Graham

Installation, Operation and Maintenance Manual

AC Adjustable Frequency Drive

Model 1576 7.5 through 300 HP

1/95

For parts, service and technical assistance during
normal working hours, call 414-355-8800
For technical assistance only after hours, call 414-964-5782

23-6375-00

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SECTION ONE — INSTALLATION MANUAL

GENERAL

This instruction and service manual provides the necessary installation, adjustment and maintenance procedures for the 7.5 through 300 horsepower Graham Model 1576 adjustable frequency drive. Since these instructions are general, problems may occur which are beyond the scope of the manual. If further information is desired, please contact Graham Company for assistance.

Although every precaution has been taken in the design of the drive to ensure reliability under extreme operating conditions, it is possible to damage the equipment through misuse or misapplication. Therefore, this instruction manual should be carefully reviewed before installing and operating the equipment.

RECEIPT OF SHIPMENT

When the drive is received, it should be compared with the packing slip to ensure that everything is received. Any damages or shortages which are evident should be reported immediately to the commercial carrier who transported the drive. If necessary, contact Graham for assistance, referring to the order number, equipment description and serial number.

STORAGE

For long periods of storage, the drive should be covered to prevent corrosion. It should be stored in a clean, dry location and should be checked periodically to ensure that no condensation has accumulated. After storage, again check that it is dry before applying power.

Some of the electrolytic capacitors used in the drive are subject to the relaxation of an internal formed oxide film after long periods of storage and may require reforming prior to applying power. If the drive has been stored for over 18 months, Graham should be contacted for a determination as to whether a reforming procedure is necessary.

HANDLING

Care should be used to prevent damage due to dropping or jolting when moving the drive. The 7.5 - 50 HP drives have lifting eyes at the top of the back panel. Use hooks or clevis pins thru the lifting eyes. Do not attempt to lift from the bottom of the enclosure.

The 60 - 300 HP drives have lifting eyes at the top of the enclosure. Use hooks or clevis pins thru the lifting eyes. The base of the enclosure is offset 1.63 inches from the floor to allow for a fork lift to lift the enclosure from the bottom.

1 INSTALLATION

1.1 MOUNTING

The 7.5 - 50 HP drives are designed to be wall mounted. If they must be floor mounted, a floor stand utilizing Unistrut components can be supplied. Assemble the base struts to the vertical rectangular section struts using the support brackets supplied. Attach the drive to the vertical rectangular section struts using the spring loaded fasteners provided.
The following clearances are minimums:

Floor to bottom of drive (recommended)	30"
Right side (fuse access)	12"
Left side	2"
Top (conduit entry)	As Required
Front (door swing)	33"
Back	None

Conduit must enter the drive thru the top plate. Sufficient clearance must be allowed.

The 60 - 300 HP drives are designed to be floor mounted. The following clearances are minimums:

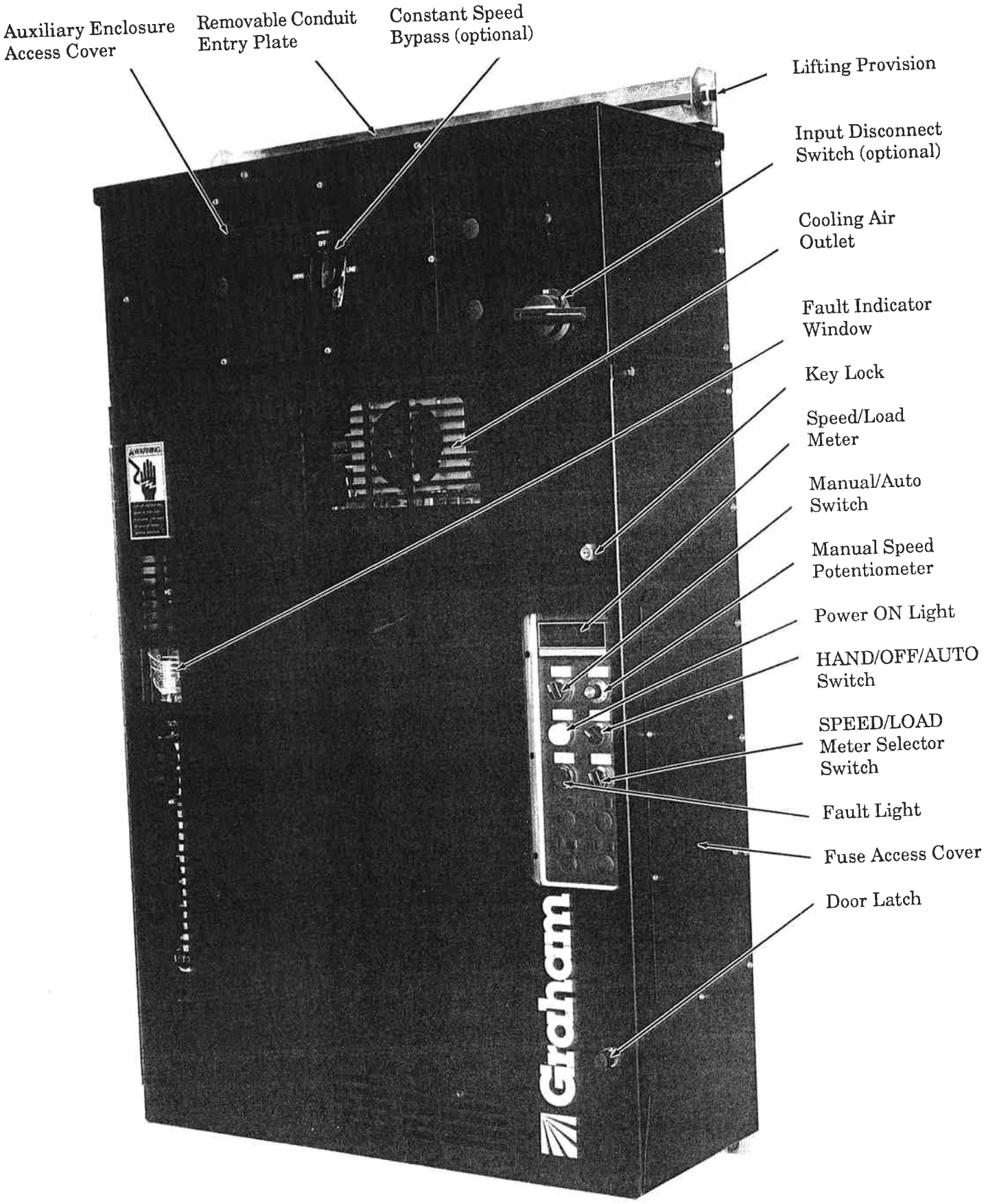
Right side	2"
Left side	2"
Top (conduit entry)	As Required
Front (door swing)	44"
Back	None

The drive is designed for top conduit entry. Sufficient clearance must be allowed.

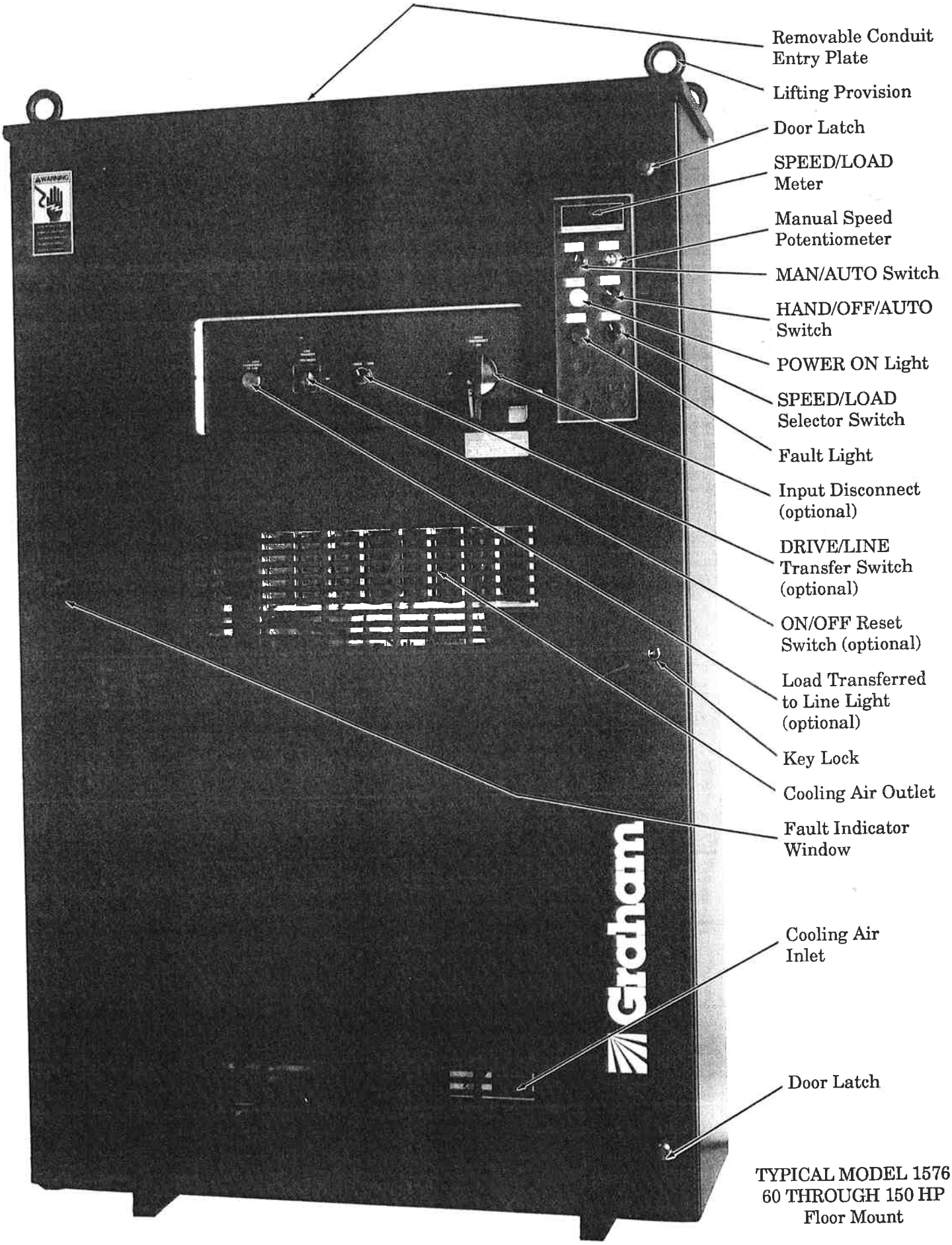
Do not remove the enclosure or the conduit entry plate while mounting the drive. They protect the drive from possible damage during mounting.

1.2 TEMPERATURE AND VENTILATION

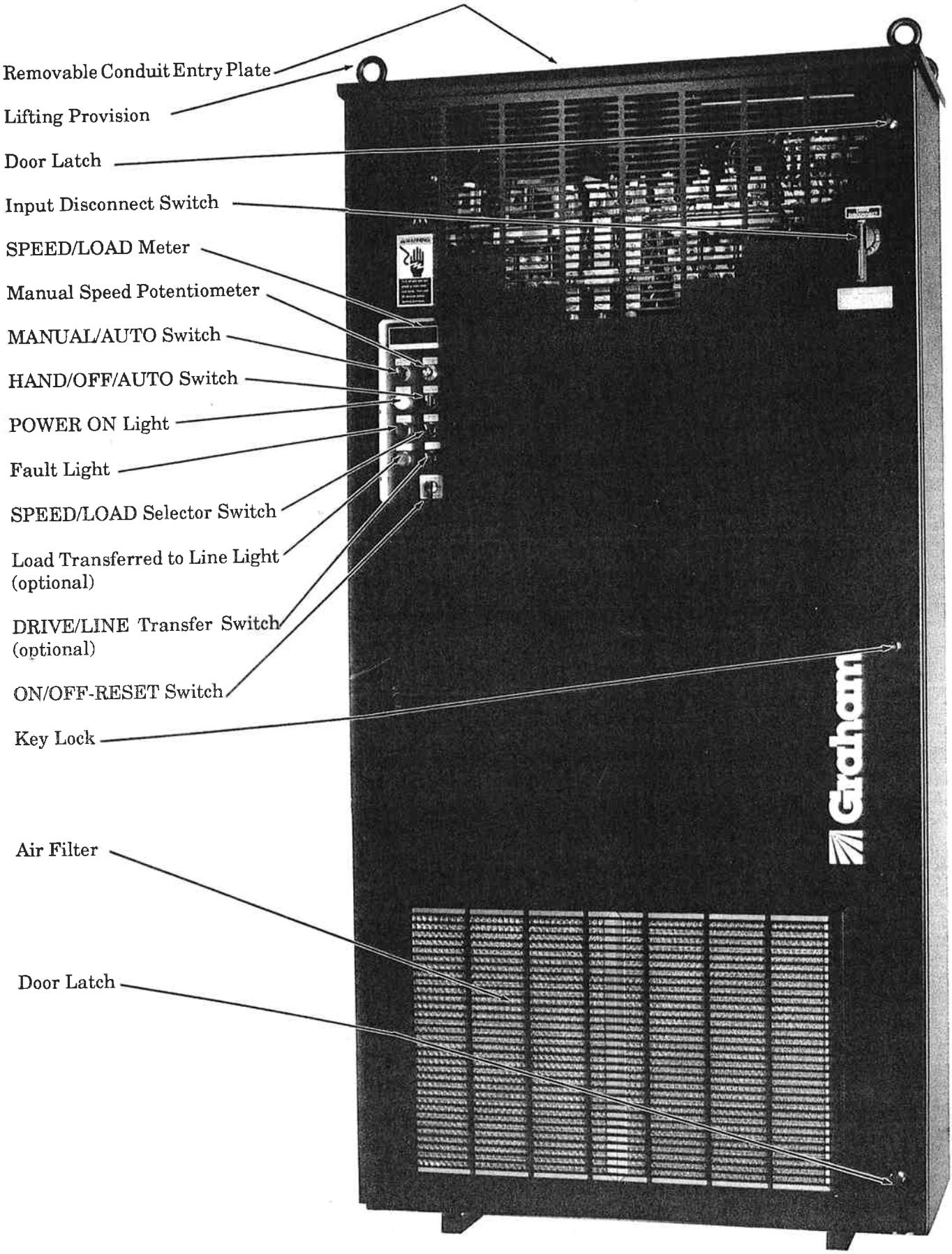
All electronic equipment is susceptible to failure if operated in ambient temperatures outside of its rating. For the Graham drive, the operating range is 0° C (32° F) to 40° C (104° F). Normally, the drive should not be operated outside these extremes. If it is known that the ambient will be below 0° C, Graham should be



TYPICAL MODEL 1576 THROUGH 50 HP
Wall Mount



TYPICAL MODEL 1576
60 THROUGH 150 HP
Floor Mount



TYPICAL MODEL 1576 175 THROUGH 300 HP
Floor Mount

notified so that special precautions can be taken, such as adding a space heater within the enclosure. Conversely, if the ambient is known to exceed 40 degrees C, extra cooling will have to be added.

The drive is cooled by fans drawing air through the slots. The slots must never be restricted in any way.

⚠DANGER

FLAMMABLE MATERIALS MUST BE KEPT AWAY FROM ALL OPENINGS IN THE ENCLOSURE.

The drive must be installed in a clean, dry environment. Periodically, the drive should be opened after shutting off the input disconnect. Any accumulation of dust should be carefully removed from the heatsinks with a vacuum cleaner and a soft long bristled brush. Lightly brush the dust from the drive components with the brush and use the vacuum cleaner to remove the dust as it falls.

⚠DANGER

DO NOT USE THE VACUUM CLEANER DIRECTLY ON THE ELECTRONIC COMPONENTS. ALWAYS SHUT OFF THE INCOMING POWER BEFORE REMOVING THE ENCLOSURE OR OPENING THE DOOR.

2. WIRING

2.1 GENERAL

The drive operates on 460 V AC (+10, -5%) 50 or 60 Hz, 3 phase power, unless it has been modified for a different input voltage. Check the drive nameplate for proper voltage before wiring the drive. A ground lug is provided for a dedicated ground wire connection. The drive must be grounded for proper operation

All provisions of the National Electrical Code and local codes must be followed. Be sure to allow for proper bending radii when determining where to enter conduit entry plate.

⚠CAUTION

CONDUIT GROUND AND DAISY CHAIN GROUNDING ARE NOT ADEQUATE. COLD WATER PIPE CONNECTIONS ARE NOT ADEQUATE. A SEPARATE GROUNDING WIRE MUST BE RUN TO AVOID POSSIBLE ELECTRICAL NOISE PROBLEMS AND POTENTIAL SAFETY HAZARDS.

2.2 INPUT DISCONNECT

The drive may be supplied with or without an input disconnect. Size the input disconnect to handle the rating of the input fuses.

2.3 ISOLATION TRANSFORMER

If an isolation transformer is used, the National Electrical Code requires that an input disconnect must be placed between the transformer secondary and the drive input.

⚠WARNING

DO NOT OPEN OR CLOSE ANY DISCONNECT ON THE PRIMARY SIDE OF THE TRANSFORMER UNTIL AFTER THE DISCONNECT ON THE SECONDARY SIDE IS OPENED. DOING THIS MAY DAMAGE THE DRIVE.

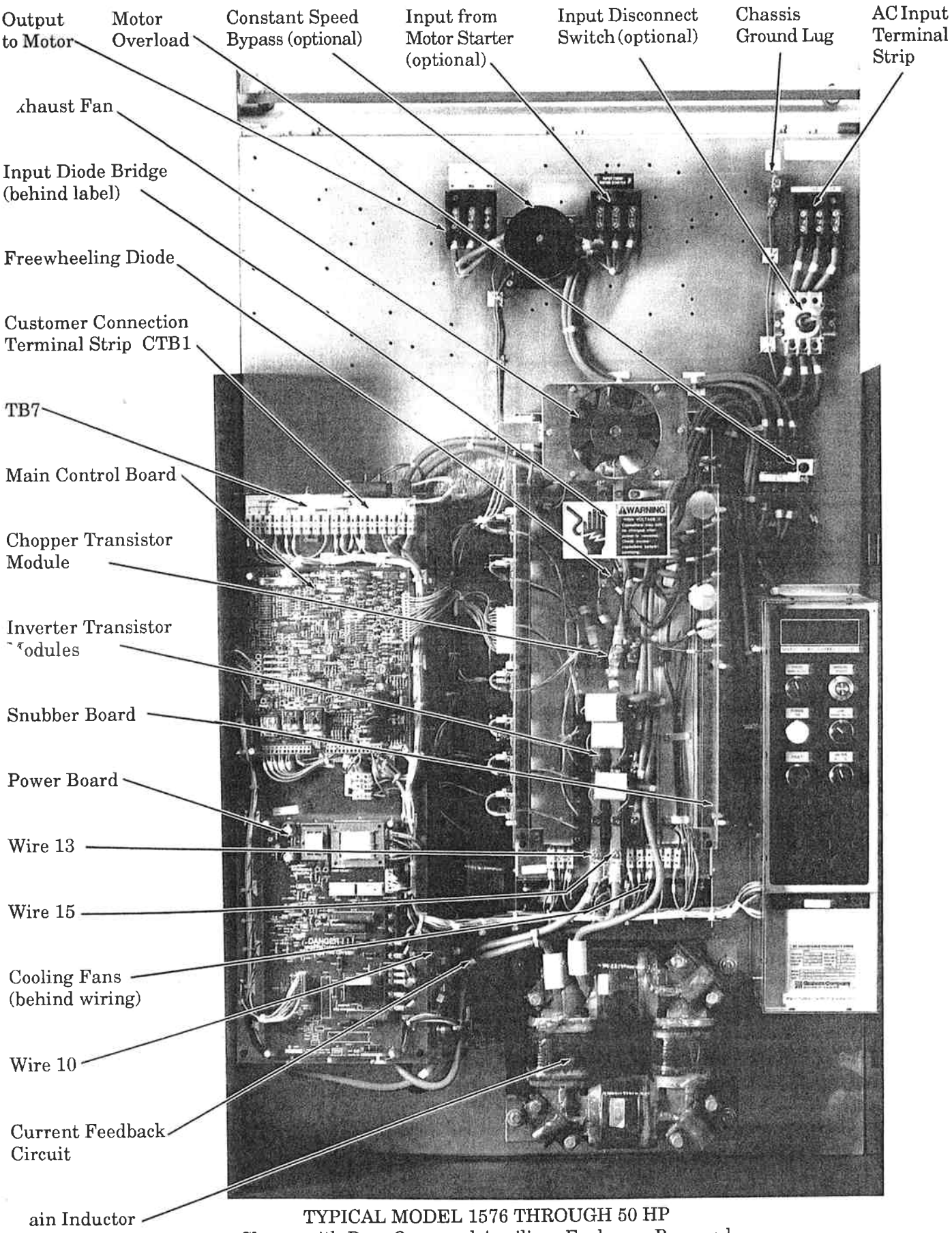
2.4 INPUT WIRING

Wire types and sizes should be selected in accordance with the input ratings and must conform to all local codes and practices.

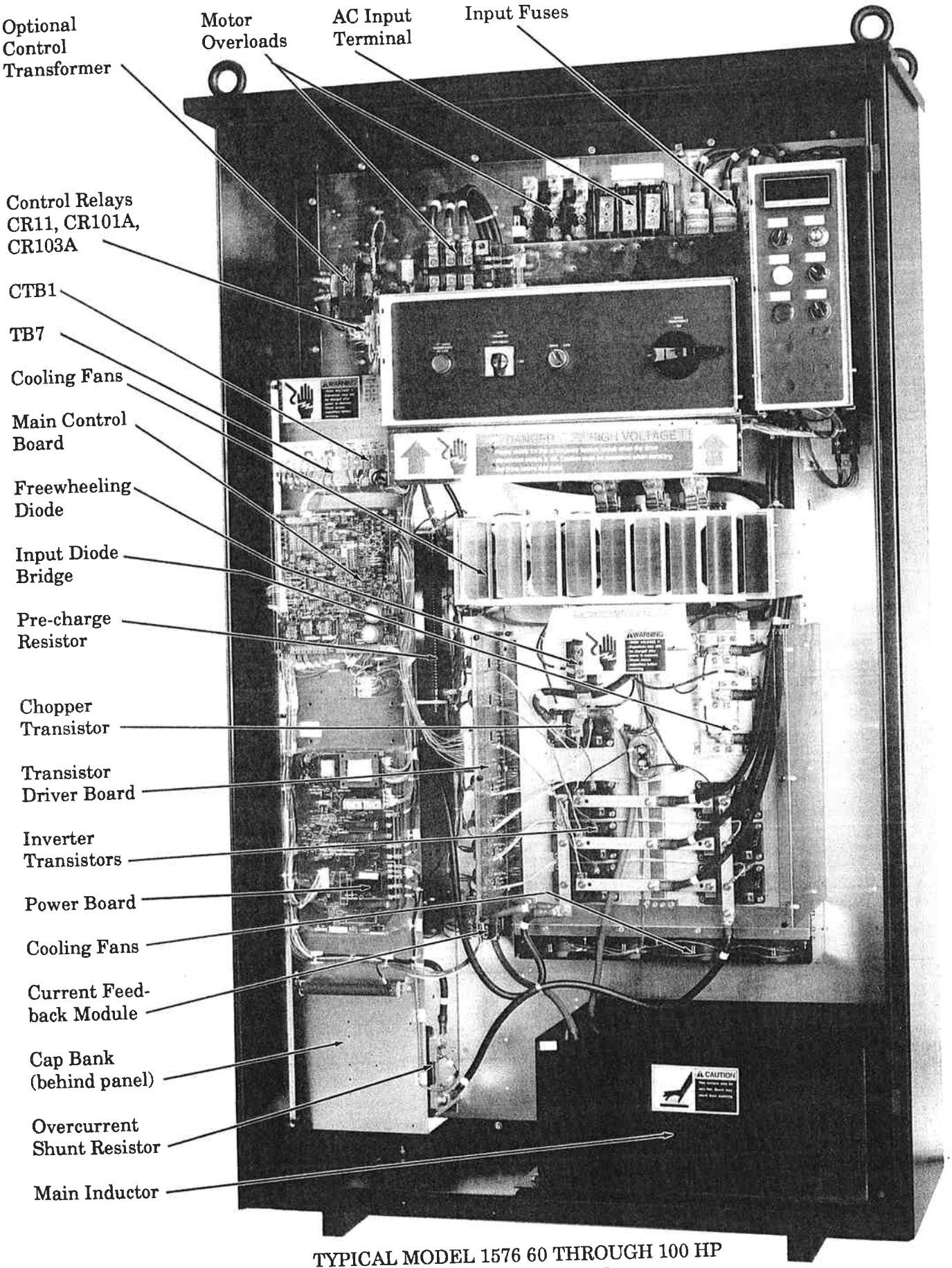
2.5 OUTPUT WIRING

Graham recommends that output wires be sized to carry the output current rating of the drive. When selecting wire to be used, all local codes and practices should be followed.

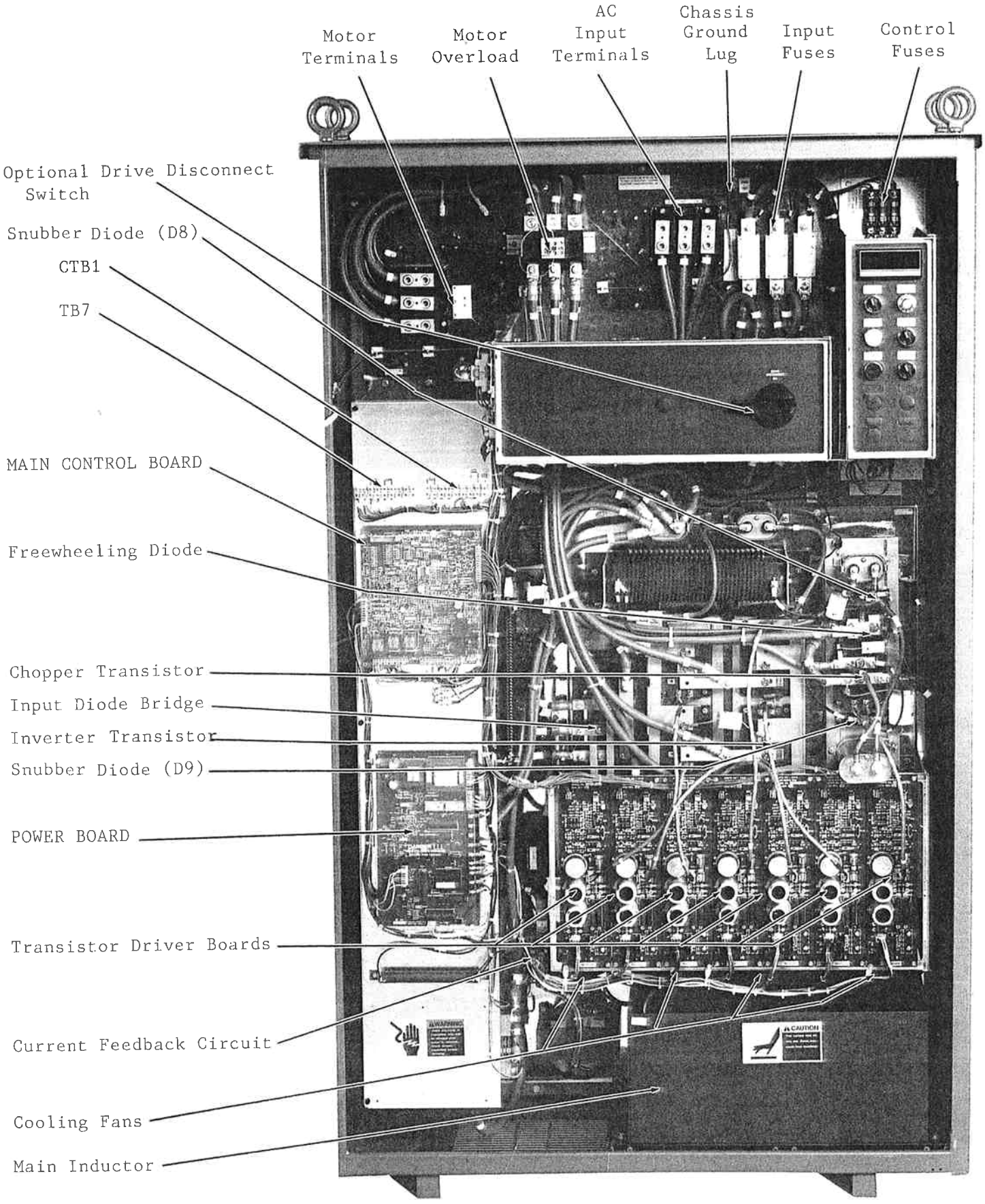
HP AT 460 V AC	MAX OUTPUT AMPS
7.5	12
10	14
15	21
20	28
25	34
30	40
40	53
50	65
60	77
75	98
100	126
125	156
150	188
200	240
300	361



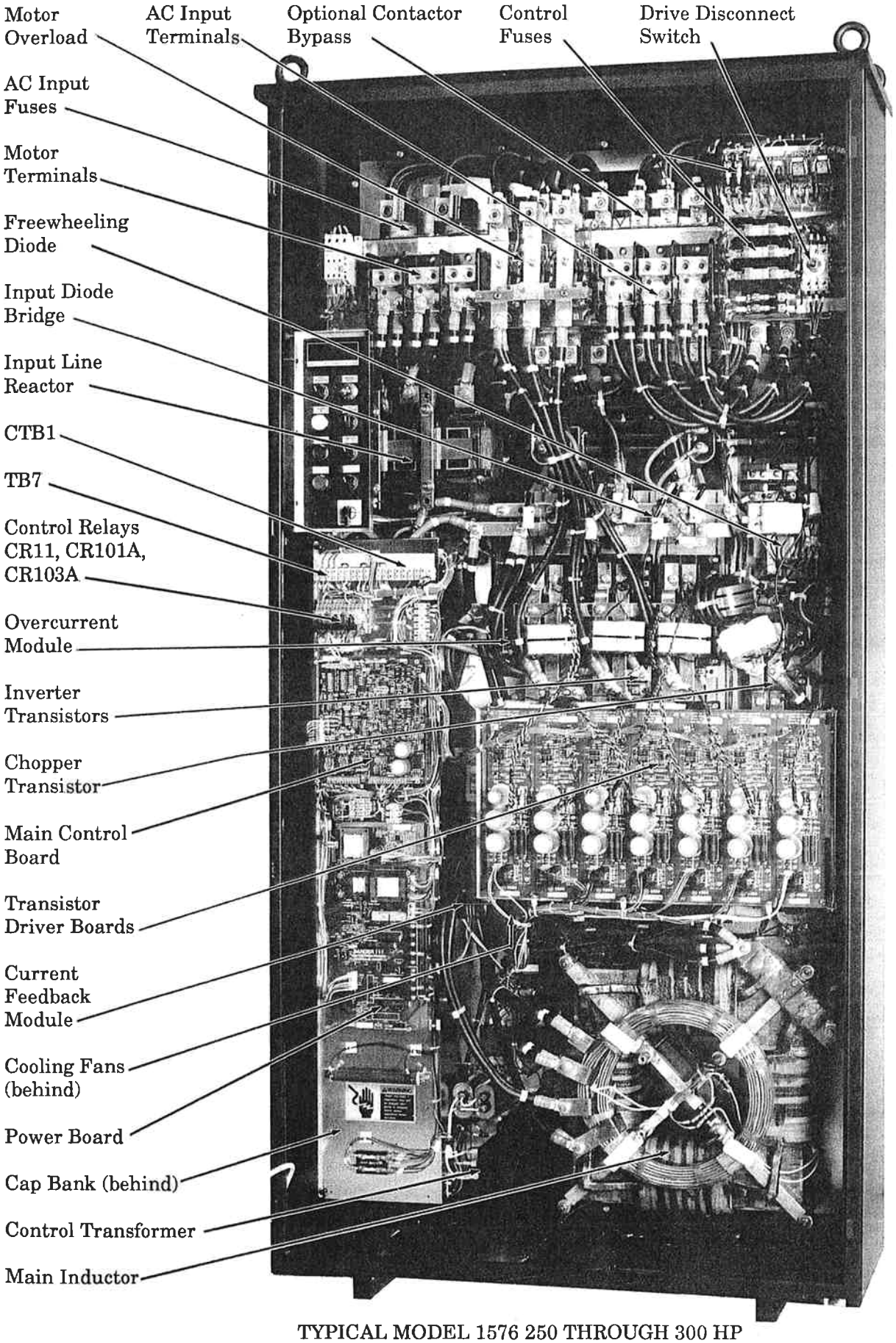
TYPICAL MODEL 1576 THROUGH 50 HP
Shown with Door Open and Auxiliary Enclosure Removed



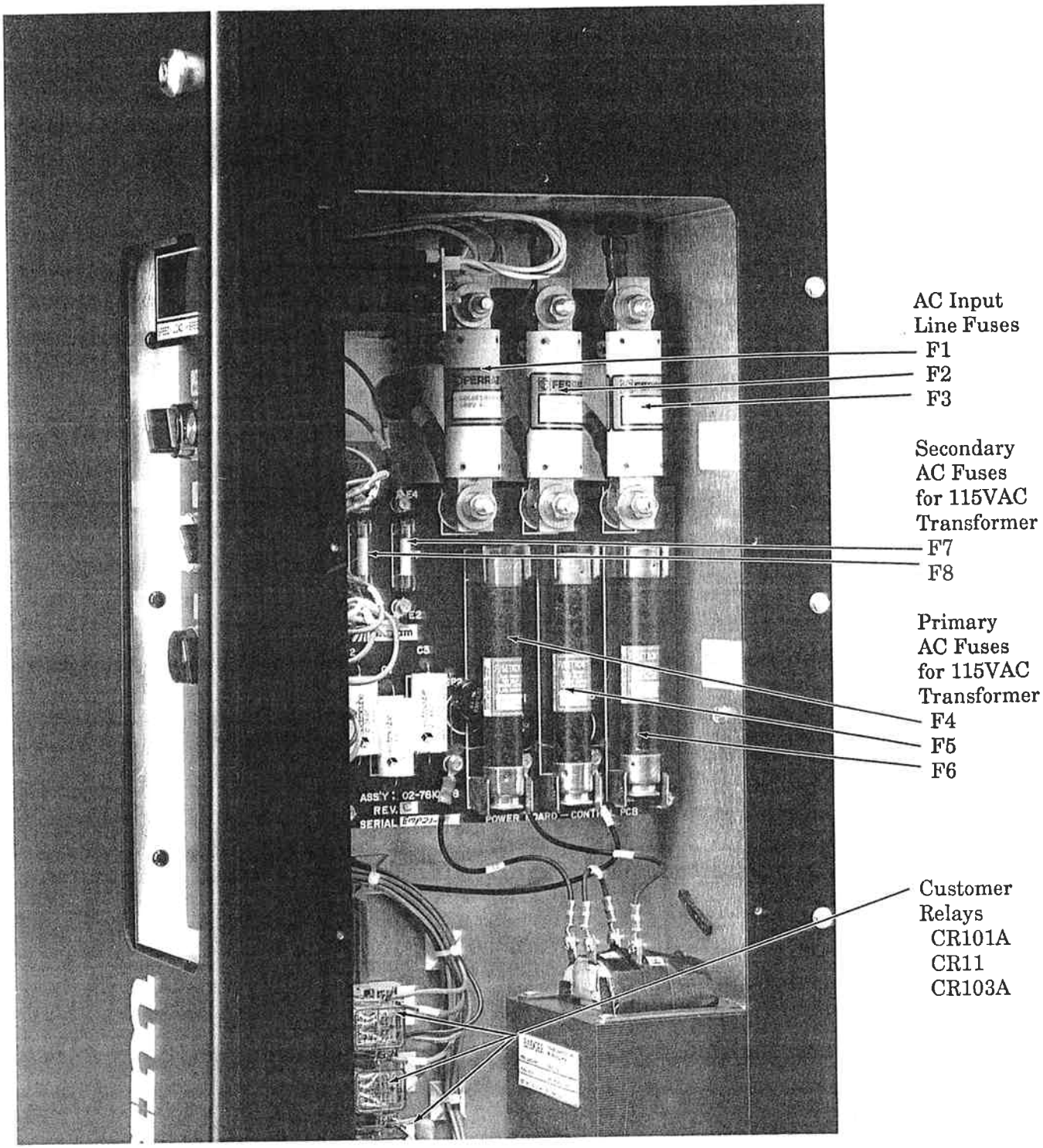
TYPICAL MODEL 1576 60 THROUGH 100 HP
ENCLOSURE OPEN



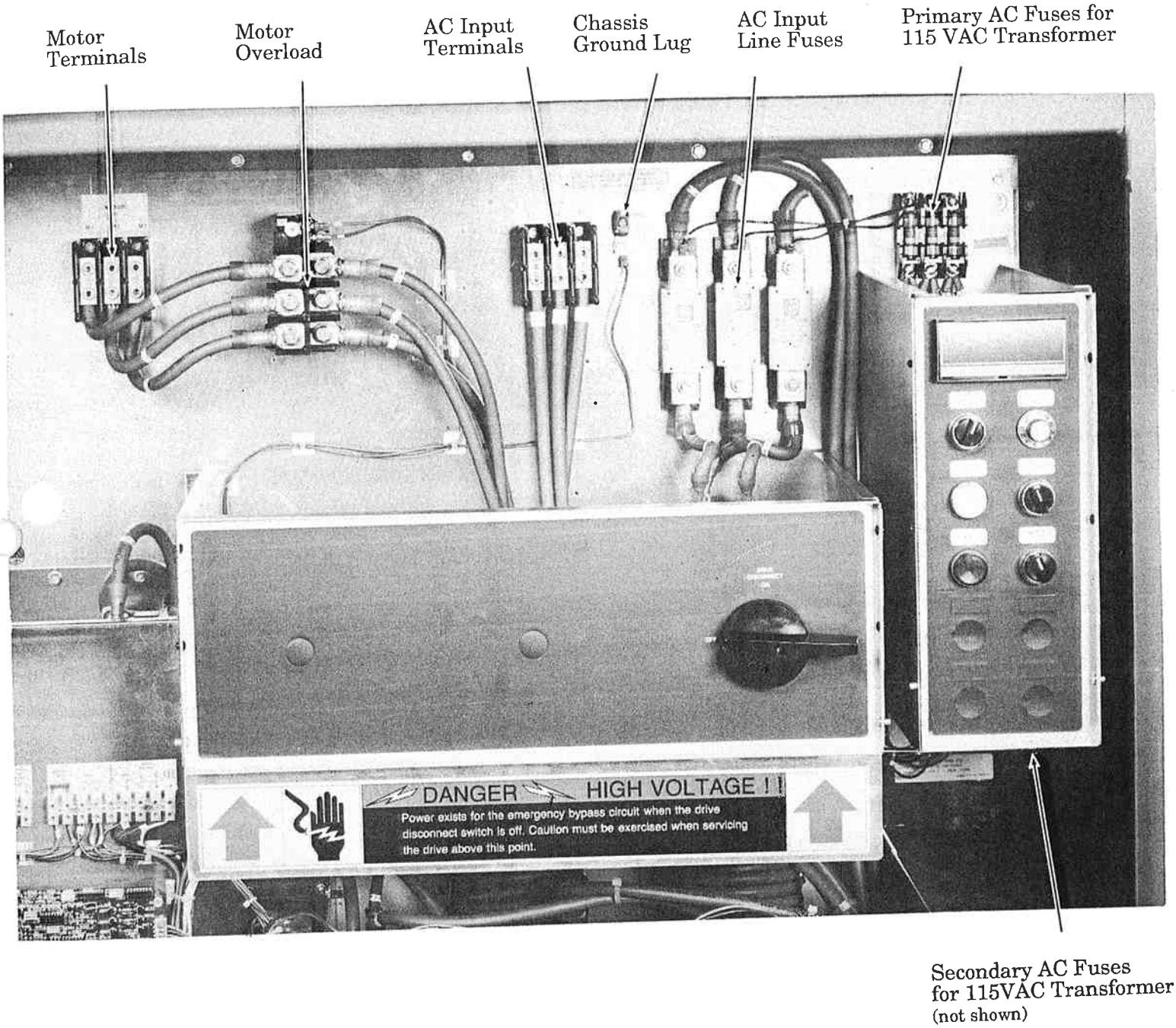
TYPICAL MODEL 1576 150 THROUGH 200HP
ENCLOSURE OPEN



TYPICAL MODEL 1576 250 THROUGH 300 HP
ENCLOSURE OPEN



FUSE ACCESS MODEL 1576 THROUGH 50 HP
Shown with side access cover removed



TYPICAL FUSE ACCESS MODEL 1576 100 HP

⚠CAUTION

DO NOT INSTALL INPUT WIRING AND MOTOR WIRING IN THE SAME CONDUIT OR RACEWAY.

⚠CAUTION

MOTOR WIRING INSTALLED IN OPEN RACEWAYS, PVC PIPING AND UNGROUNDED CONDUIT CAN EMIT ELECTRICAL NOISE WHICH CAN AFFECT SENSITIVE ELECTRICAL/ ELECTRONIC EQUIPMENT. INSTALL MOTOR WIRING IN A GROUNDED METAL CONDUIT TO PREVENT ELECTRICAL NOISE EMISSIONS.

2.6 OUTPUT DISCONNECT

IF AN OUTPUT CONTACTOR OR OTHER DISCONNECTING MEANS IS USED BETWEEN THE DRIVE OUTPUT TERMINALS AND THE MOTOR, THE FOLLOWING MUST BE OBSERVED.

1. Do not close the disconnect with the drive operating.
2. Do not close the disconnect while the motor is turning.

It is recommended that the output disconnect device be interlocked to TB7-8 and TB7-9 so that when the disconnect opens, the drive and the optional contactor bypass shut down..

NOTE: An early opening microswitch wired to open as the disconnect handle is moved is recommended. The contacts should be wired in the interlock loop of the drive (between TB7 terminals 8 and 9).

2.7 CONDUIT ENTRY

2.7.1 7.5 THROUGH 50 HP DRIVES

After mounting the drive, remove the wiring access plate on the front of the auxiliary enclosure. Mark on the top plate the locations of the conduit entries. Proper bending radii must be accommodate. Remove this plate and drill the entry holes.

⚠WARNING

DO NOT DRILL, SAW, FILE OR PERFORM ANY OPERATION ON THE ENCLOSURE OR TOP PLATE WHEN THEY ARE ON THE DRIVE. NO CHIPS OR OTHER MATERIALS CAN BE ALLOWED TO FALL ON THE DRIVE COMPONENTS.

2.7.2 60 THROUGH 300 HP UNITS

After positioning the drive, mark the locations of the conduit entries on the removable plate on the top of the drive. Be sure to accommodate all proper bending radii. Remove the top plate and drill the entry holes.

⚠WARNING

DO NOT DRILL, SAW, FILE OR PERFORM ANY OPERATION ON THE ENCLOSURE OR THE REMOVABLE PLATE WHEN THEY ARE ON THE DRIVE. NO CHIPS OR OTHER MATERIALS CAN BE ALLOWED TO FALL ON THE DRIVE COMPONENTS.

2.8 CONTROL CIRCUIT WIRING

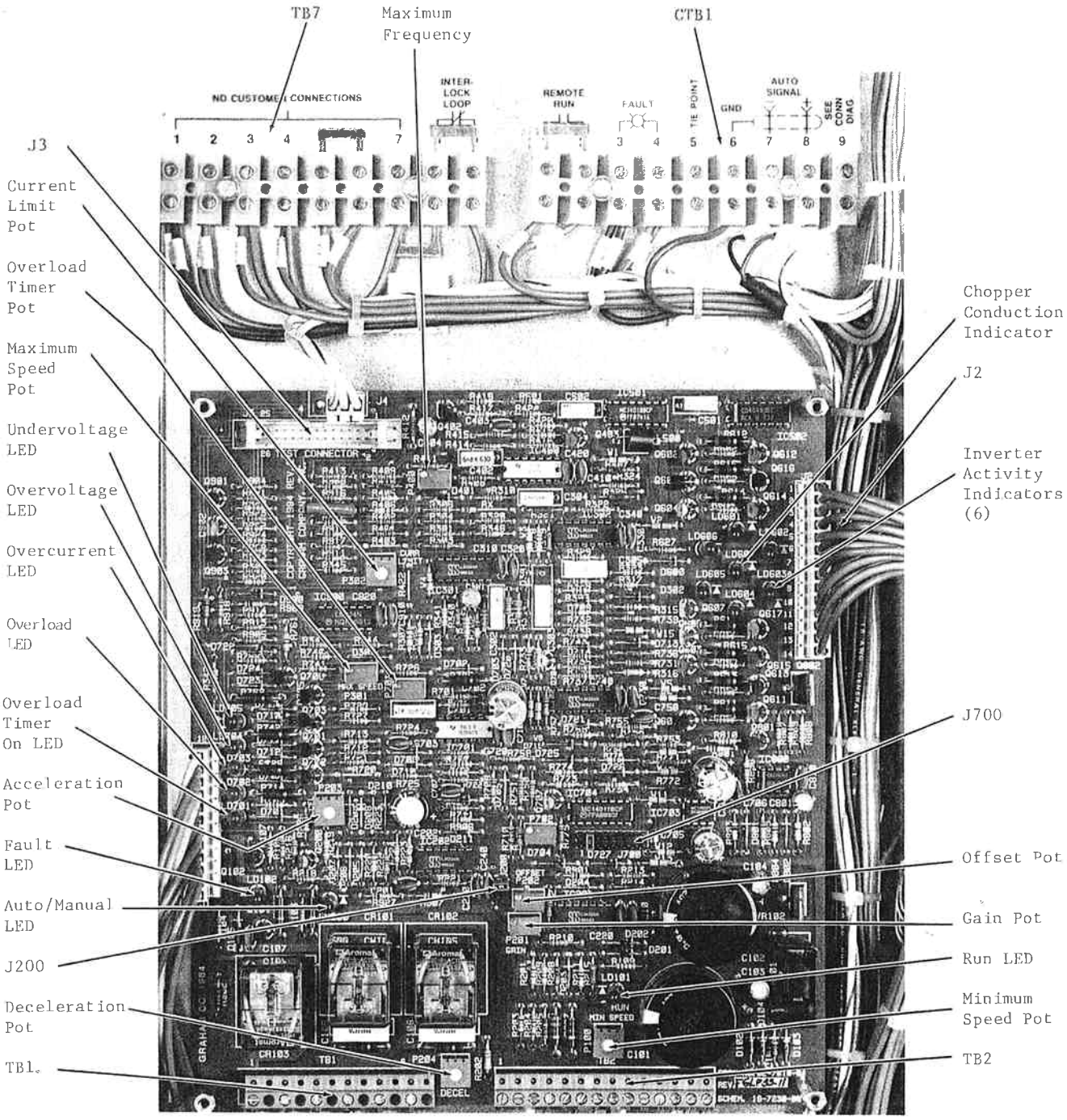
Control circuit wiring connections are made to terminal block CTB1, above the Main Control Board. Automatic control signals are brought in to terminals 7 and 8, using shielded cable. Terminate the shield to terminal 6. Common in this drive is earth ground. Do NOT ground the other end of the shield. Insulate the other end of the shield to ensure that it is not grounded. This is necessary to ensure noise immunity.

2.9 FOLLOWER CONNECTIONS

For automatic operation, the input signal is supplied to the follower circuit on the Main Control Board. Proper connections are listed below and depend upon the type of input signal connected to CTB1. See the connection diagram for your specific follower. The connections shown below were factory made if a follower was specified. To convert to a follower or to change the signal followed, make the appropriate connections.

FOLLOWER SIGNAL CONNECTIONS

Signal	+ Connection	- Connection
1-5mA	TB2, terminal 4	TB2, terminal 6
4-20mA	TB2, terminal 5	TB2, terminal 6
10-50mA	TB2, terminal 5	TB2, terminal 6
0-1 V DC thru 0-10 V DC	TB2, terminal 2	TB2, terminal 6
0-18 V DC	TB2, terminal 1	TB2, terminal 6
0-180 V DC	TB1, terminal 6	TB2, terminal 6



TYPICAL MODEL 1576 MAIN CONTROL BOARD, ALL RATINGS

⚠WARNING

TO PREVENT ERRATIC OPERATION, IF THE CONTROLLER WHICH SUPPLIES THE INPUT SIGNAL IS GROUNDED, A SIGNAL ISOLATOR MUST BE INSTALLED BETWEEN THE CONTROLLER AND THE DRIVE IF A CURRENT SINK RATHER THAN CURRENT SOURCE CONTROLLER IS USED TO SUPPLY THE INPUT SIGNAL, THE CONTROLLER MUST NOT BE GROUNDED OR A SIGNAL ISOLATOR MUST BE USED. OTHERWISE DAMAGE TO THE GRAHAM DRIVE WILL OCCUR.

3. START-UP PROCEDURE

3.1 PRE-CHECK

To prevent damage to the drive, the checks listed below should be completed before applying AC power to the drive.

1. Visually inspect the drive for any signs of shipping damage, loose connections or other defects.
2. Make sure the input line voltage is correct. On standard units, it should be between 437 and 506 V AC. Make sure that the lines are not unbalanced more than 5 V AC.
3. Make sure the drive and motor ratings are properly marked as to horsepower and voltage. Consult Graham if the motor's horsepower rating is larger than the drive's rating.
4. Check all electrical connections for tightness and retighten, if necessary.
5. Ensure that the wiring between the drive, the motor and other external locations is connected as shown on the connection diagram.

⚠WARNING

NEVER OPERATE THE DRIVE INTO A SHORT CIRCUIT.
NEVER CONNECT A MOTOR TO A DRIVE WHEN THE DRIVE IS RUNNING.
NEVER CONNECT A ROTATING MOTOR TO A DRIVE.
NEVER OPERATE MOTOR TRANSFER CIRCUITS WHILE DRIVE IS RUNNING.

3.2 OPERATOR CONTROLS

MANUAL SPEED POTENTIOMETER - Allows the operator to set the running speed of the motor between the lower limit (set by the MIN SPEED potentiometer) and the upper limit (set by the MAX SPEED potentiometer).

HAND/OFF/AUTO SELECTOR SWITCH - Select HAND to energize the run relay and start the drive. Select OFF to stop the drive. Select AUTO to start and stop the drive from a remote set of dry contacts provided by the customer.

STOP/RUN SELECTOR SWITCH - Some drives have a STOP/RUN selector switch in place of the HAND/OFF/AUTO selector switch. Select RUN to energize the run relay and start the drive. Select STOP to stop the drive.

MANUAL/AUTO SELECTOR SWITCH - In the MANUAL position, the motor's speed follows the reference from the MANUAL SPEED POTENTIOMETER. In the AUTO position, the follower is in the circuit and the drive follows an external reference such as 4 to 20 mA, 0 to 10 V DC or 135 ohm potentiometer.

SPEED/LOAD SELECTOR - Select SPEED to show a percent speed indication on the LED display at the top of the panel. Select LOAD to show percent of full load.

3.3 DRIVE STATUS INDICATORS (LEDs)

UNDERVOLTAGE - If the input voltage to the drive drops too low, this LED will light and the drive will stop, allowing the motor to coast. As soon as the low voltage condition is corrected, a timer will start. After the time delay, the LED will go out, and a drive that is equipped with a STOP/RUN SELECTOR will automatically restart. A drive which is supplied with START/STOP PUSHBUTTONS will not restart until the START pushbutton has been pressed. See Section 6.1 for a description of the automatic reset/restart timer and time selections.

OVERVOLTAGE - If the DC output bus voltage rises too high, this LED will light and the drive will stop, allowing the motor to coast.

OVERCURRENT - If the inverter section (drive output) is subjected to a sharp increase in current, this LED will light and the drive will stop, allowing the motor to coast. Possible causes of overcurrent are misapplication of the drive to too large a motor, a defective motor, power factor correction capacitors connected to the motor leads, a short circuit or component failure. To reset,

remove the power to the drive, reconnect the power and have the drive go thru its normal power-up sequence. If the fault does not reset, see Section Two — Service Manual.

OVERLOAD TIMER ON - If the drive is called upon to deliver 110% or more of its nameplate load rating, this LED will light to indicate that the one minute OVERLOAD TIMER has been activated. The LED will go out as soon as the load is reduced below the 110% level. If the load is not reduced, the OVERLOAD TIMER will time out in approximately one minute and trip the OVERLOAD SAFETY CIRCUIT. The overload trip will cause the motor to decelerate to zero speed and remain at zero speed until the OVERLOAD SAFETY CIRCUIT is reset. To reset, turn the STOP/RUN switch to the STOP position and then return it to the RUN position.

RUN - When the drive run relay is activated, this LED will light.

FAULT - If the fault relay is activated due to an UNDERVOLTAGE, OVERVOLTAGE, OVERCURRENT or OVERLOAD, this LED will light, indicating that the drive is in a fault shutdown condition.

AUTO/MANUAL - When the drive is in the MANUAL mode (manual speed potentiometer), this LED will be off. When the drive is in the AUTOMATIC mode (speed follower for transducers or external speed commands), this LED will light.

CHOPPER CONDUCTION INDICATOR - The intensity of this LED is proportional to the duty cycle of the chopper transistor and so it varies with the load on the drive.

INVERTER ACTIVITY INDICATOR - These six LEDs are arranged in a circle to show the firing sequence of the six inverter transistors. When power is applied, approximately three seconds after the undervoltage timer resets, three consecutive LEDs will light. Each LED indicates that a turn-on command is being sent to the corresponding inverter transistor driver circuit. In a properly functioning drive, only three sequential LEDs are lit at one time. The rate of flashing will increase with increasing motor speeds. Eventually, they will flash so quickly that they appear to glow continuously. The lighted LEDs will appear to rotate even when the drive is stopped.

CHOPPER TRANSISTOR DRIVER LED - This LED is located on the Transistor Driver Board and works in conjunction with the CHOPPER CONDUCTION INDICATOR on the Main Control Board. If the CHOPPER TRANSISTOR DRIVER LED does not light but the CHOPPER CONDUCTION INDICATOR DOES light, the Transistor Driver Board, or the wiring to it, has a fault.

INVERTER TRANSISTOR DRIVER LEDs - An LED on the Transistor Driver Board lights to indicate that turn-on base drive is being supplied to the inverter power transistor. The transistor drivers work in conjunction with the INVERTER ACTIVITY INDICATOR on the Main Control Board. The rate of flashing of the LEDs corresponds to the speed of the motor. If an LED on a transistor driver fails to light but the corresponding LED on the Main Control Board does light, the Transistor Driver Board, or the wiring to it, has a fault.

PHASE LOSS FAULT - This LED, located on the Power Board, lights to indicate that there is an AC input line fault which has caused the phase not used for control power to be lost. If either of the phases used for control power is lost, the Main Control Board LEDs will be off.

INPUT SURGE CYCLE COMPLETE - This Power Board LED lights when the initial application of energy to the input bus capacitors is complete.

INPUT BUS CHARGED - This Power Board LED lights when there is a charge on the input capacitor bank. After power is removed, the LED will dim as the capacitor bank slowly discharges.

⚠DANGER

DO NOT SERVICE THE DRIVE WHILE THE INPUT BUS CHARGED LED IS ILLUMINATED.

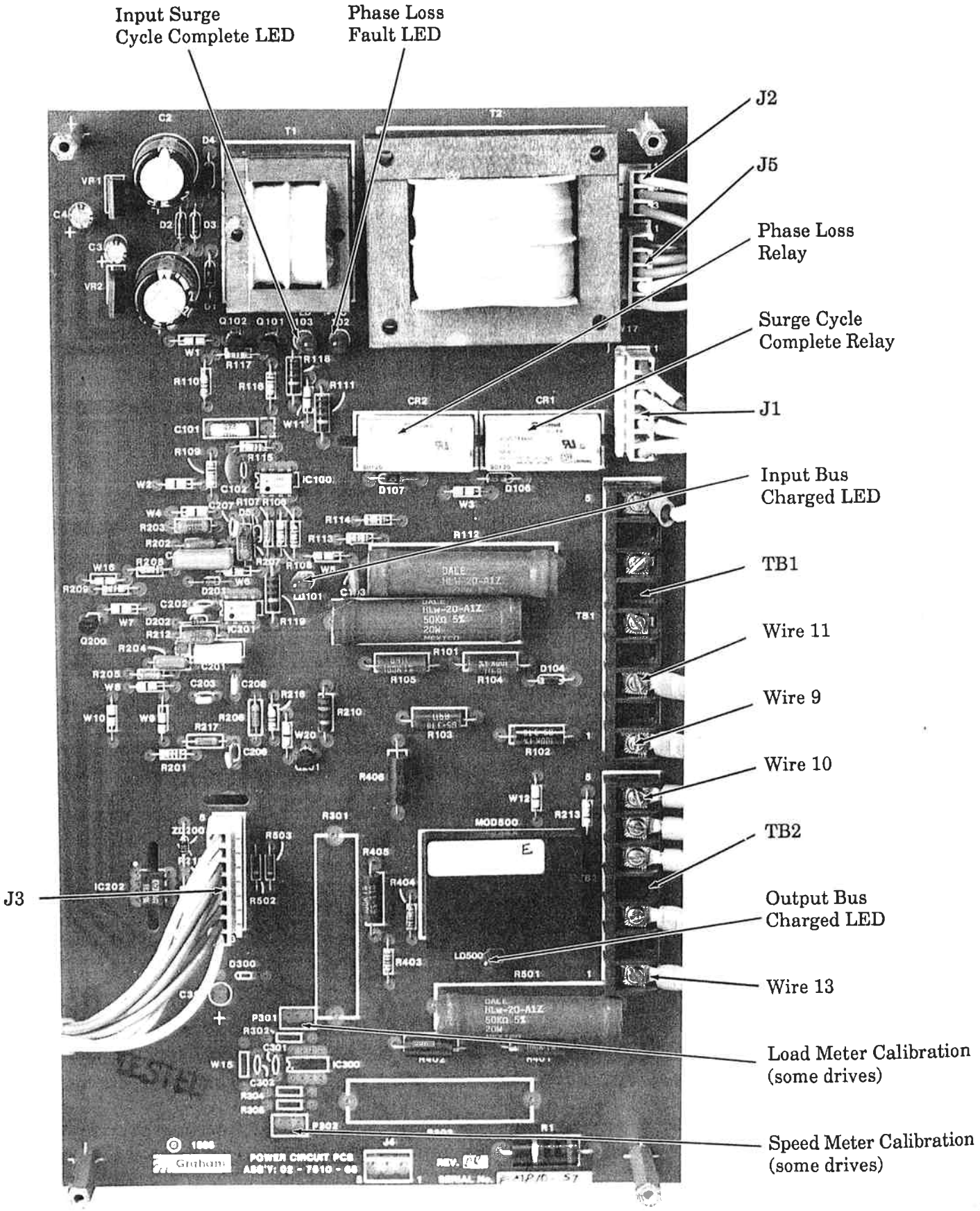
OUTPUT BUS CHARGED - This LED on the Power Board lights when there is a charge on the output bus capacitors. Its intensity varies with motor speed. After power is removed, the LED will dim as the output bus capacitors slowly discharge.

⚠DANGER

DO NOT SERVICE THE DRIVE WHILE THE OUTPUT BUS CHARGED LED IS ILLUMINATED.

3.4 INTERNAL CUSTOMER ADJUSTMENTS

MINIMUM SPEED - This Main Control Board potentiometer is used for adjusting the minimum speed when the manual speed potentiometer is used (i.e. when the MAN/AUTO switch is in the MAN position). To change this adjustment, turn the manual speed potentiometer fully counterclockwise and adjust the MINIMUM SPEED potentiometer for the desired minimum speed.



TYPICAL MODEL 1576 POWER CIRCUIT BOARD, ALL RATINGS

MAXIMUM SPEED - This Main Control Board potentiometer sets the motor's maximum speed. To adjust it, set the MAN/AUTO switch to the MAN position and turn the manual speed potentiometer fully clockwise. Then adjust the MAXIMUM SPEED potentiometer for the desired maximum speed. Do not set the MAXIMUM speed potentiometer for a speed greater than the motor nameplate speed.

GAIN - This Main Control Board potentiometer adjusts the drive's response to an automatic speed reference signal when the automatic follower is used (i.e. when the MAN/AUTO switch is in the AUTO position). To calibrate this adjustment, set the automatic speed reference signal at its maximum value, (10 V DC or 20 mA, etc.) and adjust the GAIN potentiometer for the desired maximum speed. IN THE AUTO MODE, THE MAXIMUM SPEED CANNOT BE GREATER THAN IT IS IN THE MANUAL MODE.

OFFSET - This Main Control Board potentiometer adjusts the minimum speed when the automatic reference input is used (i.e. when the MAN/AUTO switch is in the AUTO position). To calibrate this adjustment, set the input follower circuit signal at its minimum value (0 V DC or 4 mA, etc.) and adjust the OFFSET potentiometer for the desired automatic follower minimum speed. See Section 3.5, step 15. This adjustment does not affect the MINIMUM SPEED setting for the manual mode, although it does interact with the GAIN control.

ACCELERATION TIME - This Main Control Board potentiometer adjusts the length of time it takes the drive to accelerate the motor from zero speed to maximum speed. This time is adjustable from 3 to 60 seconds. The factory setting was approximately 60 seconds. To reduce the peak demand when starting a fan or a pump, the drive provides a soft start by increasing the length of time it takes the motor to reach set speed. Clockwise rotation of the ACCELERATION TIME potentiometer increases the accel time and counterclockwise rotation of the potentiometer decreases the accel time.

DECELERATION TIME - On some drives, the minimum deceleration time is set by the DECELERATION TIME potentiometer. On others it is set by the ACCELERATION TIME potentiometer. If the load requires a longer deceleration time, the drive will automatically compensate by extending the deceleration time. If the deceleration time must be increased, turn the potentiometer clockwise.

CURRENT LIMIT - This Main Control Board potentiometer is used to set the maximum current in the chopper circuit. The chopper current is proportional to the motor load, except when abrupt changes in motor torque requirements occur. If the drive is to be used with a motor whose full load rating is less than the nameplate rating of the drive, the CURRENT limit potentiometer may be turned counterclockwise to limit the maximum available current to the motor.

3.5 INITIAL START-UP

Prior to shipment, each Graham drive is thoroughly tested at the factory and is adjusted for maximum performance for its intended application. Minor adjustments may be necessary at the installation site.

Before any adjustments are made, this manual should be studied carefully. Do not make any adjustments without the proper measuring instruments and without a clear understanding of the function and limitation of the adjustment being made. Make sure that everything in paragraph 3.1 has been checked before power is applied to the drive. Verify that the drive is connected per the proper connection diagram.

⚠DANGER

460 V AC AND OVER 700 V DC IS PRESENT INSIDE THE DRIVE ENCLOSURE. THIS VOLTAGE IS EXTREMELY DANGEROUS AND COULD BE FATAL IF CONTACTED. THEREFORE, THE UTMOST CAUTION MUST BE EXERCISED WHEN WORKING WITHIN THE DRIVE ENCLOSURE.

1. Set the MANUAL SPEED potentiometer fully counterclockwise, the HAND/OFF/AUTO switch to OFF and the AUTO/MAN selector to MAN.

2. Turn the CURRENT LIMIT potentiometer on the Main Control Board fully counterclockwise. Access this potentiometer thru the hole in the plastic shield over the Main Control Board.

3. Verify that the pre-checks in Paragraph 3.1 have been successfully completed.

4. Apply power to the drive thru the input disconnect switch. If the drive is supplied with a constant speed bypass using motor starters, rotate the ON/OFF-RESET switch to the ON position and rotate the DRIVE/LINE switch to the DRIVE position.

5. When power is applied to the drive, the following should occur:

    1. INPUT SURGE CYCLE COMPLETE and

INPUT BUS CHARGED LEDs on the POWER CIRCUIT BOARD illuminate.

2. M1 charging contactor energizes and starts the enclosure circulation fans.
3. Panel mounted POWER ON and FAULT lights illuminate.
4. SPEED/LOAD meter illuminates.
5. FAULT and UNDERVOLTAGE LEDs illuminate on Main Control Board.

6. After a power up time delay (see Section 6.1, Undervoltage Reset Adjustment) the following will occur:

    1. Panel mounted FAULT light extinguishes
    2. FAULT and UNDERVOLTAGE LEDs on Main Control Board extinguish

7. Three to five seconds after the FAULT light extinguishes, the INVERTER ACTIVITY LEDs on the Main Control Board will light and sequence in a slow clockwise direction. The INVERTER TRANSISTOR LEDs should light and sequence in correlation with the INVERTER ACTIVITY LEDs.

8. Switch the HAND/OFF/AUTO switch to AUTO. The RUN LED on the Main Control Board should illuminate.

9. Adjust the MANUAL SPEED potentiometer to 20% speed. Slowly adjust the CURRENT LIMIT potentiometer clockwise until you hear a high pitched sound coming from the main inductor at the base of the drive. As the sound increases with further clockwise movement of the CURRENT LIMIT potentiometer, you will see the CHOPPER CONDUCTION LED and the CHOPPER TRANSISTOR DRIVER LED illuminate dimly and increase in intensity with further clockwise adjustment.

10. Check the motor rotation.

    1. If the motor doesn't rotate, check to make sure that the motor is properly connected and free to rotate. If it is, turn the CURRENT LIMIT potentiometer clockwise until rotation occurs.

    2. If the motor rotates, check for proper direction of rotation. If the motor does not rotate in the correct direction, reverse two of the motor leads.

    3. If the drive is supplied with a constant speed bypass, also check the motor's direction of rotation in the bypass mode. If it is incorrect, reverse two of the drive's incoming AC power leads.

11. If the motor rotates in the proper direction, turn the CURRENT LIMIT potentiometer fully clockwise. See caution below.

⚠CAUTION

WHEN USING MOTORS WHICH HAVE A CURRENT RATING LESS THAN THE DRIVE OUTPUT RATING, A REDUCED CURRENT LIMIT SETTING MAY BE DESIRED TO LIMIT THE DRIVE'S CURRENT CAPABILITY. THIS DOES NOT REDUCE THE OVERLOAD TRIP THRESHOLD. MOTOR OVERLOAD SETTINGS SHOULD BE SET TO PROTECT THE MOTOR. IF MULTIPLE MOTORS ARE CONNECTED TO THE DRIVE OUTPUT, INDIVIDUAL MOTOR OVERLOADS SHOULD BE SUPPLIED FOR EACH INDIVIDUAL MOTOR.

12. Turn the MANUAL SPEED potentiometer fully clockwise. The OUTPUT BUS CHARGED LED, CHOPPER CONDUCTION LED and CHOPPER TRANSISTOR DRIVER LED should be brightly illuminated. Rotate the SPEED/LOAD selector switch to SPEED. The SPEED/LOAD METER should now indicate 100% speed, unless a lower maximum speed setting was set. Rotate the SPEED/LOAD selector switch to LOAD. The SPEED/LOAD METER should now indicate the percentage of the drive's output torque capability that is being required by the motor.

13. To set up the drive for signal follower operation, rotate the HAND/OFF/AUTO switch to OFF. When the drive stops, rotate the AUTO/MAN switch to AUTO. The AUTO/MAN LED should now illuminate. Rotate the SPEED/LOAD switch to SPEED.

14. Adjust the automatic signal from the sending device to its maximum signal. Rotate the HAND/OFF/AUTO switch to AUTO. The drive should accelerate to maximum speed and the SPEED/LOAD METER should indicate 100% speed, unless otherwise specified. If the meter does not indicate the desired speed, verify that the input reference signal is at its maximum level and adjust the GAIN potentiometer for the desired indication on the meter. IN THE AUTO MODE, THE MAXIMUM SPEED CANNOT BE

GREATER THAN IN THE MANUAL MODE. The GAIN potentiometer should not be adjusted any farther than is necessary to obtain the required maximum speed.

15. Adjust the automatic signal from the sending device to its minimum signal. Adjust the OFF-SET potentiometer for the desired minimum speed.

    To obtain a lower minimum speed, remove plug P200 from jack J200 and replace it on the end of J200 market with the minus sign (-). To obtain a higher minimum speed, replace P200 on the end of J200 marked with the plus sign (+).

16. After making any changes in step 15, recheck the maximum speed per step 14 and readjust, if necessary. In some cases, it may be necessary to repeat steps 14 and 15 a few times.

17. Switch the HAND/OFF/AUTO switch to OFF and disconnect the input power to the drive. The drive is now calibrated for the manual and automatic speed control functions and the drive has completed the operational check out.

SECTION TWO — SERVICE MANUAL

4. INTRODUCTION

This section of the manual is intended for those who wish to perform their own troubleshooting and repair. Persons attempting to perform the drive service described in this section should have a strong background in power electronics, experience in using test equipment and a good understanding of analog and digital control circuitry. Graham Company offers service schools to show you how to troubleshoot and repair this drive. Contact Graham Company Service Department for service assistance.

5 DESCRIPTION OF OPERATION

The drive consists of two main sections, the Power Section and the Control Section.

The first part of the Power Section is the Input Bridge. It converts the incoming three phase AC to a fixed DC voltage. The Chopper converts the fixed DC to a regulated chopped DC voltage. The last part of the Power Section is the Inverter. The Inverter directs the regulated DC to the correct phase of the motor for the proper period of time.

The Control Section is divided between the Main Control Board and Power Circuit Board.

The Power Board contains the power up sequencing relay and the circuitry to interface the high voltage Power Section with the low voltage Control Section.

The Main Control Board contains the voltage and current regulating circuits and the transistor switching logic circuitry. The circuitry for following external references such as 0 to 10 V DC, 4 to 20 mA and a 135 ohm potentiometer is also on this board

6. ADJUSTMENTS AND TROUBLESHOOTING

6.1 INTERNAL ADJUSTMENTS — Factory Adjustments

⚠CAUTION

THESE ADJUSTMENTS SHOULD ONLY BE MADE BY FACTORY TRAINED PERSONNEL

OVERLOAD THRESHOLD - This adjustment sets the load at which the overload timer starts.

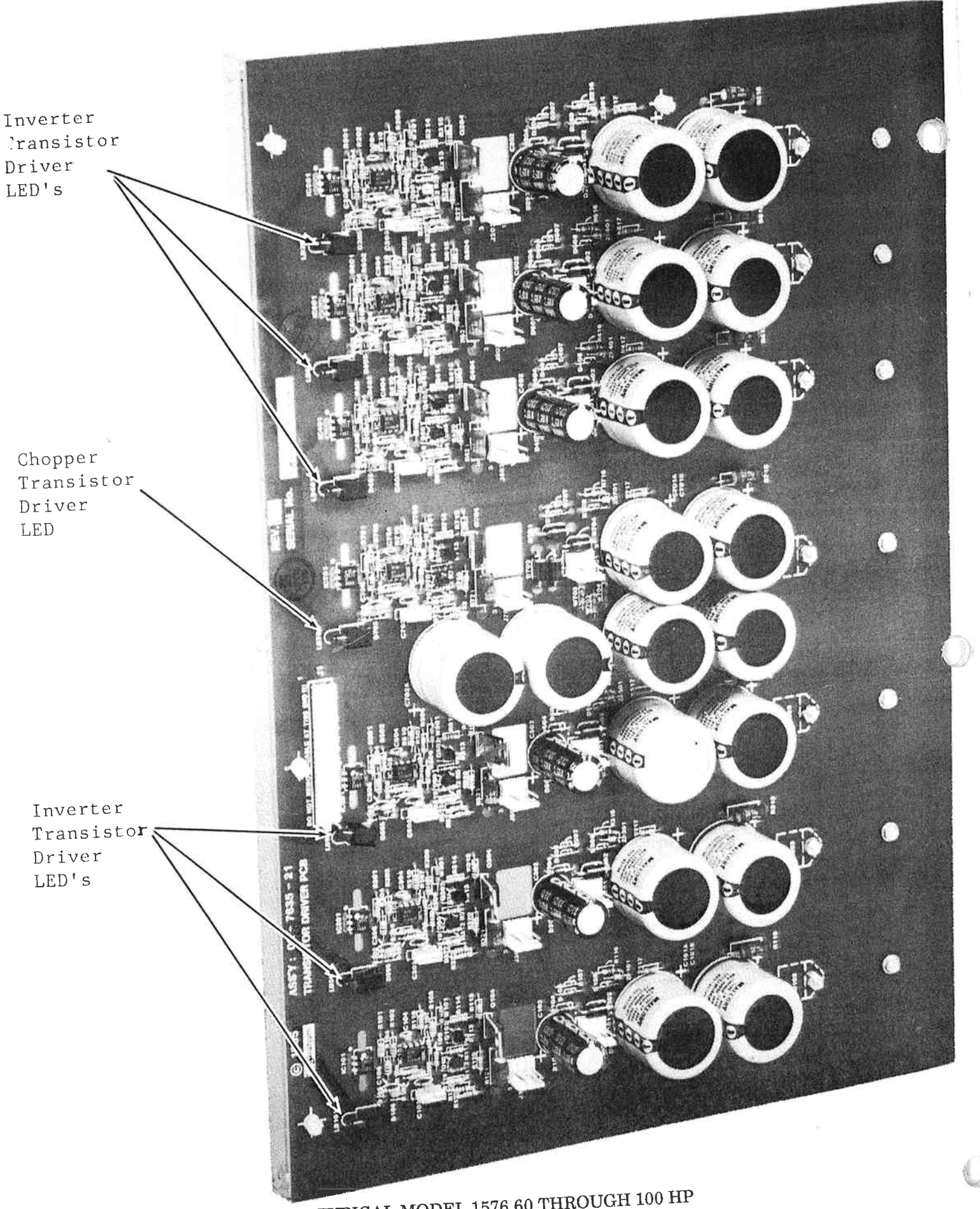
UNDERVOLTAGE TRIP - The UNDERVOLTAGE TRIP is set to turn off the drive when the input line voltage falls below 414 V AC. To properly set this trip, a means of adjusting the input voltage is necessary.

The length of the time delay before the drive resets is adjustable. When shipped from Graham, the delay was set for the maximum. To reduce the delay, remove the plug from J700 pin #7 and replace on a different pin.

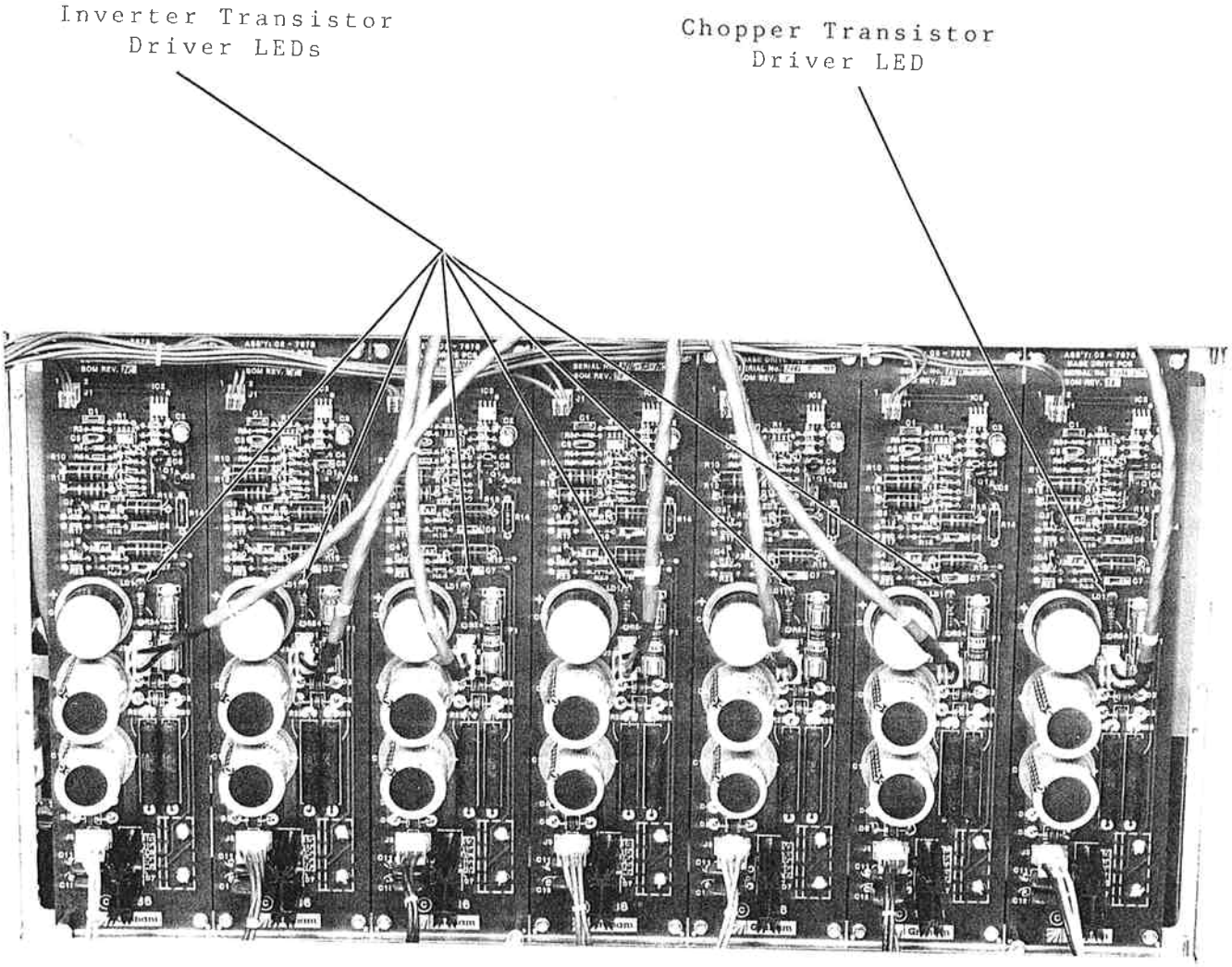
⚠CAUTION

THE DELAY MUST BE LONG ENOUGH SO THAT THE MOTOR IS NOT ROTATING WHEN THE UNDER-VOLTAGE TRIP RESETS.

To assure this, run the drive at maximum speed and then switch the drive to stop. Measure the time until the motor is completely stopped. Only select time delays which are longer than this coast down time.



TYPICAL MODEL 1576 60 THROUGH 100 HP
TRANSISTOR DRIVER BOARD



TYPICAL MODEL 1576 125 HP AND LARGER
TRANSISTOR DRIVER BOARD

UNDERVOLTAGE RESET ADJUSTMENT

J700 PIN #	TIME DELAY
	Shortest
2	
3	
6	
8	
1	
4	
5	
9	
7	Longest

LOAD CAL - The load meter calibration potentiometer is located on either the Power Board or on the back of the digital meter. Adjust it to indicate 100% on the digital meter when the motor is fully loaded.

SPEED CAL - The speed meter calibration potentiometer is located on either the Power Board or on the back of the digital meter. Adjust it to indicate 100% on the digital meter when the motor is operated at full speed.

MAX FREQ - The voltage controlled oscillator on the Main Control Board is calibrated using the MAX FREQ adjustment. Adjustment of this potentiometer will alter the volts per hertz ratio on the drive's output. This control has been set at the factory and should not be readjusted in the field.

I FDBK - This potentiometer on the Current Feedback Assembly calibrates the amount of current feedback supplied to the Main Control Board's current control circuits. The chopper duty cycle and current limit circuits are dependent on this calibration. This control has been set at the factory and should not be readjusted in the field.

6.2 TROUBLESHOOTING

The procedures outlined here are intended to assist in locating and correcting a problem in a standard drive. The use of replacement Control Boards, where necessary, is suggested to eliminate extended downtime. Power circuit measurements should only be made by qualified technicians.

⚠DANGER

EYE PROTECTION IS REQUIRED ANY TIME THAT THE ENCLOSURE IS OPEN.

⚠DANGER

EXTREME CAUTION MUST BE USED WHENEVER POWER IS APPLIED AND THE ENCLOSURE IS OPEN. ANYONE WORKING ON THE DRIVE WILL BE EXPOSED TO HIGH VOLTAGE. ALWAYS REMOVE POWER WHEN SERVICING THE COMPONENTS OF THE DRIVE. WAIT UNTIL THE "INPUT BUS CHARGED" AND "OUTPUT BUS CHARGED" LEDS EXTINGUISH. THEN, MEASURE FOR VOLTAGE FROM WIRE 11 TO WIRE 10 AND FROM WIRE 13 TO WIRE 10 ON THE POWER CIRCUIT BOARD USING A VOLTMETER SET ON THE 100 V DC SCALE. ALLOW THESE VOLTAGES TO DROP TO ZERO BEFORE WORKING ON THE DRIVE.

All power circuit voltages are floating at a very high voltage with respect to ground and require isolated or floating test equipment. All control signal voltages are referenced to ground. If a problem is isolated to a calibration setting, refer to the internal adjustments section of this manual before attempting any changes.

Some steps in these instructions use conditions setup in previous steps. Therefore, any time power is interrupted or controls are changed, care must be taken to repeat the specified sit-up.

It is recommended that a complete checkout of the Main Control Board be made or a known good Main Control Board be installed whenever problems reoccur or components continue to fail. A log of all service should be maintained. The following information should be included.

1. Date and time of failure
2. Description of symptoms
3. Operating conditions
4. What component failed
5. Other conditions occurring at the same time which may be related
6. Service performed
7. Who performed the service

6.3 MINIMUM RECOMMENDED TEST EQUIPMENT

VOLT OHM METER — Simpson #260, Fluke 87 or equal
AMMETER — Simpson #150 or equivalent
OSCILLOSCOPE — Tektronix #323 or equivalent

SCOPE PROBE — Tektronix #P600T or equivalent; set on X10 scale for use on circuit boards, X100 scale for power components

TORQUE WRENCH — For power components, with hex key sockets

HAND TACHOMETER — For measuring motor speed

6.4 DIODE AND TRANSISTOR TEST PROCEDURE

Remove the input power and wait for the INPUT BUS CHARGED LED and OUTPUT BUS CHARGED LED to extinguish. After checking to confirm that no voltage is present from wire 11 to wire 10 and from wire 13 to wire 10, visually inspect the drive for any physical evidence of a failure such as:

1. Leaking or distorted capacitors
2. Discolored component
3. Loose connections
4. Cracked or broken semiconductors

Check all power semiconductors and large capacitors for shorts. All fuses should be checked. For proper testing methods of diodes and transistors, see Section 6.6.1. These steps will generally locate most of the problems that may occur under normal operating conditions and should be performed first.

6.4.1 DIODES AND TRANSISTORS

Diodes and transistors may be tested by using the procedure outlined below to check for shorts or open circuits. When readings fall into questionable or faulty areas, do not replace the device until a comparison test is made with a known good device. Check the component out of the circuit. Always use the same ohmmeter when performing comparison tests. Failure of a power transistor indicates the need to completely check out the Transistor Driver Board. This check out must be performed by a factory trained technician. Otherwise, the Transistor Driver Board may be replaced. Failure to check out or replace the board will probably cause repeated failure.

6.4.2 DIODE AND TRANSISTOR REPLACEMENT

6.4.2.1 FREEWHEELING DIODE

7.5 through 30 HP and 60 through 200 HP

Diode D7 on the 7.5 through 30 HP and 60 through 200 HP drives is a power diode module. When changing this device, a new thermal pad, or heatsink grease, must be used. The heatsink must be thoroughly cleaned before reassembly. Retorque to 20 to 24 inch pounds.

Diode D7 on the 300 HP drive is a press pack hockey puck device.

40 and 50 HP

Diode D7 on the 40 and 50 HP drives may consist of a diode mounted into an insulated mounting block. To replace this diode, remove the four mounting bolts and lift out the mounting block. Place the large block in a vise and unscrew the diode from the mounting block. IT IS IMPORTANT TO CLAMP THE LARGE BLOCK IN THE VICE AND NOT ITS MOUNTING PLATE. CLAMPING THE MOUNTING PLATE WILL CAUSE THE BLOCK BREAK AWAY FROM THE PLATE WHEN THE DIODE IS REMOVED. Clean the surface of the mounting block, making sure that the heatsink compound is not pushed into the diode mounting hole.

Apply a new coating of thermal heatsink compound about 0.001" thick to the surface of the diode which contacts the heatsink. DO NOT apply any compound to the threads of the diode. Use Thermalcote®, manufactured by Thermalloy, Inc. (or equivalent) for the heatsink compound.

Retorque the new diode to 90 to 100 inch pounds on the 40 and 50 HP. Reinstall the mounting block on the heatsink and retorque the four mounting bolts to 20 to 24 inch pounds.

250 and 300 HP

Diode D7 on the 250 and 300 HP drives is a press pack or hockey puck type diode. To remove the diode, loosen the two bolts securing the clamp to the outer bus bar until the diode can be removed from between the bus bars. Be sure the contacts surface of the heat sink, bus bars and diode are clean. A new Isostrate pad, Graham #08-7819-00, must be used between the heat sink and bus bar.

⚠WARNING

ANY FOREIGN MATTER ON THE HEAT SINK OR BUS BAR SURFACE COULD RESULT IN A GROUND FAULT AT POWER-UP.

The pad must extend at least 0.500" beyond the bus bar in all directions. Carefully apply a uniformly thin coat, about 0.001" of Thermalcoate® or equivalent, to both contact surfaces of the diode. Insert the diode with cathode toward the heatsink. Position the diode so the holes in the diode surfaces engage with the roll pins in the bus bars. Position the clamping bar so the hole in the clamping bar engages with the roll pin in the outer bar. Tighten the clamp bolts evenly until the diode is just snugly held in place. Place the force indicator gauge, Graham #03-7005-00, firmly against the springs and

tighten each bolt ¼ turn at a time until the correct edges coincide for a HW 5000 clamp.

6.4.2.2 INPUT DIODE BRIDGE MODULES

When changing an input diode bridge module, a new thermal pad, or heatsink compound, must be used. The heatsink must be thoroughly cleaned before reassembly. Retorque to 20 to 24 inch pounds.

6.4.2.3 POWER TRANSISTOR MODULES

When changing a transistor module, a new thermal pad, or heatsink compound, must be used. The heatsink must be thoroughly cleaned before reassembly. Retorque to 20 to 24 inch pounds.

Power transistor modules for the 250 and 300 HP drive are matched sets. They should be purchased and replaced as sets.

6.5 POWER BOARD AND MAIN CONTROL BOARD TEST

6.5.1 MODEL 1000 TEST METER

The Model 1000 digital test meter provides an accurate and convenient method of monitoring critical signals on the Main Control Board. These readings are an important diagnostic aid in tracing problems occurring in the drive. The test meter simply plugs into the upper left corner of the Main Control Board at J3 and uses a rotary switch to select the signal to be monitored. Contact Graham Company for information on ordering this meter.

6.5.2 POWER UP SEQUENCE

Disable the chopper by unplugging J702 from the Transistor Driver Board. This will keep the chopper from supplying high voltage to the inverter and output sections of the drive.

⚠DANGER

HIGH VOLTAGE WILL BE PRESENT IN THE DRIVE WHEN PERFORMING OPERATIONAL TESTS WITH POWER APPLIED TO THE DRIVE.

Apply input power to the drive. The SURGE CYCLE COMPLETE LED on the Power Board should light and relay M1 should pull in. When M1 pulls in, the fans in the drive should start. The INPUT BUS CHARGED LED should light indicating the capacitors are charged. The UNDERVOLTAGE LED and FAULT LED should light and remain lit until the undervoltage reset time delay times out as set by J700. Then the UNDERVOLTAGE and FAULT LEDs should go out. About four seconds later, the INVERTER ACTIVITY INDICATOR LEDs should light and should appear to slowly rotate clockwise.

6.5.3 POWER SUPPLY ON MAIN CONTROL BOARD

Power supply common (PWR GND) is connected to TB2 terminal 13 on the Main Control Board. This terminal is connected to a ground terminal block which is located just below the Main Control Board. The ground strap on this terminal block can be used for test equipment connection in the following steps.

Check the +22 V DC power supply (Vp) on J3 terminal 17 for +18 to +24 V DC.

Check the -22 V DC power supply (Vn) on J3 terminal 15 for -20 to -26 V DC.

Check the +15 V DC power supply (V+) on J3 terminal 2 for +14.4 to +15.6 V DC.

Check the -15 V DC power supply (V-) on J3 terminal 12 for -14.4 to -15.6 V DC.

An oscilloscope should also be used in checking the above voltages to ensure that there is no excessive ripple in these DC voltages.

6.5.4 INPUT REFERENCE

Switch the AUTO/MAN switch to MAN and switch the HAND/OFF/AUTO switch to AUTO. The AUTO/MAN LED should be off and the RUN LED should be on. Adjust the MANUAL SPEED potentiometer to maximum. The speed reference signal (SR) can be monitored at J3, terminal 8 on the Main Control Board. It should increase, reaching a maximum of approximately 10 V DC.

6.6 OUTPUT CHECKS

Remove input power from the drive. Reconnect J702.

Start the drive and accelerate the motor to full speed. Measure the currents on the motor leads. These should be balanced within ± 0.5 A AC. Any lack of balance indicates a problem with the motor windings, the wiring

to the motor or the inverter circuits in the drive.

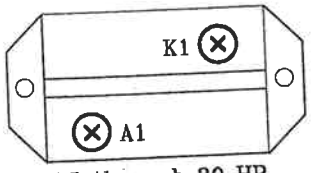
⚠DANGER

HIGH VOLTAGE WILL BE PRESENT IN THE DRIVE WHEN PERFORMING OPERATIONAL TESTS WITH POWER APPLIED TO THE DRIVE. THE POWER CIRCUITS OF THE DRIVE NECESSARILY FLOAT AT A HIGH VOLTAGE ABOVE GROUND POTENTIAL. BOTH LEADS OF ANY TEST EQUIPMENT THAT IS CONNECTED TO THE DRIVE'S POWER CIRCUITS WILL ALSO BE AT A HIGH VOLTAGE WITH RESPECT TO GROUND. INSTRUMENTS CONNECTED TO THE POWER CIRCUITS *MUST HAVE BOTH LEADS ISOLATED FROM EARTH GROUND*. IF ONE TEST LEAD IS CONNECTED TO THE CASE OF THE TEST INSTRUMENT, THE TEST INSTRUMENT'S CASE WILL ALSO BE AT A HIGH VOLTAGE WITH RESPECT TO EARTH GROUND.

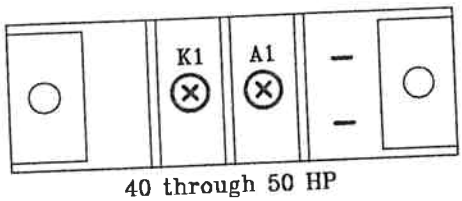
6.6.1 TRANSISTOR AND DIODE TESTING

All leads, including the bus bars, must be disconnected from the device being tested. The resistance values shown below are for good components. If a reading is in doubt, compare it to a known good component. Exact values cannot be given, as readings will vary with meter and scale used. If an inverter transistor module is found to be defective, the Transistor Driver Board must be completely checked out by a factory trained technician or replaced. Failure to do this will probably result in continued failure of the transistor module.

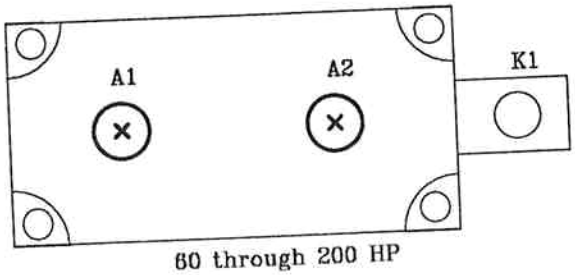
FREEWHEELING DIODE



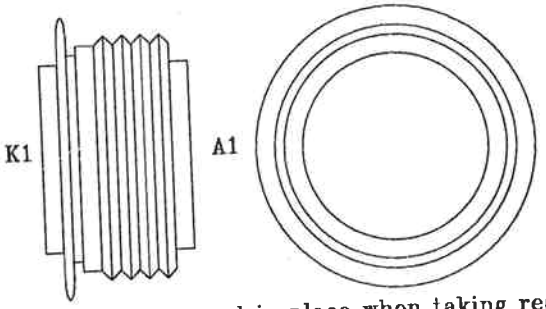
7.5 through 30 HP



40 through 50 HP



60 through 200 HP

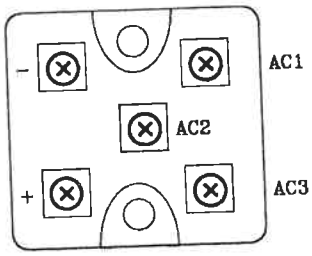


NOTE: Must be clamped in place when taking reading

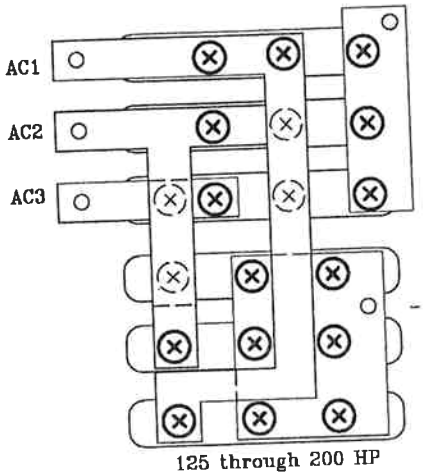
250 through 300 HP

Meter Lead		Resistance Reading Ohms
Positive Lead	**Negative Lead**	
A1	K1	<1,000
K1	A1	>10,000

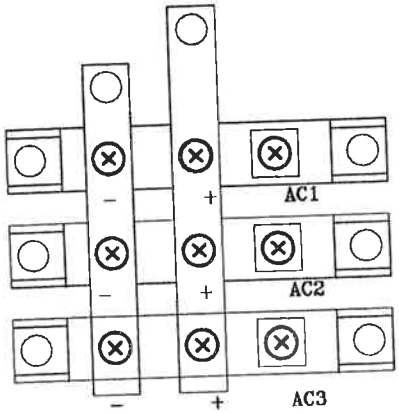
INPUT BRIDGE MODULE



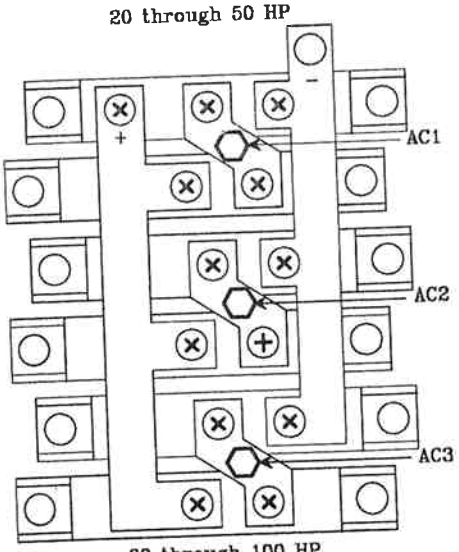
7.5 through 15 HP



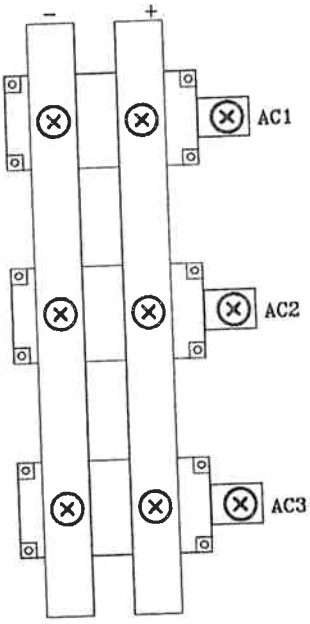
125 through 200 HP



20 through 50 HP



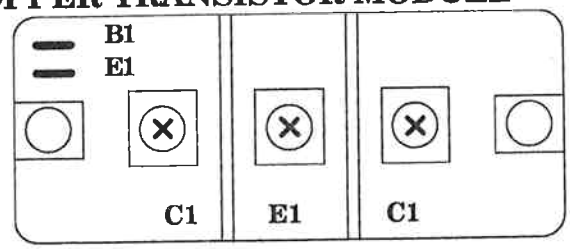
60 through 100 HP



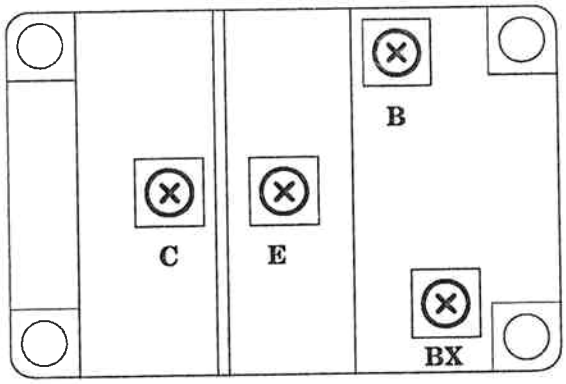
250 through 300 HP

Meter Lead		Resistance Reading
Positive Lead	**Negative Lead**	**Ohms**
+	AC1	>10,000
+	AC2	>10,000
+	AC3	>10,000
AC1	+	<1,000
AC2	+	<1,000
AC3	+	<1,000
-	AC1	<1,000
-	AC2	<1,000
-	AC3	<1,000
AC1	-	>10,000
AC2	-	>10,000
AC3	-	>10,000

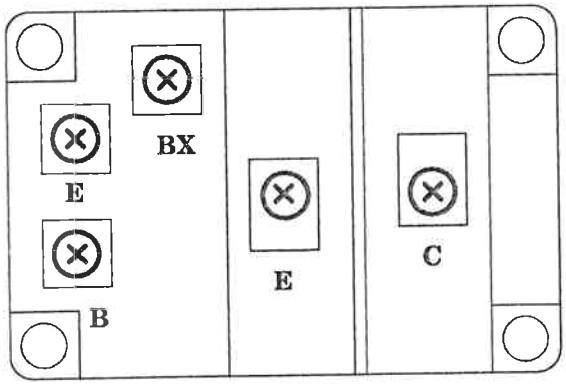
CHOPPER TRANSISTOR MODULE



7.5 through 50 HP

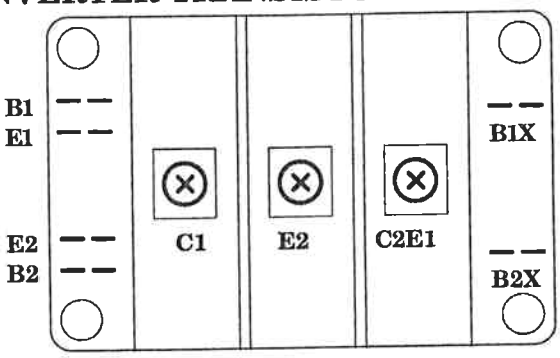


60 through 150 HP

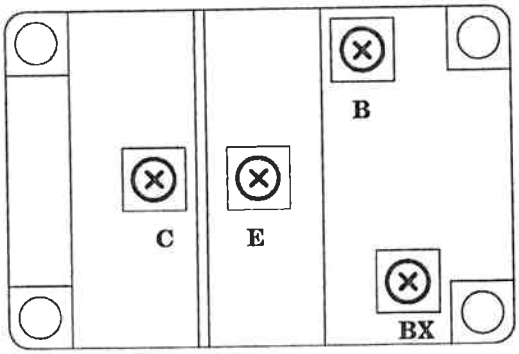


200 through 300 HP

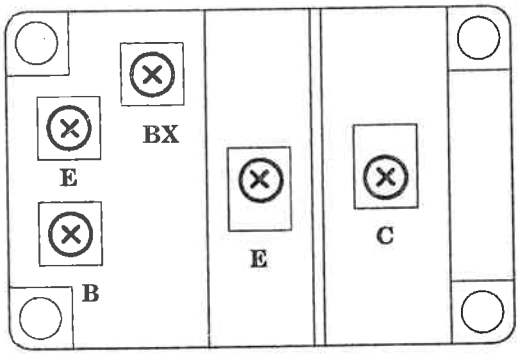
INVERTER TRANSISTOR MODULE



7.5 through 50 HP



60 through 100 HP

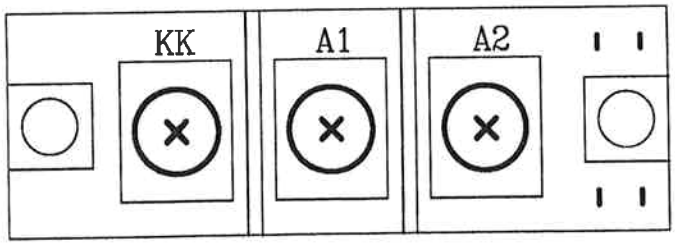


125 through 300 HP

Meter Lead		Resistance Reading Ohms
Positive Lead	**Negative Lead**	
C or C1	B or B1	>10,000
E or E1	B or B1	<1,000
B or B1	E or E1	<1,000
B or B1	C or C1	<1,000
C or C1	E or E1	>10,000
E or E1	C or C1	<1,000

Meter Lead		Resistance Reading Ohms
Positive Lead	**Negative Lead**	
C or C1	B or B1	>10,000
E or E1	B or B1	<1,000
B or B1	E or E1	<1,000
B or B1	C or C1	<1,000
C or C1	E or E1	>10,000
E or E1	C or C1	<1,000
C2	B2	>10,000
E2	B2	<1,000
B2	E2	<1,000
B2	C2	<1,000
C2	E2	>10,000
E2	C2	<1,000

CHOPPER SNUBBER DIODE



250 through 300 HP

Meter Lead		Resistance Reading
Positive Lead	Negative Lead	Ohms
A1 or A2	K1 or KK	<1,000
K1 or KK	A1 or A2	>10,000

6.7 FAULT LED DIAGNOSIS

The following sections list conditions which could cause fault indications in the drive.

6.7.1 UV LED - UNDERVOLTAGE

1. Input AC line voltage less than 437 V AC.
2. Input AC line imbalance of greater than 5 V AC.
3. One or more of fuses F1 thru F6 bad.
4. Main Control Board power supply voltages out of tolerance. The correct tolerances are:
   +15 V DC: between +14.4 and +15.6 V DC
   -15 V DC: between -14.4 and -15.6 V DC
5. Failure of C704, UV reset capacitor to reset, causing no auto UV reset.
6. Plug 700 loose or missing on J700 of main control board, causing no auto UV reset.

6.7.2 OV LED - OVERVOLTAGE

1. Motor rotating when the drive was started.
2. Fan draft or pump fluid flow, causing the motor to try to run faster than the drive's speed.
3. Power interruption to the drive while the drive is running.
4. Motor wiring has a ground fault.
5. Output bus capacitors not discharging due to faulty discharge circuit or wiring.

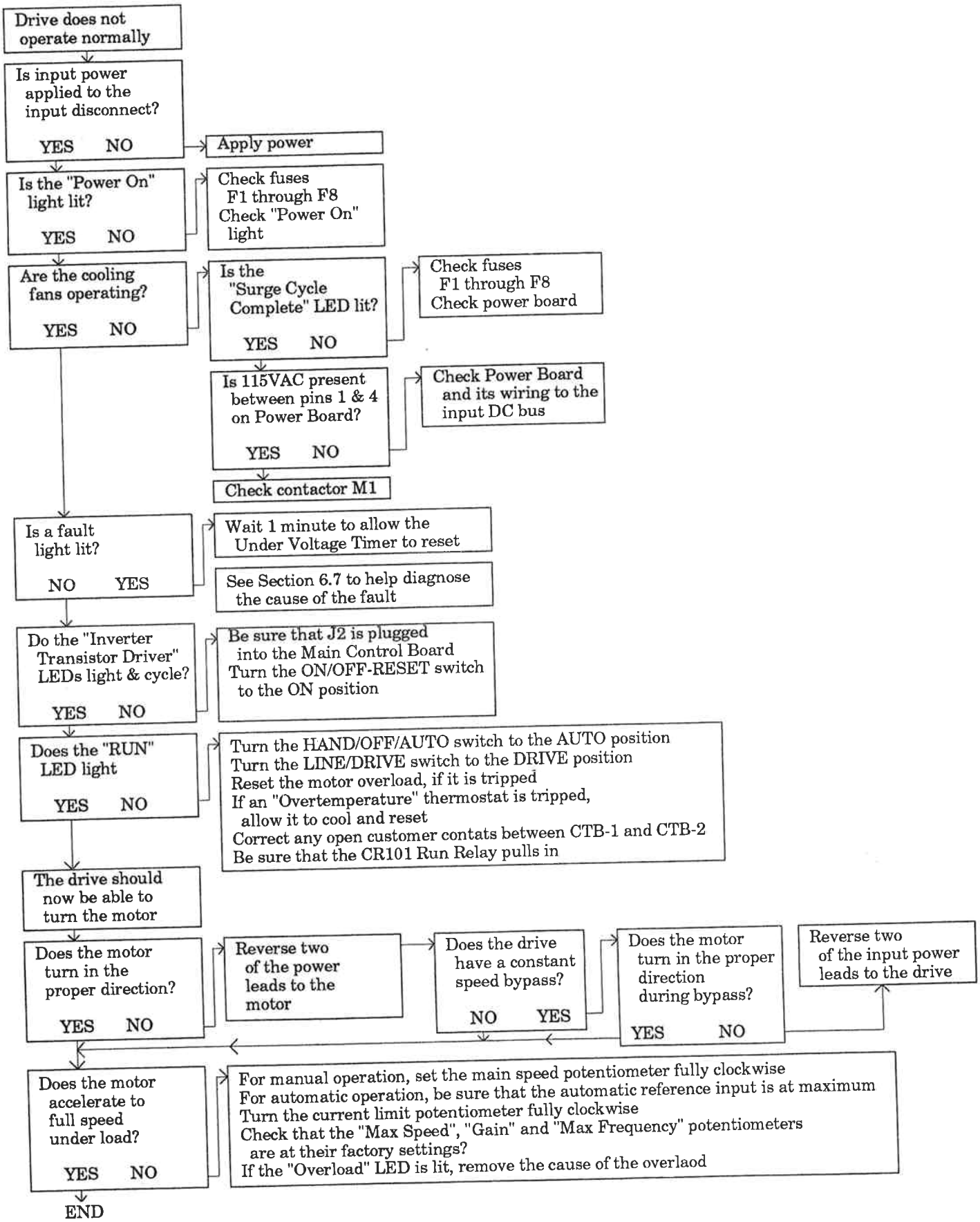
6.7.3 OC LED - OVERCURRENT

1. Motor winding shorting to ground or to another phase winding.
2. Motor windings connected for an incorrect voltage.
3. Power factor correction capacitors installed between the drive output and the motor.
4. Motor starter or contactor on the drive's output being opened and closed while the drive is running.
5. Inverter Transistors Driver LEDs sequencing improperly.
6. Inverter Transistors Q1, Q2, Q3, Q4, Q5 and Q6 shorted or open.
7. Chopper Transistor Q7 shorted.

6.7.4 OL LED - OVERLOAD

1. Motor not free to rotate.
2. Belts, if used, improperly tensioned or aligned.
3. Sheaves and/or shaft couplings improperly aligned.
4. Motor overloaded when connected to the AC line.
5. Maximum speed of the drive adjusted too high.

6.8 TROUBLESHOOTING FLOW CHART



SECTION THREE — OPTIONS

7. INTRODUCTION TO DISCONNECTS AND BYPASSES

The following options represent the input disconnect, output disconnect and bypass switching arrangements which are commonly supplied with Model 1576 drives. Bypass options are mutually exclusive, that is, any drive will have, at most, one of these options. It is not necessary for a drive to have any of these options supplied by Graham.

7.1 INPUT DISCONNECT SWITCH

The Input Disconnect Switch is a three pole, two position rotary switch. It is used as a means of interrupting the AC input line to the drive. When the switch is in the OFF position, the contracts are open and the drive circuits are isolated from the power wires feeding the drive input. In the ON position, the contacts are closed and power is fed to the drive.

⚠DANGER

THE INPUT DISCONNECT SWITCH DOES NOT INTERRUPT THE POWER TO THE BYPASS CIRCUITS. INPUT POWER WILL BE PRESENT INSIDE THE DRIVE ENCLOSURE FOR THE BYPASS CIRCUITS UNLESS THE POWER LINE FEEDING THE BYPASS IS INTERRUPTED THRU THE CUSTOMER'S DISCONNECT SWITCH, WHICH IS EXTERNAL TO THE DRIVE. OPEN THE CUSTOMER-PROVIDED POWER LINE DISCONNECT TO THE DRIVE WHEN WORKING INSIDE THE DRIVE ENCLOSURE.

7.2 BYPASS TRANSFER SWITCH

The BYPASS TRANSFER SWITCH is a three pole, three position rotary switch which is used as a means of interrupting, isolating and transferring the three phase motor leads from the output of the drive to the output of the customer's motor starter. The switch (multiple switches if the drive operates more than one motor) is labeled LINE-OFF-DRIVE.

In the LINE position, the motor is connected to the output of the motor starter. The motor will be run at base speed in this bypass mode. The drive will be isolated from the motor. Start/stop functions for the motor are provided thru the customer provided contacts and switches in series with the motor starter coil.

In the OFF position, all three phases of the motor are isolated from the output of the drive and the output of the customer's motor starter.

In the DRIVE position, the motor is connected to the output of the drive after the reset time delay. Adjustable motor speed from the drive is now available from either the manual speed potentiometer or the automatic reference signal follower circuit. The customer's motor starter is isolated from the motor.

A two pole contact block on the TRANSFER SWITCH provides a stop/disable signal when the switch is in the LINE or OFF positions. This disables the drive control logic circuits. In the DRIVE position, the drive control logic and the drive RUN circuits are enabled.

⚠DANGER

POWER IS PRESENT INSIDE THE DRIVE ENCLOSURE THRU THE BYPASS CIRCUITRY WHEN THE DRIVE INPUT DISCONNECT SWITCH IS IN THE OFF POSITION. OPEN THE CUSTOMER-PROVIDED POWER LINE DISCONNECT TO THE DRIVE WHEN WORKING INSIDE THE DRIVE ENCLOSURE.

7.3 MANUAL CONTACTOR BYPASS

The Manual Contactor Bypass is a means of interrupting, isolating and transferring the motor leads from the output of the drive to the AC line. The bypass consists of a motor starter in parallel with the drive and a contactor on the output of the drive. The operation of the motor starter and contactor are controlled thru the switches on the front of the enclosure labeled DRIVE/LINE and OFF-RESET/ON and through customer contacts connected to TB7 terminals 8 and 9.

The DRIVE/LINE switch selects between the motor being connected to the drive, for adjustable speed operation, and to the AC line for fixed speed operation from the AC line. To actually apply power to the motor in either case, the OFF-RESET/ON switch must be in the ON position.

To operate the motor in an adjustable speed mode, rotate the DRIVE/LINE switch to the DRIVE position and rotate the OFF-RESET/ON switch to the ON position. This will connect the motor to the output of the drive and isolate the motor from the AC line. After a time delay (provided to allow the motor to come to rest

from previous operation), standard drive operation will be enabled. Adjustable speed control of the motor will be available through the operator controls on the front of the drive. The drive can also be started and stopped thru the customer contacts connected to terminal strip TB7 terminals 8 and 9. The LOAD TRANSFERRED TO LINE pilot light will be off when in the DRIVE position.

To disable the start and run operation of the drive and the bypass motor starter, rotate the OFF-RESET/ON switch to the OFF-RESET position. In the OFF-RESET position, the drive output contactor and the bypass motor starter are disabled, therefore the motor is isolated from both power sources. This position is also used to reset the bypass logic when going from LINE to DRIVE operation.

To operate the motor with the constant speed bypass, rotate the DRIVE/LINE switch to the LINE position and rotate the OFF-RESET/ON switch to the ON position. This selection will connect the motor to the AC line and disconnect the motor from the output of the drive. Start and stop control of the motor starter is obtained through the OFF-RESET/ON switch and by using customer contacts connected to terminal strip TB7 terminals 8 and 9. The LOAD TRANSFERRED TO LINE pilot light will be on when the motor starter is energized.

⚠DANGER

POWER IS PRESENT INSIDE THE DRIVE ENCLOSURE EVEN WHEN THE SWITCHES ARE IN THE LINE AND OFF-RESET POSITION. OPEN THE CUSTOMER-PROVIDED POWER LINE DISCONNECT TO THE DRIVE WHEN WORKING INSIDE THE DRIVE ENCLOSURE.

7.4 AUTOMATIC CONTACTOR BYPASS

All of the features present in the MANUAL CONTACTOR BYPASS are included in the AUTOMATIC CONTACTOR BYPASS, and the operation is the same for both, except in cases of a drive fault condition. If a drive fault condition occurs, the AUTOMATIC CONTACTOR BYPASS will automatically place the motor in a full speed running mode. The LOAD/TRANSFERRED TO LINE pilot light will now be on.

In cases of an automatic transfer, the motor can be reconnected to the drive output by clearing the drive fault, rotating the OFF/RESET/ON switch to OFF/RESET and rotating the OFF/RESET/ON switch to ON. The drive will provide adjustable speed operation after the reset time delay. This delay allows the motor to come to rest before the restart.

⚠DANGER

POWER IS PRESENT INSIDE THE DRIVE ENCLOSURE EVEN WHEN THE SWITCHES ARE IN THE LINE AND OFF-RESET POSITION. BECAUSE OF THE AUTOMATIC NATURE OF THE TRANSFER AND THE TIME DELAYS INVOLVED, POWER TRANSFERS CAN TAKE PLACE WITHOUT MANUALLY OPERATING A SWITCH. OPEN THE CUSTOMER-PROVIDED DISCONNECT TO THE DRIVE WHEN WORKING INSIDE THE DRIVE ENCLOSURE.

8. PRESSURE-TO-ELECTRICAL TRANSDUCER

When specified, a pressure-to-electrical transducer is supplied to control the speed of the drive. This is commonly accomplished by using a 3 to 15 psi pressure signal. 3 psi corresponds to minimum speed and 15 psi corresponds to maximum speed. The pressure signal should be connected to the port marked "P1".