Starter Manual

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Operator's Guide and Instruction Manual

RAM INDUSTRIES LLC

Contents

Important

The information contained herein is not intended as a training manual for unqualified personnel. It does not relieve the user of responsibility to use sound practices in application, installation, operation, and maintenance of the equipment purchased or in personnel safety precautions. Should a conflict arise between the general information contained in this publication and the contents of drawings or supplementary information supplied with this equipment, the latter shall take precedence.

RAM Industries reserves the right to make changes in specifications shown herein or add improvements at any time without notice or obligation.

WARNING

DISCONNECT ALL SOURCES OF POWER AND
LOCKOUT BEFORE SERVICING THIS EQUIPMENT

This equipment should be installed and maintained by qualified personnel only, in accordance with recognized safety standards and applicable electrical or building codes. The manufacturer is not responsible for damages or injuries resulting from improper installation or use.

For the purposes of this manual, a qualified person is one who is familiar with the installation, construction, or operation of the equipment and the hazards involved. In addition, he has the following qualifications:

a) Is trained and authorized to energize, de-energize, clear, ground, and tag circuits and equipment in accordance with established safety practices.

b) Is trained in the proper care and use of protective equipment such as rubber gloves, hard hat, safety glasses or face shields, flash clothing, etc., in accordance with established safety practices.

c) Is trained and authorized to work on exposed parts that may be energized.

d) Is trained in rendering first aid.

Receiving, Handling, and Storage

Receiving

- Industrial control equipment normally includes instrumentation, contactors, relays, and other similar devices which may be damaged if roughly handled.

- Inspect all equipment for shipping damage as soon as possible after receipt. Any signs of damage to the shipping container or wrapper may indicate that hidden damage has occurred. Notify your freight carrier immediately if any damage is apparent.

Handling

- This equipment may be unbalanced or top heavy. Adequately strap or brace all equipment prior to moving.

- Do not Top-Stack this equipment or lay on side. This may cause internal component shifting and damage.

- Any skids, crating, or other wrapping material should be left on equipment until final installation whenever possible.

- Packaged equipment should be moved by fork-lift, balancing the load and using safety straps.

- Toplifting is not recommended unless suitable lifting eyes or angles have been provided. Under no circumstances should equipment be lifted by means of any panel mounted devices.

Storage

- Any equipment which is to be stored prior to its installation, should be checked before being placed in storage for possible damage during transit. It should then be repacked and stored in a location which is clean, dry, and has a uniform temperature to prevent condensation.

- When storage will be in or near buildings under construction, covers should be provided to protect against dust, moisture, and falling objects.

Installation

- Location - Unless specifically designed for unusual service conditions, this equipment should not be installed in a location where it will be exposed to ambient temperatures above 40C. (104.F), corrosive or explosive fumes, dust, vapors, dripping or standing water, abnormal vibration, shock, or at elevations above sea level greater than 2000m (6600 ft).

- All equipment should be located in-sight of, and/or as close to the motor as possible, in order to reduce requirements for additional disconnects and to reduce possible line losses.

- Floor mounted cabinets should be securely mounted to a clear level base using the mounting holes provided. Shim base of controller, if required, to prevent racking or possible misalignment of doors.

- Wall mounted cabinets should be securely mounted to a flat, vertical surface or framework using the mounting holes provided, and be sufficient for the weight involved. Shim the rear of controller, if required, to prevent possible racking and misalignment of doors.

- Wiring - Install all conduits and wiring in a professional manner in compliance with the National Electrical Code (NFPA 70).

- A suitable disconnecting means and short circuit protection must be installed ahead of this equipment unless provided as part of the controller.

- The nameplate ratings of the equipment must agree with the power supply and the rating of the load. Unless otherwise specified, this equipment is designed for use with Copper conductors, rated 75C minimum.

(continued)

- Size all conductors in accordance with the National Electrical Code and loads as shown on applicable drawings. Minimum recommended wire sizes for control voltages are 14ga.AWG for 115V AC or 12ga.AWG at line voltage.

- Assure that the correct field conductors are routed through any current monitors (if provided) prior to connecting to the proper load terminals. Tighten all connections to the proper torque values, as listed on equipment labels.

Start-Up

DANGER

HAZARD OF BURN OR ELECTRICAL SHOCK
MAKE CERTAIN THAT ALL INCOMING SOURCES OF POWER HAVE BEEN DISCONNECTED AND TAGGED PRIOR TO WORKING ON THIS EQUIPMENT

- Remove all remaining packing and blocking material, and all debris from installation from inside controller.

- With all power removed, manually exercise all circuit breakers, contactors, and relays to assure they are working freely. Pneumatic timers should be tested for proper time delay as shown on the drawings. Mechanical interlocks, if provided, should prevent one contactor from closing if the other is held in the energized state.

- Check all conductors for signs of abrasion caused during installation, and verify that adequate spacing is maintained to ground and phase to phase, and that wiring is in accordance with the diagrams as provided. Test all wiring for freedom from short circuits and/or grounds. Re-tighten all internal and field connections to proper torque values. Replace any arc chutes, insulators, or phase barriers that may have been removed during installation.

- Assure that all fuses are installed correctly and sized in accordance with the National Electric Code and drawings as provided. Check the trip settings of all circuit breakers and electronic overloads and set in accordance with diagrams. Ensure that any bi-metallic or eutectic overloads are sized correctly and properly installed.

- Assure proper operation and sequencing of electro-mechanical devices by cycling the controller with no load applied as follows:

1. Tag and temporarily remove all motor load wires from controller load terminals.

2. Close main circuit breaker in controller to apply rated line voltage.

3. Observe operation and sequencing of controller relays and contactors.

4. If manual trip features are provided on overload relays or circuit breakers, these should be tested for proper operation.

5. After confirming proper operation, open main circuit breaker in controller to disconnect line voltage. Reconnect motor load wires to controller.

6. Close door. Unit may now be energized and checked for correct motor rotation.

NOTE: Solid State Starters CANNOT be tested using the above procedure. Solid State Starters require a connected load.

Terminal & Wire Data

Line Connections
75 Deg. Copper Only

TABLE 1
Line Terminals for FVNR, YD, and Solid State

Standard Line Terminals

230V MAX HP	380V MAX HP	460V MAX HP	575V MAX HP	ABB BREAKER FRAME SIZE	TRIP AMPS	WIRE RANGE	RAM P/N	MFG P/N
30	50	60	75	S3	150/225	(1) #2 - 4/0 AWG	CB-0292	K4TC
50	75	100	125	S3	150/225	(1) #4 AWG - 300 KCMIL	CB-0293	K4TD
75	129	154	175	S4	250	(1) #4 AWG - 300 KCMIL	CB-0293	K4TD
100	172	263	250	S5	400	(2) 3/0 AWG - 250 KCMIL	CB-0296	K5TG
154	250	305	350	S6	600	(2) 250 - 500 KCMIL	CB-0297	K6TH
206	365	437	529	S6	600	(3) 2/0 AWG - 400 KCMIL	CB-0298	K6TJ
300	450	600	700	S6	800	(3) 2/0 AWG - 400 KCMIL	CB-0298	K6TJ
500	800	1043	1043	S7	1200	(4) 4/0 AWG - 500 KCMIL	CB-0299	K7TK
CF	CF	CF	CF					

Alternate Line Terminals

ABB BREAKER FRAME SIZE	TRIP AMPS	WIRE RANGE	RAM P/N	MFG P/N
S3	150/225	(1) #14 - 2 AWG	CB-0290	K3TA
S3/S4	150/225	(1) #14 - 1/0 AWG	CB-0291	K4TB
S3/S4	150/225	(1) #2 - 4/0 AWG	CB-0292	K4TC
S3/S4	150/225	(1) #4 AWG - 300 KCMIL	CB-0293	K4TD
S4	250	(1) #14 - 1/0 AWG	CB-0291	K4TB
S4	250	(1) #2 - 4/0 AWG	CB-0292	K4TC
S4	250	(1) #4 AWG - 300 KCMIL	CB-0293	K4TD
S4	250	(1) #6 AWG - 350 KCMIL	CB-0294	K4TE
S5	400	(1) 250 - 500 KCMIL	CB-0295	K5TF
S5	400	(2) 3/0 AWG - 250 KCMIL	CB-0296	K5TG
S6	600/800	(2) 250 - 500 KCMIL	CB-0297	K6TH
S6	600/800	(3) 2/0 AWG - 500 KCMIL	TL-0236	ATK750/3
S7	1200	NO ALTERNATE		

TABLE 2
Load Terminals for FVNR

STARTER SIZE BY HP 230 VOLT	STARTER SIZE BY HP 460 VOLT	TERMINALS T1 - T2 - T3
10 - 30	25 - 60	#8-1 AWG
40	75	#6 AWG - 2/0 KCMIL
50 - 60	100 - 125	#6 AWG - 250 KCMIL
75 - 100	150 - 200	#4 AWG - 400 KCMIL
125 - 150	250 - 350	(2) #4 AWG - 500 KCMIL
200 - 250	400 - 500	(2) #2/0 AWG - 500 KCMIL
300	600	(3) #2/0 AWG - 500 KCMIL

TABLE 3
Load Terminals for YDCT

STARTER SIZE BY HP 230 VOLT	STARTER SIZE BY HP 460 VOLT	TERMINALS T1 - T2 - T3 T6 - T4 - T5
10 - 15	25 - 30	#8 - 1 AWG
20 - 50	40 - 100	#8 - 1 AWG
60	125	#6 - 2/0 AWG
75 - 100	134 - 206	#6 AWG - 250 KCMIL
125 - 200	235 - 407	#4 AWG - 400 KCMIL
250 - 300	437 - 643	(2) #2/0 AWG - 500 KCMIL
350 - 450	687 - 900	(3) #2/0 AWG - 500 KCMIL

TABLE 4
Load Terminals for Solid State

STARTER SIZE BY HP 208V	230V	380V	460V	575V	CHASSIS SIZE	TERMINALS T1 - T2 - T3
	25		50		CSS	#8 AWG - #1 AWG
30	40	60	75	100	B1	#14 AWG - 2/0 AWG
50	60	100	125	154	B2 - B3	#6 AWG - 3/0 AWG
75	100	150	206	250	C1 - C2	#4 AWG - 500 KCMIL
100	125	200	250	305	C3	(2) #2 AWG - 600 KCMIL
150	206	365	450	570	D1 - D3	(2) #2/0 AWG - 500 KCMIL
200	250	500	600	800	E1	(3) #2/0 AWG - 500 KCMIL
300	300	600	735	900	E3	(3) #2/0 AWG - 500 KCMIL

TABLE 5
Recommended Tightening Torque

Unless Otherwise Noted on Individual Device

WIRE SIZE (AWG or kcmil)	TORQUE - IN/LB SLOTTED HEAD NO. 10 AND LARGER SLOT WIDTH ≤3/64 IN SLOT LENGTH ≤1/4 IN	SLOTTED HEAD NO. 10 AND LARGER SLOT WIDTH >3/64 IN SLOT LENGTH >1/4 IN	HEX HEAD OR SCREWS SOCKET HEAD
18 - 10	20	35	75
8	25	40	75
6 - 4	35	45	110
3	35	50	150
2	40	50	150
1		50	150
1/0 - 2/0		50	180
3/0 - 4/0		50	250
250 - 400		50	325
500 - 750		50	375

NOTES:

1 - Tables show range of cable size possible
Consult NEC and local codes for proper cable sizing
Use copper wire only
Temp rating 75 Deg C minimum

NOTE!

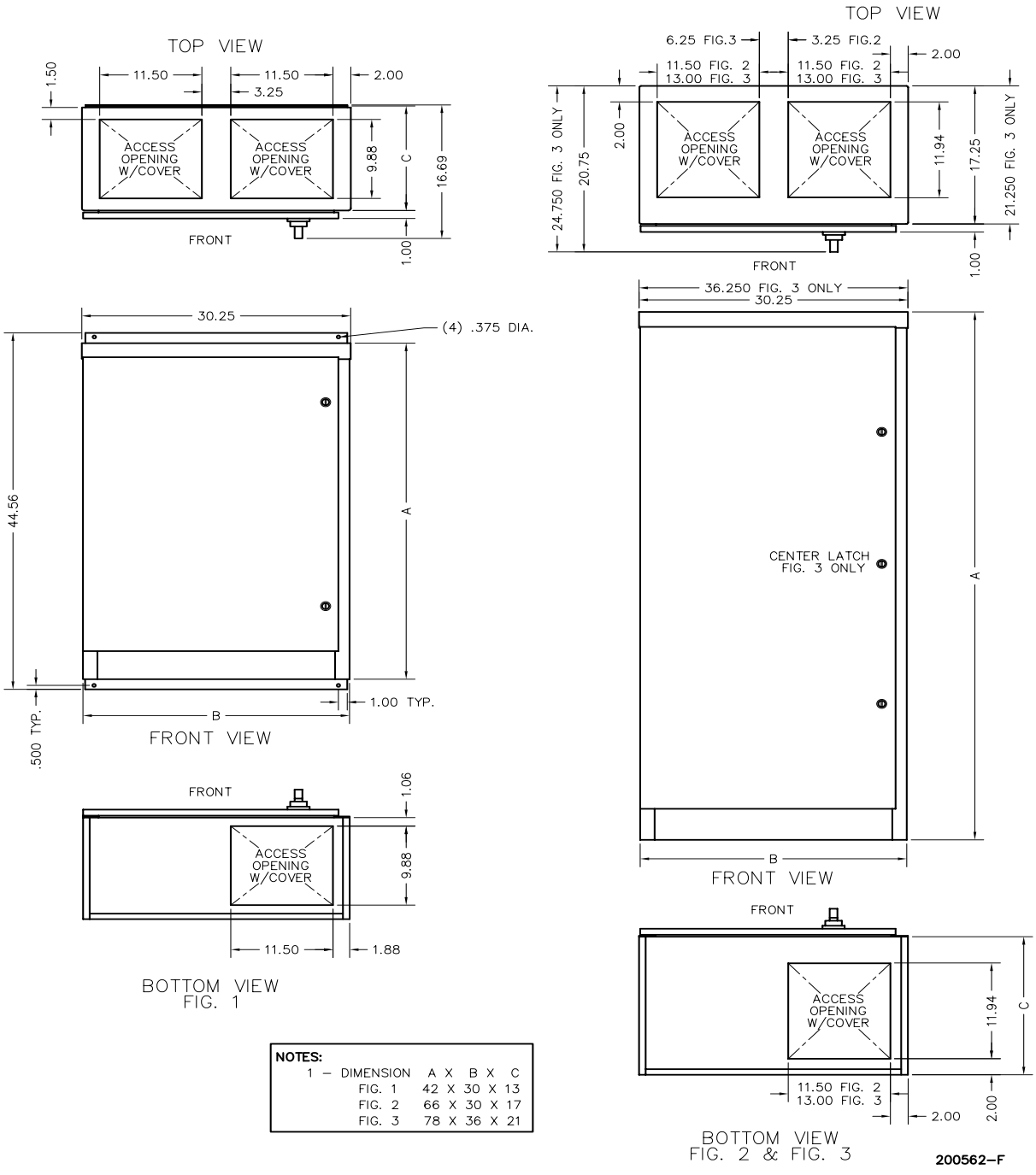
Information subject to change.
Please check website
for latest data.

www.ramusa.com

200561-H

Standard NEMA 1 Enclosure Sizes for Electromechanical Starters

STARTER SIZE BY HP		ELECT/MECH	
230 VOLT	460 VOLT	WYE DELTA CLOSED	ACROSS THE LINE
15 - 50	25 - 100	FIG. 1	FIG. 1
60	125	FIG. 1	FIG. 1
75	150	FIG. 1	FIG. 1
100-125	200 - 250	FIG. 2	FIG. 2
150	300	FIG. 2	FIG. 2
200	350 - 400	FIG. 2	FIG. 2
250	450 - 500	FIG. 3	FIG. 3
300	600	FIG. 3	FIG. 3
350	700	FIG. 3	CONSULT FACTORY
400 +	800 +	CONSULT FACTORY	CONSULT FACTORY



NOTES:

1 – DIMENSION A X B X C

FIG. 1	42 X 30 X 13
FIG. 2	66 X 30 X 17
FIG. 3	78 X 36 X 21

Dimensional Data for Standard Enclosures

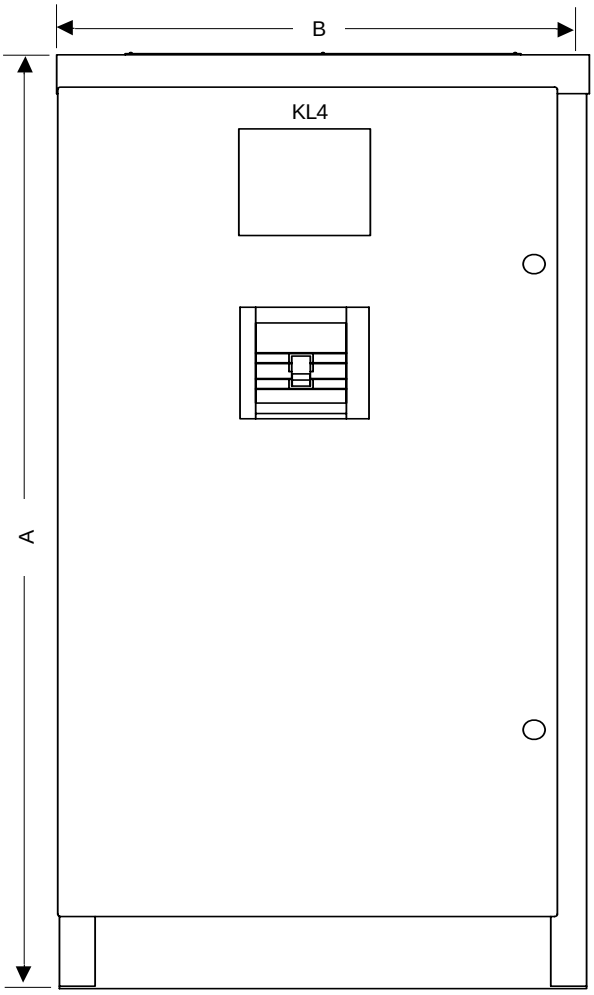
TABLE 6

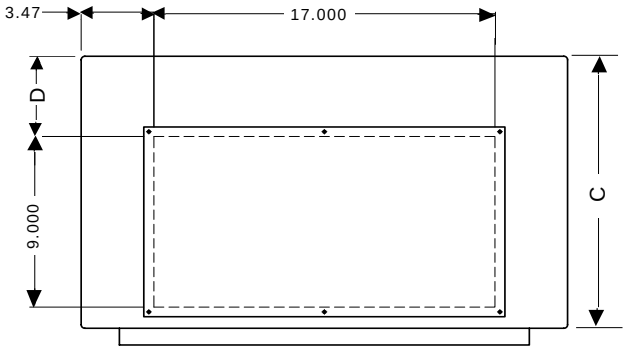
Standard Enclosure Sizes for Stand-Alone DBS Solid State Starters

(in)

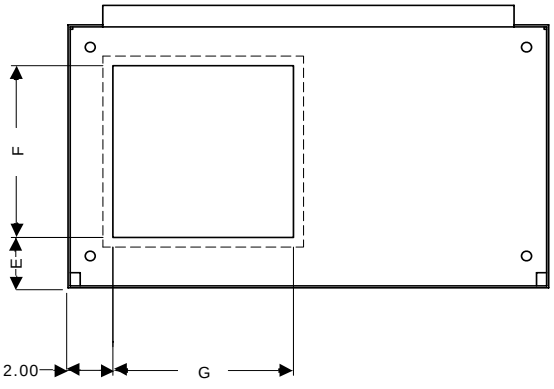
HP RANGE PER VOLTAGE					NEMA TYPE 1	CUTOUT DISTANCE FROM REAR		BOTTOM CUTOUT	
208 VOLT	230 VOLT	380 VOLT	460 VOLT	575 VOLT	A B C	D	E	F	G
30 – 50	30 – 60	60 – 100	60 – 125	75 – 150	42 x 24 x 14	4.00	2.60	9.00	9.00
60 – 100	75 – 125	125 – 200	150 – 250	200 – 300	48 x 24 x 14	4.00	2.60	9.00	9.00
125 – 250	150 – 350	250 – 500	300 – 700	350 – 900	72 x 24 x 16	3.52	2.75	10.00	13.00

FIGURE 1





TOP VIEW
CABLE ENTRY LOCATION



BOTTOM VIEW
CABLE ENTRY LOCATION

Maintenance

WARNING

Disconnect all incoming power to this equipment and lock-out and tag circuits prior to performing preventive maintenance. Discharge capacitors, if present. Positively ascertain that the equipment is totally de-energized, including possible foreign sources by using appropriate metering.

- For equipment to operate properly, and to reduce unscheduled down-time, a periodic maintenance program should be established. NFPA Publication 70B (Electrical Equipment Maintenance) may be used as a guide.

- It is recommended that at least once each year the following steps be taken.

Enclosures

- Carefully inspect all enclosure surfaces for signs of excessive heat. As a general rule of thumb, any temperature which the palm of the hand cannot stand for about 3 seconds may indicate a problem.

- Check all cabinet doors to assure proper operation and that all door latching and/or locking devices are in proper working order.

- Remove all cabinet filters, if supplied, clean as required, and replace.

- Look inside cabinets for any signs of moisture, dripping, or condensation. Seal off any conduits which may have dripped condensate or provide an alternate means for drainage. Seal off any cracks or openings which may have allowed moisture to enter the enclosure and eliminate the source of moisture on the outside of the enclosure.

- Thoroughly dry all cabinet surfaces and any insulating material which may be damp or wet. If accumulated deposits are apparent, conduct an electrical insulation test to assure proper insulation integrity.

- If there is an accumulation of dust, remove with a vacuum cleaner or clean with lint-free rags. Do not attempt to use compressed air as it may contaminate other internal components.

Wiring

- Inspect all accessible wiring for signs of looseness or overheating. Re-tighten to proper torque values as required. If major discoloration of wire insulation or cable damage is apparent, replace the affected cable.

- Identify and re-mark all cables in accordance with equipment drawings where required.

Disconnecting Means

- Inspect all terminations for signs of looseness or overheating. Re-tighten to proper torque values as required.

- Operate each device manually to assure proper operation and test manual trip feature, if equipped. Check for proper trip settings and adjust if required. Assure that any insulators or arc barriers are intact and in place.

Fuses

- Examine all fuse clips and fuse blocks for signs of overheating or looseness. If there is any indication of reduced spring tension or overheating, replace the fuse clips or fuse block assembly.

- Assure that all fuses are the correct type and the proper size as listed on devices and applicable drawings.

Contactors and Relays

- If there is an accumulation of dust, remove with a vacuum cleaner or clean with lint-free rags. Do not attempt to use compressed air as it may contaminate other internal components.

- Check all component terminals for signs of looseness or overheating and re-torque to proper values as required. If terminal is badly discolored, it may indicate that a high resistance joint or contact exists. Remove the arc chutes on the device to inspect contact condition.

- Inspect all accessible devices for breakage, cracks, or signs of sooty deposits, spattering, or carbon tracking. Clean all affected surfaces and replace damaged or cracked components.

- Inspect contact condition for signs of excessive heating, uneven wear, or unequal spring tension. Indications of light sooty deposits, minor pitting, or material displacement do not indicate a problem if all surfaces are worn equally. Do not attempt to file or dress contact surfaces with abrasives, as this will likely increase the wear rate of the contacts.

- Manually operate all power contactors and check wear indicators, if equipped. If wear indicators show 50% or less remaining life, or if contact surfaces indicate excessive or uneven wear, all contacts and spring carriers should be replaced.

- Assure that all contact screws are tightened and all barriers and arc chutes are replaced.

Overloads

- Check all terminations for looseness or overheating and re-torque to proper values.

- Assure that all devices settings are in accordance with drawings and correct for the applied load.

- Test all overloads by using the manual trip feature, if so equipped.

General

- If equipment is supplied with internal or external cooling fans, test to assure proper operation.

- List all component part numbers which may be showing signs of wear, and order replacements for installation at next scheduled shut-down period.

- Note any equipment additions and/or wiring modifications on the appropriate drawings, for maintenance use and trouble-shooting.

Maintenance After a Fault Has Occurred

> After a fault has occurred, all equipment must be de-energized, disconnected, and isolated to prevent accidental contact with live parts. Check voltage on all terminals before touching or working on equipment. Only qualified individuals should be involved in the inspection and repair procedures and all safety precautions must be observed.

- The excessive currents occurring during a fault may result in enclosure, component, and/or conductor damage due to mechanical distortion, thermal damage, metal deposits, or smoke. After a fault, determine the cause, inspect, and make any necessary repairs or replacements prior to re-commissioning this equipment. The following procedure is recommended for this inspection.

Enclosure

- Check cabinet exterior for any signs of deformation or heat damage. Assure that all hinges and cabinet latching and/or locking mechanisms are in working order. Replace affected parts if required.

Disconnecting Means

- The external disconnect operator must be capable of opening the circuit breaker or switch. Inspect all door interlocks for proper function. Replace operator mechanism, door interlock, and related parts that show signs of binding, warping, or abnormal wear.

- Inspect circuit breakers for any signs of damage or deterioration. If it is suspected that the circuit breaker has opened several short circuits, it should be replaced.

- Inspect disconnect switches for any signs of overheating, blade wear or welding, or broken or missing insulators. Replace any damaged insulators or arc chutes.

- After replacing damaged components, operate disconnect device several times to assure all mechanisms work properly.

Fuses

- Always replace all three fuses in a three phase circuit, even though only one or two are open. Possible heat damage in the remaining fuse(s) could result in a shutdown later.

Terminals and Internal Conductors

- Replace all damaged parts which show signs of discoloration, melting, or arcing damage.

Contactors and Relays

- Replace all contacts and contact springs if inspection shows signs of welding, displacement of metal, heat damage, or excessive wear. If device shows any signs of binding, or arcing and flash damage, replace the entire component. Perform an insulation resistance test to verify insulation integrity.

Overloads

- Visually inspect all overload devices for signs of arcing or other heat damage. If there is any sign of arcing or burning on the overload, or if burnout of the heater element has occurred, the entire overload device must be replaced.

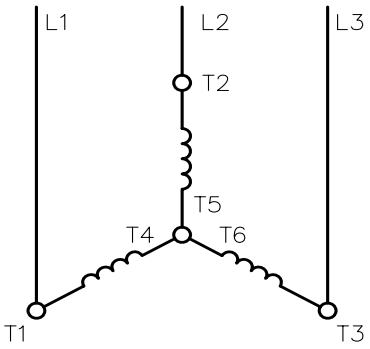
Restoring to Service

- Before restoring the equipment to service, it is recommended that the steps outlined in procedures for START-UP are followed.

Operation of RAM Wye-Delta, Closed Transition Starter

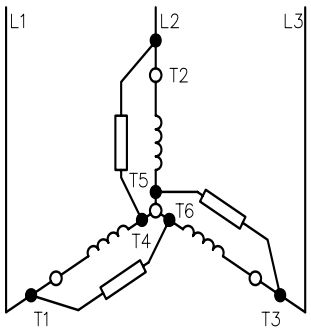
1. Closing an external "Start" contact energizes CR1. A normally open (N.O.) contact on CR1 closes and energizes the "S" contactor. This closes the three power contacts on the "S" contactor which ties together terminals T6, T4, and T5. When the "S" contactor closes, a normally open (N.O.) contact on this contactor closes and energizes the "M1" contactor. The "M1" power contacts close to energize terminals T1, T2, and T3. The motor is now energized in the wye configuration.

S AND M1 CLOSE



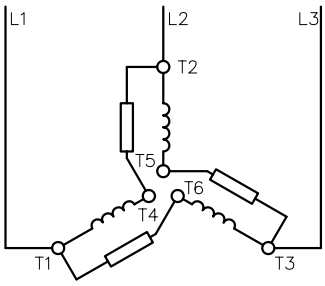
2. After a preset time period expires, a normally open, timed close (N.O.T.C.) contact on CR1 closes, energizing the "1A" contactor. The power contacts of the "1A" contactor close, keeping the motor connected to the power source through the resistors during the first transition period.

1A CLOSES



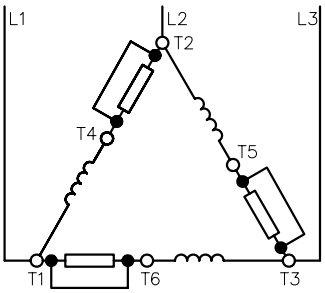
3. When the "1A" contactor is energized, a normally closed (N.C.) contact on this contactor opens and de-energizes the "S" contactor. This transition connects the motor into the delta configuration.

S OPENS



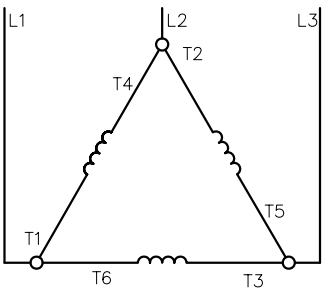
4. When the "S" contactor is de-energized, a normally closed (N.C.) contact on this contactor closes and energizes the "M2" contactor. The "M2" power contacts close and shunt the resistors, allowing the motor to continue to run in the delta configuration.

M2 CLOSES



5. When the "M2" contactor is energized, a normally closed (N.C.) contact on this contactor opens and de-energizes the "1A" contactor. The motor runs in this condition until the external "start" contact opens or an overload condition occurs.

1A OPENS



Application Guidelines

STARTER TYPE	STARTING CHARACTERISTICS IN PERCENT OF FULL VOLTAGE VALUES: VOLTAGE AT MOTOR	LINE CURRENT	STARTING TORQUE	STANDARD MOTOR	TRANSITION	EXTRA ACCELER. STEPS AVAILABLE	COST OF INSTALLATION	ADVANTAGES	DISADVANTAGES	REMARKS	APPLICATIONS
ACROSS THE LINE	100%	100%	100%	YES	NONE	NONE	LOWEST	• INEXPENSIVE • READILY AVAILABLE • SIMPLE TO MAINTAIN	• HIGH INRUSH • HIGH STARTING TORQUE		• MANY AND VARIOUS
AUTO TRANS-FORMER	80% 65% 50%	64% 42% 25%	64% 42% 25%	YES	CLOSED	NO	HIGH	• HIGH TORQUE PER LINE CURRENT • ADJUSTABLE TAPS FOR TORQUE • SUITABLE FOR RELATIVELY LONG ACCELERATION • MOTOR AMPS ARE GREATER THAN LINE AMPS	• LOW POWER FACTOR • LARGE PHYSICAL SIZE • MOST EXPENSIVE IN LOWER HP RATINGS	• VERY EFFICIENT • FLEXIBLE THRU TAP CHANGES	• BLOWERS • PUMPS • COMPRESSORS • CONVEYORS
PART WINDING	100%	65%	48%	ONLY ON 230V	CLOSED	YES (BUT NOT COMMON)	LOW	• LEAST COSTLY METHOD • SMALL SIZE	• NOT SUITED FOR LONG ACCELERATING LOADS • REQUIRES A SPECIAL MOTOR FOR 460V • NOT SUITED FOR HIGH INERTIA LOADS • NOT RECOMMENDED FOR 3600 RPM MOTORS	• ACTUALLY NOT A REDUCED VOLTAGE STARTER, BUT AN INCREMENTAL TYPE CONTROL	• RECIPROCATING COMPRESSORS • PUMPS • FANS
WYE DELTA OPEN NOT RECOMMENDED	100%	33%	33%	NO	OPEN	NO	MEDIUM	• SUITABLE FOR HIGH INERTIA LONG ACCELERATING LOADS • IDEAL FOR FREQUENT STARTING • IDEAL FOR STRIN-GENT UTILITY REQUIREMENTS	• REQUIRES A SPECIAL MOTOR • LOW STARTING TORQUE • (OPEN TRANSITION TYPE ONLY) DISCONNECTION OF MOTOR FROM LINE, DURING TRANSITION, MAY CAUSE HIGH TRANSIENTCURRENTS, REDUCING MOTOR INSULATION LIFE AND ALSO NUISANCE TRIPS OF CIRCUIT BREAKERS	• ACTUALLY AN INCREMENTAL TYPE STARTER • VERY EFFICIENT	• CENTRIFIGAL COMPRESSORS • CENTRIFUGES
WYE DELTA CLOSED	100%	33%	33%	NO	CLOSED	NO	MEDIUM				
SOLID STATE	0-100%	25-100%	10-100%	YES	NONE	STEPLESS	MEDIUM TO HIGH	• SUITABLE FOR LONG ACCELERATION • STEPLESS TRANSI-TION • HIGHEST ADJUSTABILITY • NO MOVING PARTS	• MAY CAUSE TORQUE CUSP PROBLEMS WITH SOME MOTORS • VOLTAGE DROP ACROSS SCR's MAY CAUSE HEAT PROBLEMS IN SOME APPLICATIONS • IN CURRENT LIMIT MODE, MAY CAUSE MOTOR STALLING OR FAILURE TO ACCELERATE • REQUIRES HGHER LINE CURRENT THAN WYE-DELTA TO DEVELOP THE SAME MOTOR TORQUE.	• TEMPERATURE SENSITIVE • REQUIRES SET-UP ON SITE	• MANY AND VARIOUS

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