



CONTROL DIVISION

YORK
ELECTRO-MECHANICAL
CHILLER STARTER
MANUAL

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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

D A N G E R
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 feeding 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.

TERMINAL & WIRE DATA

TABLE 1

**LINE TERMINALS FOR
NON-FUSED DISCONNECTS**

DISC FLA	DEVICE SIZE	DISC TYPE	CABLES EA. PHASE L1-L2-L3
80	150	SW	(1) #2-4/0
86	150	SW	(1) #2-4/0
173	250	SW	(1) #6-350
195	250	SW	(1) #6-350
320	400	SW	(2) #3/0-250
347	400	SW	(2) #3/0-250
480	600	SW	(2) #250-500
521	600	SW	(2) #250-500
640	800	SW	(3) #2/0-400
695	800	SW	(3) #2/0-400
800	800	SW	(3) #2/0-400
960	1200	SW	(4) #4/0-500
1043	1200	SW	(4) #4/0-500
1739	2000	BPS	(8) #2-600
2299	3150	BPS	(8) #2-600

TABLE 4

**LINE TERMINALS FOR WYE-DELTA
(WITHOUT DISCONNECTS)**

RAM STARTER SIZE	MAX FLA RATING	(6) TERMINALS NO. CABLES/PH 1L1-1L2-1L3 1L1-1L2-1L3
3A	165	(2) #6-2/0
3B	191	(2) #6-2/0
4A	278	(2) #6-250
4B	311	(2) #6-250
4C	364	(2) #6-250
5A	476	(4) #4-500
5B	606	(4) #4-500
6A	901	(4) #4-500
6B	1039	(4) #4-500
6C	1342	CONSULT FACTORY
7A	1559	(6) #2-600
8A	2355	CONSULT FACTORY
9A	4416	CONSULT FACTORY

TABLE 6

**LINE TERMINALS FOR ATL & RVAT
(WITHOUT DISCONNECTS)**

RAM STARTER SIZE	MAX FLA RATING	TERMINALS NO. CABLES/PH 1L1-1L2-1L3
3A	95	(1) #6-2/0
3B	110	(1) #6-2/0
4A	160	(1) #6-250
4B	180	(1) #6-250
4C	210	(1) #6-250
5A	275	(2) #4-500
5B	350	(2) #4-500
6A	520	(2) #4-500
6B	600	(2) #4-500
6C	775	CONSULT FACTORY
7A	900	(3) #2-600
8A	1360	CONSULT FACTORY
9A	2550	CONSULT FACTORY

TABLE 2

**LINE TERMINALS FOR
FUSED DISCONNECTS**

DISC FLA	DEVICE SIZE	DISC TYPE	CABLES EA. PHASE L1-L2-L3	FUSE TYPE
80	100	FD	(1) #14-2/0	J-T
86	200	FD	(1) #6-300	J-T
173	200	FD	(1) #6-300	J-T
195	400	FD	(1) #2-600	J-T
320	400	FD	(1) #2-600	J-T
347	600	FD	(2) #2-600	J-T
480	600	FD	(2) #2-600	J-T
521	800	FD	(4) #2-600	L
640	800	FD	(4) #2-600	L
695	1200	BPS	(6) #2-600	L
800	1200	BPS	(6) #2-600	L
960	1200	BPS	(6) #2-600	L
1043	1200	BPS	(8) #2-600	L
1739	2500	BPS	(8) #2-600	L
2299	3000	BPS	(8) #2-600	L

TABLE 5

LOAD TERMINALS FOR WYE-DELTA

RAM STARTER SIZE	MAX FLA RATING	(6) TERMINALS NO. CABLES/PH T1-T2-T3 T4-T5-T6
3A	165	(1) #6-2/0
3B	191	(1) #6-2/0
4A	278	(1) #6-250
4B	311	(1) #6-250
4C	364	(1) #6-250
5A	476	(2) #4-500
5B	606	(2) #4-500
6A	901	(2) #4-500
6B	1039	(2) #4-500
6C	1342	CONSULT FACTORY
7A	1559	(3) #2-600
8A	2355	CONSULT FACTORY
9A	4416	CONSULT FACTORY

TABLE 7

LOAD TERMINALS FOR ATL & RVAT

RAM STARTER SIZE	MAX FLA RATING	TERMINALS NO. CABLES/PH T1-T2-T3
3A	95	(1) #6-2/0
3B	110	(1) #6-2/0
4A	160	(1) #6-250
4B	180	(1) #6-250
4C	210	(1) #6-250
5A	275	(2) #4-500
5B	350	(2) #4-500
6A	520	(2) #4-500
6B	600	(2) #4-500
6C	775	CONSULT FACTORY
7A	900	(3) #2-600
8A	1360	CONSULT FACTORY
9A	2550	CONSULT FACTORY

TABLE 3

**LINE TERMINALS FOR
CIRCUIT BREAKERS**

DISC FLA	DEVICE SIZE	C/B TYPE	CABLES EA. PHASE L1-L2-L3
86	150	S3	(1) #2-4/0
195	250	S4	(1) #6-350
347	600	S6	(2) #250-500
521	800	S6	(3) #2/0-400
695	1200	S7	(4) #4/0-500
869	1200	S7	(4) #4/0-500
1043	1600	SEB	(4) #1/0-750
1739	2500	SEB	(6) #1/0-750
2239	N/A	N/A	N/A

FD = FUSED DISCONNECT
(FUSES SUPPLIED BY CUSTOMER)

SW = NON-FUSED MOLDED CASE SWITCH
HIGH MAGNETIC INTERRUPT
DISCONNECT, NON-ADJUSTABLE

BPS = BOLTED PRESSURE SWITCH
(FUSED SUPPLIED BY CUSTOMER,
REQUIRES SPECIAL ENCLOSURE)

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

TABLE 8

**RECOMMENDED TIGHTENING TORQUE
UNLESS OTHERWISE NOTED ON INDIVIDUAL DEVICE**

WIRE SIZE	TORQUE - in/lb	
	SLOTTED HEAD SCREWS	HEX OR SOCKET HEAD SCREWS
#18 - #14 AWG	12	70
#12 - #8 AWG	20	70
#6 - #4 AWG	35	135
#2 - 2/0 AWG	50	165
3/0 - 4/0 AWG		225
250 - 400 MCM		295
500 - 750 MCM		340

DIMENSIONS

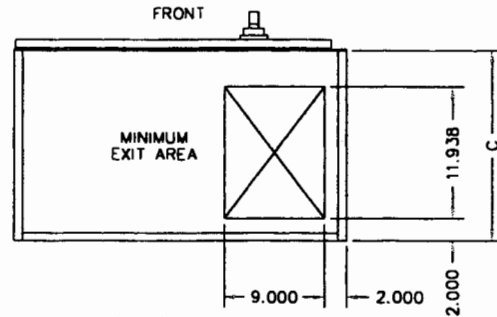
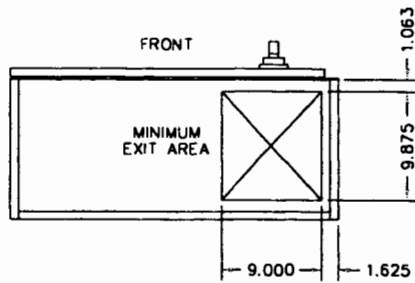
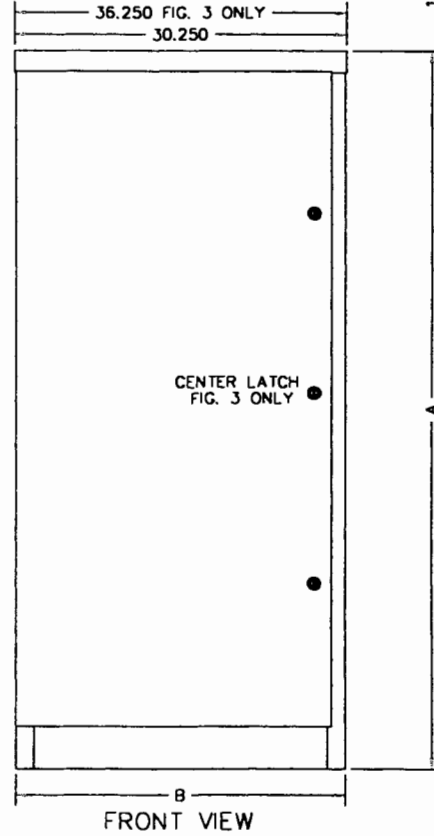
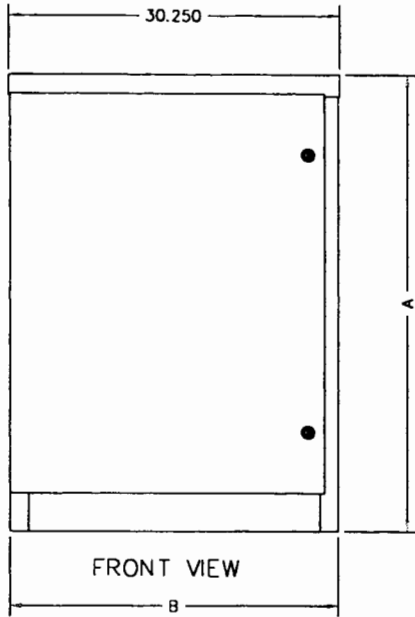
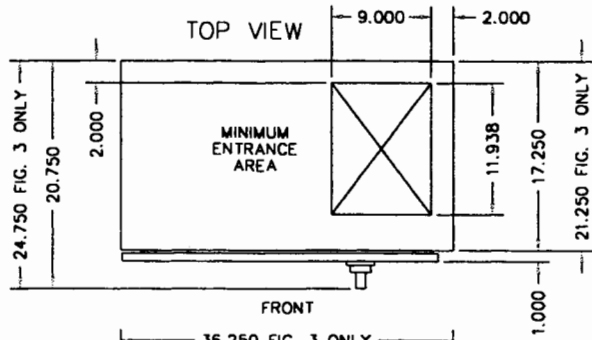
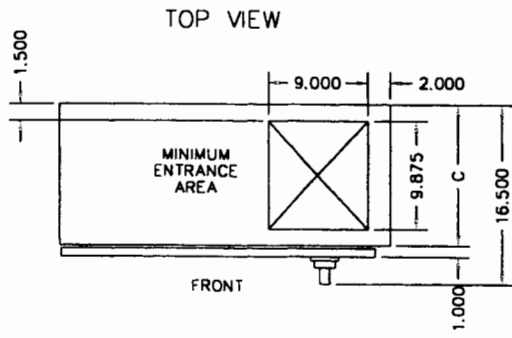
NEMA 1 ENCLOSURES

WYE-DELTA			ACROSS-THE-LINE			AUTO-TRANS		
STARTER SIZE	FIG	DIMENSION A X B X C	STARTER SIZE	FIG	DIMENSION A X B X C	STARTER SIZE	FIG	DIMENSION A X B X C
3A	1	42 X 30 X 13	3A	1	42 X 30 X 13	3A	1	42 X 30 X 13
3B	1	42 X 30 X 13	3B	1	42 X 30 X 13	3B	1	42 X 30 X 13
4A	1	42 X 30 X 13	4A	1	42 X 30 X 13	4A	1	42 X 30 X 13
4B	2	66 X 30 X 17	4B	1	42 X 30 X 13	4B	2	66 X 30 X 17
4C	2	66 X 30 X 17	4C	1	42 X 30 X 13	4C	2	66 X 30 X 17
5A	2	66 X 30 X 17	5A	2	66 X 30 X 17	5A	2	66 X 30 X 17
5B	2	66 X 30 X 17	5B	2	66 X 30 X 17	5B	2	66 X 30 X 17
6A	3	78 X 36 X 21	6A	2	66 X 30 X 17	6A	3	78 X 36 X 21
6B	3	78 X 36 X 21	6B	2	66 X 30 X 17	6B	3	78 X 36 X 21
6C	3	78 X 36 X 21	6C	3	78 X 36 X 21	6C	3	78 X 36 X 21
7A	4	90 X 48 X 20	7A	3	78 X 36 X 21	7A	3	78 X 36 X 21
8A	6	90 X 72 X 36	8A	3	78 X 36 X 21	8A	6	90 X 72 X 36
9A	6	90 X 72 X 36	9A	5	90 X 72 X 24	9A	6	90 X 72 X 36

SEE PAGE 5 FOR DIMENSIONAL AND LAYOUT DRAWINGS

DIMENSION DRAWINGS

FIG 1, 2, & 3



**BOTTOM VIEW
FIG. 1**

**BOTTOM VIEW
FIG. 2 & FIG. 3**

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
- FIG. 4 CF
- FIG. 5 CF
- FIG. 6 CF

SEE PAGE 4 FOR SELECTION OF PROPER ENCLOSURE SIZE

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.

CIRCUIT BREAKERS

- 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.

APPLICATION GUIDELINES

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



CONTROL DIVISION