs for Power Auxiliary Assembly

ADDENDUM TO PUBLICATION 180 FOR REDUCED VOLTAGE BULL 4291

The magnet economizing circuit (reduced voltage control circuit) is energized with DC line voltage at all times. When the control is at rest, the ME contactor is picked up through the normally closed contact on 1L and the RES1 resistor. This contactor has a 115-volt coil (on 230V systems), and RES1 drops the other half (115V) of the supply voltage. The 1L contact is bypassed or "latched" by the normally open auxiliary on ME. When the lift contactors are energized, the 1L contact opens and the 2L contact closes, leaving ME sealed in by its own auxiliary. This starts the 1AT across the ME coil to 0, and the contactor drops open. The full 230V control voltage is now placed across RES1, which maintains current through 1AT to keep it closed, and ME open. When the drop cycle is started, the 2L aux. opens, the 1L aux. recloses, and ME picks up instantly. An arc suppressor, AI, is standard across ME to protect the timer from voltage surges.

When ME is closed at rest, it bypasses the economizing resistor R1-R2. During the first few seconds of lift, full voltage is placed across the magnet M1-M2, to "pick" the load. When 1AT times out and ME opens, the economizing resistor is placed in series with the magnet, reducing the magnet voltage to the "transport" value so that the magnet will not overheat during long lift cycles. The economizing resistor must be properly matched to the magnet so that the voltage on the magnet is reduced enough to keep it cool, but not so low that it will drop any of the load. Typical magnet voltages are 230-275V for lifting; and 180-200V reduced.



Hubbell Industrial Controls, Inc

a subsidiary of Hubbell Inc. 4301 Cheyenne Dr., Archdale, NC 27263 Telephone (336) 434-2800 • FAX (336) 434-2803 http://www.hubbell-icd.com Sales@hubbell-icd.com

WINKLE INDUSTRIES

SECTION 15

BALDOR DC GENERATOR INSTALLATION AND OPERATING MANUAL



Integral Horsepower DC Motor

Installation & Operating Manual



P.O. Box 2400 Ft. Smith, AR 72902-2400 (479) 646-4711 Fax (479) 648-5792

CH	D	UK	F
TEL:+41 52 647 4700	TEL: +49 89 90 50 80	TEL:+44 1454 850000	TEL: +33 145 10 7902
FAX:+41 52 659 2394	FAX: +49 89 90 50 8491	FAX:+44 1454 850001	FAX: +33 145 09 0864
TEL:+39 11 562 4440 FAX:+39 11 562 5660	AU TEL:+61 29674 5455 FAX:+61 29674 2495	CC TEL: +65 744 2572 FAX: +65 747 1708	MX TEL:+52 477 761 2030 FAX:+52 477 761 2010

lumidity And Brush Wear	3-5
Guide To Commutator Appearance	3-6
Guide To Commutator Appearance	3-7
Commutator	
Rapid Commutator Wear	3-7
Turning The Commutator	3-8
Commutator Undercutting	3-8
Blowers & Filters	3-8
Troubleshooting	3-8
Armature Overheating	3-8
Affination Overheating	3-9
Field Coil Overheating	3-9
Excessive Load	
Jogging and Repeated Starts	3-9
Heating	3-9
Thermostat	3-9
Troubleshooting Chart	3-10
Troubleshooting Chart	3-11
Accessories	
Reflash Instructions	3-12
Section 4 Connection Diagrams	4-1

Section 1 General Information

<u>Overview</u>

This manual contains general procedures that apply to Baldor Motor products. Be sure to read and understand the Safety Notice statements in this manual. For your protection, do not install, operate or attempt to perform maintenance procedures until you understand the Warning and Caution statements. A Warning statement indicates a possible unsafe condition that can cause harm to personnel. A Caution statement indicates a condition that can cause damage to equipment.

important:

This instruction manual is not intended to include a comprehensive listing of all details for all procedures required for installation, operation and maintenance. This manual describes general guidelines that apply to most of the motor products shipped by Baldor. If you have a question about a procedure or are uncertain about any detail, Do Not Proceed. Please contact your Baldor distributor for more information or clarification.

Before you install, operate or perform maintenance, become familiar with the following:

- NEMA Publication MG 2, Safety Standard for Construction and guide for Selection, Installation and Use of Electric Motors and Generators.
- The National Electrical Code
- Local codes and Practices

Limited Warranty

- 1. Baldor Electric motors are warranted for a period of one (1) year, from date of shipment from the factory or factory warehouse against defects in material and workmanship. To allow for stocking and/or fabrication period and to provide one year of actual service, the warranty period is extended for an additional period of six (6) months for a total of eighteen (18) months from the original date of shipment from the factory or factory warehouse stock. In no case will the warranty period be extended for a longer period. Baldor extends this limited warranty to each buyer of the electric motor for the purpose of resale and to the original purchaser for use.
- 2. Baldor will, at its option repair or replace a motor which fails due to defects in material or workmanship during the warranty period if:
 - a. the purchaser presents the defective motor at or ships it prepaid to, the Baldor plant in Fort Smith, Arkansas or one of the Baldor Authorized Service Centers and
 - the purchaser gives written notification concerning the motor and the claimed defect including the date purchased, the task performed by the Baldor motor and the problem encountered.
- 3. Baldor will not pay the cost of removal of any electric motor from any equipment, the cost of delivery to Fort Smith, Arkansas or a Baldor Authorized Service Center, or the cost of any incidental or consequential damages resulting from the claimed defects. (Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above exclusion may not apply to you.) Any implied warranty given by laws shall be limited to the duration of the warranty period hereunder. (Some states do not allow limitations on how long an implied warranty lasts, so the above limitation may not apply to you.)
- 4. Baldor Authorized Service Centers, when convinced to their satisfaction that a Baldor motor developed defects in material or workmanship within the warranty period, are authorized to proceed with the required repairs to fulfill Baldor's warranty when the cost of such repairs to be paid by Baldor does not exceed Baldor's warranty repair allowance. Baldor will not pay overtime premium repair charges without prior written authorization.
- 5. The cost of warranty repairs made by centers other than Baldor Authorized Service Centers <u>WILL NOT</u> be paid unless first authorized in writing by Baldor.
- 6. Claims by a purchaser that a motor is defective even when a failure results within one hour after being placed into service are not always justified. Therefore, Baldor Authorized Service Centers must determine from the condition of the motor as delivered to the center whether or not the motor is defective. If in the opinion of a Baldor Authorized Service Center, a motor did not fail as a result of defects in material or workmanship, the center is to proceed with repairs only if the purchaser agrees to pay for such repairs. If the decision is in dispute, the purchaser should still pay for the repairs and submit the paid invoice and the Authorized Service Center's signed service report to Baldor for further consideration.
- 7. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

v Notice:

This equipment contains high voltage! Electrical shock can cause serious or fatal injury. Only qualified personnel should attempt installation, operation and maintenance of electrical equipment.

Be sure that you are completely familiar with NEMA publication MG 2, safety standards for construction and guide for selection, installation and use of electric motors and generators, the National Electrical Code and local codes and practices. Unsafe installation or use can cause conditions that lead to serious or fatal injury. Only qualified personnel should attempt the installation, operation and maintenance of this equipment.

WARNING: Do not touch electrical connections before you first ensure that

power has been disconnected. Electrical shock can cause serious or fatal injury. Only qualified personnel should attempt the

installation, operation and maintenance of this equipment.

WARNING: Be sure the system is properly grounded before applying power.

Do not apply power before you ensure that all grounding instructions have been followed. Electrical shock can cause serious or fatal injury. National Electrical Code and Local codes

must be carefully followed.

WARNING: Avoid extended exposure to machinery with high noise levels. Be

sure to wear ear protective devices to reduce harmful effects to

your hearing.

WARNING: This equipment may be connected to other machinery that has

rotating parts or parts that are driven by this equipment. Improper use can cause serious or fatal injury. Only qualified personnel should attempt to install operate or maintain this equipment.

WARNING: Do not by-pass or disable protective devices or safety guards.

Safety features are designed to prevent damage to personnel or equipment. These devices can only provide protection if they

remain operative.

WARNING: Avoid the use of automatic reset devices if the automatic restarting

of equipment can be hazardous to personnel or equipment.

WARNING: Be sure the load is properly coupled to the motor shaft before

applying power. The shaft key must be fully captive by the load device. Improper coupling can cause harm to personnel or equipment if the load decouples from the shaft during operation.

WARNING: Use proper care and procedures that are safe during handling,

lifting, installing, operating and maintaining operations. Improper methods may cause muscle strain or other harm.

WARNING: Before performing any motor maintenance procedure, be sure that

the equipment connected to the motor shaft cannot cause shaft rotation. If the load can cause shaft rotation, disconnect the load from the motor shaft before maintenance is performed. Unexpected mechanical rotation of the motor parts can cause injury or motor

damage.

WARNING: Disconnect all electrical power from the motor windings and

accessory devices before disassembly of the motor. Electrical shock can cause serious or fatal injury.

WARNING: Do not use these motors in the presence of flammable or

combustible vapors or dust. These motors are not designed for atmospheric conditions that require explosion proof construction.

Safety Notice Continued

UL listed motors must only be serviced by authorized Baldor WARNING:

Service Centers if these motors are to be returned to a flammable

and/or explosive atmosphere.

Thermostat contacts automatically reset when the motor has WARNING:

slightly cooled down. To prevent injury or damage, the control circuit should be designed so that automatic starting of the motor

is not possible when the thermostat resets.

To prevent premature equipment failure or damage, only qualified Caution:

maintenance personnel should perform maintenance.

Do not lift the motor and its driven load by the motor lifting Caution:

hardware. The motor lifting hardware is adequate for lifting only the motor. Disconnect the load from the motor shaft before moving the

motor.

If eye bolts are used for lifting a motor, be sure they are securely Caution:

tightened. The lifting direction should not exceed a 20° angle from the shank of the eye bolt or lifting lug. Excessive lifting angles can

cause damage.

To prevent equipment damage, be sure that the electrical service is Caution:

not capable of delivering more than the maximum motor rated amps

listed on the rating plate.

If a HI POT test (High Potential Insulation test) must be performed, Caution:

follow the precautions and procedure in NEMA MG 1 and MG 2

standards to avoid equipment damage.

If you have any questions or are uncertain about any statement or procedure, or if you require additional information please contact your Baldor distributor or an Authorized Baldor Service Center.

ivina

Each Baldor Electric Motor is thoroughly tested at the factory and carefully packaged for shipment. When you receive your motor, there are several things you should do immediately.

- Observe the condition of the shipping container and report any damage immediately to the commercial carrier that delivered your motor.
- Verify that the part number of the motor you received is the same as the part number listed on your purchase order.

Storage

If the motor is not put into service immediately, the motor must be stored in a clean, dry and warm location. Several precautionary steps must be performed to avoid motor damage during storage.

- Use a "Megger" periodically to ensure that the integrity of the winding insulation has been maintained. Record the Megger readings. Immediately investigate any significant decrease in insulation resistance.
- Do not lubricate bearings during storage. Motor bearings are packed with a slushing compound at the factory.
- Rotate motor shaft at least 10 turns every two months during storage (more frequently if possible). This will prevent bearing damage due to storage.
- If the storage location is damp or humid, the motor windings must be protected from moisture. This can be done by applying power to the motors' space heater (if available) while the motor is in storage.

Unpacking

Each Baldor motor is packaged for ease of handling and to prevent entry of contaminants.

- To avoid condensation inside the motor, do not unpack until the motor has reached room temperature. (Room temperature is the temperature of the room in which it will be installed). The packing provides insulation from temperature changes during transportation.
- When the motor has reached room temperature, remove all protective wrapping material from the motor.

Handling

The motor should be lifted using the lifting lugs or eye bolts provided.

- Use the lugs or eye bolts provided to lift the motor. Never attempt to lift the motor and additional equipment connected to the motor by this method. The lugs or eye bolts provided are designed to lift only the motor. Never lift the motor by the motor shaft.
- If the motor must be mounted to a plate with the driven equipment such as pump, compressor etc., it may not be possible to lift the motor alone. For this case, the assembly should be lifted by a sling around the mounting base. The entire assembly can be lifted for installation. Do not lift using the motor lugs or eve bolts provided.

If the load is unbalanced (as with couplings or additional attachments) additional slings or other means must be used to prevent tipping. In any event, the load must be secure before lifting.

Lifting Magnet Generators Treat Baldor lifting magnet generators like motors during installation or maintenance. Generally, they have standard compound self-excited fields. Standard magnetism is for counter-clockwise rotation (facing the drive end of the motor). To reverse (operate clockwise), refer to the connection diagrams in Section 4 of this manual.

Section 2 Installation & Operation

Overview

Installation should conform to the National Electrical Code as well as local codes and practices. When other devices are coupled to the motor shaft, be sure to install protective devices to prevent future accidents. Some protective devices include, coupling, belt guard, chain guard, shaft covers etc. These protect against accidental contact with moving parts. Machinery that is accessible to personnel should provide further protection in the form of guard rails, screening, warning signs etc.

Location

The motor should be installed in an area that is protected from direct sunlight, corrosives, harmful gases or liquids, dust, metallic particles, and vibration. Exposure to these can reduce the operating life and degrade performance. Be sure to allow clearance for ventilation and access for cleaning, repair, service and inspections. Ventilation is extremely important. Be sure the area for ventilation is not obstructed. Obstructions will limit the free passage of air. Motors get warm and the heat must be dissipated to prevent damage.

These motors are not designed for atmospheric conditions that require explosion proof operation. They must <u>NOT</u> be used in the presence of flammable or combustible vapors or dust.

TEFC motors can be used for indoor or outdoor standard service. They cannot be used outdoors where they would be exposed to freezing rain. Standard TEFC motors are not designed for atmospheric conditions requiring explosion-proof operation, such as flammable or combustible vapors or dust.

Mounting

The motor must be securely installed to a rigid foundation or mounting surface to minimize vibration and maintain alignment between the motor and shaft load. Failure to provide a proper mounting surface may cause vibration, misalignment and bearing damage.

Foundation caps and sole plates are designed to act as spacers for the equipment they support. If these devices are used, be sure that they are evenly supported by the foundation or mounting surface.

After installation is complete and accurate alignment of the motor and load is accomplished, the base should be grouted to the foundation to maintain this alignment.

The standard motor base is designed for horizontal or vertical mounting. Adjustable or sliding rails are designed for horizontal mounting only. Consult your Baldor distributor or authorized Baldor Service Center for further information.

<u>Alignment</u>

Accurate alignment of the motor with the driven equipment is extremely important.

1. Direct Coupling

For direct drive, use flexible couplings if possible. Consult the drive or equipment manufacturer for more information. Mechanical vibration and roughness during operation may indicate poor alignment. Use dial indicators to check alignment. The space between coupling hubs should be maintained as recommended by the coupling manufacturer.

2. End-Play Adjustment

The axial position of the motor frame with respect to its load is also extremely important. The motor bearings are not designed for excessive external axial thrust loads. Improper adjustment will cause failure.

3. Pulley Ratio

The pulley ratio should not exceed 8:1. Consult your Baldor distributor or authorized Baldor Service Center for further information.

4. Belt Drive

Refer to NEMA MG 1 section 14.07 or Baldor application section for the application of pulleys, sheaves, sprockets, and gears. Align sheaves carefully to minimize belt wear and axial bearing loads (see End-Play Adjustment). Belt tension should be sufficient to prevent belt slippage at rated speed and load. However, belt slippage may occur during starting. Do not over-tension belts.

ling & Bolting

After proper alignment is verified, dowel pins should be inserted through the motor feet into the foundation. This will maintain the correct motor position should motor removal be required. (Baldor motors are designed for doweling.)

- Drill dowel holes in diagonally opposite motor feet in the locations provided.
- 2. Drill corresponding holes in the foundation.
- 3. Ream all holes.
- 4. Install proper fitting dowels.
- Mounting bolts must be carefully tightened to prevent changes in alignment.
 Use a flat washer and lock washer under each nut or bolt head to hold the
 motor feet secure. Flanged nuts or bolts may be used as an alternative to
 washers.

Power Connection

Motor and control wiring, overload protection, disconnects, accessories and grounding should conform to the National Electrical Code and local codes and practices. Ground the motor by attaching a strap from an established ground point to the grounding bolt provided inside the conduit box.

Conduit Box

For ease of making connections, an oversize conduit box is provided. The box can be rotated 360° in 90° increments.

Power

Connect the motor leads as shown on the connection diagram located on the name plate or inside the cover on the conduit box. Be sure the following guidelines are met:

 DC power is within ±5% of rated voltage (not to exceed 600VDC). (See motor name plate for ratings).

OR

2. DC field power is within ±1% of rated voltage.

Notor Connections

Terminal connections should be made as specified. See the connection diagrams located in Section 4 of this manual. Tables 2–1 and 2–2 show the NEMA standard lead markings and the Accessory Markings.

Table 2-1 NEMA Standard Lead Markings

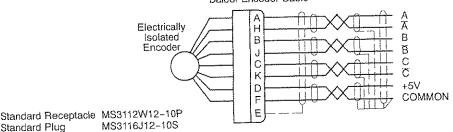
Lead Markings	Motor
Armature	A1, A2
Field (shunt)	F1, F2, F3, F4, etc.
Field (series)	S1, S2
Thermostat	P1, P2, etc.
Space Heater	H1, H2, H3, H4, etc.
Resistance Temperature Detector (RTD)	R1, R2, R3, R4, etc.
Optional Brush Monitor System	A1Probe, A2Probe

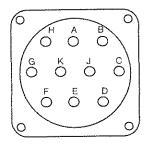
Table 2-2 Accessory Markings

DC Tachometers	+		
XPY	1	2	G
XC	Red (1)	Black (2)	G
NCS Pancake	Red	Black	
AC Tachometers 45/90V Output			Jan
45V	Red	White	
90V	Red	Black	
Brake Coil Leads	B1, B2, B3, etc.		
Space Heater (Brake)	H1, H2, H3, H4, etc.		
Brake Interlock Switch	BS1, BS2, BS3, etc.		

Figure 2-1 Encoder Connections

Color Codes for Optional Baldor Encoder Cable





Thermostats

Standard Plug

The thermostat is a pilot circuit device used in a protective relay circuit. The thermostat ratings are given in Table 2-3.

Table 2-3 Thermostat Ratings

Maximum Cur	rent Ratings fo	or Thermostats (Normally Ope	n or Closed Contacts)
Voltage	125VAC	250VAC	24VDC	Continuous Current All Voltages
Amperage	12A	8A	2A	2A

Initial Start-Up

If driven equipment can be damaged by rotating in the wrong direction, uncouple the motor from the load before checking for rotation.

If the direction of rotation needs to be corrected, disconnect the input power supply and interchange the appropriate leads. Refer to the motor connection diagrams in Section 4 of this manual.

- The first start-up and running of the motor should be with the motor uncoupled from the load.
- Check the direction of rotation by momentarily applying power to the motor.
- With the motor running, make sure it's running smoothly without too much noise or vibration. If either are present, shut down the motor immediately and find the cause of the problem.

Blower Ventilation System

Before loading a force-ventilated motor, be sure that the blowers, cooling fans, or central air supply systems are operating properly to supply cooling air to the motor. Air filters should also be in place. If you energize the main fields with the motor at standstill, the blowers or external cooling systems must be left on. This will prevent excessive heat buildup that will decrease the life of the insulation.

When using field economy circuits to reduce the voltage to the main fields during standstill, blowers do not need to be left on.

Blower motors should be checked for correct rotation. Don't rely on feeling airflow from the drive end of the motor. Look at the outline drawing or rotation arrow shown on the blower housing. Refer to Figure 2-1.

Figure 2-1 View from Air Inlet (Motor is on Opposite Side)

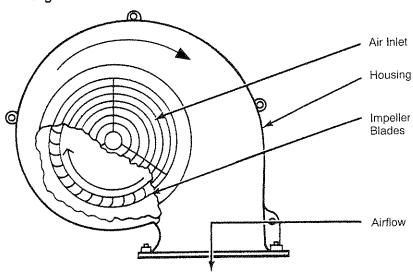


Table 2-4 Electrical Data - Forced Ventilation Blower Units

Size	Motor Frame	HP	RPM	Volts	Phase	Hz	Amps
			3000	230	1	60	0.4
LM2	180	1/40				50/60	2.6/1.3
LM3	180	1/8	3450	115/230		/	
LM3	210-250	1/8	3450	208-230/460	3	50/60	0.66-0.60/0.30
	280	1/3	3450	208-230/460	3	50/60	1.5-1.4/0.7
LM4		1/3			2	50/60	3.1-3.0/1.5
LM6	320-400	1	3450	208-230/460	J		
LM8	504-506	3/4	1750	208-230/460	3	50/60	3.4-3.2/1.6
LM9	508-5012	3	3450	208-230/460	3	50/60	8.2-7.6/3.8

Note: Motor mounted blower units. Mount on commutator end (opposite drive end of motor. We supply blowers that are powered by totally enclosed motors (standard). Blowers have a cast aluminum fan housing with washable, wire mesh filters.

Table 2-5 Minimum Blower CFM for DPBV Motors (Drip Proof Blower Ventilated)

Blower Size	Motor Frame Size	Blower CFM	Blower Static Pressure (In H ₂ O)
LM2	180	55	0.50
LM3	180	150	1,45
LM3	210	175	1.45
LM3	250 215		0.78
LM4	280	350	0.88
LM6	320	780	2.80
LM6	360	780	2.80
LM6	400	820	2.50
LM8	504-506	1120	1.58
LM9	508-5012	2000	5.00

Each motor nameplate is stamped with the above data for DPBV (less Blower), DPSV and TEPV enclosures.

Coupled Start-Up

- After the first successful no load start-up, stop the motor and assemble the coupling.
- 2. Align the coupling and be sure it is not binding in any way.
- The first coupled start-up should be without load. Check to see that the driven equipment is not transmitting any vibration back to the motor through the coupling or the base. Vibrations (if any) should be within acceptable levels.
- Run about 1 hour with driven equipment unloaded.
- 5. After completing these steps, the motor can now be loaded.
- 6. Do not exceed the value of armature nameplate amperes under steady continuous loads.

General Inspection

Inspect the motor at regular intervals, approximately every 500 hours of operation or every 3 months, whichever occurs first. Keep the motor clean and the ventilation openings clear. The following steps should be performed at each inspection:

- Check that the motor is clean. Check that the interior and exterior of the motor is free of dirt, oil, grease, water, etc. Oily vapor, paper pulp, textile lint, etc. can accumulate and block motor ventilation. If the motor is not properly ventilated, overheating can occur and cause early motor failure.
- Use a "Megger" periodically to ensure that the integrity of the winding insulation has been maintained. Record the Megger readings. Immediately investigate any significant drop in insulation resistance.
- Check all electrical connectors to be sure that they are tight.
- Check for too much vibration or looseness. It may be caused by improper alignment, an unbalanced coupling sheave, damaged motor bearings, or loose mounting bolts. Excessive vibration will damage the motor bearings, brushes and commutator.
- Listen for unusual noises, especially in the area of the bearings. Also, rubbing
 or rumbling noises could be signs of internal damage. Check for loose parts on
 the motor such as thru bolts, hold down bolts, bad alignment of hoods, etc. An
 unbalanced armature or load may also cause noise.
- Note: Motors applied with rectified power supplies will often make a humming noise when operating normally. This is even more noticeable at lower operating speeds. If you can hear a growling or erratic hum, the power supply should be checked for proper operation and phase balance. Improper adjustment or functioning of the power supply can cause overheating of the motor and shorten its life.
- At start-up, check the tightness of the main and commutating pole bolts (external on the frame) as listed in Table 3-1. Loose pole bolts could be a source of unpleasant noise when rectified power runs the motor.

Table 3-1 Torque Specifications for Commutating and Main Pole Bolts

Bolt Size	Torque (lb-ft)
3/8 - 16	24 - 30
3/8 - 16	24 - 30
3/8 - 16	24 - 30
1/2 - 13	60 - 75
1/2 - 13	60 - 75
3/8 - 16	24 - 30
3/8 - 16	24 - 30
1/2 - 13	60 - 75
	3/8 - 16 3/8 - 16 3/8 - 16 1/2 - 13 1/2 - 13 3/8 - 16 3/8 - 16

cation & Bearings

Bearing grease will lose its lubricating ability over time, not suddenly. The lubricating ability of a grease (over time) depends primarily on the type of grease, the size of the bearing, the speed at which the bearing operates and the severity of the operating conditions. Good results can be obtained if the following recommendations are used in your maintenance program.

Type of Grease

A high grade ball or roller bearing grease should be used. Recommended grease for standard service conditions is Polyrex EM (Exxon Mobil).

Equivalent and compatible greases include:

Texaco Polystar, Rykon Premium #2, Pennzoil Pen 2 Lube and Chevron SRI-2.

- Maximum operating temperature for standard motors = 110° C.

- Shut-down temperature in case of a malfunction = 115° C.

Lubrication Intervals

Recommended lubrication intervals are shown in Table 3-2. It is important to realize that the recommended intervals of Table 3-2 are based on average use.

Refer to additional information contained in Tables 3-3 and 3-4.

Table 3-2 Lubrication Intervals *

		Base Spe	ed - RPM	
NEMA / (IEC) Frame Size	>2500	1750	1150	<800
	5500 Hrs.	12000 Hrs.	18000 Hrs.	22000 Hrs.
Up to 210 incl. (132)	3600 Hrs.	9500 Hrs.	15000 Hrs.	18000 Hrs.
Over 210 to 280 incl. (180)	* 2200 Hrs.	7400 Hrs.	12000 Hrs.	15000 Hrs.
Over 280 to 360 incl. (225)	*2200 Hrs.	3500 Hrs.	7400 Hrs.	10500 Hrs.
Over 360 to 500 incl. (300)	^2200 Hrs.	00001110.		<u> </u>

Lubrication intervals are for ball bearings. For roller bearings, divide the listed lubrication interval by 2.

Table 3-3 Service Conditions

Severity of Service	Ambient Temperature Maximum	Atmospheric Contamination	Type of Bearing Deep Groove Ball Bearing	
	40° C	Clean, Little Corrosion		
	50° C	Moderate dirt, Corrosion	Ball Thrust, Roller	
Severe		Severe dirt, Abrasive dust,	All Bearings	
Extreme	>50° C* or Class H Insulation	Corrosion		
Low Temperature	<-30° C **		All Bearings	

Special high temperature grease is recommended (Dow Corning DC44). Note that Dow Corning DC44 grease does not mix with other grease types. Thoroughly clean bearing & cavity before adding grease.

Table 3-4 Lubrication Interval Multiplier

Severity of Service	Multiplier	
Standard	1.0	
Severe	0.5	
Fxtreme	0.1	
Low Temperature	1.0	

Special low temperature grease is recommended (Aeroshell 7). Different brushes may also be required. Contact your local Baldor district office or an authorized Baldor service center for technical assistance.

Table 3-5 Bearings Sizes and Types

Frame Size NEMA (IEC)	Bearing Description (These are the "Large" bearings (Shaft End) in each frame size)						
	Bearing	OD D mm	Width B mm	Weight of Grease to	Volume of grease to be added		
		***************************************		add * oz (Grams)	in ³	tea- spoon	
Up to 210 incl. (132)	6307	80	21	0.30 (8.4)	0.6	2.0	
		120	29	0.61 (17)	1.2	3.9	
Over 210 to 280 incl. (180)	6311		33	0.81 (23)	1.5	5.2	
Over 280 to 360 incl. (225)	6313	140			4.1	13.4	
Over 360 to 500 incl. (300)	NU319	200	45	2.12 (60)	4.1	10,4	

Weight in grams = .005 DB

Lubrication Procedure

Be sure that the grease you are adding to the motor is compatible with the grease already in the motor. Consult your Baldor distributor or an authorized service center if a grease other than the recommended type is to be used.

Caution: To avoid damage to motor bearings, grease must be kept free of dirt.

For an extremely dirty environment, contact your Baldor distributor or an authorized Baldor Service Center for additional information.

With Grease Outlet Plug

- 1. Clean all grease fittings.
- Remove grease outlet plug.
- 3. If motor is stopped, add the recommended amount of grease.
 If motor is to be greased while running, a slightly greater quantity of grease will have to be added. Add grease slowly until new grease appears at shaft hole in the endplate or purge outlet plug.
- 4. Re-install grease outlet plug.

Without Grease Outlet Plug

- 1. Disassemble motor.
- 2. Add recommended amount of grease to bearing and bearing cavity. (Bearing should be about 1/3 full of grease and outboard bearing cavity should be about 1/2 full of grease.)

Note: Bearing is 1/3 full when only one side of bearing is completely full of grease.

Assemble motor.

Sample Lubrication Determination

Assume - NEMA 286T (IEC 180), 1750 RPM motor driving an exhaust fan in an ambient temperature of 43° C and the atmosphere is moderately corrosive.

- 1. Table 3-2 list 9500 hours for standard conditions.
- Table 3-3 classifies severity of service as "Severe".
- 3. Table 3-4 lists a multiplier value of 0.5 for Severe conditions.
- 4. Table 3-5 shows that 1.2 in³ or 3.9 teaspoon of grease is to be added.

Note: Smaller bearings in size category may require reduced amounts of grease.

B h Replacement

Do not change brush grades or suppliers without first contacting Baldor for technical assistance.

Brush life will vary greatly due to motor load conditions and the operating environment. The brush pigtail leads should be checked for secure connection to the brush support stud. Brushes should be replaced when their pigtails touch the top of the brush holder.

When replacing brushes, proper seating is important!

- Wrap a strip of coarse grit (60#) sandpaper, rough side out, around the commutator and under the brush holder. (Do not use metal oxide based sandpaper or emery cloth that contains electrically conductive materials).
- Slide the new brush into the holder and snap the spring clip in place.
- 3. Rotate the armature slowly in the direction of normal motor rotation.
- Remove the brush and inspect the face. The brush should be seated over 90% of the face area and completely seated from leading to trailing edge.

Brushes should move freely in their holders. If brushes stick, it is usually due to built up dirt and oil. Brushes should be inspected on occasion to see that they are long enough to press firmly against the commutator. Brush springs should have equal tension. Only brushes of the same size, grade and shape as those originally supplied should be used.

All motors have their brushes set on neutral before leaving Baldor's factory. After replacing the brush holder, realign it to the factory neutral mark.

When replacing a turned-down commutator in the motor with a new commutator, the brush holder assembly must be adjusted. Keep 1/16" clearance between the bottom of the brush holder and commutator. The brush holder assembly is designed with a nut/bolt guide assembly for ease in positioning of the brush-box.

During periodic inspections, check that electrical connections are tight and properly insulated.

ush Springs

Brush springs should be inspected for proper tension during brush replacement. If the spring shows a loss in tension, it should be replaced. Routine replacement of brush springs is recommended with every third set of brushes.

Poor Brush Life

Poor brush life may be caused by overloading, brushes operating at higher than their rated speed, or very light electrical loads. These can be corrected by using a brush with greater current-carrying capacity for overloads. Friction-reducing treatments reduce wear on high speed applications. Where light loading is the cause, the answer may be to remove some brushes from the motor (with multiple brushes per pole). Another is to install brushes with a higher content of graphite that can handle the lower current and still film properly. Poor brush life is generally not related to the "softness" or "hardness" of the brush.

Do not change brush grades or the number of brushes per pole. Doing so may void the warranty and make the motor unsafe to operate. Contact your local Baldor district office or an authorized Baldor service center for technical assistance.

Brush Chatter or Bounce

Brush chatter or bouncing can be caused by vibration from an external source. This may be a bad gearbox coupling or condition, or insecure mounting of the motor. Stronger carbon grades are available that provide more capacity for the brush to resist vibration. It is always best to fix the cause of the problem.

Brush Sparking

Excessive sparking of brushes may be due to electrical causes such as an overload or a very unstable DC power supply. Mechanical causes include a flat spot on the commutator or external vibration. Changing to a better brush grade, or a split-brush design may be required.

Carbon Brushes For Special Operating Conditions

Sometimes, there are problems if motor operation requires a different design or grade of carbon brush than what was installed when the motor was built. These special operating conditions include long periods of operation with loads that are significantly greater or less than rated load capacity. Also, operation in the presence of certain chemicals, or extreme temperature and humidity can degrade brush performance.

Generally, poor brush life or commutator wear can occur if one or more of the above conditions exist. The brush used doesn't match the operating conditions.

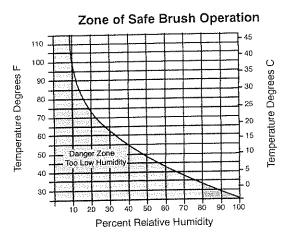
Baldor offers optional brush grades for the above conditions and has replacement brushes available to retrofit motors. Contact your local Baldor District Office or an Authorized Baldor Service Center for technical assistance.

Do not change brush grades or the number of brushes per pole. Doing so may void the warranty and make the motor unsafe. Contact your local Baldor district office or an authorized Baldor service center for technical assistance.

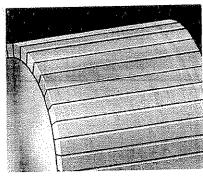
Authorized Service

Baldor catalog 505 (and the Baldor CD-ROM) lists service shops authorized to service Baldor DC motors. Contact your local Baldor District Office for more information.

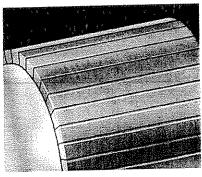
Humidity And Brush Wear This curve represents 2 grains of water per cubic foot of dry air or 4.6 grams per cubic meter of dry air.



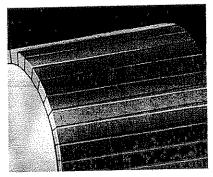
e To Commutator Appearance



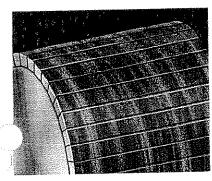
Light Film: Indicates good brush performance. Light load, low humidity, brush grades with low filming rates, or film reducing contamination can cause lighter color.



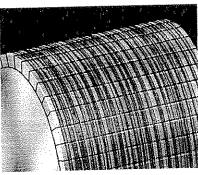
Medium Film: is the ideal commutator condition for maximum brush and commutator life.



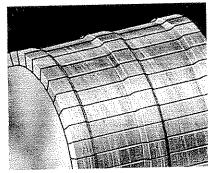
Heavy Film: Results from high load, high humidity or heavy filming rate grades. Colors not in the brown tones indicate contamination resulting in high friction and high resistance.



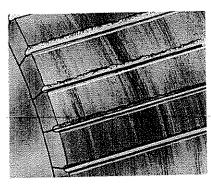
Streaking: Results from metal transfer to the brush face. Light loads and/or light spring pressure are most common causes. Contamination can also be a contributing factor.



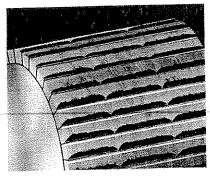
Threading: Is a further development of the streaking condition as the metal transferred becomes work hardened and machines into the commutator surface. With increased loads and increased spring pressure this condition can be avoided.



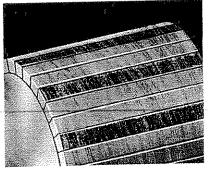
Grooving: May result from an overly abrasive brush grade. The more common cause is poor electrical contact resulting in arcing and the electrical machining of the commutator surface. Increased spring pressure reduces this electrical wear.



Copper Drag: Develops as the commutator surface becomes overheated and softened. Vibration or an abrasive grade causes the copper to be pulled across the slots. Increased spring pressure will reduce commutator temperature.



Bar Edge Burning: Results from poor commutation. Check that brush grade has adequate voltage drop, that the brushes are properly set on neutral and that the interpole strength is correct.



Slot Bar Marking: Results from a fault in the armature windings. The pattern relates to the number of conductors per slot.

This chart courtesy of Helwig Carbon Products, Inc., Milwaukee, WI

Commutator

After several hours of operation, the commutator surface under the brush should take on a darker bronze color. This is due to self-generated film caused by normal commutation. This coloration should be even, without blotches or black areas. A shiny copper color or black streaks in the brush tracks are signs of improper commutation or contamination by a foreign material. Contact Baldor for assistance in correcting these problems.

If the commutator becomes rough and burned, or becomes black, it should be cleaned of dirt and carbon particles. This can be done by wiping it with a dry, lint-free cloth. Also vacuuming or blowing out the motor with a dry air supply are suitable cleaning methods. Do not use solvents or cleaning solutions on the commutator. To remove spots or contamination that will not wipe off, wrap a strip of coarse (60# grit) sandpaper around the commutator. Then rotate the armature back and forth by hand. Do not use emery cloth as this contains electrically conductive materials.

Another method of commutator resurfacing is to use a commercially available commutator dressing stone. This should only be done by trained and experienced people. This stone should be taped or attached to the end of a stick made of electrically insulated material. The motor should be run at about half speed and the stone applied lightly to the commutator surface. This operation must be done with no load on the motor.

The surface of the commutator should be smooth and round. This can be checked while the motor is running at low speed. Press lightly on one brush with an insulated stick. **Do not use a lead pencil as this contains electrically conductive graphite**. If you feel movement of the brush, it suggests a worn or uneven commutator. The armature must be removed from the motor and the commutator machined by a qualified repair shop.

Rapid Commutator Wear

Light electrical loads and contamination are the usual causes of rapid commutator wear. Light loading may require the removal of some brushes on motors with multiple brushes per pole. Sometimes a low current density brush grade is used. There are also brushes that have a mild polishing action. These prevent certain chemicals, especially chlorine and silicone, from attacking the commutator. Brushes, are available for use in plastic extruder applications where PVC is present. Usually, you do not have to change the design or grade of the brushes on new motors unless special operating conditions exist.

Do not change brush grades or the number of brushes per pole. Doing so may void the warranty and make the motor unsafe. Contact your local Baldor district office or an authorized Baldor service center for technical assistance.

ng The Commutator After commutator turning, check its run-out with the bearings on V blocks. For all commutators, maximum run-out is .002". New and minimum commutator diameters are listed as follows.

Frame	New Motor Commutator Diameter (inches)	Minimum Diameter after Refinishing (inches)	
180	2.750	2.51	
210	4.500	4.29	
250	5.000	4.72	
280	5.750	5.45	
320	6.500	6.20	
360	7.500	7.21	
400	8.250	7.90	
500	10.250	9.72	

Notes:

The above diameters are approximate.

They are for standard design and speed motors. high speed motors require larger minimum bar diameters. Contact Baldor for dimensions.

Commutator surface finish, after machining, should be between 40 and 65 micro-inch RMS.

mutator Undercutting Check the commutator mica between bars for an under-cut depth of 1/64" minimum, 5/64" maximum. The grooves of the under-cut are to be free of mica and chips.

⚠ Caution:

Be very careful when repainting a drip proof motor. Do not get any paint on the commutator. Paint on the commutator will show up as black marks in brush tracks. Also, excessive brush sparking or erratic operation can be caused by paint or other material on the commutator.

Blowers & Filters

Do not use silicone RTV around DC motors as commutator surface damage can occur. Intake filters on blowers and louvers of drip proof motors should be cleaned to remove any dust or foreign matter. Canister type filters should be replaced when dirty. Failure to keep air intakes clear will cause overheating and premature failure of the insulating system.

Troubleshooting **Armature Overheating**

Excessive overloads will cause a noticeable odor of overheated varnish or charred insulation. The commutator may eventually become blackened and pitted and the brushes burned. This overheating may be general and uniform. To cure, remove the overload and rewind or replace armature if damaged beyond use.

An open-circuited armature coil will cause flashing at the commutator. Two adjacent bars will show severe burning and a resulting overheated armature. Short-circuited coils or commutator bars may cause local heating that could destroy the insulation at that spot. This may result in the burning of the armature coils, banding or commutator bars.

Grounds in the armature circuit may be found by using a megger. Connect one lead to motor frame and the other lead to a commutator bar. If the armature is grounded, the megger will show less than 1 meg ohm.

These tests should be done by experienced and qualified personnel.

Field Coil Overheating

The blowers or external cooling systems should be left in operation if the main field windings remain fully energized with the motor at standstill. Failure to do so may cause too much heat build-up which could cause reduced insulation life.

When using field economy circuits to reduce voltage to the main fields during standstill, blowers do not need to be operating. The most common failure with overheated field coils is a short in one or more of the shunt coils.

Shorted coils show less than half the line voltage for two pole motors. This is with the fields connected for high voltage (in series). Shorted four pole motor coils will read less than 1/4 of the line voltage with the coils connected for high voltage (in series).

A grounded coil may cause overheating. This defect may be tested as shown by the ground test for an armature. With brushes lifted, place one test point of the megger on either field lead, the other on the motor frame. The megger will read less than 1 meg ohm, if a grounded coil is present.

An open field coil on a motor will cause the armature to have no torque. The motor may run at a very high speed at no load. The commutator may be flashing. To locate an open coil, apply line voltage to the shunt coils (brushes lifted). A voltmeter will show no reading across a good coil. It will show about the line voltage across the open coil.

These tests should be done by experienced and qualified personnel. If you find any of the above defects, don't run the motor. First contact your local Baldor District Office or an Authorized Baldor Service Center for repairs.

Excessive Load

Excessive load may be found by checking the DC armature ampere input and comparing it with the rating on the nameplate. An excessive load may prevent the motor from starting or accelerating to full load speed. It could finally result in premature failure of the motor or control. Be sure to use an averaging type ammeter if the motor's power is coming from a rectifier or SCR control.

Jogging and Repeated Starts

Repeated starts or jogs of motors may reduce the life of the brushes and winding insulation. The heat produced by excessive starting may be more than what can be dissipated by the motor under a constant full load conditions. If you must frequently start or jog a motor, you should check the application with the local Baldor District Office.

Heating

Duty cycle and maximum ambient temperature are shown on the nameplate of the motor. If there is any question about safe operation, contact the local Baldor District Office. Motor overheating may be caused by improper ventilation, excessive ambient temperature, dirty conditions or an inoperable blower or dirty filter. Electrical causes may be due to excess current caused by an overload or over-voltage to the fields.

Thermostat

Most stock Baldor DC motors 180 frame and above have a standard temperature-sensing thermostat mounted to their interpole winding. This normally closed thermostat opens when the temperature limit is exceeded. Another option available is a normally open thermostat that closes with temperature.

On blower cooled or separately ventilated motors, the protection capabilities of the thermostats are greatly reduced at low speeds. This is because the interpoles have the same amount of heat transfer regardless of speed. Armature heat transfer is less at low speed. There is less internal air turbulence at low speeds causing higher temperatures at the armature.

The thermal time constant for interpoles can be as much as five times longer than the armature's time constant. Because of this, the thermostat cannot be relied upon to protect the armature during extreme overloads lasting a short time.

The ripple of the rectified power supply and manufacturing tolerances of mounting the device affect the thermostat's accuracy.

For thermostat contact ratings, refer to Thermostats in Section 2 of this manual.

Table 3-6 Troubleshooting Chart

· · · · · · · · · · · · · · · · · · ·	Possible Causes	Possible Solutions
Symptom	Usually caused by line trouble, such	Check source of power. Check overloads, fuses,
Notor will not start	as, single phasing at the starter.	controls, etc.
xcessive humming	High Voltage.	Check input line connections.
excessive numining	Loose pole pieces.	Torque the bolts as specified in Table 3-1.
	Overload. Compare actual amps	Locate and remove source of excessive inction in
Notor Over Heating	(measured) with nameplate rating.	motor or load.
	(measured) with nameplate rains	Reduce load or replace with motor of greater capacity.
	Leadingtion	Check external cooling blower to be sure air is moving
	Improper ventilation.	properly across cooling tips.
		l'ou de la
		Objects motor bruch covers to ensure they are solid on
		the commutator end and that they are not louveled.
		Chook filter for dirt clean of replace.
		Excessive dirt build-up on motor. Clean motor.
	I bles an otator	Chack air gap clearance and bearings.
	Armature rubbing on stator.	Timeten "Thru Bolts" that hold the endplates to frame.
		Torque the pole bolts as specified in Table 3-1.
		Chook input voltage
	Field over voltage.	Reduce field voltage to 60% with field economy circuit
	Full voltage on field with motor	in the control.
	stopped.	Perform dielectric test and repair as required.
	Grounded winding.	Perform dielectric test and repair as requires:
	Improper connections.	Inspect all electrical connections for proper
	The second secon	termination, clearance, mechanical strength and
		electrical continuity. Refer to connection diagram.
ring Over Heating	Misalignment.	Check and align motor and driven equipment.
Titig Over meaning	Excessive belt tension.	Reduce belt tension to proper point for load.
	Excessive end thrust.	Doduce the end thrust from driven machine.
;	Excessive end undoc	Remove grease until cavity is approximately ³ / ₄ filled.
	Excessive grease in bearing.	Add gross until cavity is approximately % Illeu.
	Insufficient grease in bearing.	Clean bearing cavity and bearing. Hepack with correct
	Dirt in bearing.	grease until cavity is approximately $^{3}/_{4}$ filled.
		Check and align motor and driven equipment.
Vibration	Misalignment.	Isolate and eliminate cause of rubbing.
• • • • • • • • • • • • • • • • • • • •	Rubbing between rotating parts and	Isolate and eliminate cause of raparity
	stationary parts.	Have armature balance checked are repaired at your
	Armature out of balance.	Have armature balance checked are repaired at year
		Baldor Service Center.
	Resonance.	Tune system or contact your Baldor Service Center for
	T (Coordanoo)	assistance.
	Foreign material in air gap or	Remove armature and foreign material. Reinstall
Noise	ventilation openings.	armature. Check insulation integrity. Clean ventilation
	Ventuation openings.	ingo
	Ded booring	Clean all grease from cavity and nev
Growling or whining	Bad bearing.	bearing. Repack with correct grease until cavity is
		approximately 3/4 filled.

Accessories

The following list shows some accessories available through Baldor's Mod Express or available on custom manufactured motors. Contact your Baldor supplier for information on each additional accessory or those listed below.

Bearing RTD

RTD (Resistance Temperature Detector) devices are used to measure or monitor the temperature of the motor bearing during operation.

Bearing Thermocouples

Used to measure or monitor bearing temperatures.

Bearing Thermostat

Temperature device that activates when bearing temperatures are excessive. Used with an external circuit to warn of excessive bearing temperature or to shut down a motor.

Blowers with Filters:

Available to increase the constant torque speed range of DPFG motors. This increases the continuous operating torque range at low speeds.

Brush Wear Indicator:

Provides a warning when the brushes have worn down to the level where they need to be replaced (before damage to the commutator).

Condensation Drains & Breathers:

Stainless steel drains and separate breathers are available.

Conduit Boxes

Optional conduit boxes are available in various sizes to accommodate accessory devices.

Cord & Plug Assembly

Adds a line cord and plug for portable applications.

Designed for use when motor is mounted in a vertical position. Contact your Baldor distributor to confirm that the motor is designed for vertical mounting.

Fan Cover & Lint Screen

To prevent build-up of debris on the cooling fan.

Additional stainless steel nameplates are available.

Roller Bearings

Recommended for belt drive applications with a speed of 1800 RPM or less.

Rotation Arrow Labels

Rotation arrows are supplied on motors designed to operate in one direction only. Additional rotation arrows are available.

Slide Bases:

Allows easy belt adjustment while maintaining correct pulley and belt alignment.

Space Heater

Added to prevent condensation of moisture within the motor enclosure during periods of shut down or storage.

Stainless Hardware

Stainless steel hardware is available. Standard hardware is corrosion resistant zinc plated steel.

Tachometers:

DC, AC and digital outputs are available. These can be mounted to our motors or shipped separately. Tachs help the SCR control achieve more precise speed regulation than by armature feedback alone.

Transparent Brush Inspection:

For easy brush inspection and commutation monitoring without disassembly of the motor.

Winding RTD

RTD (Resistance Temperature Detector) devices are used to measure or monitor the temperature of the motor winding during operation.

Winding Thermocouples

Used to measure or monitor winding temperatures.

Winding Thermostat

Temperature device that activates when winding temperatures are excessive. Used with an external circuit to warn of excessive winding temperature or to shut down a motor.

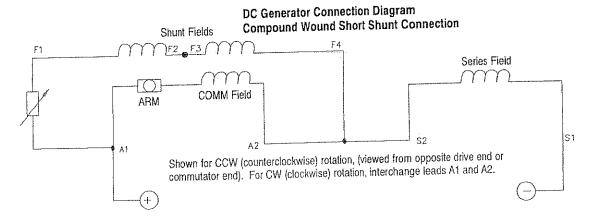
Reflash Instructions

Instructions to reflash the residual magnetism for Lifting Magnet Generators only.

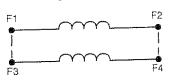
These generators are self-exciting. If voltage will not build up, it is possible the residual magnetism is insufficient to initiate excitation. This procedure is to restore sufficient residual magnetism to self excite.

Note: Loss of residual magnetism can be caused by misconnection (reversing the connections) of F1 and F4.

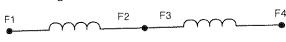
- Disconnect F1 and F4. All other leads may remain connected.
- Connect 24 to 40VDC power source positive lead to F1 and negative to F4. DC source may be batteries, a DC welder (not AC) or rectified AC.
- Drive generator at rated RPM. 3.
- Measure the voltage across A1 and A2. Voltage should be 150 to 200% of F1 to F4 voltage. When A1 to A2 voltage level reaches this level (approximately 30 seconds) carefully remove the source leads, an arc may be present during disconnect.
- Stop the generator.
- Reconnect F1 and F4 as shown in the DC Generator Connection Diagram. Rotation is viewed from opposite drive end (commutator end) A1 is positive for CCW rotation. A2 is positive for CW rotation. S1 is always negative.



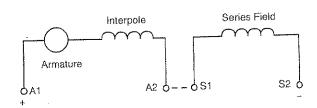
Low Voltage connection Shunt Field



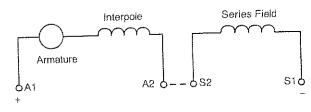
High Voltage connection Shunt Field



Field Reversing Series Motor

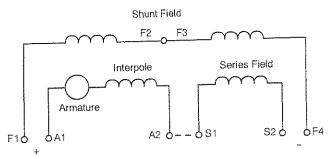


Series Motor CCW Rotation (Facing Commutator End)

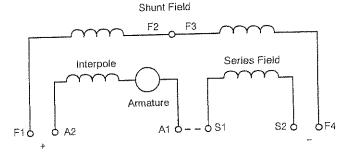


Series Motor CW Rotation (Facing Commutator End)

Armature Reversing Compound and Stabilized Motors

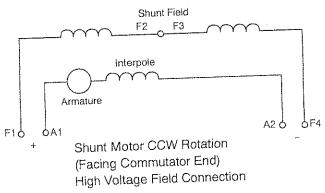


Compound or Stabilized Shunt Motor CCW Rotation (Facing Commutator End) High Voltage Field Connection

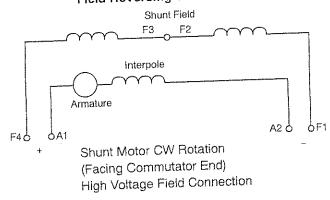


Compound or Stabilized Shunt Motor CW Rotation (Facing Commutator End) High Voltage Field Connection

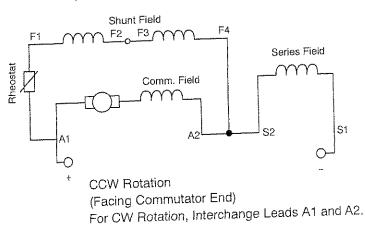
Field Reversing Shunt Motor



Field Reversing Shunt Motor



DC Generator Connection Diagram Compound Wound Short Shunt Connection



Baldor District Offices

UNITED STATES

ARIZONA
PHOENIX
4211 S 43RD PLACE
PHOENIX, AZ 85040
PHONE: 602-470-0467
FAX: 602-470-0464

CALIFORNÍA LOS ANGELES 6480 FLOTILLA COMMERCE, CA 90040 PHONE: 323-724-6771 FAX: 323-721-5859

> HAYWARD 21056 FORBES STREET HAYWARD, CA 94545 PHONE: 610-785-9900 FAX: 610-785-9910

COLORADO DENVER 2520 W BARBERRY PLACE DENVER, CO 80204 PHONE: 303-623-0127 FAX: 303-595-3772

CONNECTICUT
WALLINGFORD
65 SOUTH TURNPIKE ROAD
WALLINGFORD, CT 06492
PHONE: 203-259-354
FAX; 203-259-5495

FLORIDA TAMPA/PUERTO RICO/ VIRGIN ISLANDS 3906 EAST 11TH AVENUE TAMPA, FL 33605 PHONE: 813-248-5078 FAX: 813-247-2984

GEORGIA
ATLANTA
62 TECHNOLOGY DR.
ALPHARETTA, GA 30005
PHONE: 770-772-7000
FAX: 770-772-7200

ILLINOIS CHICAGO 1601 FRONTENAC ROAD NAPERVILLE, IL 60563 PHONE: 630-848-5100 FAX: 630-848-5110

INDIANA INDIANAPOLIS 5525 W. MINNESOTA STREET INDIANAPOLIS, IN 46241 PHONE: 317-246-5100 FAX: 317-246-5110 800-428-4141

IOWA
DES MOINES
1800 DIXON STREET, SUITE C
DES MOINES, IA 50316
PHONE: 515-263-6929
FAX: 515-263-6515

MARYLAND
BALTIMORE
6860 SANTA BARBARA RD.
SUITE 22-24
ELKRIDGE; MD 21075
PHONE: 410-579-2135
FAX: 410-579-2677

MASSACHUSETTS
BOSTON
6 PULLMAN STREET
WORCESTER, MA 01606
PHONE: 508-854-0708
FAX: 508-854-0291

MICHIGAN
DETROIT
33782 STERLING PONDS BLVD.
STERLING HEIGHTS, MI 48312
PHONE: 586-978-9800

FAX: 586-978-9969 MICHIGAN Continued GAND RAPIDS 668 3 MILE ROAD NW GRAND RAPIDS, MI 49504 PHONE: 616-785-1784 FAX: 616-785-1788

MINNESOTA MINNEAPOUS 21086 134TH AVE. NORTH ROGERS, MN 55374 PHONE: 763-428-3633 FAX: 763-426-4551

MISSOURI ST LOUIS 422 INDUSTRIAL DRIVE MARYLAND HEIGHTS, MO 63043 PHONE: 314-298-7660 FAX: 314-298-7660

KANSAS CITY 915 N W PLATTE VALLEY DR RIVERSIDE, MO 64150 PHONE: 816-587-0272 FAX: 816-587-3735

NEW YORK AUBURN ONE ELLIS DRIVE AUBURN, NY 13021 PHONE: 315-255-3403 FAX: 315-253-9923

NORTH CAROLINA GREENSBORO 1220 ROTHERWOOD ROAD GREENSBORO, NO 27406 P O BOX 16560 GREENSBORO, NC 27416 PHONE: 336-272-6104 FAX: 336-273-6628

OHIO CINCINNATI 2929 CRESCENTVILLE ROAD WEST CHESTER, OH 45069 PHONE: 513-771-2600 FAX: 513-772-2219

CLEVELAND 8929 FREEWAY DRIVE MACEDONIA, OH 44056 PHONE: 330-468-4777 FAX: 330-468-4778

OKLAHOMA TULSA 2 EAST DAWES BIXBY, OK 74008 PHONE: 918-366-9320 FAX: 918-366-9338

OREGON PORTLAND 20393 SW AVERY COURT TUALATIN, OR 97062 PHONE: 503-691-9010 FAX: 503-691-9012

PENNSYLVANIA
PHILADELPHIA
1035 THOMAS BUSCH
MEMORIAL HIGHWAY
PENNSAUKEN, NJ 08110
PHONE: 856-661-1442
FAX: 856-663=6363.

PITTSBURGH 616H BEATTY ROAD MONROEVILLE, PA 15146 PHONE: 412-380-7244 FAX: 412-380-7250

TENNESSEE
MEMPHIS
4660 WINCHESTER ROAD
MEMPHIS, TN 36118
PHONE: 901-365-2020
FAX: 901-365-3914

TEXAS
HOUSTON
4647 PINE TIMBERS
SUITE # 135
HOUSTON, TX 77041
PHONE: 713-895-7062
FAX: 713-690-4540

DALLAS 3040 QUEBEC DALLAS, TX 75247 PHONE: 214-634-7271 FAX: 214-634-8874

UTAH
SALT LAKE CITY
2230 SOUTH MAIN STREET
SALT LAKE CITY, UT 84115
PHONE: 801-832-0127
FAX: 801-832-8911

WISCONSIN MILWAUKEE 2725 SOUTH 163RD STREET NEW BERLIN, WI 53161 PHONE: 262-784-5940 FAX: 262-784-1215

INTERNATIONAL SALES FORT SMITH, AR P.O. BOX 2400 FORT SMITH, AR 72902 PHONE: 479-646-4711 FAX: 479-648-5895

CANADA
EDMONTON, ALBERTA
4055-92 STREET
EDMONTON, ALBERTA T6E 6R8
PHONE: 780-434-4900
FAX: 780-438-2600

OAKVILLE, ONTARIO 2750 COVENTRY ROAD OAKVILLE, ONTARIO LGH 6R1 PHONE: 905-829-3301 FAX: 905-829-3302

MONTREAL, QUEBEC 1844 WILLIAM STREET MONTREAL, QUEBEC H3J 1R5 PHONE: 514-933-2711 FAX: 514-933-8639

VANCOUVER, BRITISH COLUMBIA 1538 KEBET WAY PORT COQUITLAM, BC V3C 5M5 PHONE 604-421-2822 FAX: 604-421-3113

WINNIPEG, MANITOBA 54 PRINCESS STREET WINNIPEG, MANITOBA R3B 1K2 PHONE: 204-942-5205 FAX; 204-956-4251

AUSTRALIA UNIT 3, 6 STANTON BOAD SEVEN HILLS, NSW 2147, AUSTRALIA PHONE: (61) (2) 9674 5455 FAX: (61) (2) 9674 2495

> UNIT 8, 5 KELLETTS ROAD ROWVILLE, VICTORIA, 3178 AUSTRALIA PHONE: (61) (3) 9753 4355 FAX: (61) (3) 9753 4366

BALDOR CENTROAMERICA RESIDENCIAL PINARES DE SUIZA POL 15 #44, NVA. SAN SALVADOR EL SALVADOR, CENTRO AMERICA PHONE: (603) 288-1519 FAX: (503) 288-1518

BALDOR SUDAMERICA CALLE F, EL CANGREJO CONDOMINIO PH. CONDADO PLAZA APT. 11D, BELLA VISTA PANAMÁ CITY, REP. DE PANAMÁ PHONE: (507) 265-6041 CHINA
SHANGHAI JIAHUA BUSINESS CENTER
ROOM NO. A-8421
808 HONG QIAO ROAD
SHANGHAI 200030
PHONE: 86-21-64473060
FAX: 86-21-64078620

GERMANY
DIESELSTRASSE 22
D-65551 KIRCHHEIM
MUNICH, GERMANY
PHONE: (49) (89) 90508 - 0
FAX: (49) (89) 90508 - 492

DIA 14, COMMERCE AVENUE MAHAGANESH COLONY PAUD ROAD PUNE - 411 038 MAHARASHTRA, INDIA PHONE: 91 20 25 45 95 31/32 FAX: 91 20 24 55 95 30

ITALY
BALDOR ASR AG
SUCCURSALE DI MENDRISIO
VIA BORROMINI, 20A
CH-6850 MENDRISIO
SWITZERLAND
PHONE: 41 91 640 9952
FAX: 41 91 630 2633

JAPAN
DIA BLOG 802,
2-21-1 TSURUYA-CHO,
KANAGAWA-KU
YOKOHAMA, 221-0835, JAPAN
PHONE: B1-45-412-4506
FAX: B1-45-412-4507

KOREA ROM 210 BUPYEONG INDUSTRIAL COMMERCIAL COOPERATIVE 396-16 CHEONGCHEON 2-DONG, BUPYEONG-GU INCHEON, KOREA, 403-858 PHONE: 82 32 508 3252 FAX: 82 32 508 3253

MÉXICO KM. 2.0 BLVD. AL AEROPUERTO LEÓN 37545, GUANAJUATO, MÉXICO PHONE: 52 477 761 2030 FAX: 52 477 761 2010

MIDDLE EAST & NORTH AFRICA VSE INTERNATIONAL CORP. 3233 NORTH ARLINGTON HEIGHTS SUITE 100W ARLINGTON HEIGHTS, IL 60004 PHONE: 847 590 5547

SINGAPORE 51 KAKI BUKIT ROAD 2 K B WAREHOUSE COMPLEX SINGAPORE 417863 PHONE: (65) 6 744 2572 FAX: (65) 6 747 1708

SWITZERLAND
POSTFACH 73
SCHUTZENSTRASSE 59
CH-8245 FEUERTHALEN
SWITZERLAND
PHONE: (41) (52) 6474700
FAX: (41) (52) 6592394

TAIWAN
4F, NO, 25, SEC. 1,
TUNHUA S ROAD,
TAIPEI 10557, TAIWAN, R.O.C.
PHONE: (886-2) 2577-4352
FAX: (886-2) 2577-4157

UNITED KINGDOM
6 BRISTOL DISTRIBUTION PARK
HAWKLEY DRIVE
BRISTOL BS32 0BF U.K.
PHONE: 44 1454 850000
FAX: 44 1454 859001



P.O. Box 2400 Ft. Smith, AR 72902-2400 (479) 646-4711 Fax (479) 648-5792

CH	D	UK	F
TEL:+41 52 647 4700	TEL: +49 89 90 50 80	TEL: +44 1454 850000	TEL:+33 145 10 7902
FAX:+41 52 659 2394	FAX: +49 89 90 50 8491	FAX: +44 1454 850001	FAX:+33 145 09 0864
I	AU	CC	MX
TEL: +39 11 562 4440	TEL: +61 29674 5455	TEL: +65 744 2572	TEL:+52 477 761 2030
FAX: +39 11 562 5660	FAX: +61 29674 2495	FAX: +65 747 1708	FAX:+52 477 761 2010

WINKLE INDUSTRIES

SECTION 16

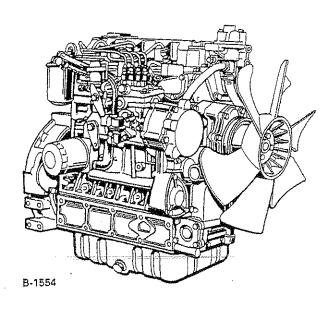
KUBOTA ENGINE MANUAL

OPERATORISMANU/AIE

DESEL ENGINE

MODELS

V3600-E3 · V3600-T-E3 · V3800-DI-T-E3 · V3300-E3BG · V3600-E3BG · V3600-T-E3BG



READ AND SAVE THIS MANUAL

Kuboka

California Proposition 65

A WARNING A

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

CONTENTS

	. 1
▲ SAFE OPERATION	1
SERVICING OF THE ENGINE	٠,
NAMES OF PARTS	. ∠
PRE-OPERATION CHECK	3 3 3
OPERATING THE ENGINE STARTING THE ENGINE(NORMAL) COLD WEATHER STARTING STOPPING THE ENGINE CHECKS DURING OPERATION Radiator Cooling water(Coolant) Oil pressure lamp Charge lamp Fuel Color of exhaust Immediately stop the engine if; REVERSED ENGINE REVOLUTION AND REMEDIES How to tell when the engine starts running backwards Remedies MAINTENANCE	5 6 6 6 7 7 7
MAINTENANCE	9
SERVICE INTERVALS PERIODIC SERVICE FUEL Fuel level check and refueling Air bleeding the fuel system Checking the fuel pipes Cleaning the fuel filter pot Fuel filter cartridge replacement ENGINE OIL Checking oil level and adding engine oil Changing engine oil Replacing the oil filter cartridge RADIATOR Checking coolant level, adding coolant Changing coolant Remedies for quick decrease of coolant	12: 13 14 15 15 15 17 17 17 17
Remedies for quick decrease of coolant	
Checking radiator hoses and clamp Precaution at overheating Cleaning radiator core(outside) Anti-freeze	19 20

	21
AIR CLEANER	21
For the air cleaner with a dust cup (optional).	22
Dust indicator (optional)	22
BATTERY	23
Battery charging Direction for long term storage	23
Adjusting Fan Belt Tension	
TOTAL OF AND CTODACE	25
CARRIAGE AND STORAGE	. 25
CARRIAGE	25
STORAGE	~ ~
TROUBLESHOOTING	. 26
TROUBLEBRIOU (IIVO	28
SPECIFICATIONS	
	. 32
MAIDING DIAGRAMS	



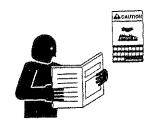
SAFE OPERATION

Careful operation is your best assurance against an accident. Read and understand this section carefully before operating the engine. All operators, no matter how much experience they may have, should read this and other related manuals before operating the engine or any equipment attached to it. It is the owner's obligation to provide all operators with this information and instruct them on safe operation.

Be sure to observe the following for safe operation.

1. OBSERVE SAFETY INSTRUCTIONS

- Read and understand carefully this "OPERATOR'S MANUAL" and "LABELS ON THE ENGINE" before attempting to start and operate the engine.
- Learn how to operate and work safely. Know your equipment and its limitations. Always keep the engine in good condition.
- Before allowing other people to use your engine, explain how to operate and have them read this manual before operation.
- DO NOT modify the engine. UNAUTHORIZED MODIFICATIONS to the engine may impair the function and/or safety and affect engine life. If the engine does not perform properly, consult your local Kubota Engine Distributor first.



1AAACAAAP008B

2. WEAR SAFE CLOTHING AND PERSONAL PROTECTIVE EQUIPMENT (PPE)

- DO NOT wear loose, tom or bulky clothing around the machine that may catch on working controls and projections or into fans, pulleys and other moving parts causing personal injury.
- Use additional safety items-PPE, e.g. hard hat, safety protection, safety goggles, gloves, etc., as appropriate or required
- DO NOT operate the machine or any equipment attached to it while under the influence of alcohol, medication, or other drugs, or while fatigued.
- DO NOT wear radio or music headphones while ¹AEAAAAAP0¹30 operating the engine.







3. CHECK BEFORE STARTING & OPERATING THE ENGINE

- Be sure to inspect the engine before operation. Do not operate the engine if there is something wrong with it. Repair it immediately.
- Ensure all guards and shields are in place before operating the engine. Replace any that are damaged or missing.
- Check to see that you and others are a safe distance from the engine before starting.
- Always keep the engine at least 3 feet (1 meter) away from buildings and other facilities.
- DO NOT allow children or livestock to approach the machine while the engine is running.
- DO NOT start the engine by shorting across starter terminals. The machine may start in gear and move. Do not bypass or defeat any safety devices.



1BAABADAP0010

4. KEEP THE ENGINE AND SURROUNDINGS CLEAN

- Be sure to stop the engine before cleaning.
- Keep the engine clean and free of accumulated dirt, grease and trash to avoid a fire. Store flammable fluids in proper containers and cabinets away from sparks and heat.
- Check for and repair leaks immediately.
- DO NOT stop the engine without idling; Allow the engine to cool down, first. Keep the engine idling for about 5 minutes before stopping unless there is a safety 1AEAAAAAPD120 problem that requires immediate shut down.



5. SAFE HANDLING OF FUEL AND LUBRICANTS -KEEP AWAY FROM FIRE

- Aiways stop the engine before refueling and/or lubricating.
- DO NOT smoke or allow flames or sparks in your work area. Fuel is extremely flammable and explosive under certain conditions.
- Refuel at a well ventilated and open place. When fuel and/or lubricants are spilled, refuel after letting the engine cool down.
- DO NOT mix gasoline or alcohol with diesel fuel. The mixture can cause a fire or severe engine damage.
- Do not use unapproved containers e.g. buckets, bottles, jars. Use approved fuel storage containers and 1AAACAAAPOO1A dispensers.



6. EXHAUST GASES & FIRE PREVENTION

. Engine exhaust fumes can be very harmful if allowed to accumulate. Be sure to run the engine in a well ventilated location and where there are no people or livestock near the engine.

 The exhaust gas from the muffler is very hot. To prevent a fire, do not expose dry grass, mowed grass, oil or any other combustible materials to exhaust gas. Keep the engine and muffler clean at all times.

To avoid a fire, be alert for leaks of flammable substances from hoses and lines. Be sure to check for leaks from hoses or pipes, such as fuel and hydraulic fluid by following the maintenance check list.

 To avoid a fire, do not short across power cables and wires. Check to see that all power cables and wirings are in good condition. Keep all electrical connections clean. Bare wire or frayed insulation can cause a 1AAACAAAPO11A dangerous electrical shock and personal injury.



7. ESCAPING FLUID

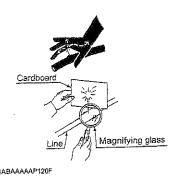
 Relieve all pressure in the air, the oil and the cooling systems before disconnecting any lines, fittings or related items.

 Be cautious of possible pressure relief when disconnecting any device from a pressurized system that utilizes pressure. DO NOT check for pressure leaks with your hand. High pressure oil or fuel can cause personal injury.

• Escaping fluid under pressure has sufficient force to penetrate skin causing serious personal injury.

Fluid escaping from pinholes may be invisible. Use a piece of cardboard or wood to search for suspected leaks: do not use hands and body. Use safety goggles or other eye protection when checking for leaks.

 If injured by escaping fluid, see a medical doctor immediately. This fluid can produce gangrene or severe 1ABAAAAAP120F allergic reaction.



8. CAUTIONS AGAINST BURNS & BATTERY EXPLOSION

 To avoid burns, be cautious of hot components, e.g. muffler, muffler cover, radiator, hoses, engine body, coolants, engine oil, etc. during operation and after the engine has been shut off.

 DO NOT remove the radiator cap while the engine is running or immediately after stopping. Otherwise hot water will spout out from the radiator. Walt until the radiator is completely cool to the touch before removing the cap. Wear safety goggles.

 Be sure to close the coolant drain valve, secure the pressure cap, and fasten the pipe band before 1AEABAAAP0080 operating. If these parts are taken off, or loosened, it will result in serious personal injury.

 The battery presents an explosive hazard. When the battery is being charged, hydrogen and oxygen gases are extremely explosive.

 DO NOT use or charge the battery if its fluid level is below the LOWER mark.

Otherwise, the component parts may deteriorate earlier than expected, which may shorten the service life or cause an explosion. Immediately, add distilled water until the fluid level is between the UPPER and LOWER marks.

 Keep sparks and open flames away from the battery, especially during charging. DO NOT strike a match near

 DO NOT check the battery charge by placing a metal object across the terminals. Use a voltmeter or hydrometer.

DO NOT charge a frozen battery. There is a risk of explosion. When frozen, warm the battery up to at least 16° C (61° F).







9. KEEP HANDS AND BODY AWAY FROM ROTATING PARTS

 Be sure to stop the engine before checking or adjusting the belt tension and cooling fan,

 Keep your hands and body away from rotating parts, such as the cooling fan, V-belt, fan drive V-belt, pulley or flywheel. Contact with rotating parts can cause severe personal injury.

 DO NOT run the engine without safety guards. Install safety guards securely before operation.





1ABAAAAAAP1470

10. ANTI-FREEZE & DISPOSAL OF FLUIDS

 Anti-freeze contains poison. Wear rubber gloves to avoid personal injury. In case of contact with skin, wash it off immediately.

 DO NOT mix different types of Anti-freeze. The mixture can produce a chemical reaction causing harmful substances. Use approved or genuine KUBOTA Antifreeze.

Be mindful of the environment and the ecology. Before draining any fluids, determine the correct way to dispose of them. Observe the relevant environmental protection regulations when disposing of oil, fuel, coolant, brake fluid, filters and batteries.

When draining fluids from the engine, place a suitable

container underneath the engine body.

 DO NOT pour waste onto the ground, down a drain, or into any water source. Dispose of waste fluids according to environmental regulations.





11. CONDUCTING SAFETY CHECKS & MAINTENANCE

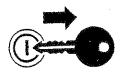
 When inspecting the engine or servicing, place the engine on a large flat surface. DO NOT work on anything that is supported ONLY by lift jacks or a hoist. Always use blocks or the correct stands to support the engine before servicing.

 Disconnect the battery from the engine before conducting service. Put a "DO NOT OPERATE!" tag on

the key switch to avoid accidental starting.

 To avoid sparks from an accidental short circuit always disconnect the battery's ground cable (-) first and reconnect it last.

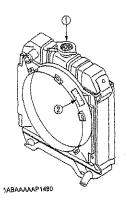
- Be sure to stop the engine and remove the key when conducting dally and periodic maintenance, service and cleaning.
- Check or conduct maintenance after the engine, coolant, muffler, or muffler cover have cooled off completely.
- Always use the appropriate tools and fixtures. Verify that they are in good condition before performing any service work. Make sure you understand how to use them before service.
- Use ONLY correct engine barring techniques for manually rotating the engine. DO NOT attempt to rotate the engine by pulling or prying on the cooling fan and V- 1BJABAAAP0200 belt. This practice can cause serious personal injury or premature damage to the cooling fan and belt. .
- Replace fuel pipes and lubricant pipes with their hose clamps every 2 years or earlier whether they are damaged or not. They are made of rubber and age gradually.
- When servicing is performed together by two or more persons, take care to perform all work safely.
- Keep a first aid kit and fire extinguisher handy at all





12. WARNING AND CAUTION LABELS

① Part No.19077-8724-1 or 16667-8724-1 (37mm in diameter) (55mm in diameter)





② Part No.TA040-4957-1 Stay clear of engine fan and fan belt



13. CARE OF WARNING AND CAUTION LABELS

- 1. Keep warning and caution labels clean and free from obstructing material.
- 2. Clean warning and caution labels with soap and water, dry with a soft cloth.
- 3. Replace damaged or missing warning and caution labels with new labels from your local KUBOTA dealer.
- 4. If a component with warning and caution label(s) affixed is replaced with a new part, make sure
- the new label(s) is (are) attached in the same location(s) as the replaced component.

 5. Mount new warning and caution labels by applying to a clean dry surface and pressing any bubbles to the outside edge.

8

SERVICING OF THE ENGINE

Your dealer is interested in your new engine and has the desire to help you get the most value from it. After reading this manual thoroughly, you will find that you can do some of the regular maintenance yourself.

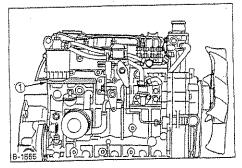
reading unis manual thoroughly, you will find that you can do some of the regular maintenance yourself. However, when in need of parts or major service, be sure to see your KUBOTA dealer.

For service, contact the KUBOTA Dealership from which you purchased your engine or your local KUBOTA dealer.

When in need of parts, be prepared to give your dealer the engine serial number.

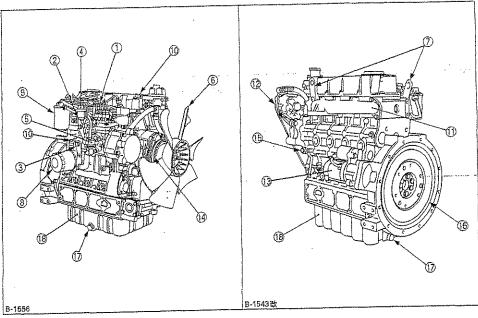
Locate the serial number now and record them in the space provided.

	Туре	Serial No.
Engine		
Date of Purchase		
Name of Dealer		·



(1) Engine serial number

NAMES OF PARTS



- (1) Intake manifold
 (2) Speed control lever
 (3) Engine stop lever
 (4) Shut off solenoid
 (5) Fuel feed pump
 (6) Cooling fan
 (7) Engine hook
 (8) Oil filter cartridge
 (9) Fuel filter
 (10) Oil filter plug

- (11) Exhaust manifold (12) Alternator (13) Starter (14) Fan belt (15) Oil pressure switch (16) Flywheel (17) Oil drain plug (18) Oil pan

PRE-OPERATION CHECK

- During the engine break-in period, observe the following by all means:

 1. Change engine oil and oil filter cartridge after the first 50 hours of operation. (See "ENGINE OIL" in "PERIODIC SERVICE" section.)
- 2. When ambient temperature is low, operate the machine after the engine has been completely warmed up.

DAILY CHECK

To prevent trouble from occurring, it is important to know the conditions of the engine well. Check it before starting.



A CAUTION

To avoid personal injury:

• Be sure to install shields and safeguards attached to the engine when operating.

Be sure to install shields and saleguards attached to the engine when operating.
Stop the engine at a flat and wide space when checking.
Keep dust or fuel away from the battery, wiring, muffler and engine to prevent a fire. Check and clear them before operating everyday. Pay attention to the heat of the exhaust pipe or exhaust gas so that it can not ignite trash.

	Item '	Ref. page
Parts which had trouble in previous operation		
2. By walking around the machine	(1) Oil or water teaks	15 to 20
3	(2) Engine oil level and contamination	15
	(3) Amount of fuel	12
	(4) Amount of coolant	18
	(5) Dust in air cleaner dust cup	21
	(6) Damaged parts and loosened bolts and nuts	
By inserting the key into the starter switch	(1) Proper functions of meters and pilot lamps; no stains on these parts	-
********	(2) Proper function of glow lamp timer	-
4. By starting the engine	(1) Color of exhaust fumes	7
and the state of t	(2) Unusual engine noise	7
	(3) Engine start-up condition	5
	(4) Slow-down and acceleration behavior	7

OPERATING THE ENGINE

STARTING THE ENGINE(NORMAL)



CAUTION

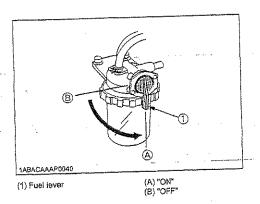
To avoid personal injury:

- Do not allow children to approach the machine while the engine is
- · Be sure to install the machine on which the engine is installed, on a flat place.
- Do not run the engine on gradients.
- Do not run the engine in an enclosed area. Exhaust gas can cause air pollution and exhaust gas poisoning.
- Keep your hands away from rotating parts (such as fan, pulley, belt, flywheel etc.) during operation.
- Do not operate the machine while under the influence of alcohol or drugs.
- Do not wear loose, torn or bulky clothing around the machine. It may catch on moving parts or controls, leading to the risk of accident. Use additional safety items, e.g. hard hat, safety boots or shoes, eye and hearing protection, gloves, etc., as appropriate or required.
- Do not wear radio or music headphones while operating engine.
- Check to see if it is safe around the engine before starting.
- Reinstall safeguards and shields securely and clear all maintenance tools when starting the engine after maintenance.

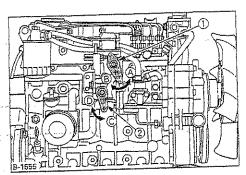
IMPORTANT:

- Do not use ether or any starting fluid for starting the engine, or a severe damage will occur.
- When starting the engine after a long storage (of more than 3 months), first set the stop lever to the "STOP" position and then activate the starter for about 10 seconds to allow oil to reach every engine

1. Set the fuel lever to the "ON" position.

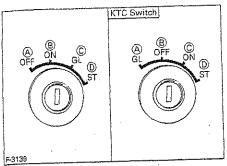


- 2. Place the engine stop lever to the "START" position.
- 3. Place the speed control lever at more than half "OPERATION".



- (1) Speed control lever (2) Engine stop lever
- "IDLING" (B) "OPERATION" (C) "START"
- (D) "STOP"

4. Insert the key into the key switch and turn it "ON".



- (A) *SWITCHED OFF
- (B) "OPERATION"
 (C) "PREHEATING"
- (D) "STARTING"
- (A) "PREHEATING" (B) "SWITCHED OFF"
- (C) "OPERATION"
- (D) "STARTING"
- 5. Turn the starter switch to the "PREHEATING" position to allow the glow lamp to redden.

NOTE:

(with lamp timer in use)

- The glow lamp goes out in about 5 seconds when the lamp timer is up. Refer to this for pre-heating. Even with the glow lamp off, the glow plug can be pre-heated by turning the starter switch to the "PRE-HEATING" position.
- 6. Turn the key to the "STARTING" position and the engine should start. Release the key immediately when the engine starts.
- 7. Check to see that the oil pressure lamp and charge lamp are off. If the lamps are still on, immediately stop the engine, and determine the cause. (See "CHECKS DURING OPERATION" in "OPERATING THE ENGINE" section.)

NOTE:

- If the oil pressure lamp should be still on, immediately stop the engine and check;
 - if there is enough engine oil.
 - If the engine oil has dirt in it.
 - if the wiring is faulty.

8. Warm up the engine at medium speed without load.

IMPORTANT:

- If the glow lamp should redden too quickly or too slowly, immediately ask your KUBOTA dealer to check and
- If the engine does not catch or start at 10 seconds after the starter switch is set at "STARTING" position, wait for another 30 seconds and then begin the engine starting sequence again. Do not allow the starter motor to run continuously for more than 20 seconds.

COLD WEATHER STARTING

If the ambient temperature is below -5°C(23°F)* and the engine is very cold, start it in the following manner: Take steps (1) through (4) above.

5. Turn the key to the "PREHEATING" position and keep it there for a certain period mentioned below.

IMPORTANT:

 Shown below are the standard preheating times for various temperatures. This operation, however, is not required, when the engine is warmed up.

	Preheating time	
Ambient temperature	V3600-E3 V3600-T-E3 V3300-E3BG V3600-E3BG V3600-T-E3BG	V3800-DI-T-E3
Above 10°C (50°F)	NO NEED	
10°C (50°F) to -5°C (23°F)	Approx.5 seconds	Approx.15 seconds
Below -5°C (23°F)	Approx.10 seconds	Approx.30 seconds
Limit of continuous use	20 seconds	30 seconds

6. Turn the key to the "STARTING" position and the engine should start. (If the engine fails to start after 10 seconds, turn off the key for 5 to 30 seconds. Then repeat steps (5) and (6).)

IMPORTANT:

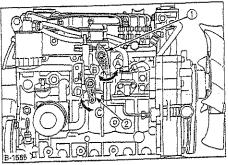
- Do not allow the starter motor to run continuously for more than 20 seconds.
- Be sure to warm up the engine, not only in winter, but also in warmer seasons. An insufficiently warmed-up engine can shorten its service life.
- When there is fear of temperature dropping below -15°C (5°F) detach the battery from the machine, and keep it indoors in a safe area, to be reinstalled just before the next operation.

STOPPING THE ENGINE

1. Return the speed control lever to lowidle, and run the engine under idling conditions.

IMPORTANT:

- If equipped with a turbo-charger, allow the engine to ldle for 5 minutes before shutting it off after a full load operation.
- Failure to do so may lead to turbo-charger trouble.
- 2. The engine should stop with the starter switch placed at the OFF position. (In case of non-stopping, set the engine stop lever to the "STOP" position manually.)
- 3. After stopping the engine, remove the key.(Be sure to return the engine stop lever to the START position to be ready for the next starting in case of manually stopping.)



- Speed control lever (2) Engine stop lever
- "IDLING"
- (B) "OPERATION" (C) "START"
- (D) "STOP"

CHECKS DURING OPERATION

While running, make the following checks to see that all parts are working correctly.

Radiator Cooling water(Coolant)



WARNING

To avoid personal injury:

 Do not remove radiator cap until coolant temperature is well below its boiling point. Then loosen cap slightly to the stop position, to before pressure, any relieve removing cap completely.

When the engine overheats and hot coolant overflows through the radiator and hoses, stop the engine immediately and make the following checks-todetermine the cause of trouble:

Check item

- Check to see if there is any coolant leak;
- 2. Check to see if there is any obstacle around the cooling air inlet or outlet;
- 3. Check to see if there is any dirt or dust between radiator fins and tube;
- Check to see if the fan belt is too loose;
- 5. Check to see if radiator water pipe is clogged; and
- 6. Check to see if anti-freeze is mixed to a 50/50% mix of water and anti-freeze.

■Oil pressure lamp

The lamp lights up to warn the operator that the engine oil pressure has dropped below the prescribed level. If this should happen during operation or should not go off even after the engine is accelerated more than 1000rpm, immediately stop the engine and check the following:

- oll level (See "ENGINE OIL" Engine "PERIODIOSERVICE" section.)
- Lubricant system (See "El "PERIODIOSERVICE" section.) "ENGINE OIL"

Charge lamp

The lamp lights up to warn the operator that the battery charge is low. If this should happen during operation, immediately stop the engine and check the following:

- 1. Cable broken
- Poor connection at alternator terminal
- Fan belt too loose or damaged

≋Fuel



A CAUTION

To avoid personal injury:

- Fluid escaping from pinholes may be invisible. Do not use hands to search for suspected leaks; Use a piece of cardboard or wood, instead. If injured by escaping fluid, see a medical doctor at once. This fluid can produce gangrene or a severe allergic reaction.
- Check any leaks from fuel pipes or fuel injection pipes. Use eye protection when checking for leaks.

Be careful not to empty the fuel tank. Otherwise air may enter the fuel system, requiring fuel system bleeding. (See "FUEL" in "PERIODIOSERVICE" section.)

■Color of exhaust

While the engine is run within the rated output range:

- The color of exhaust remains colorless.
- If the output slightly exceeds the rated level, exhaust may become a little colored with the output level kept constant.
- If the engine is run continuously with dark exhaust emission, it may lead to trouble with the engine.

Immediately stop the engine if;

- The engine suddenly slows down or accelerates.
- Unusual noises are suddenly heard.
- Exhaust fumes suddenly become very dark.
- The oil pressure lamp or the water temperature alarm lamp lights up.

REVERSED ENGINE REVOLUTION AND REMEDIES



CAUTION

To avoid personal injury:

- Reversed engine operation can make the machine reverse and run it backwards. It may lead to serious trouble.
- Reversed engine operation may make exhaust gas gush out into the intake side and ignite the air cleaner; It could catch fire.

Reversed engine revolution must be stopped immediately since engine oil circulation is cut quickly, leading to serious trouble.

How to tell when the engine starts running backwards

- 1. Lubricating oil pressure drops sharply. Oil pressure warning light, if used, will light.
- 2. Since the intake and exhaust sides are reversed, the sound of the engine changes, and exhaust gas will. come out of the air cleaner.
- 3. A louder knocking sound will be heard when the engine starts running backwards.

Remedies

- 1. Immediately turn the starter switch to the "OFF" position and set the engine stop lever to the "STOP" position to stop the engine.
- 2. After stopping the engine, check the air cleaner, intake rubber tube and other parts and replace parts as needed.

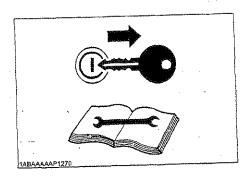
MAINTENANCE



CAUTION

To avoid personal injury:

- Be sure to conduct daily checks, periodic maintenance, refueling or cleaning on a level surface with the engine shut off and remove the key.
- Before allowing other people to use your engine, explain how to operate, and have them read this manual before operation.
- When cleaning any parts, do not use gasoline but use regular cleanser.
- Always use proper tools, that are in good condition. Make sure you understand how to use them, before performing any service work.
- When installing, be sure to tighten all bolts lest they should be loose.
 Tighten the bolts by the specified torque.
- Do not put any tools on the battery, or battery terminals may short out.
 Severe burns or fire could result.
 Detach the battery from the engine before maintenance.
- Do not touch muffler or exhaust pipes while they are hot; Severe burns could result.





SERVICE INTERVALS

Observe the following for service and maintenance.
The lubricating oil change intervals listed in the table below are for Class CF lubricating oil of API classification with a low-sulfur fuel in use. If the CF-4, CG-4, CH-4 or CI-4 lubricating oil is used with a high-sulfur fuel, change the lubricating oil at shorter intervals than recommended in the table below depending on the operating condition.

Interval	ltem	Ref. page	***	
	Check of fuel pipes and clamp bands	14		@
Every 50 hours	Draining water separator	-		٠
See NOTE	Change of engine oil	15 to 17	0	
See NOTE	Cleaning of air cleaner element	21	*1	@
*.	Cleaning of fuel filter	14		
· .	Check of battery electrolyte level	22		
Every 250 hours	Check of fan belt tightness	24		
	Check of radiator hoses and clamp bands	19		
	Check of intake air line	-		@
	Replacement of oil filter cartridge	17	0	
	Replacement of fuel filter cartridge	15		@
Every 500 hours	Removal of sediment in fuel tank	-		
	Cleaning of water jacket (radiator interior)	18 to 20		
	Replacement of fan belt	24		
	Cleaning of water separator	-	<u> </u>	
Every one or two	Recharging of battery	22, 23		
Every year	Replacement of air cleaner element	21	*2	@
Every 1000 hours	Check of valve clearance	26	<u> </u>	_
Every 1500 hours	Check of fuel injection nozzle injection pressure	-	*3	@
Every root com-	Check of turbo charger	-	*3	@
Every 3000 hours	Check of injection pump	-	*3	@
Lyony dodd mana	Check of fuel injection timer	-	*3	0
	Change of radiator coolant (L.L.C.)	19 to 20	<u> </u>	_
•	Replacement of battery	22, 23		_
•	Replacement of radiator hoses and clamp bands	19	1	-
Every two years	Replacement of fuel pipes and clamp bands	14	*3	
	Replacement of intake air line	-	*4	(
	Replacement of fan belt (or every 500 hours)	24		

IMPORTANT:

- The jobs indicated by ② must be done after the first 50 hours of operation.
- *1 Air cleaner should be cleaned more often in dusty conditions than in normal conditions.
- *2 After 6 times of cleaning.
- *3 Consult your local KUBOTA Dealer for this service.
- *4 Replace only if necessary.
- When the battery is used for less than 100 hours in a year, check its electrolyte yearly. (for refillable battery's only)
- The items listed above (@ marked) are registered as emission related critical parts by KUBOTA in the U.S. EPA nonroad emission regulation. As the engine owner, you are responsible for the performance of the required maintenance on the engine according to the above instruction. Please see the Warranty Statement in detail.

Changing Interval of engine oil

Models	Interval
V3600-E3, V3600-T-E3, V3300-E3BG, V3600-E3BG; V3600-T-E3BG	250 Hrs or 1 year whichever comes first
V3800-DI-T-E3	500 Hrs or 1 year whichever comes first
initial	50 Hrs

- API service classification: above CF grade
- Ambient temperature: below 35°C (95°F)

NOTE:

With strict emission control regulations now in effect, the CF-4 and CG-4 engine oils have been developed for use with low sulfur fuels, for On-Highway vehicle engines. When a Non-Road engine runs on high sulfur fuel, it is advisable to use a "CF or better" classification engine oil with a high Total Base Number (a minimum TBN of 10 is recommended).

Lubricating oil recommended when a low-sulfur or high-sulfur fuel is employed.

O : Recommendable X : Not recommendable

Lubricating	Fuel		Remarks
oil classification	Low-sulfur	High-sulfur	
CF	0	.0	*TBN≥10
CF-4	0	×	
CG-4	0	×	
CH-4	0	×	
CI-4	O'	×	

*TBN: Total Base Number

Diesel Fuel Specification Type and Sulfur Content % (ppm) used, must be compliant with all applicable emission

Diesel Fuel Specification Type and Sulfur Content % (ppm) used, must be compliant with all applicable emission regulations for the area in which the engine is operated.
Use of diesel fuel with sulfur content less than 0.10 % (1000 ppm) is strongly recommended.
If high-sulfur fuel (sulfur content 0.50 % (5000 ppm) to 1.0 % (10000 ppm)) is used as a diesel fuel, change the engine oil and oil filter at shorter intervals. (approximately half).
DO NOT USE Fuels that have sulfur content greater than 1.0 % (10000 ppm).
Since KUBOTA diesel engines of less than 56 kW (75 hp) utilize EPA Tier 4 and Interim Tier 4 standards, the use of low sulfur fuel or utilize low sulfur fuel is mandatory for these engines, when operated in US EPA regulated areas.

of low sulfur fuel or ultra low sulfur fuel is mandatory for these engines, when operated in US EPA regulated areas. Therefore, please use No.2-D S500 or S15 diesel fuel as an alternative to No.2-D, and use No.1-D S500 or S15 diesel fuel as an alternative to No.1-D for ambient temperatures below -10°C (14°F).

1) No.1-D or No.2-D, S500 : Low Sulfur Diesel (LSD) less than 500 ppm or 0.05 wt.%

No.1-D-or-No.2-D, S15 -- Ultra Low-Sulfur Diesel-(ULSD) 15-ppm-or-0.0015 wt.%

- CJ-4 classification oil is intended for use in engines equipped with DPF (Diesel Particulate Filter) and is Not
- Recommended for use in Kubota E3 specification engines.

 Oil used in the engine should have API classification and Proper SAE Engine Oil according to the ambient temperatures as shown below:

SAE30, SAE10W-30 or 15W-40
SAE20, SAE10W-30 or 15W-40
SAE10W, SAE10W-30 or 15W-40

Recommended API classification

Refer to the following table for the suitable American Petroleum Institute (API) classification of engine oil according Refer to the following table for the suitable American Petroleum Institute (API) classification of engine oil according to the engine type (with internal EGR, external EGR or non-EGR) and the Fuel Type Used: (Low Sulfur, Ultra Low Control Sulfur or High Sulfur Fuels).

	Engine oil classification (API classification)		
Fuel type	Engines with non-EGR Engines with internal EGR	Engines with external EGR	
High Sultur Fuel (0.05 % (500 ppm) < Sulfur Content < 0.50 % (5000 ppm))	CF (If the "CF-4, CG-4, CH-4 or CI-4" engine oil is used with a high-sulfur fuel, change the engine oil at shorter intervals. (approximately half))		
Low Sulfur Fuel- [Sulfur Content < 0.05 % (500 ppm)] or Ultra Low Sulfur Fuel [Sulfur Content < 0.0015 % (15 ppm)]	CF, CF-4, CG-4, CH-4 or Cl-4	CF or Ci-4 (Class CF-4, CG-4 and CH-4 engine, oils cannot be used on EGR type engines.)	

EGR: Exhaust Gas Re-circulation

PERIODIC SERVICE

FUEL

Fuel is flammable and can be dangerous. You should handle fuel with care.



A CAUTION

To avoid personal injury:

- Do not mix gasoline or alcohol with diesel fuel. This mixture can cause an explosion.
- Be careful not to spill fuel during refueling. If fuel should spill, wipe it off at once, or it may cause a fire.
- Do not fail to stop the engine before refueling. Keep the engine away from the fire.
- Be sure to stop the engine while refueling or bleeding and when cleaning or changing fuel filter or fuel pipes. Do not smoke when working around the battery or when refueling.
- Check the above fuel systems at a well ventilated and wide place.
- When fuel and lubricant are spilled, refuel after letting the engine cool off.
- Always keep spilled fuel and lubricant away from engine.

Fuel level check and refueling

- Check to see that the fuel level is above the lower limit of the fuel level gauge.
- If the fuel is too low, add fuel to the upper limit. Do not overfill.

Flash Point, °C (°F)	Water and Sediment, volume %	Carbon Residue on, 10 percent Residuum, %	Ash, weight %
Min	Max	Max	Max
52 (125)	0.05	0.35	0.01

Distillation Temperatures, °C(°F) 90% Point		Viscosity Kinematic oSt or mm²/s at 40°C		Viscosity Saybolt, SUS at 37.8°C(100°F)	
Młn	Max	Min	Max	Min	Max
282 (540)	338 (640)	1.9	4.1	32.6	40.1

Sulfur, weight %	Capper Strip Corrosian	Cetane Number	
Max	Max Min		
0.50	No. 3	40	

- Cetane Rating: The minimum recommended Fuel Cetane Rating is 45. A-cetane rating greater than 50 is preferred, especially for ambient temperatures below -20 °C (-4 °F) or elevations above 1500 m (5000 ft).
- Diesel Fuel Specification Type and Sulfur Content % (ppm) used, must be compliant with all applicable emission regulations for the area in which the engine is operated.
- Use of diesel fuel with sulfur content less than 0.10 % (1000 ppm) is strongly recommended.
- If high-sulfur fuel (sulfur content 0.50 % (5000 ppm) to 1.0 % (10000 ppm)) is used as a diesel fuel, change the engine oil and oil filter at shorter intervals (approximately half).
- DO NOT USE Fuels that have sulfur content greater than 1.0 % (10000 ppm).
- Diesel fuels specified to EN 590 or ASTM D975 are recommended.
- No.2-D is a distillate fuel of lower volatility for engines in industrial and heavy mobile service. (SAE J313 JUN87)
- Since KUBOTA diesel engines of less than 56 kW (75 hp) utilize EPA Tier 4 and Interim Tier 4 standards, the use of low sulfur fuel or utira low sulfur fuel is mandatory for these engines, when operated in US EPA regulated areas. Therefore, please use No.2-D S500 or S15 diesel fuel as an alternative to No.2-D, and use No.1-D S500 or S15 diesel fuel as an alternative to No.1-D for ambient temperatures below -10 °C (14 °F).
 - 1) SAE: Society of Automotive Engineers
 - 2) EN : European Norm
 - ASTM: American Society of Testing and Materials
 - US EPA : United States Environmental Protection
 Agency
 - 5) No.1-D or No.2-D, S500 : Low Sulfur Diesel (LSD) less than 500 ppm or 0.05 wt.%
 - No.1-D or No.2-D, S15 : Ultre Low Sulfur Diesel (ULSD) 15 ppm or 0.0015 wt.%

IMPORTANT:

- Be sure to use a strainer when filling the fuel tank, or dirt or sand in the fuel may cause trouble in the fuel injection pump.
- For fuel, always use diesel fuel. You are required not to use alternative fuel, because its quality is unknown or it may be inferior in quality. Kerosene, which is very low in cetane rating, adversely affects the engine. Diesel fuel differs in grades depending on the temperature.
- Be careful not to let the fuel tank become empty, or air can enter the fuel system, necessitating bleeding before next engine start.

Air bleeding the fuel system



CAUTION

To avoid personal injury;

• Do not bleed a hot engine as this could cause fuel to spill onto a hot exhaust manifold creating a danger of fire.

Air bleeding of the fuel system is required if;

- · after the fuel filter and pipes have been detached and refitted:
- after the fuel tank has become empty; or
- before the engine is to be used after a long storage.

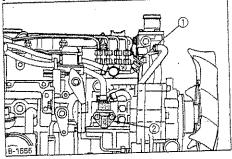
[PROCEDURE (A)] (gravity feed fuel tanks only)

- 1. Fill the fuel tank to the fullest extent. Open the fuel
- filter lever. Open the joint bolt on top of the fuel injection pump.
- Turn the engine, continue it for about 10 seconds, then stop it, or move the fuel feed pump lever by hand (optional).
- 4. Close the Joint bolt on top of the fuel injection pump.

IMPORTANT:

 Always keep the air vent cock on the fuel injection pump closed except when air is vented, or it may cause the engine to stop.

[GRAVITY FEED SYSTEM]



(1) Joint bott (2) Fuel feed pump

NOTE:

 For the engine equipped with automatic venting (optional) no manual bleeding of fuel lines is required.

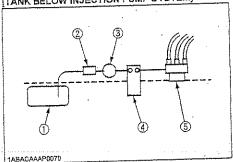
[PROCEDURE ®] (fuel tanks lower than injection pump)

- 1. For fuel tanks that are lower than the injection pump. The fuel system must be pressurized by the fuel system electric fuel pump.
- 2. If an electric fuel pump is not used, you must manually actuate the pump by lever to bleed.
- 3. The primary fuel filter 3 must be on the pressure side of the pump if the fuel tank is lower than the injection pump.
- 4. To bleed follow (2) through (5) above. (PROCEDURE (A))

IMPORTANT:

Tighten air vent plug of the fuel injection pump except when bleeding, or it may stop the engine suddenly.

ITANK BELOW INJECTION PUMP SYSTEM]



- (1) Fuel tank below injection pump
- (3) Electric or Mechanical pump (4) Main Filter
- (5) injection pump

屬Checking the fuel pipes



CAUTION

To avoid personal injury;

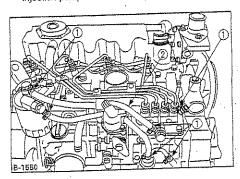
 Check or replace the fuel pipes after stopping the engine. Broken fuel pipes can cause fires.

Check the fuel pipes every 50 hours of operation. When

- If the clamp band is loose, apply oil to the screw of the band, and tighten the band securely.
- 2. If the fuel pipes, made of rubber, became worn out, replace them and clamp bands every 2 years.
- If the fuel pipes and clamp bands are found worn or damaged before 2 years' time, replace or repair them at once.
- After replacement of the pipes and bands, air-bleed the fuel system.

IMPORTANT:

 When the fuel pipes are not installed, plug them at both ends with clean cloth or paper to prevent dirt from entering. Dirt in the pipes can cause fuel intesting pure and installed. injection pump malfunction.

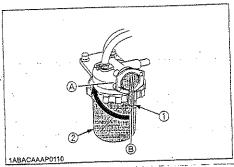


(1) Clamp band (2) Fuel pipe

Cleaning the fuel filter pot

Every 100 hours of operation, clean the fuel filter in a clean place to prevent dust intrusion.

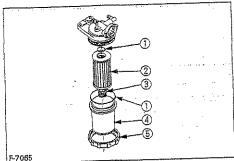
Close the fuel filter lever.



- (1) Fuel filter lever
- (2) Fuel filter pot
- (B) "ON"
- 2. Remove the top cap, and rinse the inside with diesel
- 3. Take out the element, and rinse it with diesel fuel.
- 4. After cleaning, reinstall the fuel filter, keeping out of dust and dirt.
- Air-bleed the injection pump.

IMPORTANT:

 Entrance of dust and dirt can cause a malfunction of the fuel injection pump and the injection nozzle. Wash the fuel filter cup periodically.



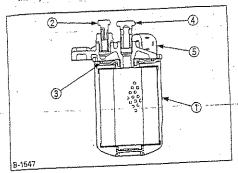
- F-7065
- (1) O ring (2) Filter element
- (3) Spring (4) Filter bowl
- (5) Screwring

Fuel filter cartridge replacement

- 1. Replace the fuel filter cartridge with a new one every 500 operating hours.
- 2. Apply fuel oil thinly over the gasket and tighten the cartridge into position by hand-tightening only.
- 3. Finally vent the air.

IMPORTANT:

 Replace the fuel filter cartridge periodically to prevent wear of the fuel injection pump plunger or the injection nozzle, due to dirt in the fuel.



- (1) Fuel filter cartridge
- (2) Air vent plug
- (3) O ring (4) Pipe joint
- (5) Cover

NOTE:

The fuel filter cartridge and water separator should be replaced more earlier according to the fuel classification in use.

ENGINE OIL



CAUTION

To avoid personal injury:

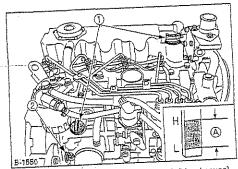
- Be sure to stop the engine before checking and changing the engine oil and the oil filter cartridge.
- Do not touch muffler or exhaust pipes while they are hot; Severe burns could result. Always stop the engine and allow it to cool before conducting inspections, maintenance, or for a cleaning procedure.
- Contact with engine oil can damage your skin. Put on gloves when using engine oil. If you come in contact with engine oil, wash it off immediately.

IMPORTANT:

Do not operate a diesel engine when engine oil is overfilled. This oil can drain through the air intake system, which cause engine disacceleration and oil leaks from breather pipings. It could result in a overrunning or oil hammering of engine in case of the engine with suction blow-by gases breathered in.

Checking oil level and adding engine oil

- Check the engine oil level before starting or more than 5 minutes after stopping the engine.
- Remove the oil level gauge, wipe it clean and reinstall it.
- Take the oil level gauge out again, and check the oil level.



(1) Oil filler plug (2) Oil level gauge

[Lower end of oil level gauge] (A) Engine oil level within this range is proper.

- if the oil level is too low, remove the oil filler plug, and add new oil to the prescribed level.
- After adding oil, walt more than 5 minutes and check the oil level again. It takes some time for the oil todrain down to the oil pan.

Models	Engine oil quantity
V3600-E3, V3600-T-E3, V3800-DI-T-E3, V3300-E3BG, V3600-E3BG, V3600-T-E3BG	13.2 L (3.49 U.S. gal.)

* API service classification: above CF grade

IMPORTANT:

 Engine oil should be MIL-L-2104C or have properties of API classification CF or higher.
 Change the type of engine oil according to the ambient temperature.

above 25°C (77°F)	SAE30 or SAE10W-30 SAE15W-40
0°C to 25°C (32°F to 77°F)	SAE20 or SAE10W-30 SAE15W-40
below 0°C (32°F)	SAE10W or SAE10W-30 SAE15W-40

 When using oil of different brands from the previous one, be sure to drain all the previous oil before adding the new engine oil.

NOTE:

 Be sure to inspect the engine, locating it on a level place. If placed on gradients accurately, oil quantity may not be measured.

Changing engine oil

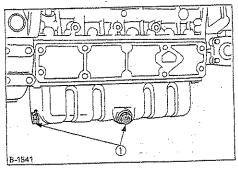


CAUTION

To avoid personal injury:

- Be sure to stop the engine before draining engine oil.
- When draining engine oil, place some container underneath the engine and dispose it according to local regulations.
- Do not drain oil after running the engine. Allow engine to cool down sufficiently.
- Change oil after the initial 50 hours of operation and every 500 (for DI spec), 250 (for IDI spec) hours thereafter.
- When the annual operating hours are below 500 (DI spec) or 250 (IDI spec), replace the oil every year.

 2. Remove the drain plug at the bottom of the engine,
- Remove the drain plug at the bottom of the engine, and drain all the old oil. Drain oil will drain easier when the oil is warm.
- When letting out the oil, remove the filler plug too.
 With the filler plug still in place, it would be difficult to discharge the oil completely.
- Add new engine oil up to the upper limit of the oil level gauge. Be careful not to add oil above the upper limit of the oil level gauge.



(1) Oil drain plug

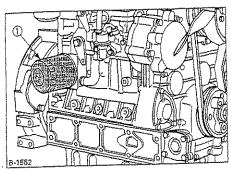
■Replacing the oil filter cartridge



CAUTION

To avoid personal injury:

- Be sure to stop the engine before changing the oil filter cartridge.
- Allow engine to cool down sufficiently, oil can be hot and cause burns.
- Replace the oil filter cartridge. Oil filter cartridge should be replaced after the initial 50 hours of operation and every 500 hours thereafter.
- 2. Remove the old oil filter cartridge with a filter wrench.
- Apply a film of oil to the gasket for the new cartridge.
 Screw in the cartridge by hand. When the gasket contacts the seal surface, tighten the cartridge enough by hand. Because, if you tighten the cartridge with a wrench, it will be tightened too much.



(1) Oil filter cartridge

5. After the new cartridge has been replaced, the engine oil level normally decreases a little. Thus, run the engine for a while and check for oil leaks through the seal before checking the engine oil level. Add oil if necessary.

NOTE:

Wipe off any oil sticking to the machine completely.

RADIATOR

Coolant will last for one day's work if filled all the way up before operation start. Make it a rule to check the coolant level before every operation.



WARNING

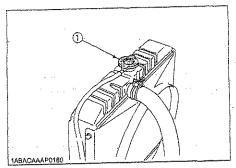
To avoid personal injury:

- Do not stop the engine suddenly, stop it after about 5 minutes of unloaded idling.
- Work only after letting the engine and radiator cool off completely (more than 30 minutes after it has been stopped).
- Do not remove the radiator cap while coolant is hot. When cool to the touch, rotate cap to the first stop to allow excess pressure to escape. Then remove cap completely.

If overheats should occur, steam may gush out from the radiator or recovery tank; Severe burns could

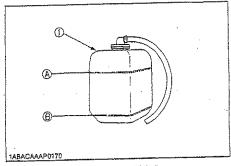
■Checking coolant level, adding coolant

 Remove the radiator cap, after the engine has completely cooled, and check to see that coolant reaches the supply not. - reaches the supply port.



(1) Radiator pressure cap

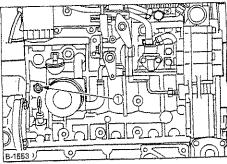
 If the radiator is provided with a recovery tank, check the coclant level of the recovery tank. When it is between the "FULL" and "LOW " marks, the coclant will last for one day's work.

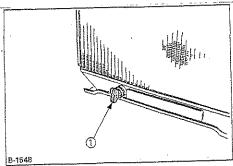


(1) Recovery tank

(A) "FULL" (B) "LOW"

- 3. When the coolant level drops due to evaporation, add water only up to the full level.
- Check to see that two drain cocks; one is at the crankcase side and the other is at the lower part of the radiator as figures below.





(1) Coolant drain cock

IMPORTANT:

- If the radiator cap has to be removed, follow the caution and securely retighten the cap.
 If coolant should be leak, consult your local KUBOTA

 If coolant should be leak, consult your local KUBOTA
- Make sure that muddy or sea water does not enter the radiator.
- Use clean, fresh water and 50% anti-freeze to fill the recovery tank.
- Do not refill recovery tank with coolant over the "FULL" level mark.
- Be sure to close the radiator cap securely. If the cap is loose or improperly closed, coolant may leak out and decrease quickly.

置Changing coolant

- 1. To drain coolant, always open both drain cocks and simultaneously open the radiator cap as well. With the radiator cap kept closed, a complete drain of water is impossible.
- 2. Remove the overflow pipe of the radiator pressure cap to drain the recovery tank.
- Prescribed coolant volume (U.S.gallons)

Models	Quantity
V3600-E3, V3600-T-E3, V3800-DI-T-E3, V3300-E3BG, V3600-E3BG, V3600-T-E3BG	9.0 L (2.38 U.S. gal.)

NOTE:

- Coolant quantities shown are for standard radiators.
- An improperly tightened radiator cap or a gap between the cap and the seat quickens loss of
- Check and clean the plug threads and surface and the pucking thims of the water drain plug to prevent dirt and debris from the entering the engine.
- 6. Coolant (Radiator cleaner and anti-freeze)

Season		Coolant	
	Summer	Pure water and radiator cleaner	
-	Winter (when temperature trops below 0°C (32°F)) or all season	Pure water and anti-freeze (See "Anti-freeze" in "RADIATOR" section.)	

Remedies for quick decrease of coolant

- 1. Check any dust and dirt between the radiator fins and tube. If any, remove them from the fins and the tube.
- 2. Check the tightness of the fan belt. If loose, tighten it securely.
- 3. Check the internal blockage in the radiator hose. If scale forms in the hose, clean with the scale inhibitor or its equivalent.

■Checking radiator hoses and clamp



CAUTION

To avoid personal injury:

 Be sure to check radiator hoses and clamp bands periodically. If radiator hose is damaged or coolant leaks, overheats or severe burns could occur.

Check to see if radiator hoses are properly fixed every 250 hours of operation or 6 months, whichever comes

- 1. If clamp bands are loose or water leaks, tighten clamp bands securely.
- 2. Replace hoses and tighten clamp bands securely, if radiator hoses are swollen, hardened or cracked. Replace hoses and clamp bands every 2 years or earlier, if checked and found that hoses are swollen, hardened or cracked.

■Precaution at overheating

Take the following actions in the event the coolant temperature is nearly or more than the bolling point, what is called "Overheating". Take these actions if the engine's alarm buzzer sounds or the alarm lamp lights

- 1. Stop the engine operation in a safe place and keep the engine unloaded idling.
- Do not stop the engine suddenly. Stop it after about 5 minutes of unloaded idling.
- If the engine stalls within about 5 minutes of running under no load, immediately leave and keep yourself away from the machine. Do not open the hood and any other part.
- 4. Keep yourself and others well away from the engine for further 10 minutes or while the steam blown out.
- Checking that there gets no danger such as burn, get rid of the causes of overheating according to the manual, see "TROUBLESHOOTING" section. And then, start again the engine.

Cleaning radiator core(outside)

If dust is between the fin and tube, wash it away with running water.

IMPORTANT:

 Do not clean radiator with firm tools such as spatulas or screwdrivers. They may damage specified fin or tube. It can cause coolant leaks or decrease cooling

■Anti-freeze



CAUTION

To avoid personal injury:

- When using anti-freeze, put on some protection such as rubber gloves (Antifreeze contains poison.).
- If should drink anti-freeze, throw up at once and take medical attention.
- When anti-freeze comes in contact with the skin or clothing, wash it off immediately.
- Do not mix different types of antifreeze. The mixture can produce chemical reaction causing harmful substances.
- Anti-freeze is extremely flammable and explosive under certain conditions. Keep fire and children away from antifreeze.
- When draining fluids from the engine, place some container underneath the engine body.
- Do not pour waste onto the grounds, down a drain, or into any water source.
- relevant observe the Also, environmental protection regulations when disposing of anti-freeze.

Always use a 50/50 mix of long-life coolant and clean soft water in KUBOTA engines. Contact KUBOTA concerning coolant for extreme

- conditions. Long-life coolant (hereafter LLC) comes in several types. Use ethylene glycol (EG) type for this engine.
- 2. Before employing LLC-mixed cooling water, flush the radiator with fresh water. Repeat this procedure 2 or 3 times to clean up the radiator and engine block from inside.
- 3. Mixing the LLC Premix 50% LLC with 50% clean soft water. When mixing, stir it up well, and then fill into the radiator.
- 4. The procedure for the mixing of water and antifreeze differs according to the make of the anti-freeze. Refer to SAE J1034 standard, more specifically also to SAE J814c.

Vol %	Freezing Point		Boiling	Point *
Anti-freeze	°c	۴F	°C	۴۰
50	-37	-34	108	226

*At 1,013 × 10⁵Pa (760 mmHg) pressure (atmospheric). A higher boiling point is obtained by using a radiator pressure cap which permits the development of pressure within the cooling system.

- .5. Adding the LLC
 - (1) Add only water if the coolant level reduces in the cooling system by evaporation.
 - (2) If there is a coolant leak, add the LLC of the same manufacturer and type in the same coolant percentage.
 - *Never add any long-life coolant of different manufacturer. (Different brands may have different additive components, and the engine may fall to perform as specified.)
- 6. When the LLC is mixed, do not employ any radiator cleaning agent. The LLC contains anti-corrosive agent. If mixed with the cleaning agent, sludge may build up, adversely affecting the engine parts.
- 7. Kubota's genuine long-life coolant has a service life of 2 years. Be sure to change the coolant every 2 vears.

NOTE:

The above data represent industry standards that necessitate a minimum glycol content in the concentrated anti-freeze.

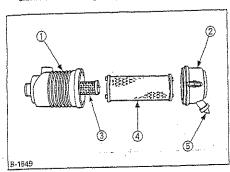
Radiator cement

As the radiator is solidly constructed, there is little possibility of water leakage. Should this happen, however, radiator cement can easily fix it. If leakage is serious, contact your local KUBOTA dealer.

AIR CLEANER

Since the air cleaner employed on this engine is a dry type, never apply oil to it.

- 1. Open the evacuator valve once a week under ordinary conditions - or dally when used in a dusty place. This will get rid of large particles of dust and
- 2. Wipe the inside air cleaner clean with cloth if it is dirty or wet.
- 3. Avoid touching the primary element except when cleaning.
- 4. When dry dust adheres to the element, blow compressed air from the Inside turning the element. Pressure of compressed air must be under 205 kPa (2.1 kgf/cm2, 30 psi).
- 5. Replace the primary element every year or every 6 cleanings. If the primary element is stained heavily, replace it soon. At this time, replace the secondary element too.
- 6. The secondary element should be removed only if it is to be replaced.
- 7. To protect the engine, do not remove the secondary element in servicing the primary element.



- (1) Air cleaner body
- (3) Secondary element (4) Primary element
- (5) Evacuator valve

IMPORTANT:

- Make sure the hooking clip for the element is tight enough. If it is loose, dust and dirt may be sucked in, wearing down the cylinder liner and piston ring earlier and thereby resulting in poor power output.
- Do not overservice the air cleaner element. Overservicing may cause dirt to enter the engine causing premature wear. Use the dust indicator as a guide on when to service.

Cleaning Primary Air Filter Element

1. To clean the element, use clean dry compressed air on the inside of the element.

Air pressure at the nozzle must not exceed 205 kPa (2.1 kgf/cm2; 30 psi).

Maintain reasonable distance between the nozzle and the filter.

2. To wash the elements, use Donaldson ND-1500 Filter Cleaner, or its equivalent, which is especially effective on oily and soot-laden fitters. Follow instructions that are supplied with the filter cleaner.

≣Evacuator valve

Open the evacuator valve once a week under ordinary conditions - or daily when used in a dusty place - to get rid of large particles of dust and dirt.

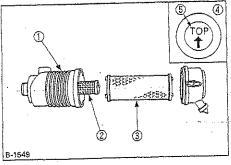
■For the air cleaner with a dust cup (optional)

Remove and clean out the dust cup before it becomes half full with dust; usually once a week, or even every

day if the working surroundings are dusty.
Install the air cleaner dust cup with "TOP" indicated on the rear of the cup in the up position. (However, it may be installed in either direction when the cover is placed at the lower part.)

IMPORTANT:

 If the dust cup is mounted incorrectly, dust or dirt does not collect in the cup, and direct attachments of the dust to the element will cause its lifetime to shorten to a great extent.

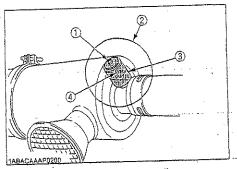


- (1) Air cleaner body
- (2) Secondary element (3) Primary element
- (5) "Top" mark

Bust indicator (optional)

If the red signal on the dust indicator attached to the air cleaner is visible, the air cleaner has reached the service level.

Clean the element immediately, and reset the signal with the "RESET" button.



- (1) "RESET" button
- (2) Dust indicator (3) Service level
- (4) Signal

BATTERY



CAUTION

To avoid personal injury:

- Be careful not to let the battery electrolyte contact your body or clothing.
- Wear eye protection and rubber gloves, since the diluted sulfuric acid solution burns skin and eats holes in clothing. Should this occur, immediately wash it off with running water and get medical attention.

Mishandling of the battery shortens the service-life and adds to maintenance costs. Obtain the maximum performance and the longest life of the battery by handling properly and with care.

Engine starting will be more difficult, if the battery charge is low. Be careful to recharge it at an early occasion before it is too late.

Battery charging



CAUTION

The battery comes in two types: refillable and non-refillable.

 For using the refillable type battery, follow the instructions below. Do not use or charge the battery if its fluid level stands below the LOWER (lower limit level) mark. Otherwise, the battery component parts may deteriorate earlier than expected, which may shorten the

battery's service life or cause an explosion. Immediately, add distilled water until the battery's fluid level is

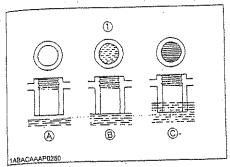
between the UPPER and LOWER levels.

CAUTION

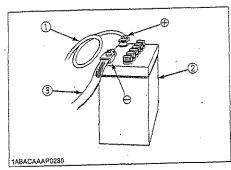
To avoid personal injury:

- · When the battery is being activated, hydrogen and oxygen gases in the battery are extremely explosive. Keep open sparks and flames away from the battery at all times, especially when charging the battery.
- When charging the battery, remove the battery vent plugs.
- When disconnecting the cable from the battery, start with the negative terminal, and when connecting them, start with the positive terminal
- DO NOT check the battery charge by placing a metal object across the terminals. Use a voltmeter or hydrometer.

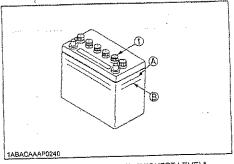
 Make sure each electrolyte level is to the bottom of vent wells, if necessary, add only distilled water in a well-ventilated place.



- (1) Battery electrolyte level
- (A) "TOO LOW" (B) "PROPER" (C) "TOO HIGH"
- To slow charge the battery, connect the charger positive terminal to the battery positive terminal, and the negative to the negative, then recharge in the standard fashion.
- Quick recharging charges the battery at a high rate in a short time. This is only for emergencies.
- Recharge the battery as early as possible, or battery life will be extremely shortened.
- When exchanging an old battery for a new one, use battery of equal specification shown in Page 28.



- (1) Thick cable red(+)
- (2) Battery case
- (3) Earth cable black(-)



(1) Plug

(A) "HIGHEST LEVEL" (B) "LOWEST LEVEL"

IMPORTANT:

- Connect the charger positive terminal to the battery positive terminal, and negative to the negative.
- When disconnecting the cable from the battery, start with the negative terminal first.
 When connecting the cable to the battery, start with the positive terminal first.

If reversed, the contact of tools on the battery may cause a short.

置Direction for long term storage

- When storing the engine for long periods of time, remove the battery, adjust the electrolyte to the proper level, and store in a dry and dark place.
- The battery naturally discharges while it is stored. Recharge it once a month in summer, and every 2 months in winter.

ELECTRIC WIRING



CAUTION

To avoid personal injury:

- Shorting of electric cable or wiring may cause a fire.
 - Check to see if electric cables and wiring are swollen, hardened or cracked.
 - Keep dust and water away from all power connections.

Loose wiring terminal parts, make bad connections. Be sure to repair them before starting the engine.

Damaged wiring reduces the capacity of electrical parts. Change or repair damaged wiring immediately.

FAN BELT

■Adjusting Fan Belt Tension



CAUTION

To avoid personal injury:

- Be sure to stop the engine and remove the key before checking the belt tension.
- Be sure to reinstall the detached safety shield after maintenance or checking.

Proper fan belt tension

A deflection of between 10 to 12 mm (0.39 to 0.47 in.) when the belt is pressed in the middle of the

Stop the engine and remove the key.

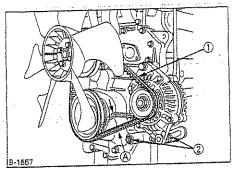
2. Apply moderate thumb pressure to belt between the pulleys.

bolts and, using a lever placed between the alternator mounting bolts and, using a lever placed between the alternator and the engine block, pull the alternator out until the deflection of the belt falls within acceptable limits. acceptable limits.

4. Replace fan belt if it is damaged.

IMPORTANT:

 If belt is loosen or damaged and the fan is damaged, it could result in overheats or insufficient charging. Correct or replace belt.



(1) Fan belt (2) Bolt and nut

(A) 10 to 12 mm (0.39 to 0.47 in.) (under load of 6-7 kgf (13.2-15.4 lbs))

CARRIAGE AND STORAGE

CARRIAGE



A CAUTION

To avoid personal injury:

- Fix the engine securely not to fall during operation.
- Do not stand near or under the engine while carrying it.
- The engine is heavy. In handling it, be very alert not to get your hands and body caught in.
- 1. Use carrier such as crane when carrying the engine, or hurt your waist and yourself. Support the engine securely with rope not to fall while carrying It.
- 2. When lifting the engine, put the hook securely to metal fittings attached to the engine. Use strong hook and fittings enough to hang the engine.

STORAGE



CAUTION

To avoid personal injury:

- Do not clean the machine with engine running.
- To avoid the danger of exhaust fume poisoning, do not operate the engine in a closed building without proper ventilation.
- When storing the engine just after running, let the engine cool off.

Before storing the engine for more than a few months, remove any dirt on the machine, and:

- 1. Drain the coolant in the radiator. Open the cock at the bottom of the radiator, and remove the pressure cap to drain water completely. Leave the cock open. Hang a note written "No water" on the pressure cap. Since water may freeze when the temperature drops below 0°C (32°F), it is very important that no water is left in the machine.
- Remove dirty engine oil, fill with new oil and run the engine for about 5 minutes to let the oil penetrate to all the parts.
- 3. Check all the bolts and nuts, and tighten if necessary.
- Remove the battery from the engine, adjust the electrolyte level, and recharge it. Store the battery in a dry and dark place.
- 5. When the engine is not used for a long period of time, run it for about 5 minutes under no load every 2 to 3 months to keep it free from rust. If the engine is stored without any running, moisture in the air may condense into dew over the sliding parts of the engine, resulting in rust there.
- 6. If you forget to run the engine for longer than 5 to 6 months, apply enough engine oil to the valve guide and valve stem seal and make sure the valve works smoothly before starting the engine.
- 7. Store the engine in a flat place and remove the key from engine.
- 8. Do not store the engine in a place where has flammable materials such as dry grass or straw.
- 9. When covering the engine for storage, let engine and muffler cool off completely.
- 10. Operate the engine after checking and repairing damaged wirings or pipes, and clearing flammable materials carried by mouse.

TROUBLESHOOTING

If the engine does not function properly, use the following chart to identify and correct the cause.

■When it is difficult to start the engine

Cause	Countermeasures	
Fuel is thick and doesn't flow.	 Check the fuel tank and fuel filter. Remove water, dirt and other impurities. As all fuel will be filtered by the filter, if there should be water or other foreign matters on the filter, clean the filter with kerosene. 	
Air or water mixed in fuel system	 If air is in the fuel filter or injection lines, the fuel pump will not work properly. To attain proper fuel injection pressure, check carefully for loosened fuel line coupling, loose cap nut, etc. Loosen joint boit stop fuel filter and air vent screws of fuel injection pump to eliminate all the air in the fuel system. 	
Valve clearance is not as specified.	* Adjust valve clearance to 0.23 to 0.27 mm (0.009 to 0.011 in.) when the angine is cold.	
Leaking valves	* Grind valve.	
Fuel injection timing is not as specified.	Chack injection timing The injection timing 0.105 rad (6) before top dead center.	
Engine oil becomes thick in cold weather and engine cranks slow.	* Change grade of oil according to the weather (temperature.)	
Low compression	 Bad valve or excessive wear of rings, pistons and liners cause insufficient compression. Replace with new parts. 	
Battery is discharged and the engine will not crank.	Charge battery. in winter, always remove battery from machine, charge fully and keep indoors, install in machine at time of use.	

■When output is insufficient

Cause	Countermeasures	
Compression is Insufficient. Leaking valves	Bad valve and excessive wear of rings, pistons and liners cause insufficient compression. Replace with new parts. Grind valves.	
Fuel is insufficient.	Check fuel system.	
Overheating of moving parts	Check lubricating oil system. Check to see if lubricating oil filter is working properly. Filter element deposited with impurities would cause poor lubrication. Change element. Check the clearance of bearing are within factory specs. Check linjection timing. Check timing 0.105 rad (6) before top dead center.	
Valve clearance is not as specified.	Adjust to proper valve clearance of 0.23 to 0.27 mm (0.009 to 0.011 in.) with engine cold.	
Air cleaner is dirty	Clean the element every 100 hours of operation.	
Fuel injection pressure is not as specified.	Check injection pressure. 1st Stage 18.6 MPa(190 kgf/cm; 2702 psi) 2nd Stage 22.6 MPa(230 kgf/cm; 3271 psi)	
injection pump wear	Do not use poor quality fuel as it will cause wear of the pump. Only use No. 2-D diesel fuel. (See "FUEL" in "PERIODIC SERVICE" section.) Check the fuel injection pump element and delivery valve assembly and replace as necessary.	

NOTE:

If the cause of trouble can not be found, contact your KUBOTA dealer.

■When engine suddenly stops

Cause	Countermeasures	
Lack of fuel	Check the fuel tank and refill the fuel, if necessary. Also check the fuel system for air or leaks.	
Bad nozzie	* if necessary, replace with a new nozzle.	
Moving parts are overtieated due to shortage of lubrication oil or improper lubrication.	Check amount of engine oil with oil level gauge. Check lubricating oil system. At every 2 times of oil change, oil filter cartridge should be replaced. Check to see if the engine bearing clearances is within factory specs.	

■When color of exhaust is especially bad

Cause	Countermeasures	
Fuel governing - device bad	* Contact dealer for repairs.	
Fuel is of extremely poor quality.	* Select good quality fuel. Use No. 2-D diesel fuel only.	
Nozzie is bad.	If necessary, replace with new nozzle.	
Combustion is incomplete.	Cause is poor atomization, improper injection timing, etc. Because of trouble in injection system or in poor valve adjustment, or compression leakage, poor compression, etc. Check for the cause.	

When engine must be stopped immediately

Cause	Countermeasures * Check the adjustments, injection liming and the fuel system.	
Engine revolution suddenly decreases or increases.		
Unusual sound is heard suddenly.	* Check all moving parts carefully.	
Color of exhaust suddenly turns dark.	* Check the fuel injection system, especially the fuel injection nozzle.	
Bearing parts are overheated.	* Check the lubricating system.	
Oil lamp lights up during operation.	Check the jubricating system. Check, if the engine bearing clearances are within factory specs. Check the function of the relieve valve in the jubricating system. Check pressure switch. Check filter base gasket.	

When engine overheats

availed engine evening			
Cause	Countermeasures		
Engine oil insufficient	 Check oil level. Replenish oil as required. 		
Fan belt broken or elongated	* Change belt or adjust belt tension,		
Coolant insufficient	* Replenish coolant.		
Excessive concentration of antifreeze	* Add water only or change to coolant with the specified mixing ratio		
Radiator net or radiator fin clogged with dust	* Clean net or fin carefully.		
Inside of radiator or coolent flow route corroded	* Clean or replace radiator and parts.		
Fan or radiator or radiator cap defective	* Replace defective parts.		
Thermostat defective	Check thermostat and replace if necessary.		
Temperature gauge or sensor defective	* Check temperature with thermometer and replace if necessary.		
Overload running	* Reduce load.		
Head gasket defective or water leakage	* Replace parts.		
Incorrect injection timing	* Adjust to proper timing.		
Unsuitable fuel used	"-"Use the specified tuel.		

SPECIFICATIONS

Model	V3600-E3	V3600-T-E3	
Type	Vertical, water-cooled, 4-cycle diesel		
Number of cylinders	4		
Bore and stroke mm (in.)	98 × 120 (3.86 × 4.72)		
Total displacement L(cu.in.)	3.620 (2		
Combustion type	Spherical typ		
SAE NET Intermittent kW / min ⁻¹ (rpm) H.P. (SAEJ1349) (HP / min ⁻¹ (rpm))	49.1 / 2600 (65.8 / 2600)	58.8 / 2600 (78.8 / 2600)	
SAE NET Continuous kW/min ⁻¹ (rpm) H.P. (SAEJ1349) (HP/min ⁻¹ (rpm))	42.6 / 2600 (57.1 / 2600)	51.1 / 2600 (68.4 / 2600)	
SAE Standby kW / min ⁻¹ (rpm) H.P. (SAEJ1349) (HP / min ⁻¹ (rpm))			
Maximum bare speed min-1(rpm)	2800		
Maximum bare idling speed min ⁻¹ (rpm)	775 to		
Order of firing	1-3-4-2		
Direction of rotation	Counter-clockwise (viewed from flywheel side)		
Injection pump	Bosch type mini pump		
Injection pressure MPa (kgf / cm², psi)	13.93 (142, 2020)		
Injection timing (Before T.D.C.)	0.14 rad (8°)	0.07 rad (4°)	
Compression ratio	22.6	21.8	
Fuel	Diesel fuel		
Lubricant (API classification)	above C		
Dimension mm (in.) (length × width × height)	745 × 536 × 741.5 (29.33 × 21.10 × 29.19)	745 × 538.5 × 794 (29.33 × 21.20 × 31.26)	
Dry weight kg (lbs.)	264 (582)	- 275 (606.3)	
Starting system	Cell starter (with glow plug)		
Starting motor	12V, 3.0kW		
Charging generator	12V, 1080W(KEA), 720W(EU)		
Recommended battery capacity	12V, 136AH (400 CCA or higher) 0°F (-17.8°C) SAE rating		

NOTE:

• Specifications are subject to change without notice.

Model	V3800-DI-T-E3
	Vertical, water-cooled, 4-cycle diesel
Type Number of cylinders	4
	100 × 120 (3.94 × 4.72)
DOI 0	3.769 (230)
Otal Giophastic	Direct Injection type (E-CDIS)
Combustion type	71.4 / 2600
SAE NET Intermittent kW / min ⁻¹ (rpm) H.P. (SAEJ1349) (HP / min ⁻¹ (rpm))	(95.7 / 2600)
SAE NET Continuous kW/min ⁻¹ (rpm)	62.0 / 2600
H.P. (SAEJ1349) (HP / min ⁻¹ (rpm))	(83.1 / 2600)
SAE Standby kW / min ⁻¹ (rpm)	_
H.P. (SAEJ1349) (HP / min ⁻¹ (rpm))	
Maximum bare speed min-1(rpm)	2800
Maximum bare idling speed min ⁻¹ (rpm)-	775 to 825
Order of firing	1-3-4-2
Direction of rotation	Counter-clockwise (viewed from flywheel side)
Injection pump	Bosch type mini pump
Injection pressure MPa	First opening pressure 18.63 (190, 2275)
(kgf / cm ² , psl)	Second opening pressure 23.54 (240, 3128)
injection timing (Before T.D.C.)	0.10 rad (6°)
Compression ratio	19.0
Fuel	Diesel fuel oil No.2-D
Lubricant (API classification)	above CF grade
Dimension mm (in.)	745 × 549 × 794
(length × width × height)	(29.33 × 21.61 × 31.26)
Dry weight kg (lbs.)	288 (634.9)
Starting system	Cell starter (with air heater)
Starting motor	12V, 3.0kW
	12V, 1080W(KEA),
Charging generator	720W(EU)
Recommended battery capacity	12V, 136AH (400 CCA or higher) 0°F (-17.8°C) SAE rating

NOTE:
Specifications are subject to change without notice.

Model	V3300-E3BG		
Type	Vertical, water-cooled, 4-cycle diesel		
Number of cylinders	. 4		
Bore and stroke mm (in.)	98 × 110 (3.86 × 4.33)		
Total displacement L(cu.in.)	3.318 (202.49)		
Combustion type	Spherical type (E-TVCS)		
SAE NET Continuous kW/min ⁻¹ (rpm)	28.1 / 1800 (37.7 / 1800)		
H.P. (SAEJ1349) (HP / min ⁻¹ (rpm))	23.0 / 1500 (31.3 / 1500)		
SAE Standby kW / min ⁻¹ (rpm)	31.0 / 1800 (42.1 / 1800)		
H.P. (SAEJ1349) (HP / min ⁻¹ (rpm))	, 25.4 / 1500 (34.5 / 1500)		
Maximum bare speed min 1 (rpm)	1890		
Order of firing	1-3-4-2		
Direction of rotation	Counter-clockwise (viewed from flywheel side)		
Injection pump	. Bosch type mini pump		
Injection pressure MPa	<u> </u>		
(kgf / cm ² , psi)	13.93 (142, 2020)		
Injection timing (Before T.D.C.)	0.17 rad (10°)		
Compression ratio	22.6 ·		
Fuel	Diesel fuel oil No.2-D		
Lubricant (API classification)	above CF grade		
Dimension mm (in.)	769 × 536 × 770		
(length × width × height)	(30.28 × 20.10 × 30.31)		
Dry weight kg (lbs.)			
Starting system	Cell starter (with air heater)		
Starting motor	12V, 2.5kW		
Charging generator	12V 540W		
Recommended battery capacity	12V, 88AH		

NOTE:

Specifications are subject to change without notice.

- NOTE (FOR E3BG or T-E3BG type):

 Flywheel type is SAE clutch No.11-1/2, SAE clutch No.10 or its equivalent.

 Flywheel housing type is SAE No.3 or its equivalent.

 Governor drop is within 5%.

 Continuous will operate at the stated rating continuously and have a 10% overload capability for one hour in 12 better.
- Standby will operate at the stated full rating for one hour in 12 hours. No overload capacity is specified for this rating.

Model	V3600-E3BG	V3600-T-E3BG	
	Vertical, water-cooled, 4-cycle diesel		
Type Number of cylinders	4		
Bore and stroke mm (in.)	98 × 110 (3.86 × 4.33)	98 × 120 (3.86 × 4.72)	
Total displacement L(cu.in.)	3.318 (202.49)	3.620 (220.9)	
Ottal Graphia	Spherical typ	e (E-TVCS)	
Combustion type	32.1/1800 (43.0/1800)	39.2/1800 (52.5/1800)	
SAE NET Continuous kW/min ⁻¹ (rpm) H.P. (SAEJ1349) (HP/min ⁻¹ (rpm))	26.3/1500 (35.3/1500)	32.1/1500 (43.0/1500)	
	35.3/1800 (47.3/1800)	43.1/1800 (57.8/1800)	
SAE Standby	28.9/1500 (38.8/1500)	35.3/1500 (47.3/1500)	
Maximum bare speed min ⁻¹ (rpm)	1890		
SALCOVITY	1-3-4-2		
Order of firing	Counter-clockwise (viewed from flywheel side)		
Direction of rotation			
Injection pump	Bosch type mini pump		
Injection pressure MPa (kgf / cm², psi)	13.93 (142, 2020)		
Injection timing (Before T.D.C.)	0.21 rad (12°)	0.09 rad (5°)	
Compression ratio	22.6	21.8	
Fuel	Diesel fuel	oil No.2-D	
Lubricant (API classification)	above CF grade		
Dimension mm (in.)	769 × 536 × 770	769 × 539 × 803	
(length × width × height)	(30.28 × 20.10 × 30.31)	(30.28 × 21.22 × 31.61)	
Dry weight kg (lbs.)	276 (608)	283 (624)	
2017 17 13 11	Cell starter (with air heater)		
Starting system	12V, 3,0kW		
Starting motor	12V 540W		
Charging generator	12V, 88AH		
Recommended battery capacity	12.91		

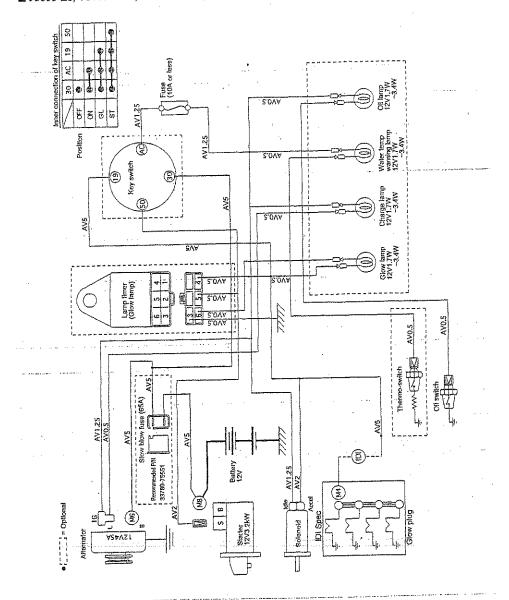
NOTE:

Specifications are subject to change without notice.

- Flywheel type is SAE clutch No.11-1/2, SAE clutch No.10 or its equivalent.
 Flywheel housing type is SAE No.3 or its equivalent.
 Governor drop is within 5%.
 Continuous will operate at the stated rating continuously and have a 10% overload capability for one hour in 12 hours.
- Standby will operate at the stated full rating for one hour in 12 hours. No overload capacity is specified for this rating.

WIRING DIAGRAMS

■V3600-E3, V3600-T-E3, V3300-E3BG, V3600-E3BG, V3600-T-E3BG



WINKLE INDUSTRIES

SECTION 17

MAGNET PREVENTIVE MAINTENANCE MANUAL



Winkle Industries 2080 West Main Street, Alliance, Ohio 44601 Tel: 330.823.9730 Fax: 330.823.9788

MAGNET PREVENTIVE MAINTENANCE MANUAL AND PREVENTIVE MAINTENANCE SEMINAR

Table of Contents

<u>Description</u>	Page #
I.) Safe Operational Practices	1
II.) De-rating Load	2
III.) Practices to Extend Magnet Life	3
IV.) Preventive Maintenance	4 5
V.) Monthly Inspection Report	6-8
VI.) Ohm's Law	9
VI.) OHITS LAW	

I.) SAFE OPERATIONAL PRACTICES

- 1.) Never attempt to operate any lifting device designated as out of service.
- 2.) Operators should follow practices set forth by **ASME B30.20a-1996**, **Section 20-4.4**.
- 3.) Be sure **all** electrical connections are in good working condition and securely attached to the proper receptacle.
- 4.) Check for correct power inputs to magnets, controllers and where applicable rectifiers, also if magnet controller is variable voltage, check for the proper power setting.
- 5.) When handling hot material, (300° F or hotter), keep magnet's exposure to material at a minimum.
- 6.) Be sure no foreign material is between the magnet lifting surface and material to be handled.
- 7.) Lift magnet/ magnet system and position at the center of load to be lifted.
- 8.) Set magnet/ magnet system on load to be lifted, making sure air gap between the magnet's poleshoes and lifting face of material to be handled is at a minimum.
- 9.) Energize magnets, allowing them to sit for 3-5 seconds before lifting to allow the magnetic field to fully generate.
- 10.) Lift load straight up, never at an angle.
- 11.) Transport load with magnets energized.
- 12.) Set load in a stable unloading position.
- 13.) * De-energize magnets. *
- * If magnet controller is equipped with a dribble control, it may be necessary to adjust drop cycle pot to achieve clean drop. *

II.) DERATING LOADS

Although all magnets will operate through an air gap induced between their lifting faces and the material to be handled, it is best to keep this gap to a minimum. Ideally, the gap should never be over 1/8" and more than 70% of the magnet's lifting face area should be in contact with the material. However, circumstances such as scale, twists and bowing of the material to be handle warrants the following reduction in force:

For each 1/8" of air gap added and 5% reduction in magnet contact with the load to be handled, the safe lifting capacity should be reduced by 15%

III.) PRACTICES TO EXTEND MAGNET LIFE

Magnets are specifically designed for moving material with magnetic force. They should not be used for purposes other than this. Below is a list of just some of the practices and misuses to which magnets are subjected. These uses severely reduce a magnet's effective life.

- DO NOT use magnets as drop balls or wrecking balls to break up cast scrap.
- DO NOT use magnets to straighten stacks of material (i.e. "bumping" slab stacks in cooling beds).
- DO NOT use magnets as drag weights for railcars.
- DO NOT use magnets to straighten bent billets, slabs or blooms.
- When not in use DO NOT set the magnet directly on ground, set it on wooden support blocks (Magnets draw moisture when set directly on the ground after operation).
- Allow the magnet to rest on load to be lifted while energizing (5 second minimum). This allows the <u>maximum</u> magnetic field to build. Also, by resting the magnet directly on load, impacting to the bottom plate and surface of the magnet help reduce mechanical shock applied to the coil.
- When disconnecting magnets after operating wait AT LEAST (5) minutes after power to the magnet has been cut before unplugging. Magnets store a residual electrical charge. If this charge is not allowed to dissipate before unplugging the magnet, a destructive electrical field collapse can occur (The voltage spikes occurring with this collapse can be as much as 15,000 Volts or more, depending on magnet size). These spikes can cause dangerous electrical arcing from the magnet and insulation breakdown.
- Rotate magnets in and out of service in accordance with their duty cycle and use. As with any electrical device, magnets heat up with usage. By following the magnet suppliers recommended operating (hot) amp rating, service life can be extended. When using magnets for high duty cycle or hot material applications, rotate magnets in and out of service as often as possible to preserve coils by letting hot magnets cool.

IV.) PREVENTIVE MAINTENANCE

As with any piece of equipment, preventive maintenance for magnets can not only preserve your investment but allow your magnet to operate at its peak efficiency throughout its service life. In this section we will recommend a preventive maintenance plan, specify tools and instruments needed to gather operating data for magnets.

- Whether the magnet is new or rebuilt, designate the magnet with an identification number in a visible location on top of the magnet case.

- Start a file or folder for each magnet put into service:

When starting a file, make sure to put the date the magnet went into service and the identification number in the file. This will help to designate problem areas in operation (i.e., wrong magnet in service for application). Note all possible problems; cracked, worn ears, lifting devices, exposed lead wires, etc. Also, take the magnet's electrical operating data. (We weld a steel tag with all pertinent electrical data to the case top.)

- Inventory instruments needed for basic magnet testing and repair:

This includes a hand held multi- meter (to check resistance), MegOhm 500V minimum test voltage (to check for grounding), wrenches, etc. (Examples: Multi-meter/FLUKE 21 Series 2 Multimeter, Meg-Ohm Meter/ Associated Research Model 2003A)

- Train personnel in magnet maintenance:

Train key personnel in testing and basic repair techniques to keep magnets operating at peak efficiency, (Resistance reading, MegOhm testing, proper insulation and splicing of magnet power connections, tightening lead box bolts, etc.)

- Begin a regular Preventive Maintenance Schedule to check magnets thoroughly:

By establishing a cycle or rotation of once-a-month thorough inspection of magnets, possible major breakdowns can be averted.

- At the beginning of each shift, a quick observation check can save time and money:

By teaching the magnet operator or maintenance personnel to take a quick inspection at the beginning of each shift, possible problems such as cracked case welds, exposed lead wires or worn lifting devices can be discovered, noted and repaired before they become serious problems that may take your magnet out of service and cause costly repairs.

V.) MONTHLY INSPECTION REPORT

The data on the following sheet is a basic monthly inspection guideline. These checks will help save time and money by discovering minor problems that could become costly repairs or safety hazards.

MONTHLY INSPECTION REPORT

DATE:	ATE: FILLED OUT BY:				
MAC	SNET I.D.#:				
1837 14					
Make sure magnet is	safely disconnected and properly supported when inspecting bottom surface.				
	mapecing bottom curred.				
	MAGNET CASE:				
1.) Check for cracks, bro	oken welds, missing, broken or worn sections, discolored				
metal (from heat or fluids					
•					
OOMA TOTALS.					
	LIFTING LUGS:				
2.) Check for cracked m	naterials, welds and wear on both pin hole diameter and				
inside face of lifting lugs					
Oomano.					
	LIFTING DEVICE:				
3.) Check for worn links	s, broken or missing sections, missing or worn chain pins.				
	LEAD BOX:				
4.) Check for broken lea	ad hold downs, missing cover bolts, broken welds or				
cracks, filling compound	l leakage and arcing burns under leads.				
OOMATIONIO.					

LEAD CABLE:

5.) Check for exposed wire (cuts), pinched or twisted leads, plug damage.
Comments:
MAGNET COIL:
6.) To check coil insulation, connect a MegOhm Meter (500V or 1000V) between one lead wire and the magnet case. Switch the meter setting to the " $M\Omega$ " symbol. Readings for a cold magnet should be above 500 MegOhms, readings for a magnet that was just in service should be between 10 and Infinity. Record readings. Use a hand held Multi-Meter to check conductor resistance, connect each lead to the external lead junction and record a steady resistance reading. (NOTE: Readings \underline{MUST} be taken under the same conditions. (i.e.) Beginning of
each day, end of each day.
Comments:
BOTTOM PLATE:
7.) Check for wear, cracked or bent plate, cracked welds, discolored metal.
(Make sure magnet is safely supported when checking bottom).
Comments:
Confinents.
POLE FACES:
8.) Check for uneven wear, broken sections or missing sections and bolts,
inches of metal to bottom plate. (Make sure magnet is safely supported when
checking bottom).
Comments:

VI.) OHM'S LAW

I = E/R

Where:

I = Current (Amperes)

E = Voltage

R = Resistance (Ohms)

Using the above equation, the basic electrical operating parameters of any magnet can be derived. This formula is a useful tool in determining how close your magnet is to its operating (hot) amp value.

Example:

R3131M Rectangular Series magnet Electrical Data

- Cold Amps: 12.1

- Operating Amps (hot): 8.5

- Cold Resistance: 19.0 Ohms

- Magnet Voltage: 230 VDC

Using a Multi- meter, a 31" x 31" magnet's resistance is taken after operation, the reading is 32 Ohms, using the known data, amp draw can be calculated.

I = E/R

1 = ???

E = 230 VDC

R = 32 Ohms

1 = 230/32

(l = 7.2 Amps)

The current value derived from the equation is below the recommended operating (hot) amp rating and this magnet should be taken out of service and allowed to cool so that severe coil damage can be avoided.

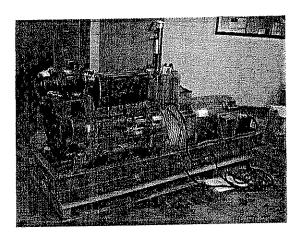
WINKLE INDUSTRIES

SECTION 18

INSTRUCTIONS FOR ENGINE DRIVEN DC MAGNET GENERATOR SETS



Winkle Industries 2080 West Main Street, Alliance, Ohio 44601 Tel: 330.823.9730 Fax: 330.823.9788



INSTRUCTIONS FOR ENGINE DRIVEN DC MAGNET GENERATOR SETS

The Winkle Industries – Generator sets, both diesel and gasoline driven, use reliable engines, which will give long service if the instructions for starting, operation and maintenance are followed. All engines are shipped with oil already in the crankcase and in the air cleaner. The oil level should be checked to make sure it is proper.

The engine –generator sets are run-in and tested at our factory. It can be used directly on the job. The unit should however, be checked for nameplate speed to prevent any over speed or under speed problems. Most engines use a variable speed governor. Do not touch this control. It has been preset at the factory. In no case should the generator speed exceed 2200 RPM, for an 1800-RPM generator or 3000 RPM for a 2500-RPM generator.

5, 7.5 & 10 Kw units are designed to run at a Base speed of 2500 RPM'S 15, 20, 25, 33 & 40 Kw units are designed to run at a Base speed of 1750 RPM'S

Mount the Engine / Generator set on a flat surface using Shock & Vibration mounts such as "Advanced Anti-vibration mounts" properly sized for the units total frame weight.

**** DO NOT TWIST THE BASE WHEN TIGHTING DOWN THE UNIT **** Doing so will cause mis-alignment of the engine to generator coupling and result in generator premature damage or failure. Use lock washers on all bolted connections.

Run the engine-generator set and make sure it does not vibrate excessively. If there is a vibration problem, reinforce the bolt-down points. If the vibration is being produced by other parts of the machine, isolate the engine-generator from this vibration with isolation mounts.

The engine speed should be checked when other normal maintenance is preformed. Only qualified maintenance personal should perform maintenance on the unit assembly.



INSTRUCTIONS FOR HYDRAULIC ENGINE DRIVEN DC MAGNET GENERATOR

The generators used for hydraulically driven applications comes with "C" face machining of the shaft covers so that an adaptor can be mounted to the face of the generator and directly attach a hydraulic motor. This gives perfect alignment between the generator and motor shaft, and eliminates vibration. Since the hydraulic motor mounts directly to the generator, only the generator needs to be mounted.

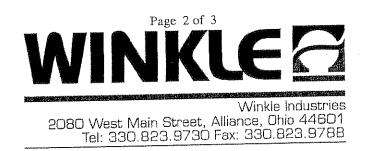
Flow control to the hydraulic motor must be maintained to avoid over speeding of the generator during the "DROP Cycle" or hunting of the generator speed during changes in load conditions. It is also required that a separate auxiliary hydraulic pump be used to power the generator.

Some precautions to note are: A rigid mounting of the generator must be made to avoid excessive vibration. The generator should not be operated at low speeds for extended periods of time. This will cause excess commutator filming and lead to poor operation of the generator. The generator should be installed in an open or well ventilated area. Avoid high heat sources near the generator or direct exhaust at the generator. This will cause generator overheating and shorten its life. Check the generator speed every time maintenance is done.

SAFETY WARNINGS AND CAUTIONS

WARNING: All Engine Driven DC Magnet Generator sets produce 230 DC voltage to the systems magnet controller. Any of the following failures: WILL RESULT IN AN UNEXPECTED DROP OF THE MAGNET LOAD.

- 1) Engine Failure: A) Running out of diesel fuel or gasoline.
 - B) Failure of the DC generator to engine coupling.
 - C) "Low" Oil Pressure will cause engine shut down.
 - D) Electrical failure of the alternator and battery charging system.
 - 2) A dirty air cleaner.
 - 3) A dirty or plugged fuel filter.
 - 4) Water or dirt in the fuel system.
 - 5) Failure to maintain the proper engine operating RPM's do to governor failure or mis-adjustment of engine speed.
 - 6) Loose or broken Fan/Alternator Belt



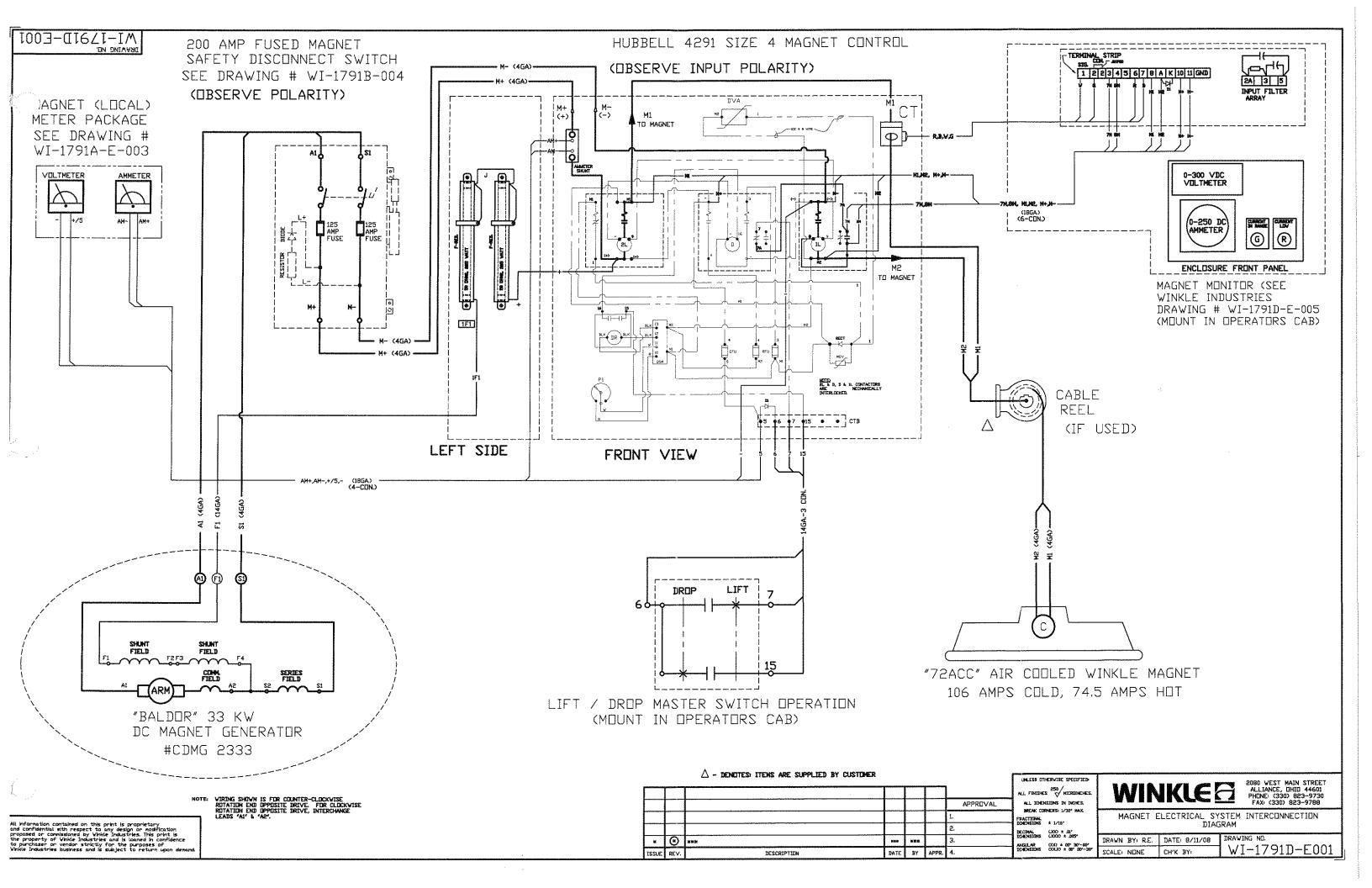
Continued from page 2

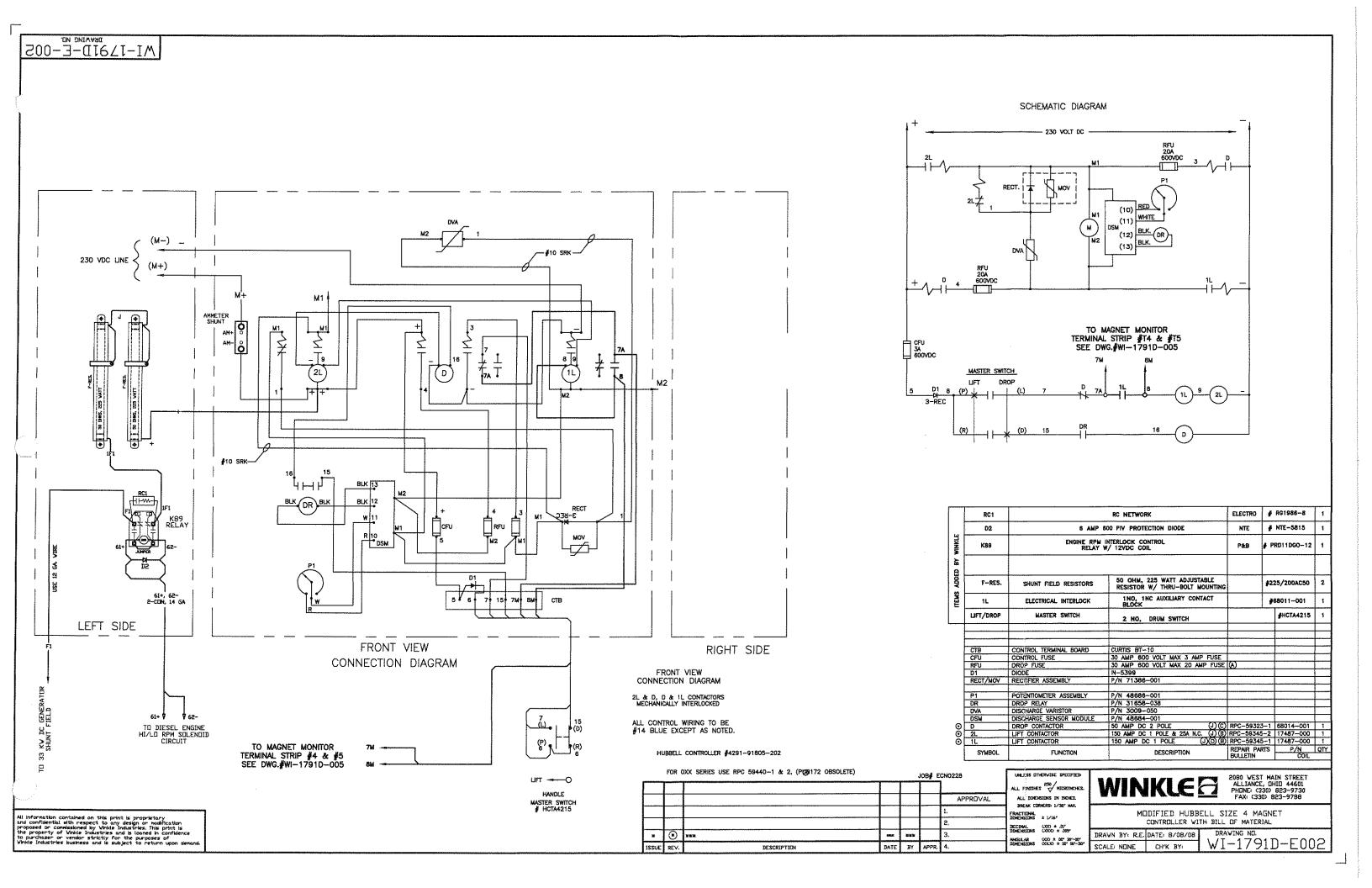
- 2) Blown fuses is the magnet safety disconnect switch.
- 3) Badly worn generator brushes.
- 4) Generator failure do to excessive heat causing damage to the field windings. (Refer to the DC generator installation and operating manual # MN605).
- 5) Dirty or badly worn "Lift" contact tips in the magnet controller.
- 6) Failure of the cranes cable reel.
- 7) Chopped magnet leads.
- Caution: Always disconnect all electrical power when servicing this equipment, failure to do so can result in serious or fatal injury.
- Caution: The DC magnet generator connection to the engine has rotating parts. Keep clear during operation. Be sure to wear the proper ear and eye protection when servicing this engine-generator set. Failure to do so can result in personal or fatal injury.
- Caution: Daily and weekly inspections of the complete system should be performed to insure proper operation and to avoid unexpected dropping of the magnet load.

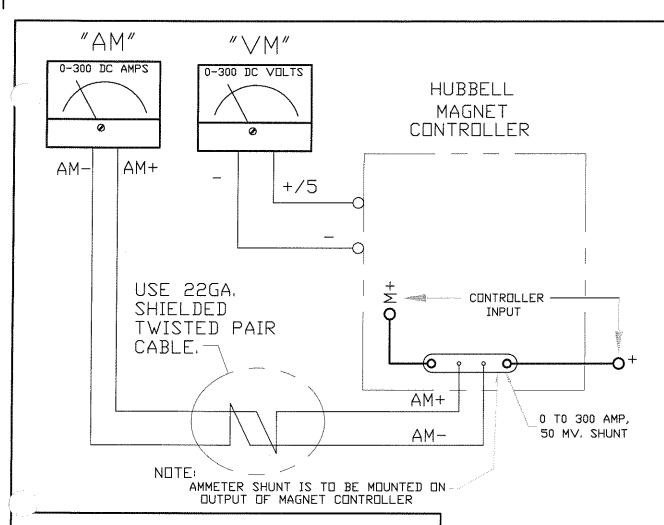
WINKLE INDUSTRIES

SECTION 19

MAIN ELECTRICAL CONTROL DRAWINGS







MAGNET MONITOR PACKAGE OPERATION:

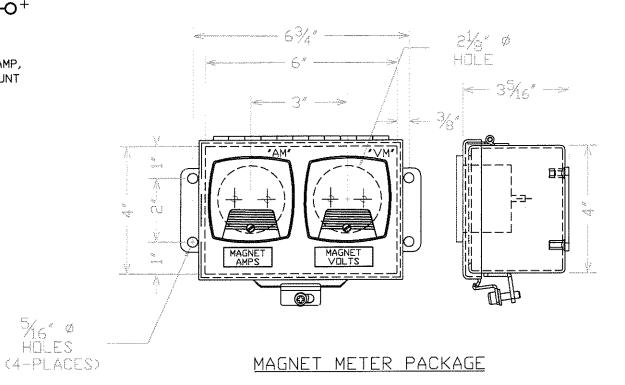
THE AMMETER & VOLTMETER ARE USED TO MONITOR THE MAGNET VOLTS & AMPS DURING OPERATION.

AS THE MAGNET IS USED, HEAT BUILDS UP IN THE MAGNET COIL, THIS HEAT BUILD UP CAUSES THE MAGNET DHMS TO INCREASE AND THE MAGNET DC AMPS TO DROP,

THIS CHANGE DC AMPS WILL GIVE THE OPERATOR AN INDICATION THAT THE MAGNET IS REACHING OR HAS REACHED THE HOT AMPS & DHMS RATING PROVIDED BY THE MAGNET MANUFACTURE, WHEN THESE HOT VALUES ARE EXCEEDED BUY 10% OR MORE, THE MAGNET SHOULD BE TAKEN OUT OF SERVICE AND ALLOWED TO COOL. THIS WILL AVOID RISK OF DAMAGING THE MAGNET COIL.

A "SAFE HOT AMP READING" IS NOT DBSERVED, EXCESSIVE HEAT BUILD-UP WILL CAUSE DAMAGE TO THE MAGNET COIL WINDINGS.

			BILL OF MATERIAL DW	G, #	WI-1791A-E003
MFR.	QUA	USAGE	DESCRIPTION		CAT. NUMBER
PC&S	1	'VM'	2-1/2" VOLTMETER, 0-300 VDC WITH HEAVY DUTY DAMPENING		#ST70DC300V- 300V
	1	"AM"	2-1/2' AMP METER, 0-300 DCA, 50M WITH HEAVY DUTY DAMPENING	∨,	#ST70UDC50MV -300A
	1	TNUH2	300 AMP, 50 MV. SHUNT		#C300-50
SAGINAW	1	ENCL,	6"x 4" x 3" TYPE "CH" ENCLOSUR	E	A604CH
	1				



JDB # ECN 221



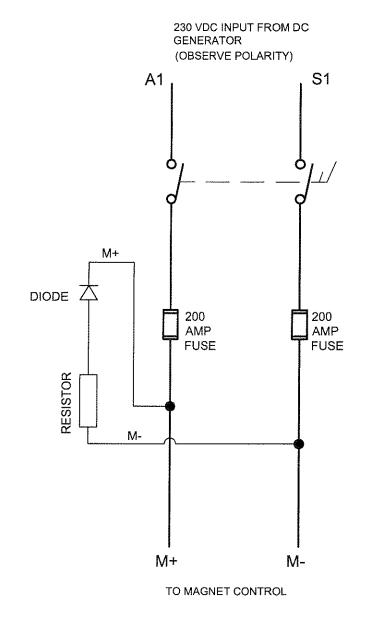
2080 WEST MAIN STREET ALLIANCE, OHIO 44601 PHONE: (330) 823-9730 FAX: (330) 823-9788

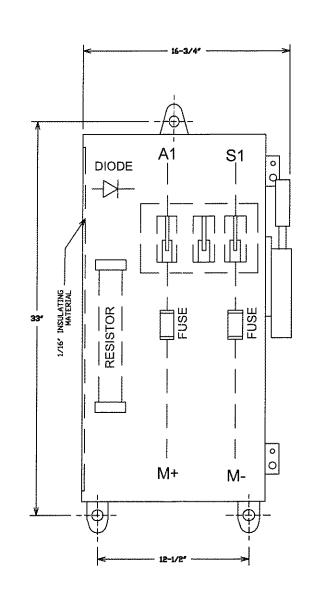
O TO 300 AMP MAGNET METER PACKAGE

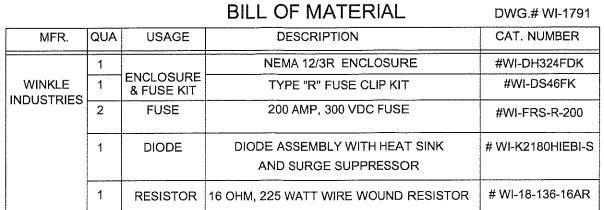
DATE: DWG #: DRAWN BY: R.E. 6/14/08 WI-1791A-E-003 CH'K BY: SCALE NONE

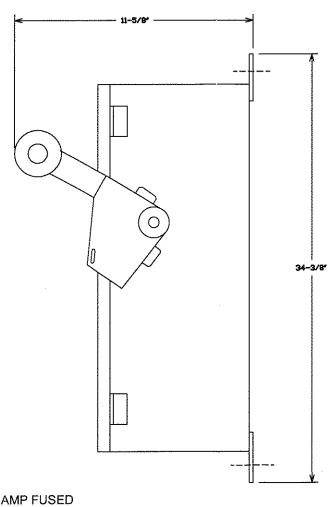
PART # WI-RMP-300-300

5/6° Ø HOLES









200 AMP FUSED MAGNET DISCONNECT SWITCH

UNLESS OTHERWISE SPECIFIED:

ALL DIMENSIONS IN INCHES.
BREAK CORNERS 1/32" MAX.

(XX) ± 00° 30'-00" (XX.X) ± 00° 00'-30'

information contained on this print is proprietary and confidential with respect to any design or modification proposed or commissioned by Winkle Industries. This print is the property of Winkle Industries and is loaned in confidence to purchaser or vendor strictly for the purposes of Winkle Industries business and is subject to return upon demand.

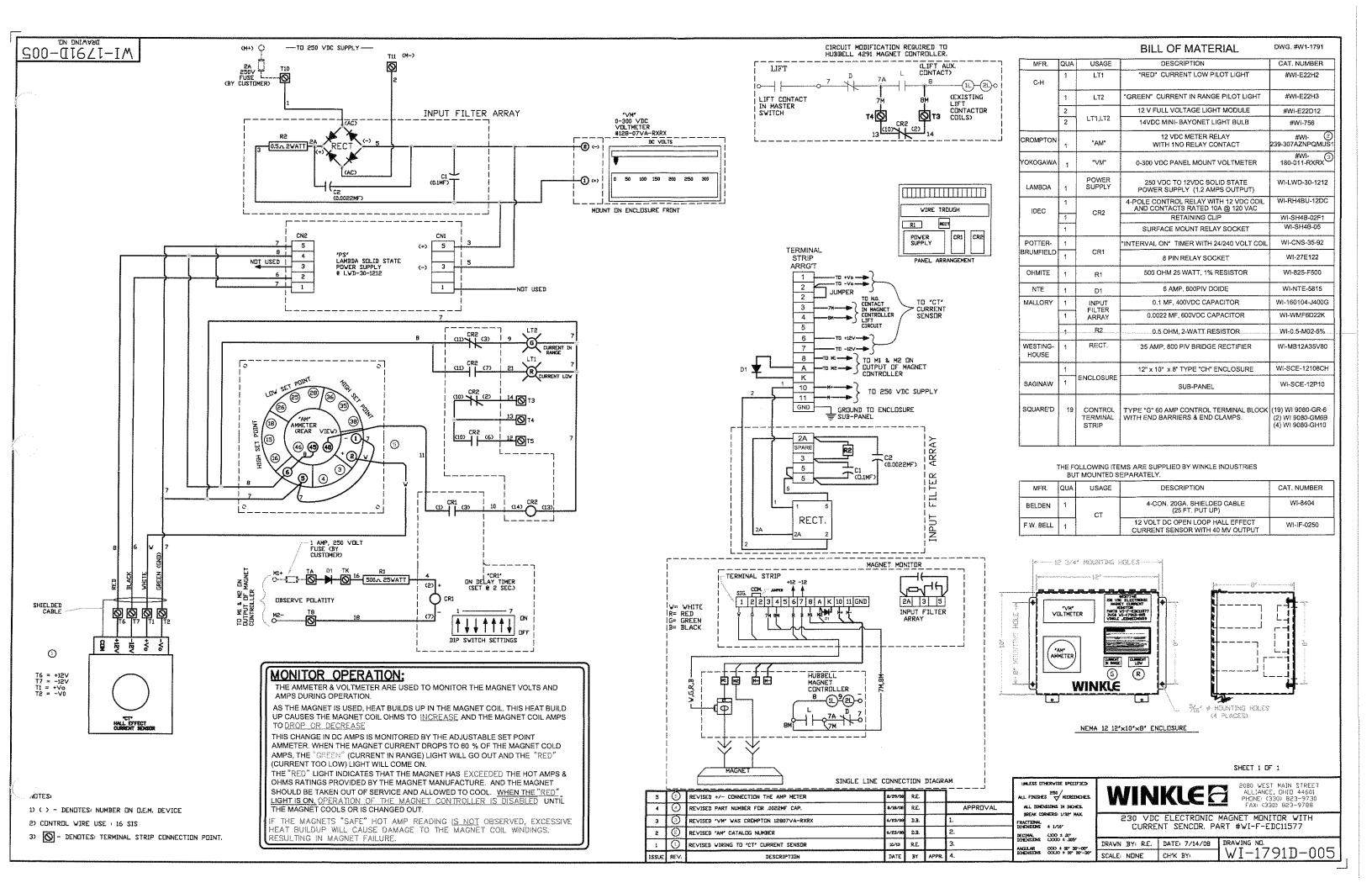
							ALDFINIS
						APPROVAL	ALL DIN
						1.	BREAK C FRACTIONAL
						2.	DECIMAL /
٠	0	***	***	***		3.	DIMENSIONS ANGLE AR
ISSUE	REV.	DESCRIPTION	DATE	BY	APPR.	4.	ANGULAR DIMENSIONS

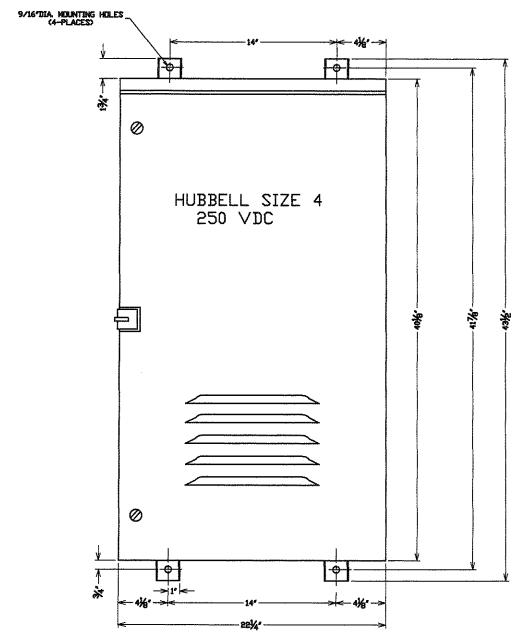
WINKLE

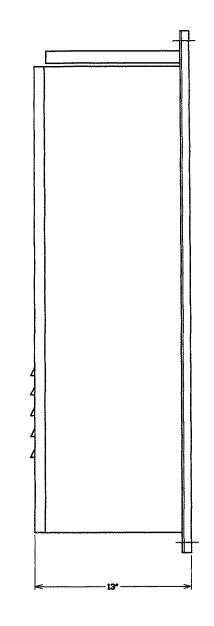
2080 WEST MAIN STREET ALLIANCE, OHIO 44601 PHONE: (330) 823-9730 FAX: (330) 823-9788

200 AMP FUSED MAGNET DISCONNECT SWITCH WINKLE INDUSTRIES PART # WI-SDS-200

DRAWN BY: R.E.	DATE: 4/13/04	DRAWING NO.
SCALE: NONE	CH'K BY:	WI-1791B-E-004







HUBBELL #4291-91805-202, NEMA SIZE 4 MAGNET CONTROL

SUPPLIED FOR SEPARATE MOUNTING (1-REQUIRED) (180 LBS.)

NOTE: FOR HUBBELL CONTROLLER SCHEMATIC DRAWING SEE HUBBELL DRAWINGS # C-75942-021

UNLESS OTHERWISE SPECIFIED

ALL DIRECTIONS IN ACCESS.
BREAK CHRISTS //32 NAX.
RACTIONAL
DIRECTION 1/1/10

WINKLE

2080 WEST MAIN STREET ALLIANCE, DHID 44601 PHONE (330) 823-9730 FAX: (330) 823-9788

HUBBELL SIZE 4 MAGNET CONTROLLER ENCLOSURE & BILL OF MATERIAL

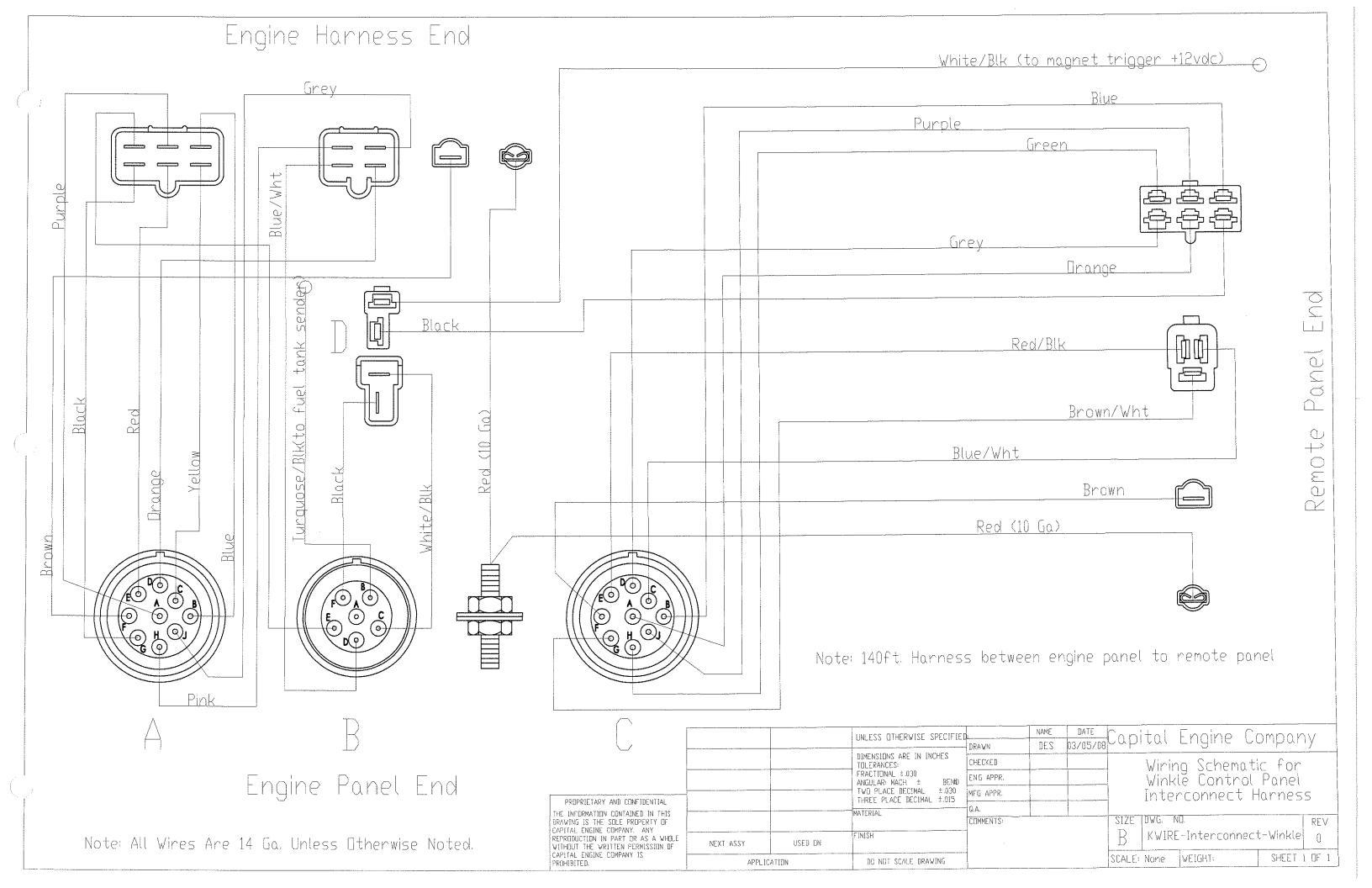
DRAWN BY: R.E. DATE: 7/14/08 DRAWING NO.
SCALE: NONE CH'K BY: WI-1791D-E006

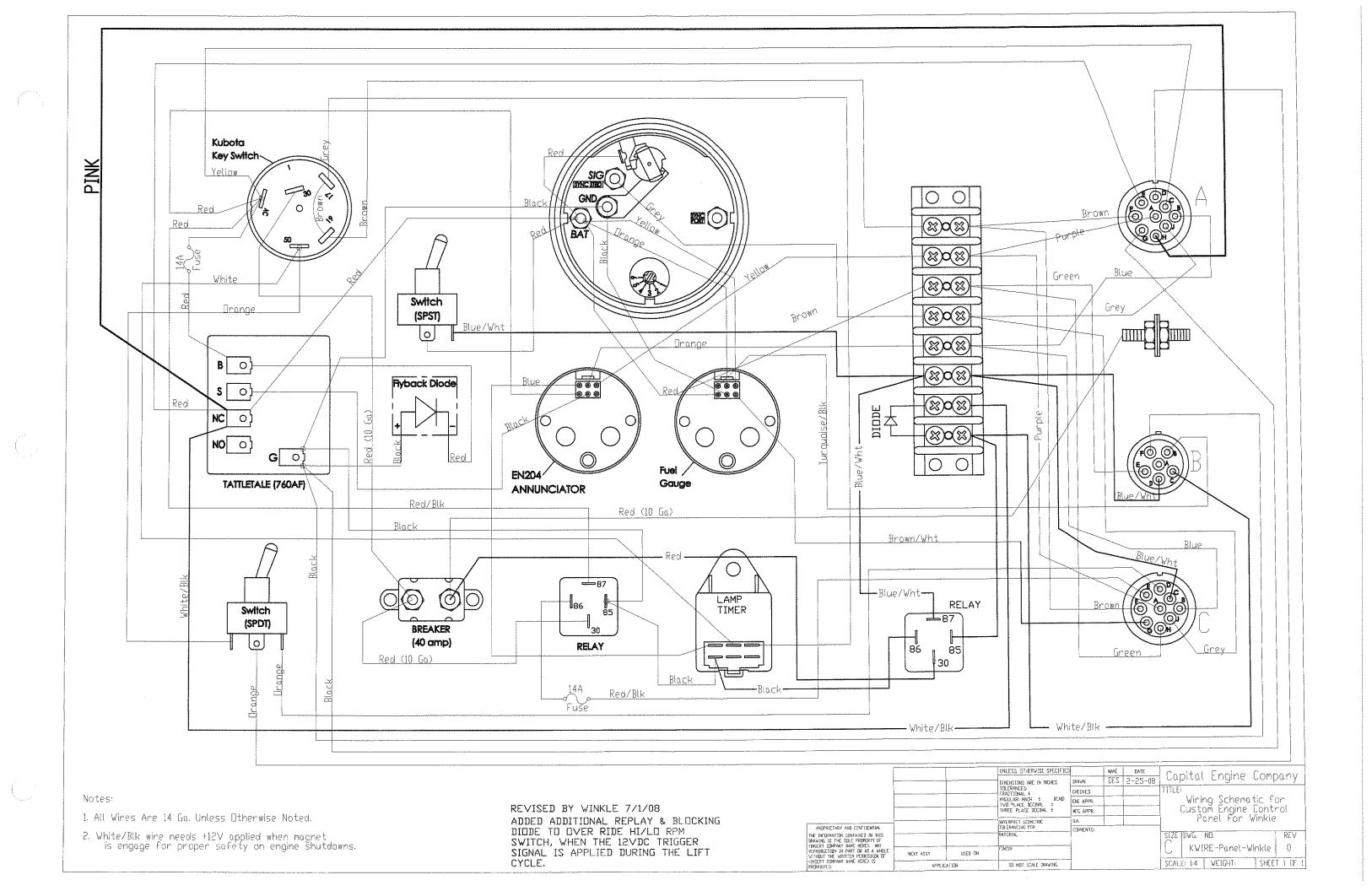
All information contained on this print is proprietary and confidential with respect to any design or nodification proposed or convissioned by Vinkie Industries. This print is the property of Vinkie Industries and is loaned in confidence to purchaser or vendor strictly for the purposes of Vinkie Industries business and is subject to return upon demond.

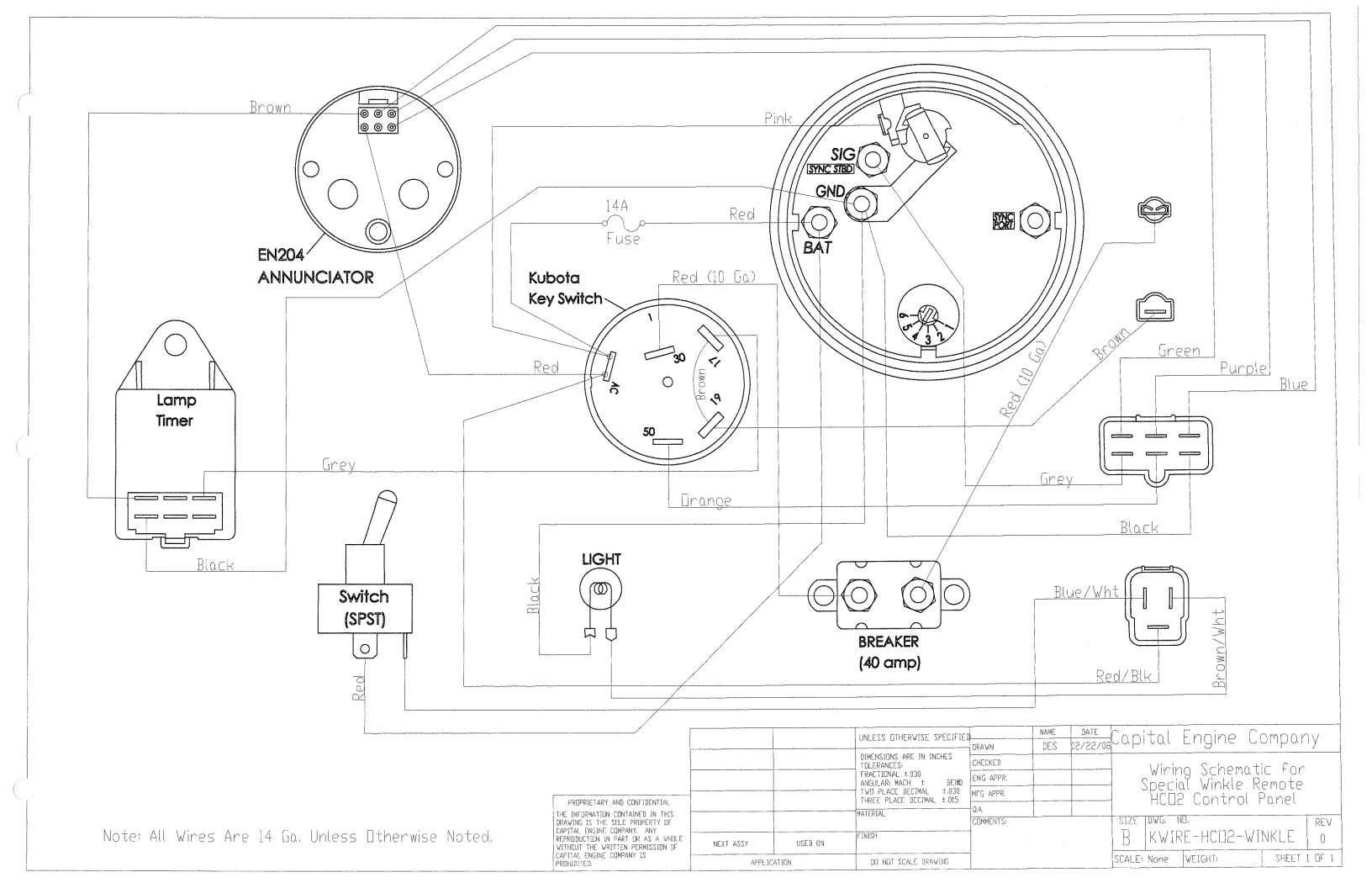
SECTION 20

ENGINE AND GENERATOR ELECTRICAL DRAWINGS

,		



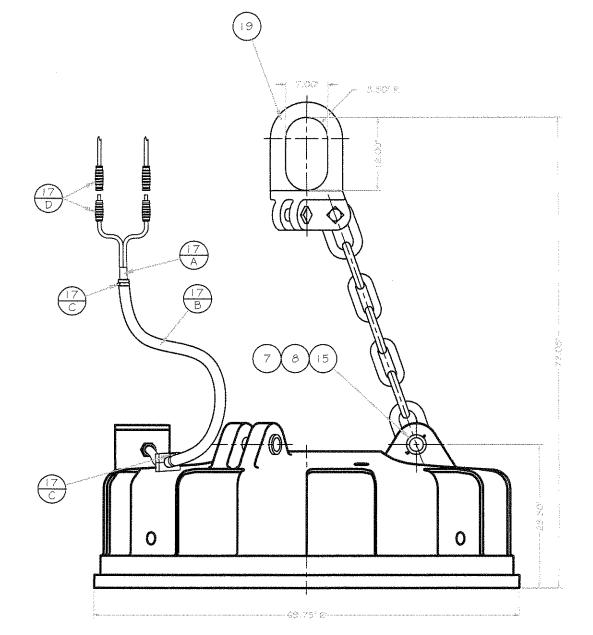




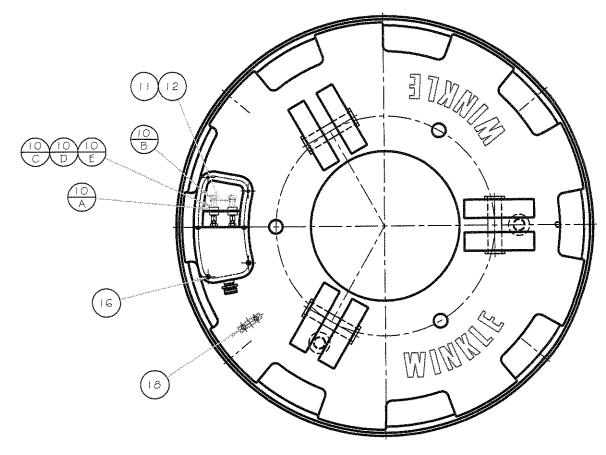
SECTION 21

MAGNET DRAWING

MIO I O.A.D. OOC



#	DESCRIPTION	DRAVING #	CADT 4	1 OTV
		Distribute #1	PART #	GTY.
	CHAIN PIN- 2.25' Ø T.G.4P.	WIG 1 07D-003	MP108022503	3
	CHAIN PN COLLAR- 2.36° LD.	WIO I 075-003	PC108022503	6
	INSULATOR ASSEMBLY- INCLUDES ITEMS "A" THRU "E"	WI0107D-00G		- 5
Λ	WIRKLE- TYPE INDULATOR (CUT OT PIT)	W01070-006	RIS0231	ĉ
E5	STEAR SPLIT BOLT CONNECTOR	W10107D-006	\$100012	4
Ċ	BRASS ALL-THREAD 1/2°NC (CUT TO RT)	WIO+070-006	#A50020	2
D	BRASS PLAT WASHER	WIO 1 0712-004	HADOH67	4
Ĉ.	BEASE LOCK WASHER	W10:070-002	NAEQ124	À
	SPARK ARRESTOR	W103068-000	W0306B190	2
	TUNGSTEN ROD I/EI Ø (CUT TO AT)	WID: 07D-006	-	2
	COTTER PIN- 3/8" Ø X 4-1/2" LG.		PASO 107	ေ
	SOCKET HEAD CAP SCREW- 1/2" NC X 1-1/2" LG.		HAB0340	G
	LEAD ASSEMBLY, WICLIDES ITEMS "A" THPU "C"	WIO I 07T-006	68ACCW(0107019)	1
Α	LEAD WRE: #2/2 AWG TYPE "W" WRE X G-O" LG.		CDR0210	
8	RADIATOR HOSE- 1-1/2" LD. x 41-0" LG.		HQ5000 F	1 .
C	7105E CLAMP- #10	-	F/(50006)	2
12	TWIST-LOCK MALE/FEMALE CONNECTOR SET	-	MF-200	ŝ
	LEAD STRESS REJEF HOLD DOWN	-	PASO: 23	1
	STEADY-LIFE CHAIN ASSEMBLY- 41-7" VERTICAL REACH- 150,000 WILL	-	537:-02000	:
	CORD GRIP POR #2/2 WIRE	-	ELC0142	T
	8 C D A B C C	HEQUATOR ASSEMBLY: INCLUDES TEMS *A* THRU *F* A WRITE- TYPE INSULATOR (CUT OT PT) B STE-F-SPLIT BOLT CONNECTOR C BRASS ALL THREAD 1/250C (CUT TO PT) D BRASS PLAY WASHER 6 BRACE LOCK WASHER 5 BRACE LOCK WASHER 5 STARK ARRESTOR TURGSTER ROD 1/6* Ø (CUT TO PT) COTTER PIN-3/8* Ø X 4-1/2* LC. 50CNET HEAD CAP SCREW-1/2* NCX 1-1/2* LG. 10 SOUNT HEAD CAP SCREW-1/2* NCX 1-1/2* LG. 10 LEAD ASSEMBLY: HICLUDES TEMS *A* THRU *D* A LEAD WIRE #2/2 AWG TYPE *A* WIRE X C-O* LG. B RADIATOR HOSSE-1-1/2* LD, X 4-0* LG. C HOSE GLAMP-#10 D TWIST-LOCK MALEFEMALE CONNECTOR SET LEAD STRESS RELIEF HOLD DOWN STEADY-LIFT CHAIN ASSEMBLY: 4-7* VERTICAL REACH-150,000 WILL	REULATOR ASSEMBLY: RICLUSES TEMS "A" THRU "E" WIG 10 7D-006	MINISTRA ASSEMBLY - NICLURES ITEMS "AT THRU "F" WIG 107D-006 BIS0851 MINISTRA ASSEMBLY - NICLURES ITEMS "AT THRU "F" WIG 107D-006 BIS0851 MINISTRA ASSEMBLY - NICLURES ITEMS "AT THRU "F" WIG 107D-006 BIS0851 BIS085 FLAT WASHER WIG 107D-006 WIG 107D-006 MAE0020 DI BRASS FLAT WASHER WIG 107D-006 MAE0020 DI BRASS FLAT WASHER WIG 107D-006 MAE0167 DI BRASS FLAT WASHER WIG 107D-006 MAE0167 DI BRASS FLAT WASHER WIG 107D-006 MAE0124 DI BRASS FLAT WASHER WIG 107D-006 MAE0140 DI BRASS FLAT WASHER WIG 107D-006 DI BRASS FLAT WASHER WIG 107D-006 MAE0140 DI BRASS FLAT WASHER WIG 107D-006 DI BRASS FLAT WASHER WIG 107D-006 MAE0140 DI BRASS FLAT WASHER WIG 107D-006 DI BRASS F



-MAGNET SPECIFICATIONS -

- 1.) WEIGHT: 17,150 LBS W/ LIFTING CHAIN
- 2.) VOLTAGE: 230 VDC- SINGLE VOLTAGE
- 3.) RESISTANCE (COLD): 2.16 OHM5 @ 20° C
- 4.) CURRENT (COLD): 106.5 AMPS
- 5.) CURRENT (HOT): 74.5 AMPS
- 6.) KILOWATTS (MAX.): 24.5
- 7.) DUTY CYCLE: 50% CONTINUOUS

SHEET 6 OF 6

UNLESS DITHERMISES SPECIFIED

ALL FIDISHES \$50 MICROBINCHES.
ALI DIMENSIONS RENCHES.

BREAK CORNERS 1/38" MAX.

CENTERAL ASSET

2080 WEST MAIN STREET
ALIANCE, OHIO 44601
PHONE: (380) 823-9780
FAX: (380) 823-9785

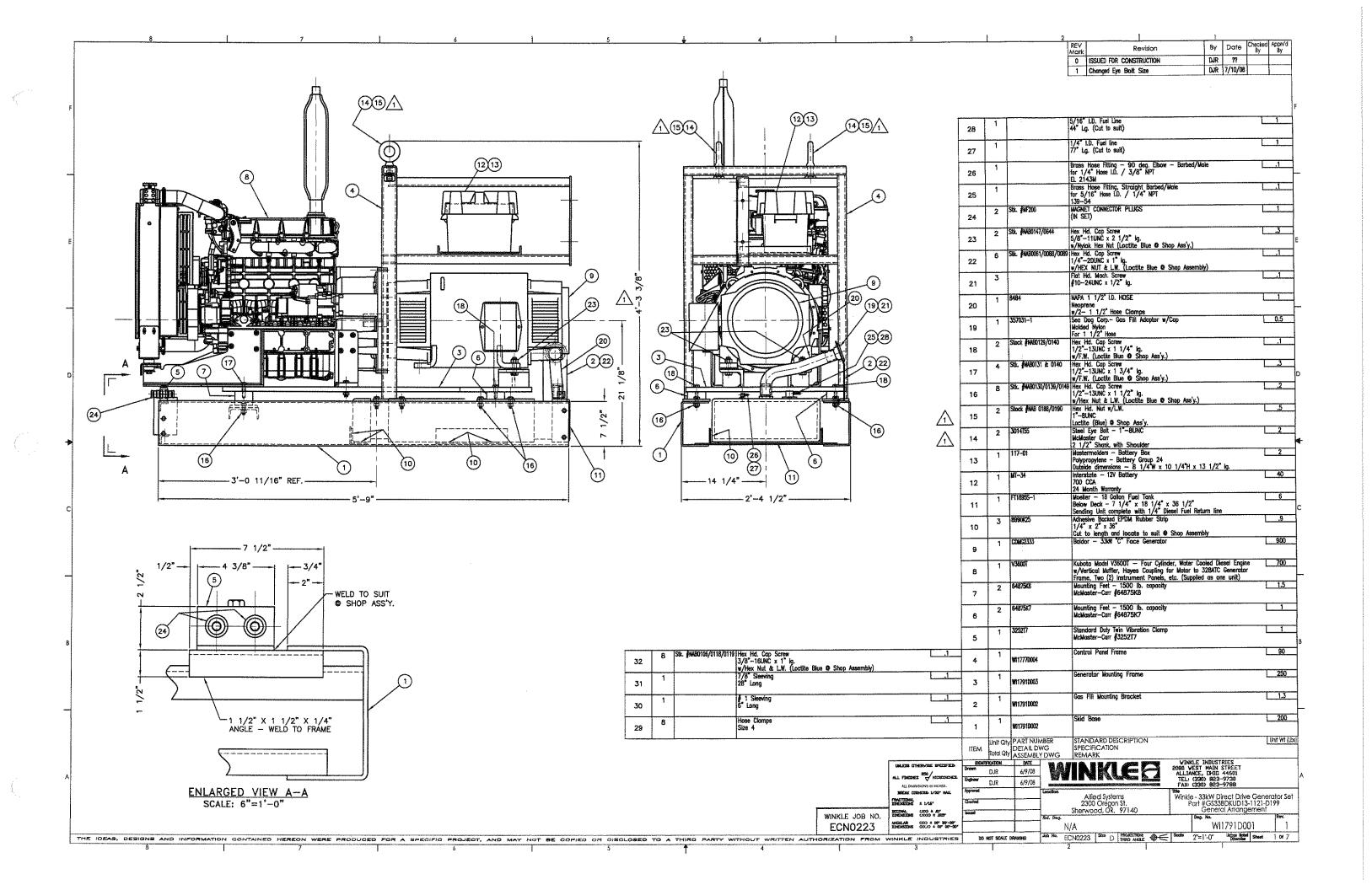
GENERAL ASSEMBLY AND RENEWAL PARTS-72ACC ELECTROMAGNET DESCRIPTION

BRAWN BY MUC DATE: FO/20/03 WIO 1070-006
SCALE: NONE CH'K BY: DRAWING NO.

All information contained on this print is proprietury and confidential with respect to any design or socilification proposed or consistence by White Industries. The print is the property of Vinkie Industries and is loaned in confidence to purchaser or vendor strictly for the purposes of Vinkie Industries and is subject to return upon denand.

SECTION 22

GENERATOR GENERAL ARRANGEMENT DRAWING



SECTION 23

NOTES

NOTES