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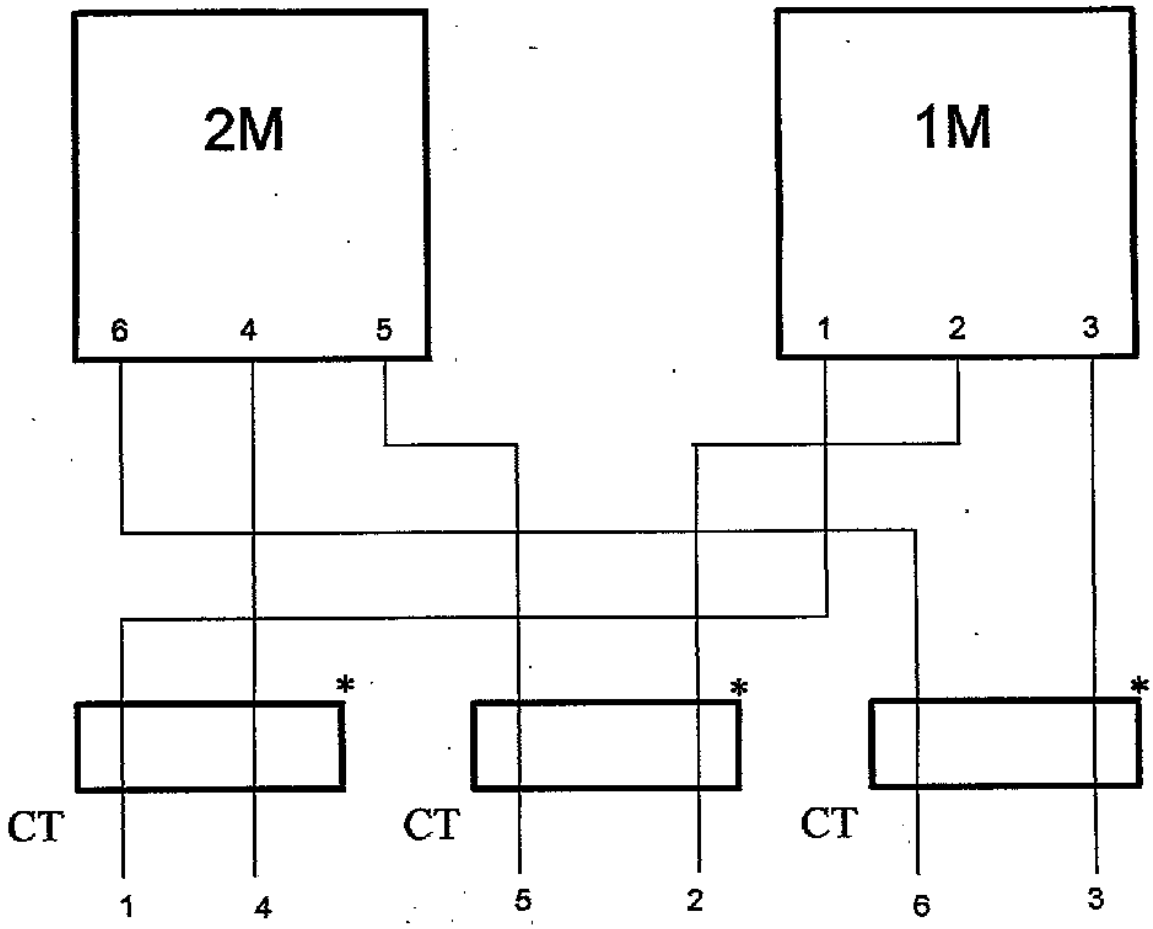
FIGURE 10
PHASE/GROUND CURRENT RELAY



MOTOR TERMINALS

* If Current Transformers are marked with a dot, all 3 must be oriented the same.

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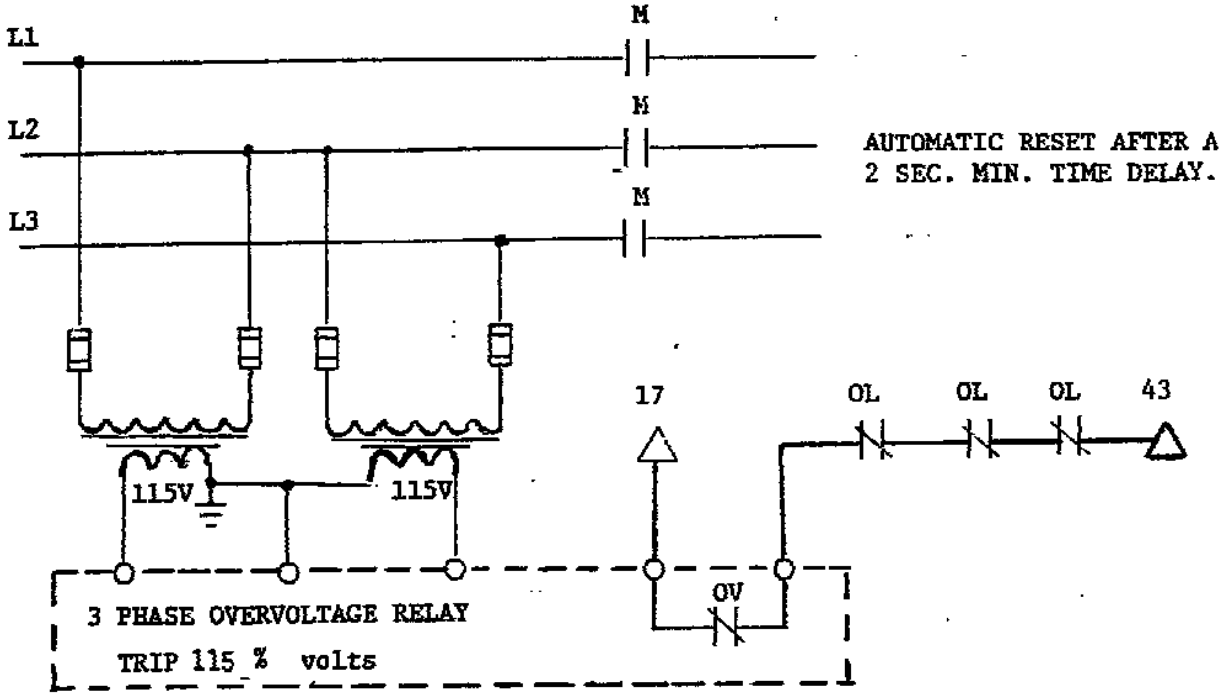
FIGURE 8 - OVERVOLTAGE RELAY



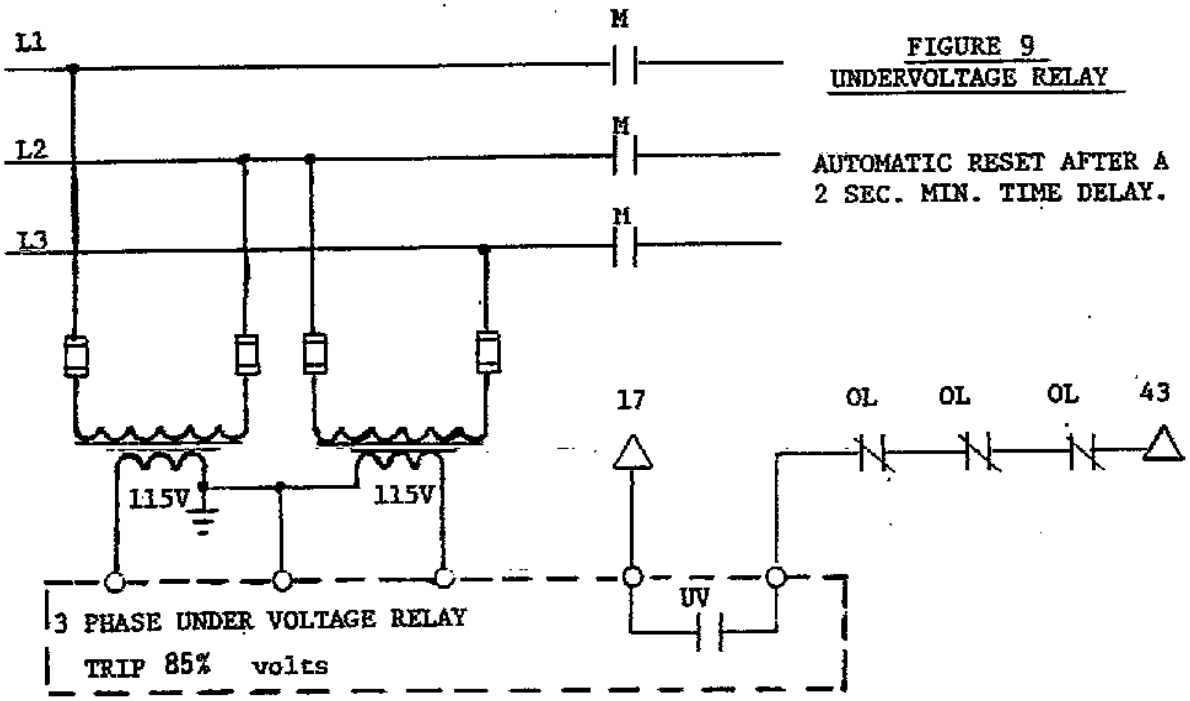


FIGURE 9
UNDERVOLTAGE RELAY

AUTOMATIC RESET AFTER A
2 SEC. MIN. TIME DELAY.

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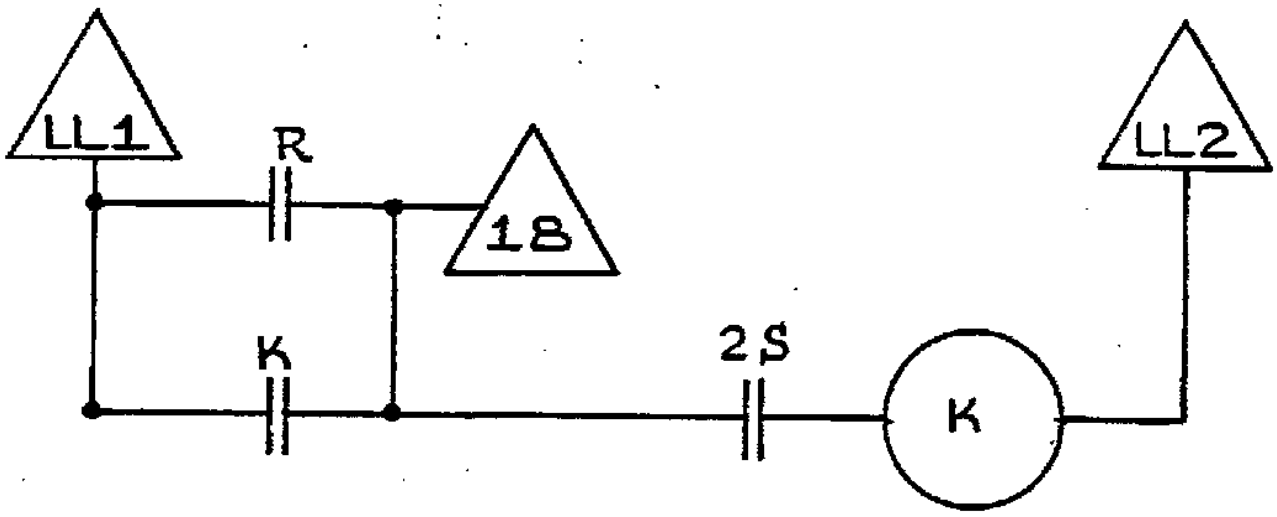
FIGURE 7



R - RUN CONTACTOR

2S - START CONTACTOR

K - PILOT RELAY

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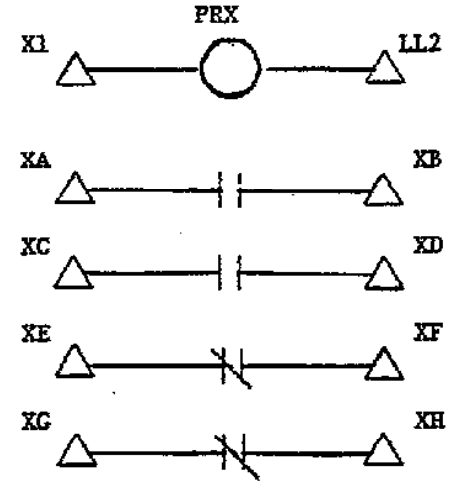
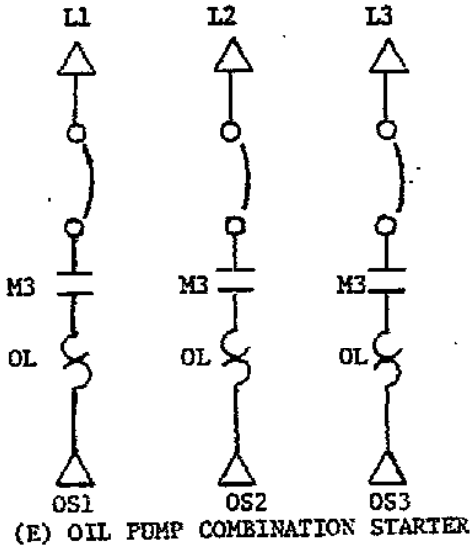
Not applicable to starters with PIC controls

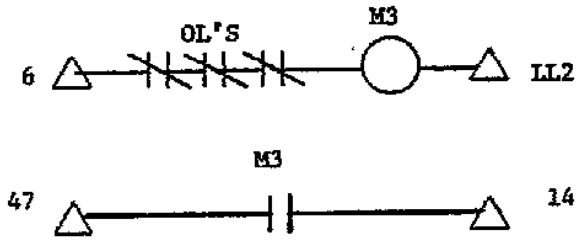
FIGURE 6 (CONTINUED)



(D) PILOT RELAY
ADDITIONAL POLES AVAILABLE



(E) OIL PUMP COMBINATION STARTER



Not applicable to starters with PIC controls

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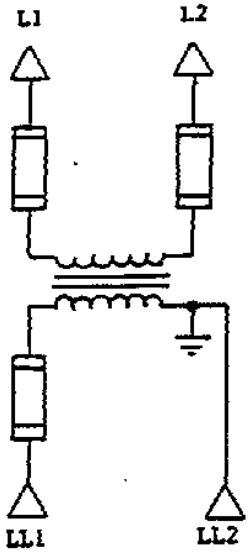
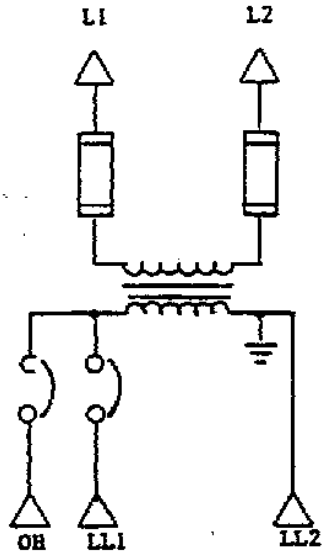
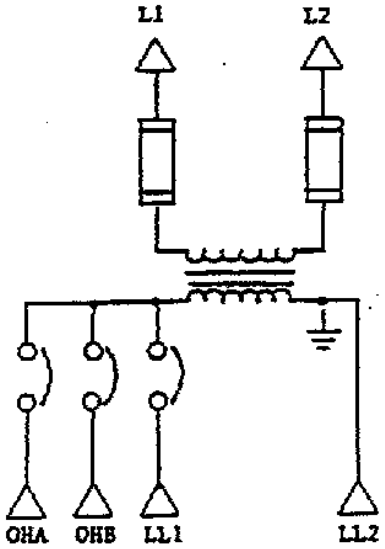
FIGURE 6



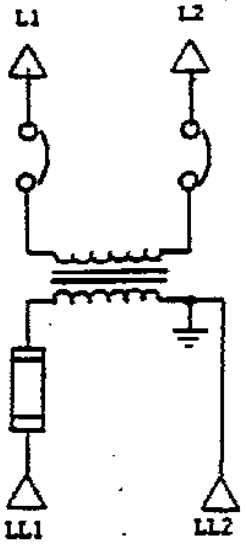
(A) CONTROL TRANSFORMER



(B) CONTROL TRANSFORMER WITH ONE OIL HEATER DISCONNECT



(C) CONTROL TRANSFORMER WITH TWO OIL HEATER DISCONNECTS (DUAL STARTERS)



(D) CONTROL TRANSFORMER PRODUCT INTEGRATES CONTROLS.

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Not applicable to starters with PIC controls

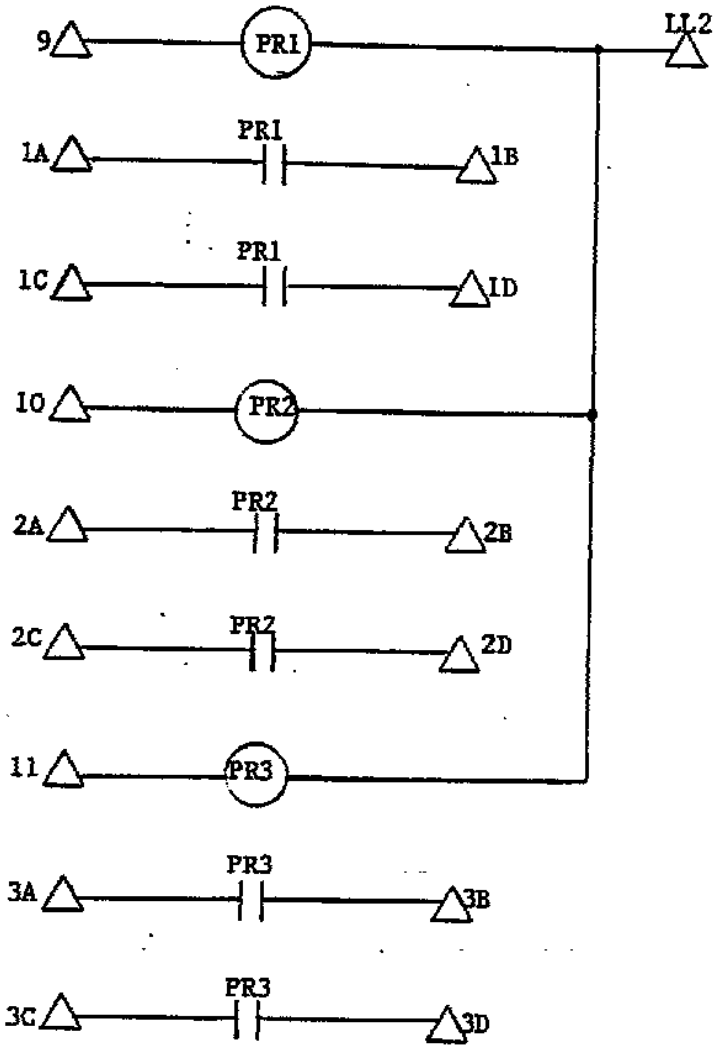

FIGURE 5

WHEN SUPPLIED FOR A DUAL STARTER, ONLY ONE SET OF RELAYS SHALL BE PROVIDED, DO NOT SUFFIX THE TERMINALS.

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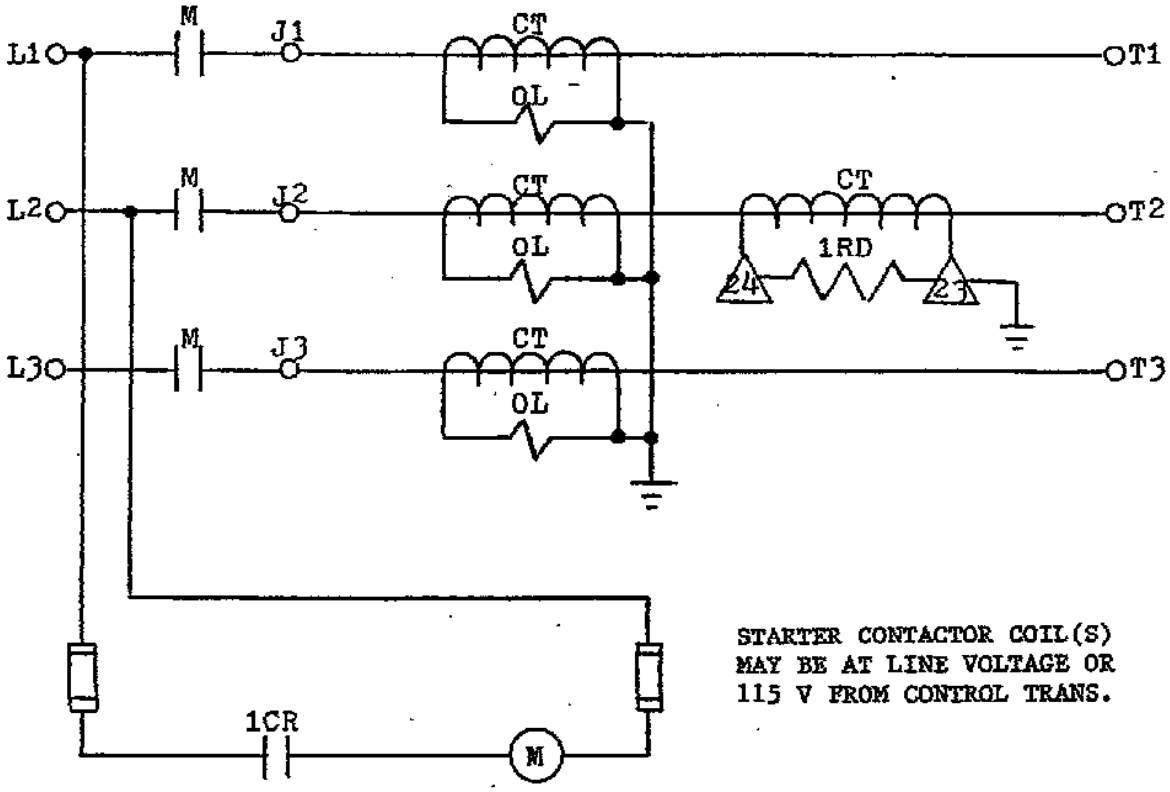
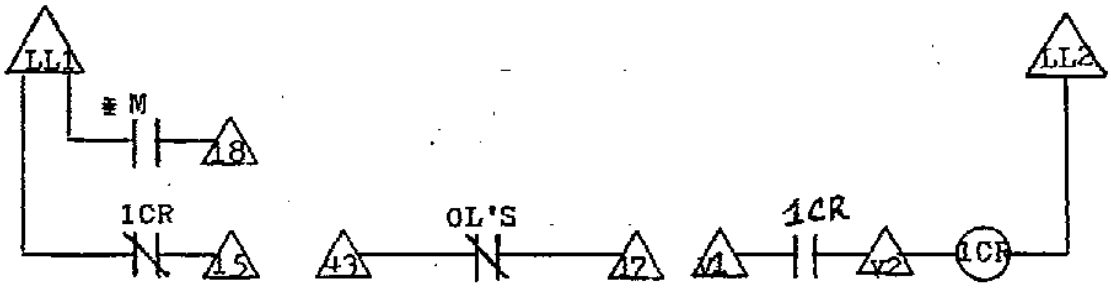
FIGURE 4 CONTROL SCHEMATIC
TYPICAL X-LINE STARTER
*
32SM OR PNEUMATIC CONTROLS



STARTER CONTACTOR COIL(S) MAY BE AT LINE VOLTAGE OR 115 V FROM CONTROL TRANS.

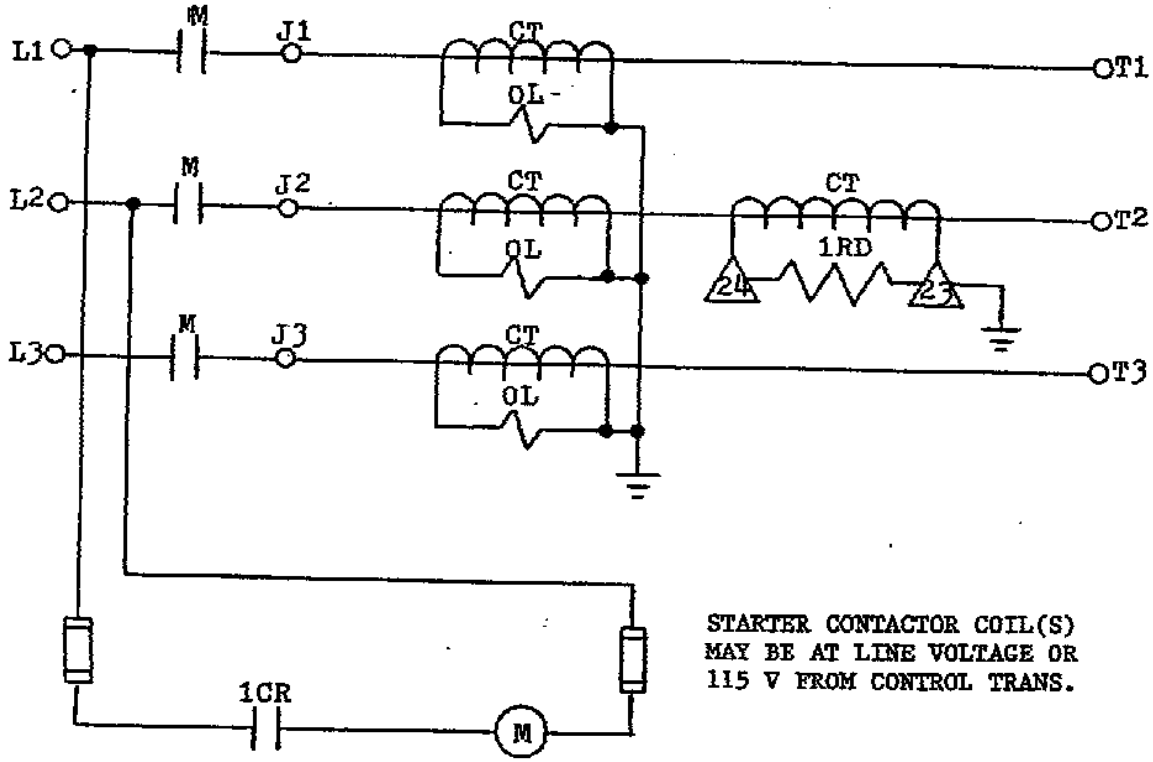


* CLOSES WHEN MOTOR IS AT FULL VOLTAGE
J1, J2, J3 LOCATION OF OPTIONAL POWER FACTOR CORRECTION CAPACITOR TERMINALS

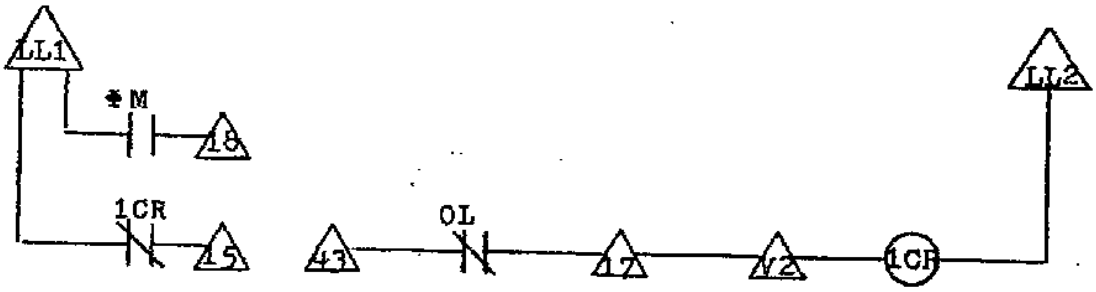
TERMINALS FURNISHED BY STARTER MANUFACTURER

TITLE: MOTOR STARTING REQUIREMENT	DATE 6/12/96	DOCUMENT NUMBER Z-375

FIGURE 3 CONTROL SCHEMATIC
TYPICAL X-LINE STARTER
*
32MP CONTROLS



STARTER CONTACTOR COIL(S) MAY BE AT LINE VOLTAGE OR 115 V FROM CONTROL TRANS.



* CLOSES WHEN MOTOR IS AT FULL VOLTAGE
J1, J2, J3 LOCATION OF OPTIONAL POWER FACTOR CORRECTION CAPACITOR TERMINALS

△ TERMINALS FURNISHED BY STARTER MANUFACTURER

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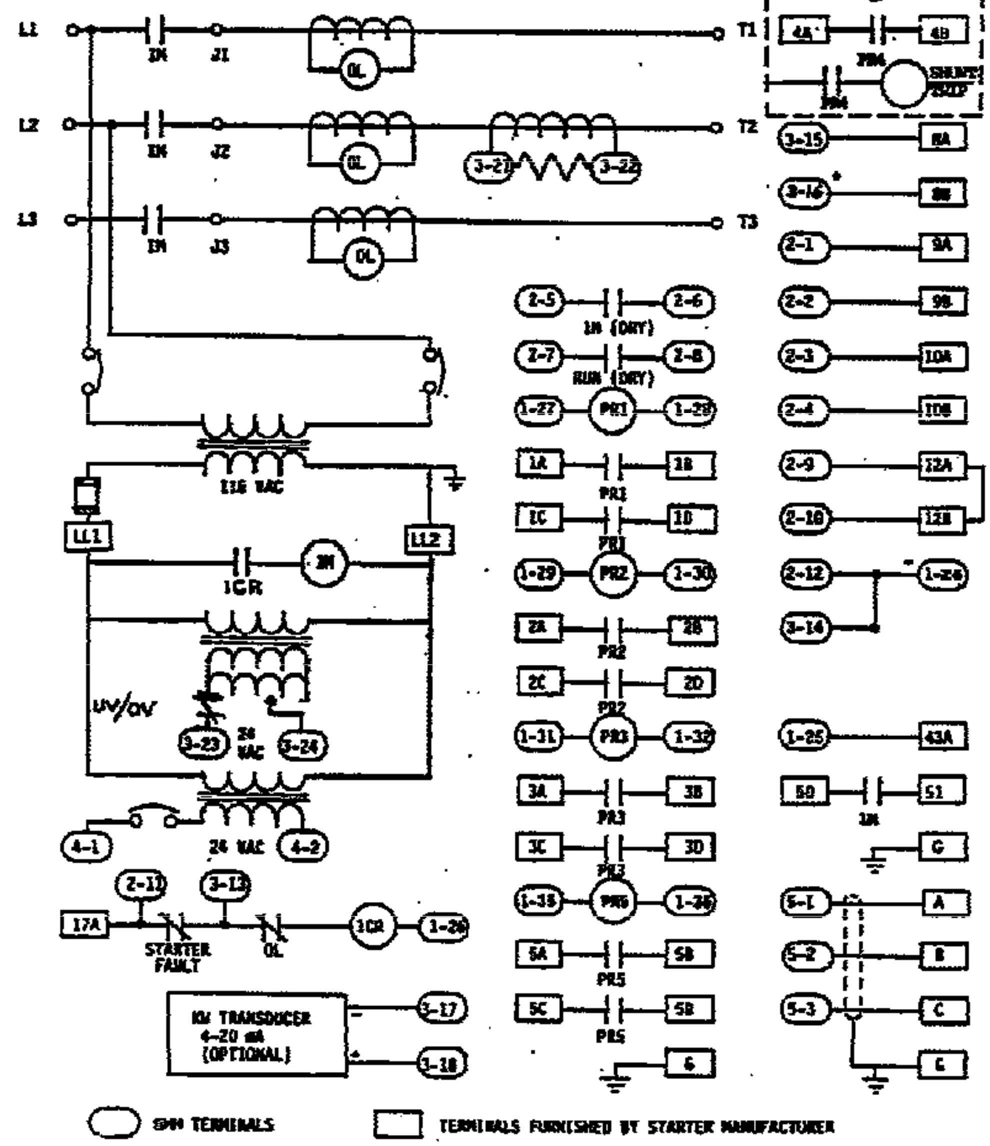
FIGURE 2
CONTROL SCHEMATIC
TYPICAL LOW VOLTAGE X-LINE STARTER
PIC CONTROLS



1. J1, J2 and J3 are locations for optional power factor correction capacitor terminals
2. Starter fault circuit to include contacts for all motor protective relays except for overvoltage and undervoltage.

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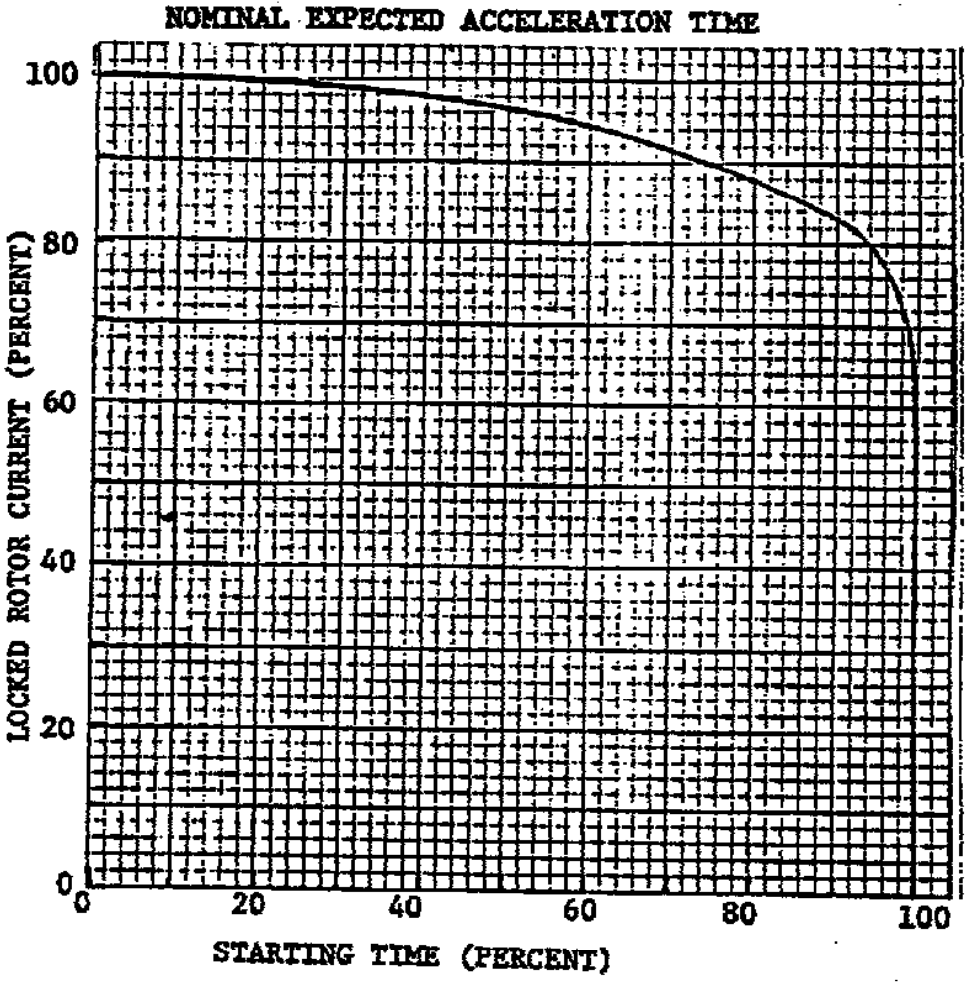
FIGURE 1



	STARTING TIME (SEC)	
% RATED VOLTS	17/19 DK, DM, DR, 19 , FA	19CB
100	5	7
80	9	12
65	12	17
58	15	25
100 IN Y	15	25

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TABLE 3.2.2 - STARTER SOFTWARE DOCUMENTATION FLOW

Order Confirmation and Hold for Approval Submittals

Description	Send To	No. of Copies	Within Weeks after P.O.
Acknowledgment copy of Carrier's Purchase Order	Field Purchasing Expediter, Syracuse	1	1
Transmittal Sheet	Field Purchasing Expediter, Syracuse	1	1
	Carrier Salesman Address per P.O.	1	1
Compressor Starter Outline Drawing	Carrier Salesman Address per P.O.	Per P.O.	Below 1 600 V (1)
Accessories & Modification Outlines	"	"	"
Schematic & Wiring Diagrams	"	"	"
Installation, Operation and Maintenance Instructions	"	"	"

Note: (1) 4 weeks are allowed for hold for approval submittals.

Final Submittal

All of the above information except for the acknowledgment copy of Carrier's purchase order is to be sent as indicated on the purchase order to the Carrier salesman at the time of starter shipment. In addition, one set is to be securely fastened to the starter.

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11 SPECIFIC CHILLER REQUIREMENTS

Requirements that are specific to the different 17 and 19 series refrigeration machines are detailed below. The chiller series and model number are the first 4 characters of the chiller model number.

Series		19		17	23
Type of Motor		Hermetic		Open	All
Models		DK,DM,DR, EF,FA, XL,XT,XR, XRT,EX	CB	DK,DM, DR,EX	XL
Locked Rotor Time for Motor Overload Calibration (Seconds) ± 20%	100% volts	10	20	10	10
	58% Volts or Y	45	90	30	45
Acceleration Timer Settings for Reduced) Voltage Starting (Sec)	Range	60	180	60	30
	Factory Setting	30	60	25	5

Note: (1) other percentages of reduced voltage starting methods should be limited to the same maximum time ratios as those shown.

12 ENGINEERING APPROVED MANUFACTURERS

12.1 The manufacturers listed below have experience in supplying starters which meets this specification.

Low Voltage	Medium Voltage	Solid State
Cutler Hammer	Cutler Hammer	Benshaw
Siemens	Siemens	
Allen Bradley	General Electric	
Square D	Square D	

12.2 Surge arresters are not required for medium voltage starters with vacuum contactors made by the companies listed below:

Cutler Hammer

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10.13 Starter Auxiliary Contacts

Installation additional normally open or normally closed auxiliary contact(s) on starter contactors, as specified, rated at least 10 amperes at 115VAC and wired to terminal blocks.

10.14 Watt Transducer

Watt transducer with 4 to 20 MA output proportional to motor KW. Transducer shall be sized for at least 110% of motor KW.

10.15 Modifications To Meet Special Codes

It shall be the manufacturer's responsibility to ascertain the requirements of, and ensure the starter includes any necessary accessories and/or modifications, in order to comply with any special codes and regulations specified on the order.

10.16 Miscellaneous

10.16.1 Indicating Light

Color red, labeled "run," installed on starter door, connect in parallel with 1CR relay coil or energize through an auxiliary contact on the run contactor.

10.16.2 Start Counter

Mount and wire a 5 or 6 digit counter to increment by one each time an auxiliary contact of 1CR closes or wire in parallel with 1CR coil.

10.16.3 Elapsed Time Meter

Install a 6 or more digit elapsed time meter powered from an auxiliary contact of 1CR or wired in parallel with the 1CR coil.

10.11.1.2 Install a 600V, three-phase, min. 15 amp circuit breaker in the main compressor motor starter enclosure. For dual starters, a circuit breaker must be used. Connect the disconnect in accordance with Section 4.11

10.11.2 Medium Voltage Starters

10.11.2.1 Install and wire a fusible disconnect or circuit breaker (as specified on the purchase order) in a separate NEMA 1 enclosure for field mounting. The disconnect shall be lockable in the open position.

10.11.2.2 Provide one medium voltage step-down transformer, including fusible disconnect on the primary and circuit breaker protection on the secondary. Provide fusible disconnect protection on the secondary if specified on the purchase order. Primary voltage to match the starter line voltage, secondary voltage as specified on the purchase order. Mount and wire in a separate NEMA 1 enclosure, or as specified on the purchase order.

If a non-load break-type primary disconnect is supplied, provide interlocking to ensure that the secondary is disconnected before the primary is opened. The disconnect shall be lockable in the open position. Provide line and load terminals suitable for the application.

10.12 Auxiliary Disconnect Devices

If an auxiliary disconnect device, such as for oil pump, control power or oil heater is ordered installed in the main starter enclosure, the device shall be installed such that the operating handle is within the main enclosure and not operable from the outside. The taps between the primary overcurrent protection and the power source must be less than ten feet long and must. have short circuit and overcurrent protection in each leg.

If main motor starter disconnect is not supplied, the auxiliary disconnect device shall be wired to the line side of the main motor starter. The disconnect device shall not be wired to the main motor starter load side.

The disconnect device must be a circuit breaker located to that it can be easily tripped without coming near any live metal parts and clearly identified as "control power disconnect," "oil pump disconnect" or "oil heater disconnect." A preferred location is eye level in the front portion of the enclosure. Any live metal parts on the circuit breaker must be shielded to prevent personal contact.

Connect the primary to the line side of the starter disconnect. Provide one 15 amp single pole circuit breaker for control power, LL1 and one 15 or 25 amp single pole circuit breaker for oil heater power, OH as specified. See Figure 6B.

10.8.2 Controls Plus Two Oil Heaters - 3.5 to 5 KVA (For Dual Starters)

An oil heater power supply may only be provided if the starter is equipped with a main disconnect, (except for chillers with PIC controls).

Connect the primary to the line side of the starter disconnect. Provide one 15 amp single pole circuit breaker for control power, LL1, one 15 amp single pole circuit breaker for compressor A oils heater, OHA and one 15 amp single pole circuit breaker for compressor B oil heater, OHB. See Figure 6C.

10.9 Power Factor Correction Capacitors

Three-phase power factor correction capacitors, complete with fuses in each ungrounded conductor, insulated terminals, and discharge resistor. For a dual starter, capacitors are to be provided for each motor. Capacitors are not to be connected between the load limit control signal current transformer and the motor terminals unless the capacitor leads are run back through the current transformer to cancel out the power factor current. Install in starter enclosure and connect at locations J1, J2 and J3. Capacitor KVAR ratings in the starter order are at the capacitor rated voltage.

10.10 Pumpout Unit Disconnect

Install a 600V, min. 15 amp, three-pole circuit breaker mounted in main compressor starter enclosure.

10.11 Oil Pump Starter and Disconnect

10.11.1 Low Voltage Starters

Install the following in the main compressor motor starter enclosure or in individual NEMA 1 enclosure, as specified on the purchase order:

10.11.1.1 Combination 600V, three-phase, automatic, full -voltage oil pump starter, including circuit breaker, motor contactor, three motor overload protection devices and auxiliary contact. See Figure 6E. Current ratings are to be as specified on the purchase order. Connect disconnect switch in accordance with Section 4.11.

Current or voltage sensing three-phase relay to detect phase loss and phase unbalance using the negative sequence principle. Manual or automatic reset normally closed contacts. Automatic reset after a 10 second minimum time delay. Calibrate relay to trip when voltage unbalance is more than 10%.

10.7 Chiller Control Packages

Install specified control within starter enclosure or in individual NEMA enclosure, as specified. These controls are for operation with the Carrier chiller control and are to be electrically separated from starter controls. Refer to schematic diagrams for control circuit details.

10.7.1 Pilot Relays

For 32SM and 32MP controls only, install one or more pilot relays (PR1, PR2, PR3, PR5) as specified on the order. When supplied for a dual starter, only one set shall be provided. See Figure 5.

10.7.2 Auxiliary Pilot Relay

Used for any applicable auxiliary control application specified. See Figure 6D (Note: X = 6,7,8 etc.).

10.7.3 Stop Switch

Used to stop the chiller from the starter. On starters without shunt trip provide a normally closed, maintained contact pushbutton switch, colored red in the starter door. The switch shall be a push-push or push-pull, maintained contact device. This device is to be wired in series with the overload contacts. This device is to be wired in series with the overload contacts. Voltage and current rating must be in accordance with 1CR pilot relay. If shunt trip is provided, a normally open, maintained contact pushbutton switch shall be provided to activate the shunt trip.

10.8 Control Transformer For More Than 3 KVA

When a control transformer is specified for greater than 3 KVA, the transformer is to be installed as specified in Section 4.11 or Section 5.4.3 and in accordance with the following requirements.

10.8.1 Controls Plus One Oil Heater - 3.5 or 5 KVA

An oil heater power supply may only be provided if the starter is equipped with a main disconnect, except for chillers with PIC controls.

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10.6 Motor Protective Relays

Relays under this heading may be provided individually or may be combined into a single relay where available. Relay contacts shall be connected in the starter fault circuit on PIC starter or as shown in Figure 2, 3 or 4. Contact ratings are specified in Section 5, 6 or 7.

10.6:1 Undervoltage Protection (UV)

Three-phase undervoltage relay complete with potential transformer (if needed) and having one contact which is closed under normal voltage conditions and opens at 85% volts or less after 5 seconds minimum. Automatic reset after a 10 second minimum time delay. See Figure 9.

10.6.2 Overvoltage Protection (OV)

Three-phase overvoltage relay complete with potential transformer (if needed) and having one contact which is closed under normal voltage conditions and opens at 115% volts or less after 5 seconds minimum. Automatic reset after a 10 second minimum time delay. See Figure 8.

10.6.3 Ground Fault Protection

Low level, ground fault relay instantaneous operation. Manual reset normally closed contacts, complete with current transformer.
The relay must be capable of being set to trip within the range of from 5 to 12 amps to ground.

The relay contacts are to be wired in the starter fault circuit on PIC starters or for other starters in series with the overload contacts. When a shunt trip molded case switch or circuit breaker is provided, the shunt trip circuit shall be activated by a separate contact. The current transformer should be located between the motor and any single phase loads such as the control power transformer which might create a transient current unbalance.

10.6.4 Phase Reversal Protection

Voltage or current sensing phase reversal (or phase rotation) relay, manual or automatic reset normally closed contacts which open on reversal of normal phase rotation as defined in Section 2.1. Automatic reset after a 10 second minimum time delay.

10.6.5 Phase Failure and Phase Unbalance Protection

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10.2 Enclosure

10.2.1 NEMA type 1A, 1,2,3,4 etc.
10.2.2 Special color paint (exterior only)
10.2.3 Special paint (exterior and interior)
10.2.4 Kirk key interlock or equivalent
10.2.5 Space Heater

10.3 Surge Protection

Surge protection capacitors and lightning arresters are to be installed on the line side of starter disconnect, unless otherwise specified.

10.4 Meters

Meters are to have a 1-1/2" minimum scale and be installed on the front door of starters. Install required current transformers and potential transformers with fuse protection of the appropriate accuracy and burden. Metering current transformers shall be installed on the load side of power factor correction capacitors so as to measure actual motor current.

10.4.1 Ammeter, single phase
10.4.2 Ammeter with three-phase, four position selector switch
10.4.3 Voltmeter, single phase
10.4.4 Voltmeter with three-phase, four position selector switch
10.4.5 Watthour meter, three-phase
10.4.6 Wattmeter, three-phase
10.4.7 Power factor meter (corrected PF when PFCC's are still installed)

10.5 Low Voltage Disconnect and Short Circuit Protection

Door-interlocked, externally gang-operated, three-pole main power disconnect means, including mechanical position indicator on enclosure exterior and short circuit protective means. Coordinate short circuit protection with motor overload protection. Provide a means of pad-locking the disconnect in the open position. Fuse and circuit breaker ratings must be derated as necessary to avoid premature trip based on the specified ambient temperature plus the temperature rise in the starter. Provide one of the following as specified on the purchase order:

10.5.1 Fusible, current rated molded case disconnect switch, capable of interrupting motor stalled current. Phase failure protection relay required.

10.5.2 Molded case circuit breaker with an instantaneous overcurrent element in each phase set for the maximum current allowed by code.

9.3.3 The control transformer or auxiliary disconnect such as oil pump disconnect, if provided, is to be connected to the buss and provided with overcurrent protection and a disconnect means in accordance with Section 10.12. For medium voltage, a control transformer may be provided for each side of the starter if relays are provided to maintain control power when either side of the starter is disconnected.

9.3.4 Additional options, where required in only a single section, shall be located in the section with the control transformer. Control connections between sections shall be factory wired.

9.4 Starter Designation and Labeling

The starter supplying motor A as marked on the starter requisition form shall be fixed with a nameplate designating it as Starter A. The starter supplying motor B shall be fixed with a nameplate designating it as Starter B. If the two motors are of unequal size, motor A will always be larger than motor B.

Suffix all terminal block connections, motor power connections, and components with the starter letter designation, except the components and terminals associated with relays PR1, PR2, PR3 and DLT(when supplied); the oil pump power connections (when supplied); and terminals LL1 and LL2.

The left hand or upper unit will be nameplated Starter A; the remaining unit will be nameplated Starter B.

10 OPTIONS

10.1 General

The optional equipment listed in this section is to be provided in the starter when specified. In the case of a dual starter, options such as ammeters and power factor correction capacitors which apply to individual motors shall be provided for each starter and options such as control power transformers and volt meters which apply to the chiller are to be provided in only one section of the starter.

Other options not mentioned here may be specified to meet customers specifications. In applying such modifications, the requirements and intent of this specification must still be met. In addition, prior approval by Carrier Product Engineering is required.

Options which require field control wiring shall be wired to terminal blocks in the low-voltage compartment. The terminal blocks shall be rated 10 amperes at 600 volts. Terminals shall be identified in accordance with the figures in the appendix.

8.8 Power Factor Correction Capacitors

If power factor correction capacitors are specified, they must be connected to the line side of a solid state starter and switched on using a contactor after the motor is up to speed and off before the motor is stopped.

8.9 Start-Up Service

Starter manufacturers other than those listed below must provide start-up service by factory trained personnel as part of the price of the starter.

Benshaw

9 DUAL STARTERS

Dual starters are intended to be used with dual compressor 17/19DR chillers.

9.1 Description

A dual starter consists of two starters mounted in a single enclosure or in two enclosures fastened together. Dual starters usually have the incoming line connections bussed together with cables so that only a single field power connection is required. Dual starters shall conform with the requirements of Sections 3, 4, 6 and 8.

9.2 Dual Starter - Unbussed

A dual starter may be ordered with separate line connections for each section.

9.3 Dual Starter - Bussed

When a dual starter is specified as bussed, the following requirements apply:

9.3.1 The line side of the starters shall be tied together such that only one set of incoming line connections are required to energize both starters. The common buss shall be braced and guarded or insulated copper suitable for the full load current requirements of both starters.

9.3.2 Individual branch circuit short circuit and ground fault protection and disconnecting means

The starter then rapidly increases the voltage to full voltage.

8.2.2 An alternative method of starting current regulation is to regulate the voltage so that the current is limited to a preset value. This current limit is adjustable from 150 to 300% of the OLT amps factory set to 208%.

Motor current regulating circuits must be designed so that there is no oscillation in motor current or torque at any time due to the action of the starter.

8.3 Overcurrent Protection

Motor overload protection must be provided in accordance with Section 4.9 even though the firing circuit may include inherent protection. Power semiconductors are to be protected with semiconductor fuses.

8.4 Fault Detection

The starter must include circuits which will detect shorter and/or open power semiconductors and will either open a manual reset isolation contactor or trip a circuit breaker of molded case switch within 1 second. This protection is to be operational any time that the solid state starting circuit is energized. This protection must not activate with current unbalance less than 20%. For PIC controls see Section 5.4.6.

8.5 Electromechanical Isolation

An isolation contactor which closes before the motor starts and opens after the motor is stopped may be provided if specified.

If a load break isolation contactor is provided, it may be utilized for electromechanical isolation (auto reset), as well as a means of disconnecting the starter in the event that a fault is detected (manual reset).

8.6 Bypass Contactor

A contactor which bypasses the SCR's may be provided, if specified. This contactor closes after the motor is fully started and opens prior to stopping the motor.

8.7 Energy Saving Control Systems

Energy saver control systems which operate by reducing motor voltage at reduced load shall not be used. These systems adversely affect certain chiller control systems.

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7.3 Relay Coil and Contact Ratings

Relay contactor coiled and contacts which interface with the chiller control must operate reliably under the following conditions:

Coil Requirements

Devices	Nom. Voltage	Min. Pick-Up Voltage	Max. Inrush Current	Max. Sealed Current
1CR Oil Pump Starter Pilot Relays	115 VAC	95 VAC	1.3A	.45 A

Contact Requirements

Devices	Term No	Nom Voltage	Min. Voltage	Max. Current
1CR	15	115 VAC	95 VAC	5 A
Run Contactor Aux.	18			
Overload	17			

8 SOLID STATE STARTERS

8.1 General

Solid state starters may be used in applications up to 600 volts. Solid state starters are to comply with all provisions of Z-375 unless specified otherwise in this section.

8.2 Starting Current Regulation

8.2.1 The preferred method of starting current regulation is voltage ramp.

The starter rapidly applies an initial voltage step to prevent unnecessary energy input prior to motor rotation. This step is adjustable from 0 to 100%., factory set at 45%.

The starter then increased voltage linearly with time until the current falls off rapidly indicating that the motor is up to speed. This ramp time is adjustable from 2 to 60 seconds, factory set at 20 seconds.

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6 REQUIREMENTS FOR CHILLERS WITH 32MP CONTROLS

6.1 Application

This Section applies only to chillers which have 32MP micro-processor based controls. These controls are used on all 17DK, 17DM, 17DR, 19DK, 19 DM and 19DR new production chillers.

6.2 Chiller-Starter Interface Schematic

Figure 3 shows the basic chiller-starter interface for a full-voltage starter. All types of starters shall have the same basic interface.

6.3 Relay Coil and Contact Ratings

Relay and contactor coils and contacts which interface with the chiller control must operate reliably under the following conditions:

Coil Requirements

Devices	Nom. Voltage	Min. Pick-Up Voltage	Max. Inrush Current	Max. Sealed Current	Must Drop-Out Volts/Amps
1CR Oil Pump Starter	115 VAC	95 VAC	1.3 A	.45 A	15 MA @ 115 VAC
Pilot Relays	115 VAC	95 VAC	3.5 A 100 MS	.45A	15 MA @ 115 VAC

7 REQUIREMENTS FOR CHILLERS WITH 32SM CONTROLS

7.1 Application

This section applies only to chillers which have 32SM solid state controls or pneumatic controls. These controls are rarely used, the starter order must specify 32SM controls if applicable.

7.2 Chiller-Starter Interface Schematic

Figure 4 shows the basic chiller-starter interface for a full-voltage starter. All types of starters shall have the same basic interface.

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5.4.3 Control Power Transformer

Provide a 1, 2 or 3 KVA control power transformer. Fuse the transformer secondary at 15, 20 or 30 amps respectively. Connect the primary to the load side of the control power circuit breaker. Unless specified otherwise, use the following to determine transformer size. 23XL (1KVA). 19XL, 19XT and 19EX (2KVA). 19XR, 19XRT and 17EX (3KVA).

5.4.4 SMM Control Power Transformer and Circuit Breaker

Provide a 24 V, 40 VA control power transformer and 3 amp circuit breaker to power the starter management module as shown on Figure 2.

Note: The starter management module with instructions may be ordered as package P/N 19XB04004101.

5.4.5 Potential Transformer

Provide a potential transformer (separate from the SMM control power transformer) with a 5 watt trim potentiometer adjusted for 24 +1.0/-0.0 VAC output at motor rated voltage. Connect as shown on Figure 2.

5.4.6 Pilot Relays

Provide 4 pilot relays and connect as shown on Figure 2. Coil and contact ratings are specified in Section 5.3.

Whenever a shunt trip breaker or disconnect is specified, provide a pilot relay PR4. Connect normally open contact to activate shunt trip coil.

5.4.7 Oil Pump Circuit Breaker (Optional)

For low voltage starters, provide one 15 amp, 3 phase circuit breaker connected to the line side of the starter disconnect or to the main line lugs if no disconnect is provided. Connect the load side of the breaker to terminals labeled 0S1, 0S2 and 0S3.

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5.3 Relay and Contact Ratings

Relay and contactor coils and contacts which interface with the chiller control must operate reliably under the following conditions

Coil Requirements

Devices	Nom. Voltage	Min. Pick-Up Voltage	Max. Inrush Current	Max. Sealed Current	Must Drop-Out Amps/Volts
1CR Pilot Relays	24 VDC	18 VDC	60 MA	60 MA	10 MA @ 24 VDC

Contact Requirements

Devices	Nom Voltage	Min. Voltage	Max. Current	Min. Current
1M Contactor Aux (for smm input)	24 VDC	18 VDC	2 MA	.5 MA
Run Contactor Aux. Overload Protection Relays Stop Button	24 VDC	18 VDC	60 MA	10 MA @ 24 VDC
1M Contactor Aux. (for terms 50 & 51)	24 VAC	18 VAC	2.0 A	.4 A
Pilot Relays	115/600 VAC		10/3 A	.5/ .1A

5.4 Additional Standard Components

5.4.1 Starter Management Module (SMM)

Provide a starter management module, Carrier Part No. CES0121319, located at least 1 foot from all main motor conductors and contactors and wired as shown on Figure 2.

For all starters going to European common market countries, install an electromagnet shield per Carrier drawing 19XB05011301 over the SMM.

5.4.2 Control Power Circuit Breaker

Provide one 2-pole, 15 amp circuit breaker connected to the line side of the starter disconnect or to the main line lugs if no disconnect is provided.

For all solid state starters, the following warning label must be applied to the outside of the front door of the starter unless an isolation contactor is provide:

"Danger Electric Shock Hazard High voltage is at load side terminals and motor terminals when starter is turned off. Disconnect main power before servicing equipment.

4.14 Phase/Ground Current Relay

Provide a phase/ground current relay (P.N. HK35AC001), for all low voltage 19XL/XT/XR/XRT and 23XL chillers with motor KVA < 250. Connect relay T1 and T2 terminals to 4-1 and 4-2 24 volt AC. Connect the N.C. relay output in series with the starter fault contact between 2-11 and 3-13. Connect the current transformer leads to the relay in accordance with the color code, red or black. Locate the CT's in the bottom of the starter protected against shipping damage.

5 REQUIREMENTS FOR CHILLERS WITH PRODUCT INTEGRATED CONTROLS

5.1 Application

This section applies only to chillers which have product integrated controls. These controls are used for all 19XL, 19XT, 19XR, 19XRT, 19EX, 17EX

5.2 Chiller-Starter Interface Schematic

The chiller-starter interface schematic is shown on Figure 2.

Carrier drawing no. 19XB05003001 is to be incorporated into the starter manufacturer's schematic per Section 4.13.

Special internal wire numbers necessarily assigned by starter manufacturer shall be coded so as to be easily distinguishable from Carrier assigned numbers.

Install UL/CUL, ETL, CSA or other agency label on recognized or listed starters if specified.

Affix a label adjacent to all 120 volt field wiring terminal strips stating: "Danger! Electrical shock hazard due to back-feeding of voltage through control power transformer. Do not connect 120 V power to this starter."

If a phase ground current relay is provided in a floor mount starter, affix a label per Figure 10 to show proper routing of motor leads though the current transformers.

Affix a label in prominent position stating:

"Important: The field wiring terminal connectors supplied on this controller are suitable for use with copper conductors only. If user/installer elects to use aluminum conductors, the sole responsibility for adequate termination is his own. Successful use of aluminum requires special care and maintenance and falls beyond the scope of normal equipment warranties."

Affix label near overload relays stating:

"This overload is factory set and shall not be adjusted."

Label each end or color code all conductors. All conductors which can be above 50 volts when the main disconnect is open shall be colored solid yellow. Neutral conductors shall be white. Ground conductors shall be green.

Affix a label inside the starter door providing the name and phone number of the person to call in the event that service is required. The name is not required if the number is for a warranty administration or customer service department.

One of the following warning labels or its equivalent must be applied to the outside of the front door of the starter. If a starter disconnect is supplied, the label shall be adjacent to the handle of the disconnect. For dual starters, the label must be located adjacent to each disconnect handle.

4.13.1 No Starter Disconnect Provided

"Danger Electric shock hazard Open all remote disconnects before servicing this equipment."

4.13.2 Starter Disconnect Provided

"Danger Electric Shock Hazard This disconnect may not de-energize all internal circuits. Open all internal and remote disconnects including the control power and/or oil heater and/or oil pump disconnects before servicing this equipment.

Install one 2 KVA, 115 volt, single phase double-wound, dry type, continuously rated transformer. Connect the primary to the load side of the starter disconnect or the main line lugs if no disconnect is provided. Connect the transformer primary in accordance with Figure 6A and provide fuses to protect each primary leg. Provide one 15 amp secondary fuse. The transformer secondary must be grounded. When starters use 115V contactor and relay coils, 0.4 KVA of the specified KVA may be used for starter control.

On starters above 600V having provision for separate 115 V control test supply, provide interlocking to ensure that control transformer 115V terminals can not become energized from the test supply to avoid energizing the medium voltage side of the control transformer.

4.12 Control Components

Provide control components in accordance with diagrams and/or to perform all necessary functions.

No contacts are allowed in the grounded neutral side of the contactor. Relay coils or other devices.

Control relays, 300V rated contacts for 115V circuits, quantity and type as required.

Industrial or heavy duty pushbutton switches, indicating lights, control switches mounted on front of enclosure.

4.13 Identification

All identification shall be clearly legible and permanent.

Provide safety warning label(s) to meet applicable codes.

Affix a label stating: "This equipment conforms with Carrier Engineering Requirement Z-375.

Permanently attach a copy of detailed schematic and wiring diagram(s) to inside of control enclosure front door or some other accessible internal surface, or enclose in transparent film. Drawing shall be of best quality reproduction, good definition, non-fadeable, easy to read and absolutely legible. A basic schematic plus options sheets may be used as long as included options are clearly identified.

Permanently identify all components and terminals corresponding to drawings. Component identification must be attached to a nonremovable, unobstructed surface.

4.9 Starter Overload Protection

Install a three phase solid state overload to protect the motor during both start and run. The ultimate trip and locked rotor currents are specified on the order.

Unless approved by Engineering, only the following overloads may be used:

Furnas Model 948L108939

This overload must be calibrated in accordance with Carrier Service Bulletin C9015. The overload adjusting knobs are to be placed in a small bag tied to the overload.

Extreme care must be taken to account for the actual current being sensed by the overload versus the true motor line current as specified on the order, i.e.: phase versus line and the effect of power factor correction capacitors.

4.10 Load Limit Control Signal

Provide a 0.5 ± 0.1 volt load limit control signal proportional to motor current, i.e.: 0.0 volts at 0.5 volts at rated load amps for the compressor motor. Connect the voltage signal to terminals as indicated in Figures 2, 3 or 4 using a shielded twisted pair cable with the shield grounded.

If a current transformer and signal resistor combination is used for this purpose, the circuitry must be made continuous and permanent to avoid the possibility of open-circuit current transformer voltage.

If a system other than a current transformer and signal resistor is used to generate this signal, prior approval by Carrier is required.

The current sensed may not be influenced by power factor correction capacitors. If capacitors are used, they must be connected ahead of the current sensing or the capacitor leads must be routed back through the current transformers.

4.11 Control Transformer and Disconnect

4.11.1 General

Control transformer for chillers with product integrated controls is specified in Section 5.4.4

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4.8 Contactors

Contactors shall be air break, continuously rated, magnetic contactors, with ARC extinguishing devices mechanical interlocks and auxiliary contacts. Oil immersed contactors may be used when specified.

For starters for product integrated controls, contactor coils must have noise suppression which maintains transient voltage below 300 volts glow discharge.

Contactors rated above 600 volts shall have interrupting capacity to meet the requirements for ANSI/NEMA standard ICS class E2 controllers with fuses properly coordinated with the motor overload trip settings.

Vacuum contactors must not generate injurious voltage surges due to current chopping or multiple reignition. Manufacturers who are not listed in Section 12.2 must provide surge arresters on the load side of vacuum contactors. Vacuum contactors must operate safely if vacuum is lost.

Vacuum circuit breakers shall not be used in place of contactors.

Auxiliary contact ratings are specified in Sections 5, 6 and 7.

Include 1 (two for product integrated controls) normally open interlock contact on the main contactor of full-voltage starters and on the run contactor of Wye-Delta type starters connected as shown in Figure 2, 3 or 4. This contact must remain closed if the main contactor contacts weld.

For reduced voltage starters where welded start contactor contacts would prevent stopping the motor, include normally open interlock contacts on both the run contactor and the start contactor and a pilot relay. Contact output must be maintained if either the main contactor or the start contactor contacts weld. See Figure 7. Not required for product integrated control chillers.

For solid state starters, the up to speed contact must close and remain closed whenever full voltage is applied to at least two phases of the motor. This contact must remain open at all other times.

disconnect switch with any medium-voltage compartment door open and to prevent operating the disconnect switch while the medium-voltage contactors are closed.

4.5 Power Connections

Lugs for line and load power connections must be located to provide adequate clearance for easy connection of cables for either top or bottom entry. Entry location per job order. Terminals and lugs must be UL or ETL listed for use with copper conductors. A ground lug and lugs for line and load connections must be provided. All lugs must be sized for cables selected per the NEC for 75 wiring material. Provide multiple lugs per phase if required.

4.6 Control Connections

Terminal blocks required for customer connections must be permanently and clearly identified to match schematic and wiring diagrams.

Allow adequate clearance for easy connection of field wiring.

Include a field wiring terminal block which provides all terminals called for on Figure 2, 3 or 4 for basic starter, and those required for specified modifications, separated and identified by voltage and arranged in numerical sequence.

Use screw clamp pressure plate terminals rated for at least 10A, and for at least line voltage or 600 volts for medium voltage starters. Class 1 wire size is 14 AWG.

Keep all internal panel wiring on one side of terminal block. Opposite side shall be used exclusively for field conductors.

Do not connect more than three wires per terminal, add extra blocks and factory formed jumpers to obtain required accommodation.

4.7 Conductors

Provide continuously rated copper main conductors. Conductors must be properly designed for at least the basic starter withstand short circuit current, (5,000 amps symmetrical for size 3, 10,000 amps symmetrical for sizes 4 and 5 and 30,000 amps symmetrical for sizes 6 and 7) or for the interrupting capacity specified. All control and power cable is to be stranded copper, 16 AWG minimum size type THNN, THWN MTW or equivalent.

Conductors carrying 30V or less shall be separated from higher voltage conductors. They shall not be located in the same bundle or raceway.

Transition shall be current or time controlled. Times are indicated in Section 11. Current controlled transition when amps < RLA.

4.1.4 Solid State Starters- Shall have open/shorted SCR protection and shall operate at rated frequency +1/-4 Hz.

4.2 Starting Requirements

The motor starter is remotely controlled by the chiller control to ensure that compressor inlet vanes are closed before motor can be started, thus imposing minimum starting load.

Typical percent locked rotor current versus time is shown in Figure 1.

Provide a pilot relay, 1CR, which initiates the start sequence when energized by the chiller control. 1CR coil and contact ratings are specified in Sections 5, 6 and 7. Other loads may be connected in parallel with the 1CR relay and coil as long as the total electrical load does not exceed the specified limit.

4.3 Ampere Rating

The starter manufacturer shall verify that starter rating is suitable for motor load and locked-rotor amperes specified. If an improper size starter is specified, the manufacturer shall notify Carrier and defer further action pending receipt of official change notice.

4.4 Enclosure

Floor mounted, sheet steel NEMA type 1 enclosure, hinged front interlocked access door(s), provision for base mounting, free standing, formed, welded, bolted, and braced into rigid self-supporting structure, accommodating all basic starter equipment, accessories, and modifications, all completely factory installed, wired, and connected.

Doors must be lockable in the closed position.

Plate or paint latches, handles, and all other cabinet hardware to prevent corrosion from humidity and exposure to normal industrial environments.

All metal surfaces, inside and out, to be phosphatized, or cleaned and primed with a suitable corrosion inhibitor, finish enamel top coat or equivalent.

Starters rated above 600 volts shall have a separate compartment for the low-voltage control components. For the medium-voltage contactors and components, and for the medium-voltage disconnect and HIC fuse components. Access doors to these compartments shall be electrically and mechanically interlocked as needed to prevent opening or closing the

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4 GENERAL STARTING EQUIPMENT

4.1 Description

Alternating current, magnetic, air break or vacuum contactor, or solid state (semiconductor) induction motor. Options are full voltage, reduced voltage or Wye-Delta.

4.1.1 Full Voltage

4.1.2 Reduced Voltage

All reduced voltage starters shall be closed-circuit transition.

Contactors shall be electrically interlocked so that the whole starting impedance must be inserted in the motor circuit before the line contactor can be closed.

Transition shall be current or time controlled. Times are indicated in Section 11. Current controlled transition when amps < RLA.

4.1.2.1 Primary resistance- Three-phase, unbreakable metallic resistors for reduced voltage motor starting with taps at 65% and 80% volts. Factory connection to 65% tap.

4.1.2.2 Primary Reactor- Three-phase air-cooled auto-transformer for reduced voltage motor starting with taps at 65% and 80% volts. medium service. Factory connection to 65% taps.

4.1.2.3 Auto-transformer- Three-phase, air-cooled auto-transformer for reduced voltage motor starting with taps at 65% and 80% volts. Medium duty service, factory connection to 65% tap.

Note: Label or tag 50% tap (if supplied), of resistors, reactors or auto-transformers, "Do not use 50% tap without consulting Carrier Corporation."

4.1.3 Wye-Delta

All Wye-Delta starters shall be closed circuit transition type having unbreakable metallic transition resistors in each phase. Incomplete transition protection which will protect the resistors from overheating and disable the starter must be provided.

Mechanically and electrically interlock line and Wye contactors to prevent simultaneous closure that could result in line-to-line fault.

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3.4 Materials and Workmanship

Use only new materials. Appearance must be neat and orderly

3.5 Reliability

System Reliability-	As Shipped-	99.9%
	First 100 Operating Hours-	98.0%
	First 3600 Operating Hours	93.0%
	First 15 Years	90.0
Component Reliability-	First 3600 Operating Hours-	99.8%

Reliability Requirement assumes scheduled maintenance as recommended by the manufacturer. The typical starter operates 3600 hours/year.

Minimum number of starts is 20,000 with a nominal 15-minute interval between starts. (15 minute start to start interval control provided by Carrier controls. Minimum interval between starts can be 2 minutes with manual override of controls).

3.6 Ambient Operating Conditions

Temperature 40 F to 104 F (5 C to 40 C)

This is the temperature of the space in which the starter is located. The maximum temperature inside the starter is 40 C plus the temperature rise of the starter.

Relative Humidity	0% min., 98% max.
Location Elevation Low Voltage	6000 ft. (1800 m) max.
High/Medium Voltage	3300 ft. (1000 m) max.

3.7 Shipping and Storage Conditions

Temperature	-40 F to 140 F (-40 C to 60 C)
Relative Humidity	10% min., 100% max.
Packaging	Starter shall be adequately packaged to provide protection from short term exposure to the elements, six months of unheated storage, shipping damage, dirt and moisture.

(3) Price Discrepancies
(4) Exceptions to any terms and conditions of order

(B) Transmittal Sheet

Transmittal sheet reflecting job name, job number, Carrier order number, manufacturer reference number, location of the manufacturer's service/sales office nearest the destination point (including contact name and phone number), and bill of material of all equipment, accessories and modifications included in order.

(C) Compressor Starter Outline Drawing Including:

(1) Overall dimensions
(2) Approximate power and control conduit and raceway connection locations.
(3) Minimum service clearance requirements.
(4) Applicable lug sizes to be provided.
(5) Volt ampere rating for control transformers. This rating may be indicated on the starter
(6) Short circuit interrupt rating

(D) For accessories not installed within the compressor starter enclosure, corresponding outline drawings containing similar information, as well as how shipped and where to be installed.

3.2.2.2 Hold for Approval Submittal

(A) Transmittal Sheet
(B) Certified Dimension Drawings
(C) Schematic and Wiring Diagrams

3.2.2.3 Final Submittals

This certified submittal shall include:

(A) All Documentation under 3.2.2.2
(B) Installation, operation and maintenance instructions.

3.3 Quality

All starters shall be given a complete no-load test prior to shipment

Starters shall be audited either at Carrier or manufacturer's plant. Upon request, ship starter to Carrier at Syracuse, New York, en-route to job site.

3.2.1.3 Chiller Model and control designation

3.2.1.4 Motor data

(A) Compressor motor voltage and frequency.
(B) Compressor motor, rated load, amps, overload trip and locked-rotor amperes. (For Wye-Delta starters, locked-rotor amperes for both Wye and Delta).
(C) (If applicable) Motor power factor correction capacitor rating and corresponding nominal voltage.
(D) (If applicable)) Oil pump motor voltage.
(E) (If applicable) Pumpout unit motor voltage.

3.2.1.5 Starter data

(A) Starter type (e.g., solid state, full-voltage, auto-transformer, Wye-delta, primary reactor).
(B) Location elevation; for medium and high voltage if over 3300 ft. (1000m) above sea level. For low voltage if over 6000 ft. (1800 m) above seal level.
(C) Starter configuration (e.g., single or dual)

3.2.1.6 Ambient Conditions

(A) Ambient temperature, if over 104°F (40 C)
(B) Location elevation; for medium and high voltage if over 3300 ft. (1000 m) above sea level. For low voltage if over 600 ft (1800 m) above sea level
(C) Special environmental conditions.

3.2.1.7 Options

Carrier designations for options

3.2.2 Order Confirmation and Submittal Data

The type, quantity and distribution of documents shall be as specified in Table 3.2.2

3.2.2.1 Order confirmation. This shall consist of:

(A) Acknowledgment copy of Carrier's purchase order reflecting

(1) Information under 3.2.1
(2) Promised ship date.

2.3 Non-Standard Equipment

Prior approval by Carrier Engineering is required on a per job basis, for equipment not in accordance with or described in these requirements.

3 GENERAL

3.1 Standards

Standards shall be constructed to comply with the latest editions of the following standards applicable at the time of shipment.

3.1.1 ANSI/NEMA standards publication, industrial controls and systems, pub. no. ICS 1,2,3,4,6, UL Standard 508.
3.1.2 Other applicable codes specified on the purchase order.
3.1.3 All starters shall be suitable for installation in accordance with the national electric code ANSI/NFPA 70 or, in Canada, the Canadian Electrical Code.

3.2 Documentation

3.2.1 Order Information
Orders from Carrier to the manufacturer will include the following information:

3.2.1.1 Job data
(A) Carrier job number, name, ship to address and mark for.
(B) When applicable, reference to customer specification and/or manufacturer quotation number.
(C) Required manufacturer shipment date.
(D) Carrier salesperson's name and address.
(E) Special documentation requirements
(F) Bill of materials, including the starter and all options.

3.2.1.2 Specification and special codes
(A) This equipment shall comply with the latest edition of Carrier Engineering Requirement Z-375.
(B) (Only if applicable) This equipment shall comply with (name and number of national codes) applicable on the delivery date of the equipment.
(C) (Only if applicable) This equipment shall comply with (name and number of local codes) applicable on the delivery date of the equipment.

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1 PURPOSE AND USE

This engineering requirement provides information and data needed to design, build, and apply motor starting equipment for Carrier chillers with centrifugal and screw compressors.

In general, all new production chillers (19XL, 19XT,19XR, 19XRT, 19EX, 17EX, and 23XL) have product integrated controls (PIC) Requirements for starters used with these controls are specified in Section 5 of Z-375.

In general, chillers built prior to 1992 (17/19DK/DM/DR) have 32MP controls. Special requirements for starters used with these controls are specified in section 6 of Z-375.

In general, chillers built prior to 1985 had 32SM controls. Special requirements for starters used with these controls are specified in Section 7 of Z-375.

It should not be assumed that a chiller has 32MP or 32SM controls unless the starter order so specifies.

2 APPLICATION

2.1 Compressor Motors

Motors to be started and controlled are 50/60 Hz three-phase squirrel cage induction motors driving centrifugal and screw refrigeration compressors. With a power supply phase rotation A-B-C, motors rotate in the proper direction when phase A is connected to T1, phase B is connected to T2 and phase C is connected to T3.

2.2 Starting Methods

Allowable 17 and 19 series starting methods for squirrel cage induction motor-starter combinations:

Model Series	Motor Voltage	No. of Motor Leads	Full Voltage	Wye-Delta	Auto Xfmr	Prim. Reactor	Prim. Res.	Solid State
19,23 (Hermetic)	Under 600V	6	Yes	Yes	Yes	Yes	Yes	Yes
	2400V for BX, BY, XX sizes	6	Yes	Yes	Yes	Yes	Yes	No
	2300V to 6900V	3	Yes	No (#)	Yes	Yes	Yes	Yes
17 (open)	2300V to 7300V	3	Yes	No	Yes	Yes	Yes	No (#)

May be approved on a per job basis. Prior approval by Carrier Engineering is required.

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UNITED TECHNOLOGIES CARRIER
P.O. Box 4808
Carrier Parkway
Syracuse, New York 13221

DOC. NO.	
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Engineering Requirement

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APPROVED BY / DATE	QUALIFICATION APPROVAL / DATE	AUTHORIZATION NO.	REVISION
Mount/Holmes 6/11/96	N/A	996257KD	A

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	RELEASED

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